6/1/2013

NORTH SMITHFIELD SCHOOL DEPARTMENT

ALGEBRA I CURRICULUM GRADES 8-9

North Smithfield Middle and High School
Curriculum Writers: Amanda Bednarczyk, David Mellor, and Melissa Silverio

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This curriculum was developed based on the Common Core State Standards utilizing examples and strategies from various websites including Tucson, Arizona, Ohio, and New Jersey.

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The North Smithfield Mathematics Curriculum for grades K-12 was completed in June 2013 by a K-12 team of teachers. The team, identified as the Mathematics Task Force and Mathematics Curriculum Writers referenced extensive resources to design the document that included:

- *Common Core State Standards for Mathematics*
- *Common Core State Standards for Mathematics, Appendix A*
- *Best Practice, New Standards for Teaching and Learning in America's Schools*
- *Classroom Instruction That Works,* Marzano
- Differentiated Instructional Strategies
- Goals for the district
- High School Traditional Plus Model Course Sequence, Achieve, Inc.
- Khan Academy
- Numerous state curriculum Common Core frameworks, e.g. Ohio Department of Education (ODE), Tucson Unified School District, Arizona (TUSD), New Jersey and Connecticut
- PARCC Model Content Frameworks
- The Illustrative Mathematics Project
- Third International Mathematics and Science TIMSS)
- *Understanding Common Core State Standards, Kendall*

Mission Statement

**To foster the success of all students,
our mission is to engage them
in a challenging mathematics curriculum,
driven by standards-based instruction and focused on
mathematical practices, skills, concepts, and problem solving.**

The North Smithfield Mathematics Curriculum identifies what students should know and be able to do in mathematics. Each grade or course includes Common Core State Standards (CCSS), grade level Assessment problems, teacher notes, best practice instructional strategies, resources, a map (or suggested timeline), rubrics, checklists, and common formative and summative assessments.

COMMON CORE STATE STANDARDS

The **Common Core State Standards** (**CCSS):**

- Are fewer, higher, deeper, and clearer.
- Are aligned with college and workforce expectations.
- Include rigorous content and applications of knowledge through high-order skills.
- Build upon strengths and lessons of current state standards (GLEs and GSEs).
- Are internationally benchmarked, so that all students are prepared for succeeding in our global economy and society.
- Are research and evidence-based.

Common Core State Standards components include:

- Standards for **Mathematical Practice** (K-12)
- Standards **for Mathematical Content:**
  - Categories (high school only): e.g. numbers, algebra, functions, data
  - Domains: larger groups of related standards
  - Clusters: groups of related standards
  - Standards**:** define what students should understand and are able to do

The **North Smithfield Common Core Mathematics Curriculum** provides all students with a sequential comprehensive education in mathematics through the study of:

- Standards **for Mathematical Practice (K-12)**
  - Make sense of problems and persevere in solving them
  - Reason abstractly and quantitatively
  - Construct viable arguments and critique the reasoning of others
  - Model with mathematics*
  - Use appropriate tools strategically
  - Attend to precision
  - Look for and make use of structure
  - Look for and express regularity in repeated reasoning

This curriculum was developed based on the Common Core State Standards utilizing examples and strategies from various websites including Tucson, Arizona, Ohio, and New Jersey.

- Standards **for <u>Mathematical Content</u>:**
  - **K – 5 Grade Level Domains of**
    - Counting and Cardinality
    - Operations and Algebraic Thinking
    - Number and Operations in Base Ten
    - Number and Operations – Fractions
    - Measurement and Data
    - Geometry
  - **6-8 Grade Level Domains of**
    - Ratios and Proportional Relationships
    - The Number System
    - Expressions and Equations
    - Functions
    - Geometry
  - **9-12 Grade Level Conceptual Categories of**
    - Number and Quantity
    - Algebra
    - Functions
    - Modeling
    - Geometry
    - Statistics and Probability

RESEARCH-BASED INSTRUCTIONAL STRATEGIES

The North Smithfield Common Core Mathematics Curriculum provides a list of research-based **best practice instructional strategies** that the teacher may model and/or facilitate. It is suggested the teacher:

- Use **formative assessment to** guide instruction
- Use ***Classroom Instruction That Works*** (Marzano)
  - Setting objectives and providing feedback
  - Reinforcing effort and providing recognition
  - Cooperative learning
  - Cues, questions, and advance organizers
  - Nonlinguistic representations
  - Summarizing and note taking
  - Assigning homework and providing practice
  - Identifying similarities and differences
  - Generating and testing hypotheses
- Provide opportunities for **independent, partner** and **collaborative group work**
- Differentiate **instruction** by varying the **content, process, and product** and providing opportunities for:
  - anchoring
  - cubing
  - jig-sawing
  - pre/post assessments
  - tiered assignments
- Address **multiple intelligences** instructional strategies, e.g. visual, bodily kinesthetic, interpersonal
- Provide opportunities for **higher level thinking: Webb's Depth of Knowledge, 2,3,4,** skill/conceptual understanding, strategic reasoning, extended reasoning
- Facilitate the integration of **Mathematical Practices** in all content areas of mathematics

- Facilitate integration of the **Applied Learning Standards (SCANS):**
  - communication
  - critical thinking
  - problem solving
  - reflection/evaluation
  - research
- Employ strategies of "best practice" (student-centered, experiential, holistic, authentic, expressive, reflective, social, collaborative, democratic, cognitive, developmental, constructivist/heuristic, and challenging)
- Provide **rubrics** and **models**
- Address **multiple intelligences** and brain dominance (spatial, bodily kinesthetic, musical, linguistic, intrapersonal, interpersonal, mathematical/logical, and naturalist)
- Employ **mathematics best practice strategies** e.g.
  - using manipulatives
  - facilitating cooperative group work
  - discussing mathematics
  - questioning and making conjectures
  - justifying of thinking
  - writing about mathematics
  - facilitating problem solving approach to instruction
  - integrating content
  - using calculators and computers
  - facilitating learning
  - using assessment to modify instruction

COMMON ASSESSMENTS

The North Smithfield Common Core Mathematics Curriculum includes common assessments. Required (red ink) indicates the assessment is required of all students e.g. common tasks/units**,** standardized mid-term exam, standardized final exam.

- **REQUIRED** COMMON ASSESSMENTS
  - MID-TERM EXAM
  - FINAL EXAM
  - COMMON PROBLEMS/UNITS
- **Common Instructional Assessments (I)** - used by teachers and students during the instruction of CCSS.
- **Common Formative Assessments (F)** - used to measure how well students are mastering the content standards **before** taking state assessments
  - teacher and student use to make decisions about what actions to take to promote further learning
  - on-going, dynamic process that involves far more frequent testing
  - serves as a practice for students
- **Common Summative Assessment (S**) - used to measure the level of student, school, or program success
  - make some sort of judgment, e.g. what grade
  - program effectiveness
  - e.g. state assessments (AYP), mid-year and final exams
- Additional suggested assessments include:
  - Anecdotal records
  - Conferencing
  - Exhibits
  - Interviews
  - Graphic organizers
  - Journals
  - Mathematical Practices
  - Modeling
  - Multiple Intelligences assessments, e.g.
    - Role playing - bodily kinesthetic
    - Graphic organizing - visual
    - Collaboration - interpersonal
  - Oral presentations
  - Problem/Performance based/common tasks
  - Rubrics/checklists (mathematical practice, modeling)
  - Tests and quizzes
  - Technology
  - Think-alouds
  - Writing genres
    - Argument
    - Informative
    - Research

RESOURCES FOR ALGEBRA I

Textbooks

- *Algebra 1,* McDougal Littell
- *Exploration in Core Math* , Holt Mc Dougal

Supplementary

Technology

- Computer lab
- Computer software that generate graphs of functions
- Computers
- Document camera
- Graphing calculator
- Graphing software
- Interactive boards
- LCD projectors
- Overhead graphing scientific
- SMART Boards
- Student response systems
- TI-84 and TI emulator

Websites

- http://curriculum.northsmithfieldschools.com
- http://www.achieve.org/http://my.hrw.com
- http://www.illustrativemathematics.org/standards/practice
- http://www.ixl.com/standards/common-core/math/grade-8
- http://www.ixl.com/standards/common-core/math/high-school
- http://www.ode.state.oh.us/GD/Templates/Pages/ODE/ODEDefaultPage.aspx?page=1
- http://www.ode.state.or.us/search/page/?id=3747
- http://www.parcconline.org/sites/parcc/files/PARCC%20Math%20S
- http://www.schools.utah.gov/CURR/mathsec/Core.aspx
- http://www.tusd1.org/contents/distinfo/curriculum/index.asp
- www.commoncore.org/maps
- www.corestandards.org
- www.khanacademy.com
- www.ride.ri.gov

Materials

- Hands-on materials, such as algebra tiles
- Tables, graphs and equations of real-world applications that apply quadratic and exponential functions
- Area models

- Examples of real-world situations that lend themselves to writing equations that model the contexts.

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CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
NUMBER AND QUANTITY **The Real Number System (N-RN)** Extend the properties of exponents to rational exponents Use **Mathematical Practices** to 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		**Students** N-RN.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. • *For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)^3}$ to hold, so $(5^{1/3})^3$ must equal 5.* **Essential knowledge and skills** • Use properties of rational exponents to simplify and create equivalent forms of expressions • Determine the relationship between radicals and rational exponents • Rewrite an expression as a radical expression (TUSD) **Mathematical Practices** • Reason abstractly and quantitatively • Construct viable arguments and critique the reasoning of others N-RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents. **Essential knowledge and skills** • Rewrite expressions involving radicals and rational exponents using the properties of exponents **Mathematical Practices** • Look for and make use of structure **Teaching Examples:** • $\sqrt[3]{5^2} = 5^{\frac{2}{3}}$; $5^{\frac{2}{3}} = \sqrt[3]{5^2}$ • Rewrite using fractional exponents: $\sqrt[5]{16} = \sqrt[5]{2^4} = 2^{\frac{4}{5}}$ • Rewrite $\frac{\sqrt{x}}{x^2}$ in at least three alternate forms. Solution: (TUSD) $x^{-\frac{3}{2}} = \frac{1}{x^{\frac{3}{2}}} = \frac{1}{\sqrt{x^3}} = \frac{1}{x\sqrt{x}}$ • Rewrite $\sqrt[4]{2^{-4}}$ Using only rational exponents (TUSD) **Academic vocabulary** • Irrational numbers • Properties of exponents • Radical expression • Rational numbers • Square and cube roots	*TEACHER NOTES* *See instructional strategies in the introduction* • The *goal is to show that a fractional exponent can be expressed as a radical or a root. For example, an exponent of 1/3 is equivalent to a cube root; an exponent of ¼ is equivalent to a fourth root.* • Review *the power rule, $((b^n)^m = b^{nm})$, for whole number exponents (e.g. $(7^2)^3 = 7^6$.* • Provide *opportunities for students to explore the equality of the values using calculators, such as $7^{1/2}$ and $\sqrt{7}$.* • *Offer sufficient examples and exercises to prompt the definition of fractional exponents, and give students practice in converting expressions between radical and exponential forms.* • Stress *the two rules of rational exponents: 1) the numerator of the exponent is the base's power and 2) the denominator of the exponent is the order of the root. When evaluating expressions involving rational exponents, it is often helpful to break an*	RESOURCE NOTES See resources in the introduction Textbook • *Algebra 1,* McDougal Littell • *Exploration in Core Math,* Holt Mc Dougal Supplementary Books, Teacher (T) Student (S) Technology • Computers • Graphing calculator • Interactive boards • LCD projectors Websites • http://curriculum.northsmithfieldschools.com • http://www.achieve.org/ http://my.hrw.com • http://www.illustrativemathematics.org/standards/practice • http://www.ixl.com/standards/common-core/math/grade-8 • http://www.ixl.com/standards/common-core/math/high-school • http://www.ode.state.oh.us/GD/Templates/Pages/ODE/ODEDefaultPage.aspx?page=1 • http://www.ode.state.or.us/search/page/?id=3747 • http://www.parcconline.org/sites/parcc/files/P	ASSESSMENT NOTES See assessments in the introduction REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS • Anecdotal records • Charts/data collection • Conferencing • Exhibits • Interviews • Graphic organizers • Journals • Mathematical Practices • Modeling ★ • Multiple Intelligences assessments, e.g. ▫ Role playing - bodily kinesthetic ▫ Graphic organizing - visual ▫ Collaboration -

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CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		Assessment problems R-RN.1 • http://hotmath.com/help/gt/genericalg1/section_8_3.html (p.1) • http://www.schools.utah.gov/CURR/mathsec/Core/Sec-II-Page-1.aspx **Assessment problems R-RN.2** • Radical expressions: Simplify radical expressions (Algebra - EE.1) • Radical expressions: Simplify radical expressions by rationalizing the denominator (Algebra - EE.2) • Radical expressions: Multiply radical expressions (Algebra - EE.3) • Radical expressions: Add and subtract radical expressions (Algebra - EE.4) • Radical expressions: Simplify radical expressions using the distributive property (Algebra - EE.5) • Radical expressions: Simplify radical expressions: mixed review (Algebra - EE.6) • Algebra review: Simplify radical expressions (Geometry - A.4) • http://www.schools.utah.gov/CURR/mathsec/Core/Sec-II-Page-1.aspx (p.2) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.sr.1.00nrn.a.152_v1.pdf	*exponent into its parts – a power and a root – and then decide if it is easier to perform the root operation or the exponential operation first.* • Model *the use of precise mathematics vocabulary (e.g., base, exponent, radical, root, cube root, square root etc.).*(ODE)	ARCC%20Math%20S • http://www.schools.utah.gov/CURR/mathsec/Core.aspx • http://www.tusd1.org/contents/distinfo/curriculum/index.asp • www.commoncore.org/maps • www.corestandards.org • www.khanacademy.com • www.ride.ri.gov Materials • Hands-on materials, such as algebra tiles	interpersonal • Oral presentations • Problem/Performance based/common tasks • Rubrics/checklists (mathematical practice, modeling) • Tests and quizzes • Technology • Think-alouds • Writing genres Argument Information
NUMBER AND QUANTITY **The Real Number System (N- RN)** Use properties of rational and irrational numbers. Use **Mathematical Practices** to 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	**A**	**Students** N-RN.3 Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational. **Additional content** **Essential knowledge and skills** • Explain what type of rational or irrational is produced when an operation is performed on two rational numbers. • Explain what type of rational or irrational is produced when an operation is performed on one rational and one irrational number. (TUSD) **Teaching Examples:** • Find a rational number when performing an operation on two rational numbers. • Find an irrational number when performing an operation with a non-zero rational number. • Find perimeter of a square when the area is a prime number • Explain why the number 2π must be irrational, given that π is irrational. **Mathematical Practices** • Reason abstractly and quantitatively • Construct viable arguments and critique the reasoning of others • Model with mathematics ★	*TEACHER NOTES* *See instructional strategies in the introduction* • *This cluster is an excellent opportunity to incorporate algebraic proof, both direct and indirect, in teaching properties of number systems.* • Students *should explore concrete examples that illustrate that for any two rational numbers written in form* $\frac{a}{b}$ *and* $\frac{c}{d}$ *where b and d are natural numbers and a and c are integers, the following are true:* $\frac{a}{b}+\frac{c}{d}=\frac{ad+bc}{bd}$ *represents a*	RESOURCE NOTES See resources in the introduction Textbooks • *Algebra 1,* McDougal Littell Chapter • *Exploration in Core Math,* Holt Mc Dougal • *HM Algebra 1*	ASSESSMENT NOTES REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS See assessments in the introduction

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reasoning		○ Solution: if 2π were rational, then half of 2π would also be rational, so π would have to be rational as well. (TUSD) **Academic vocabulary** • Irrational numbers • Radical expression • Square and cube roots • Properties of exponents • Rational numbers **Assessment problems R-RN.3** • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.er.3.00nrn.b.085_v1.pdf (p.1) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-II/II-1-N-RN-3.aspx • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.er.3.00nrn.b.085_v1.pdf	*rational number and* $\frac{a}{b}+\frac{c}{d}=\frac{ac}{bd}$ *represents a rational number* (ODE)		
NUMBER AND QUANTITY **Quantities★ (N-Q)** Reason quantitatively and use units to solve problems. Use **Mathematical Practices** to 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	S	**Students** N-Q.1 Use units as a way to understand problems and to guide the solution of multi- step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. **Supporting content** **Essential knowledge and skills** • Use appropriate scales and units when graphing • Convert a given quantity in a unit rate to a different unit rate, e.g. convert feet per second to miles per hour. (TUSD) **Mathematical Practices** • Model with mathematics ★ • Use appropriate tools strategically • Attend to precision	TEACHER NOTES See instructional strategies in the introduction • *Foundation for work with expressions and functions* • *In real-world situations, answers are usually represented by numbers associated with units. Units involve measurement and often require a conversion. Measurement involves both precision and accuracy. Estimation and approximation often precede more exact computations.* • *Students need to develop sound mathematical reasoning skills and forms of argument to make reasonable judgments about their solutions. They should be able to*	RESOURCE NOTES See resources in the introduction Textbooks • *HM Algebra 1*, Activities 10.3, 13.8 • HM Curriculum Companion book, Activity 1.5A • *Algebra 1,* McDougal Littell • *Exploration in Core Math,* Holt Mc Dougal	ASSESSMENT NOTES See assessments in the introduction REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS • Anecdotal records • Charts/data collection • Conferencing • Exhibits • Interviews • Graphic organizers
	S	N-Q.2 Define appropriate quantities for the purpose of descriptive modeling. **Supporting content** **Essential knowledge and skills** • Use labels to put the answer into proper context. • Understand the relationship between quantities in order to construct expressions, equations, relations and functions. (TUSD) **Mathematical Practices** • Model with mathematics ★ • Attend to precision			
	S	N-Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. **Supporting content** **Essential knowledge and skills** • Determine reasonable limits and accuracy when solving a real life problem. **Mathematical Practices** • Attend to precision			

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		Academic vocabulary • Accuracy • Origin • Ratio • Scale equivalent • Unit • Unit conversion • Unit rate • Verbal model **Assessment problems N-Q.1** • Ratios and proportions: Scale drawings and scale factors (Algebra - C.7) • Measurement: Convert rates and measurements: customary units (Algebra - E.1) • Measurement: Convert rates and measurements: metric units (Algebra - E.2) • Measurement: Unit prices with unit conversions (Algebra - E.3) • Algebra review: Scale maps and drawings (Geometry - A.2) • Measurement: Convert rates and measurements: customary units (Geometry - U.1) • Measurement: Convert rates and measurements: metric units (Geometry - U.2) • Measurement: Convert square and cubic units of length (Geometry - U.3) • http://www.schools.utah.gov/CURR/mathsec/Common-Core/Secondary-I/I1NQ.aspx (p.1.) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.te.1.000nq.c.083_v1.pdf • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.cr.2.0numq.a.603_v1.pdf • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.0corn.a.412_v1.pdf • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.hmofc.a.268_v1.pdf **Assessment problems N-Q.2** • http://www.schools.utah.gov/CURR/mathsec/Common-Core/Secondary-I/I1NQ.aspx (p.2) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.0corn.a.412_v1.pdf **Assessment problems N-Q.3** • Measurement: Precision (Algebra - E.4) • Measurement: Greatest possible error (Algebra - E.5) • Measurement: Precision (Geometry - U.4) • Measurement: Greatest possible error (Geometry - U.5) • Measurement: Minimum and maximum area and volume (Geometry - U.6) • Measurement: Percent error (Geometry - U.7) • Measurement: Percent error: area and volume (Geometry - U.8)	*decide whether a problem calls for an estimate, for an approximation, or for an exact answer. To accomplish this goal, teachers should provide students with a broad range of contextual problems that offer opportunities for performing operations with quantities involving units. These problems should be connected to science, engineering, economics, finance, medicine, etc.* • *Some contextual problems may require an understanding of derived measurements and capability in unit analysis. Keeping track of derived units during computations and making reasonable estimates and rational conclusions about accuracy and the precision of the answers help in the problem-solving process.* (ODE)		• Journals • Mathematical Practices • Modeling ★ • Multiple Intelligences assessments, e.g. Role playing - bodily kinesthetic Graphic organizing - visual Collaboration - interpersonal • Oral presentations • Problem/Performance based/common tasks • Rubrics/checklists (mathematical practice, modeling) • Tests and quizzes • Technology • Think-alouds • Writing genres Argument Information

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		• http://www.schools.utah.gov/CURR/mathsec/Common-Core/Secondary-I/I1NQ.aspx (p.3) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.hmofc.a.268_v1.pdf • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.tuitn.a.298_v1.pdf			
ALGEBRA **Seeing structure in Expressions (A-SSE)** Interpret the structure of expressions Use **Mathematical Practices** to 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	**M** **M**	**Students** A-SSE.1 Interpret expressions that represent a quantity in terms of its context. ★ **Major content** a. Interpret parts of an expression, such as terms, factors, and coefficients. (A-SSE.1a) b. Interpret complicated expressions by viewing one or more of their parts as a single entity. (A-SSE.1b) ○ *For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P.* **Essential knowledge and skills** • Identify parts of an expression (e.g. degree, coefficient, constant) and terms. • Interpret terms in an expression to simplify and solve. **Teaching Examples:** • Write algebraic models from a verbal model. • Identify parts (and their context) of a formula in a real life problem. • 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. Similar real-world examples, such as tax rates, can also be used to explore the meaning of expressions. • Factor 3x(x – 5) + 2(x – 5). (TUSD) **Mathematical Practices** • Make sense of problems and persevere in solving them • Reason abstractly and quantitatively • Model with mathematics • Look for and make use of structure A-SSE.2 Use the structure of an expression to identify ways to rewrite it. **Major content** • *For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.*	TEACHER NOTES See instructional strategies in the introduction • *Linear, exponential, quadratic* • *Extending beyond simplifying an expression, this cluster addresses interpretation of the components in an algebraic expression. A student should recognize that in the expression 2x + 1, "2" is the coefficient, "2" and "x" are factors, and "1" is a constant, as well as "2x" and "1" being terms of the binomial expression. Development and proper use of mathematical language is an important building block for future content.* • *Factoring by grouping is another example of how students might analyze the structure of an expression. To factor 3x(x – 5) + 2(x – 5), students should recognize that the "x – 5" is common to both expressions being*	RESOURCE NOTES See resources in the introduction Textbooks • *HM Algebra 1*, Activities 10.3, 13.8 • HM Curriculum Companion book, Activity 1.5A • *Algebra 1,* McDougal Littell chapter 10 • *Exploration in Core Math,* Holt Mc Dougal • *Hands*-on materials, such as algebra tiles, can be used to establish a visual understanding of algebraic expressions and the meaning of terms, factors and coefficients. From the National Library of Virtual Manipulatives - Algebra Tiles – Visualize multiplying and factoring algebraic expressions using tiles.	ASSESSMENT NOTES See assessments in the introduction REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS • Anecdotal records • Charts/data collection • Conferencing • Exhibits • Interviews • Graphic organizers • Journals • Mathematical Practices

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		Essential knowledge and skills • Factor using special products • Factor polynomials by GCF ○ e.g. x^3-2x^2-35x • Factor out a constant, variable, or a combination of both • Identify the relationship between a situation and an algebraic model. (TUSD) **Mathematical Practices** • Reason abstractly and quantitatively • Look for and make use of structure **Academic vocabulary** • Base • Binomial • Coefficient • Completing the square • Degree • Exponent • Expression • Factor • Greatest common factor • Maximum • Minimum • Polynomial • Quadratic • Term • Transform • Trinomial • Vertex **Assessment problems** A-SSE.1 • Polynomials: Polynomial vocabulary (Algebra - Z.1) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I1ASSE1.aspx • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-II/II-3-A-SSE-1.aspx **(p.1)** **Assessment problems** A-SSE.2 • Properties: Simplify variable expressions using properties (Algebra - H.3) • Variable expressions and equations: Simplify variable expressions involving like terms and the distributive property (Algebra - I.2) • Exponents: Simplify expressions involving exponents (Algebra - V.8) • Monomials: Powers of monomials (Algebra - Y.5) • Factoring: Factor out a monomial (Algebra - AA.2) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-II/II-3-A-SSE-1.aspx • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.cr.2.0asse.a.005_v1.pdf (p.2)	*added, so it simplifies to (3x + 2)(x – 5). Students should become comfortable with rewriting expressions in a variety of ways until a structure emerges.* • *Have students 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.* ODE		• Modeling ★ • Multiple Intelligences assessments, e.g. ▯ Role playing - bodily kinesthetic ▯ Graphic organizing - visual ▯ Collaboration - interpersonal • Oral presentations • Problem/Performance based/common tasks • Rubrics/checklists (mathematical practice, modeling) • Tests and quizzes • Technology • Think-alouds • Writing genres ▯ Argument ▯ Information
ALGEBRA **Seeing structure in Expressions (A-SSE)** Write expressions in equivalent	**S**	**Students** A-SSE.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.★ **Supporting content** a. Factor a quadratic expression to reveal the zeros of the function it defines. (A-SSE.3a)	TEACHER NOTES See instructional strategies in the introduction • *Quadratic and exponential*	RESOURCE NOTES See resources in the introduction Textbooks • *Algebra 1*, chapter 10 • *HM Algebra 1*	ASSESSMENT NOTES See assessments in the introduction REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM

ALGEBRA I CURRICULUM Grades 8-9

Curriculum Writers: Amanda Bednarczyk, David Mellor, and Melissa Silverio

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
forms to solve problems Use **Mathematical Practices** to 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		b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. (A-SSE.3b) c. Use the properties of exponents to transform expressions for exponential functions. ○ *For example the expression* 1.15^t *can be rewritten as* $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ *to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.* (A-SSE.3c) **Essential knowledge and skills** • Define and use zero and negative exponents. • Exponential growth and decay formulas • Relate the algebraic and graphic solutions to a quadratic equation (x-intercepts, zero, roots) by ○ Factoring ○ Completing the square ○ Greatest common factor **Mathematical Practices** • Model with mathematics **Teaching Examples:** • Express $2(x^3 - 3x^2 + x - 6) - (x - 3)(x + 4)$ in factored form and use your answer to say for what values of x the expression is zero. • Write the expression below as a constant multiplied by a power of x and use your answer to decide whether the expression gets larger or smaller as x gets larger. $\frac{(2x^3)^2(3x^4)}{(x^2)^3}$ (TUSD) **Academic vocabulary** • Base • Binomial • Coefficient • Completing the square • Degree • Exponent • Expression • Factor • Greatest common factor • Maximum • Minimum • Polynomial • Quadratic • Term • Transform • Trinomial • Vertex **Assessment problems A-SSE.3** • Quadratic equations: Solve a quadratic equation by factoring (Algebra - BB.5) • Quadratic equations: Complete the square (Algebra - BB.6) • Exponents: Negative exponents (Algebra - V.3) • Exponents: Multiplication with exponents (Algebra - V.4) • Exponents: Division with exponents (Algebra - V.5) • Exponents: Multiplication and division with exponents (Algebra - V.6) • Exponents: Power rule (Algebra - V.7) • Exponents: Simplify expressions involving exponents (Algebra - V.8)	• *This cluster focuses on linking expressions and functions, i.e., creating connections between multiple representations of functional relations – the dependence between a quadratic expression and a graph of the quadratic function it defines, and the dependence between different symbolic representations of exponential functions. Teachers need to foster the idea that changing the forms of expressions, such as factoring or completing the square, or transforming expressions from one exponential form to another, are not independent algorithms that are learned for the sake of symbol manipulations. They are processes that are guided by goals (e.g., investigating properties of families of functions and solving contextual problems).* (ODE)	○ 10.5 activity and extension ○ Section 8.5 # 37 ○ Section 8.6 #46 • *Exploration in Core Math,* Holt Mc Dougal Technology • Graphing calculators • Graphing software, including dynamic geometry software • *Computer* Algebra Systems Materials • *Algebra* tiles • Area *models* • *Tables*, graphs and equations of real-world applications that apply quadratic and exponential functions	• FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS • Anecdotal records • Charts/data collection • Conferencing • Exhibits • Interviews • Graphic organizers • Journals • Mathematical Practices • Modeling ★ • Multiple Intelligences assessments, e.g. □ Role playing - bodily kinesthetic □ Graphic organizing - visual □ Collaboration - interpersonal • Oral presentations • Problem/Performance based/common tasks • Real-life applications involving graphing • Rubrics/checklists (mathematical practice, modeling) • Tests and quizzes • Technology

ALGEBRA I CURRICULUM Grades 8-9

Curriculum Writers: Amanda Bednarczyk, David Mellor, and Melissa Silverio

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		• Algebra review: Properties of exponents (Geometry - A.3) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-II/II-3-A-SSE-3.aspx • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.sr.1.0asse.e.015_v1.pdf			• Think-alouds • Writing genres Argument Information
ALGEBRA **Arithmetic with polynomials and rational function (A-APR)** Perform arithmetic operations on polynomials Use **Mathematical Practices** to 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	**M**	**Students** 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. **Major content** **Essential knowledge and skills** / **Mathematical Practices** • Explain why the system of polynomials is closed under addition, subtraction, and multiplication • Identify similarities and differences between the system of polynomials and the system of integers. • Use the distributive property to combine like terms. **Teaching Examples:** • When adding the polynomials 3x and 2x, the result can be explained with the distributive property as follows: x + 2x = (3 + 2)x = 5x. (TUSD) **Academic vocabulary** • Closure property • Exponential • Factor • Distributive property **Assessment problems A- APR.1** • Polynomials: Model polynomials with algebra tiles (Algebra - Z.2) • Polynomials: Add and subtract polynomials using algebra tiles (Algebra - Z.3) • Polynomials: Add and subtract polynomials (Algebra - Z.4) • Polynomials: Add polynomials to find perimeter (Algebra - Z.5) • Polynomials: Multiply a polynomial by a monomial (Algebra - Z.6) • Polynomials: Multiply two polynomials using algebra tiles (Algebra - Z.7) • Polynomials: Multiply two binomials (Algebra - Z.8) • Polynomials: Multiply two binomials: special cases (Algebra - Z.9) • Polynomials: Multiply polynomials (Algebra - Z.10) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-II/II-1-A-APR-1.aspx • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.er.3.0aapr.f.045_v1.pdf	TEACHER NOTES See instructional strategies in the introduction • *Linear and quadratic* • *The primary strategy for this cluster is to make connections between arithmetic of integers and arithmetic of polynomials. In order to understand this standard, students need to work toward both understanding and fluency with polynomial arithmetic. Furthermore, to talk about their work, students will need to use correct vocabulary, such as integer, monomial, polynomial, factor, and term.* • *In arithmetic of polynomials, a central idea is the distributive property, because it is fundamental not only in polynomial multiplication but also in polynomial addition and subtraction. With the distributive property, there is little need to emphasize misleading mnemonics, such as FOIL, which is relevant only when*	RESOURCE NOTES See resources in the introduction Textbooks • *Algebra 1,* McDougal Littell • *Exploration in Core Math,* Holt Mc Dougal Technology • Graphing calculators • Graphing software, including dynamic geometry software • *Computer* Algebra Systems Materials • *Algebra* tiles • Area *models*	ASSESSMENT NOTES REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS See assessments in the introduction

ALGEBRA I CURRICULUM Grades 8-9

Curriculum Writers: Amanda Bednarczyk, David Mellor, and Melissa Silverio

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
			multiplying two binomials, and the procedural reminder to "collect like terms" as a consequence of the distributive property. (ODE)		
ALGEBRA **Creating Equations ★ (A-CED)** Create equations that describe numbers or relationships (A-CED) Use **Mathematical Practices** to 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	**M**	**Students** 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.* **Major content** **Essential knowledge and skills** • Translate real world situations into mathematical equations and inequalities • Identify how and why a situation is best represented by an equation, or an inequality **Mathematical Practices** • Reason abstractly and quantitatively • Model with mathematics ★ • Use appropriate tools strategically **Teaching Examples:** • Given that the following trapezoid has area 54 cm^2, set up an equation to find the length of the unknown base, and solve the equation.  • Lava coming from the eruption of a volcano follows a parabolic path. The height *h* in feet of a piece of lava *t* seconds after it is ejected from the volcano is given by $h(t) = -16t^2 + 64t + 936$. After how many seconds does the lava reach its maximum height of 1000 feet? • The value of an investment over time is given by the equation $A(t) = 10{,}000(1.03)^t$. What does each part of the equation represent? Solution: The $10,000 represents the initial value of the investment. The 1.03 means that the investment will grow exponentially at a rate of 3% per year for *t* years. • You bought a car at a cost of $20,000. Each year that you own the car the value of the car will decrease at a rate of 25%. Write an equation that can be used to find the value of the car after *t* years. Solution: $C(t) = \$20{,}000(0.75)^t$. The base is 1 – 0.25 = 0.75 and is between 0 and 1, representing exponential decay. The value of $20,000 represents the initial cost of the	TEACHER NOTES See instructional strategies in the introduction • *Linear, quadratic, and exponential (integer inputs only) for A.CED.3, linear only* • *Provide examples of real-world problems that can be modeled by writing an equation or inequality. Begin with simple equations and inequalities and build up to more complex equations in two or more variables that may involve quadratic, exponential or rational functions.* • *Discuss the importance of using appropriate labels and scales on the axes when representing functions with graphs.* • *Examine real-world graphs in terms of constraints that are necessary to balance a mathematical model with the real-world context. For example, a student writing an equation to model the maximum area when the perimeter of a*	RESOURCE NOTES See resources in the introduction Textbooks • *Algebra 1,* McDougal Littell Chapters 3,6,7 • *Exploration in Core Math,* Holt Mc Dougal Technology • Graphing calculators • Graphing software, including dynamic geometry software • *Computer* Algebra Systems • Computer software that generate graphs of functions Materials • *Algebra* tiles • *Area models* • Examples of real-world situations that lend themselves to writing equations that model the contexts.	ASSESSMENT NOTES See assessments in the introduction REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS • Anecdotal records • Charts/data collection • Conferencing • Exhibits • Interviews • Graphic organizers • Journals • Mathematical Practices • Modeling ★

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		car. • An amount of $100 was deposited in a savings account on January 1st in each of the years 2010, 2011, 2012, and so on to 2020, with an annual yield of 7%. What will be the balance in the savings account at the end of the day on January 1, 2020? In your solution, illustrate the use of a formula for a geometric series when S_n represents the value of the geometric series with the first term g, constant ratio $r \neq 1$, and n + 1 terms. Before using the formula, it might be reasonable to demonstrate the way the formula is derived. Solution: $S_n = g + gr + gr^2 + gr^3 + \ldots + gr^n$ Multiply by r: $rS_n = gr + gr^2 + gr^3 + \ldots + gr^n + gr^{n+1}$ Subtract: $S_n - rS_n = g - gr^{n+1}$ Factor: $S_n(1 - r) = g(1 - r^{n+1})$ Divide by (1 – r): $S_n = g(1 - r^{n+1})/(1 - r)$ The amount of the investment on January 1, 2020 can be found using: $100(1.07)^{10} + 100(1.07)^9 + \ldots + 100(1.07) + 100$. If the first term of this geometric series is g = 100, the ratio is 1.07, and n = 10, the formula for the value of the geometric series gives S_{10} = $1578.36 to the nearest cent. (TUSD)	*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. Students can discuss the difference between the parabola that models the problem and the portion of the parabola that applies to the context.* • *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* $A = \frac{1}{2} h(b,+b_2)$ *be solved for h if the area and lengths of the bases are known but the height needs to be calculated. This strategy of selecting a different representation has many applications in science and business when using formulas.* • *Provide examples of real-world problems that can be solved by writing an equation, and have students explore the graphs of the equations on a graphing calculator to determine which parts of the graph*		• Multiple Intelligences assessments, e.g. ▫ Role playing - bodily kinesthetic ▫ Graphic organizing - visual ▫ Collaboration - interpersonal • Oral presentations • Problem/Performance based/common tasks • Rubrics/checklists (mathematical practice, modeling) • Tests and quizzes • Technology • Think-alouds • Writing genres ▫ Argument ▫ Information
	M	A-CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. **Major content** **Essential knowledge and skills** • Identify how and why a situation is best represented by a system or equations or inequalities. • Compare graphs of equations and inequalities. **Teaching Examples:** • The formula for the surface area of a cylinder is given by $V = \pi r^2 h$, where r represents the radius of the circular cross-section of the cylinder and h represents the height. Choose a fixed value for h and graph V vs. r. Then pick a fixed value for r and graph V vs. h. Compare the graphs. What is the **Mathematical Practices** • Reason abstractly and quantitatively • Model with mathematics ★ • Use appropriate tools strategically			

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		appropriate domain for r and h? Be sure to label your graphs and use an appropriate scale. (TUSD)	*are relevant to the problem context.* • *Use a graphing calculator to demonstrate how dramatically the shape of a curve can change when the scale of the graph is altered for one or both variables.* • *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.* (ODE)		
	M	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. **Major content** • *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.* **Essential knowledge and skills** • Determine if a given point is a viable solution to a system of equations or inequalities, both on a graph and using the equations **Teaching Examples:** • A club is selling hats and jackets as a fundraiser. Their budget is $1500 and they want to order at least 250 items. They must buy at least as many hats as they buy jackets. Each hat costs $5 and each jacket costs $8. ○ Write a system of inequalities to represent the situation. ○ Graph the inequalities. ○ If the club buys 150 hats and 100 jackets, will the conditions be satisfied? ○ What is the maximum number of jackets they can buy and still meet the conditions? (TUSD) **Mathematical Practices** • Reason abstractly and quantitatively • Model with mathematics ★ • Use appropriate tools strategically			
	M	A-CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. **Major content** • *For example, rearrange Ohm's law V = IR to highlight resistance R.* **Essential knowledge and skills** • Explain how and why given formulas are solved for a particular variable **Teaching Examples:** • The Pythagorean Theorem expresses the relation between the legs a and b of a right triangle and its hypotenuse c with the equation $a^2 + b^2 = c^2$. • Why might the theorem need to be solved for c? • Solve the equation for c and write a problem situation where this form of the equation might be **Mathematical Practices** • Reason abstractly and quantitatively • Model with mathematics ★ • Use appropriate tools strategically • Look for and make use of structure			

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		useful. ○ Solve $V=\frac{4}{3}\rho r^3$ for radius *r*. ○ Motion can be described by the formula below, where *t* = time elapsed, *u* = initial velocity, *a* = acceleration, and *s* = distance traveled. $s = ut+\frac{1}{2}at^2$ • Why might the equation need to be rewritten in terms of *a*? • Rewrite the equation in terms of *a*. (TUSD) **Academic vocabulary** • Coordinate axes • Graph • System • Equation • Inequality quadratic • X-intercept • Exponent • Linear • Y-intercept • Formula • Solution • Zeros **Assessment problems A-CED.1** • Variable expressions and equations: Write variable equations (Algebra - I.3) • Solve equations: Model and solve equations using algebra tiles (Algebra - J.1) • Solve equations: Write and solve equations that represent diagrams (Algebra - J.2) • Solve equations: Solve linear equations: word problems (Algebra - J.8) • Single-variable inequalities: Write inequalities from graphs (Algebra - K.2) • Single-variable inequalities: Write compound inequalities from graphs (Algebra - K.13) • Problem solving: Rate of travel: word problems (Algebra - O.4) • Problem solving: Weighted averages: word problems (Algebra - O.5) • Algebra review: Write variable expressions and equations (Geometry - A.5) • Algebra review: Solve linear equations (Geometry - A.6) • Algebra review: Solve linear inequalities (Geometry - A.7) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I1ACED1.aspx • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-II/II-3-A-CED-1-(1).aspx (p.1.) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.hmofc.a.268_v1.pdf (p.1.) **Assessment problems A-CED.2** • Relations and functions: Graph a function (Algebra - Q.9) • Relations and functions: Write a function rule: word problems (Algebra - Q.10) • Relations and functions: Write a rule for a function table (Algebra - Q.12) • Direct and inverse variation: Write direct variation equations (Algebra - R.4) • Direct and inverse variation: Write inverse variation equations (Algebra - R.7) • Direct and inverse variation: Write and solve inverse variation equations (Algebra - R.8) • Linear functions: Slope-intercept form: graph an equation (Algebra - S.5) • Linear functions: Slope-intercept form: write an equation from a graph (Algebra - S.6)			

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		• Linear functions: Slope-intercept form: write an equation (Algebra - S.7) • Linear functions: Linear function word problems (Algebra - S.8) • Linear functions: Write equations in standard form (Algebra - S.9) • Linear functions: Standard form: graph an equation (Algebra - S.11) • Linear functions: Point-slope form: graph an equation (Algebra - S.14) • Linear functions: Point-slope form: write an equation (Algebra - S.16) • Quadratic equations: Characteristics of quadratic functions (Algebra - BB.1) • Functions: linear, quadratic, exponential: Write linear, quadratic, and exponential functions (Algebra - CC.3) • Absolute value functions: Graph an absolute value function (Algebra - DD.3) • Rational functions and expressions: Rational functions: asymptotes and excluded values (Algebra - GG.1) • Lines in the coordinate plane: Graph a linear equation (Geometry - E.3) • Lines in the coordinate plane: Equations of lines (Geometry - E.4) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I1ACED1.aspx • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-II/II-3-A-CED-1-(1).aspx (p.2) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.cr.2.0aced.a.225_v1.pdf (p.2) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.cansb.a.051_v1.pdf (p.2) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.tuitn.a.298_v1.pdf (p.2) **Assessment problems A-CED.3** • Solve equations: Solve linear equations: word problems (Algebra - J.8) • Problem solving: Rate of travel: word problems (Algebra - O.4) • Problem solving: Weighted averages: word problems (Algebra - O.5) • Linear inequalities: Linear inequalities: word problems (Algebra - T.4) • Systems of linear equations: Solve a system of equations by graphing: word problems (Algebra - U.3) • Systems of linear equations: Solve a system of equations using substitution: word problems (Algebra - U.9) • Systems of linear equations: Solve a system of equations using elimination: word problems (Algebra - U.11) • Systems of linear equations: Solve a system of equations using augmented matrices: word problems (Algebra - U.13) • Systems of linear equations: Solve a system of equations using any method: word problems (Algebra - U.15) • Algebra review: Solve systems of linear equations (Geometry - A.8) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I1ACED1.aspx **(p.3)** **Assessment problems A-CED.4** • Problem solving: Rate of travel: word problems (Algebra - O.4)			

ALGEBRA I CURRICULUM Grades 8-9

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CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		• Points, lines, and segments: Midpoint formula (Geometry - B.7) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I1ACED1.aspx • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-II/II-3-A-CED-1-(1).aspx (p.4) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.cr.2.0asse.a.005_v1.pdf (p.3) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.cansb.a.051_v1.pdf			
ALGEBRA **Reasoning with Equations and Inequalities (A-REI)** Understand solving equations as a process of reasoning and explain the reasoning Use **Mathematical Practices** to 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	**M**	**Students** A-REI.1 Explain each step in solving a simple equation as following from the equality of the previous step, starting from the numbers asserted at assumption that the original equation has a solution. Construct a viable argument to justify a solution method. **Major content** **Essential knowledge and skills** • Justify each step in the process of solving equations • Check solutions of equations • Justify your reasoning when solving an equation • Properties of operations can be used to change expressions on either side of the equation to equivalent expressions. In addition, adding the same term to both sides of an equation or multiplying both sides by a non-zero constant produces an equation with the same solutions. Other operations, such as squaring both sides, may produce equations that have extraneous solutions. (TUSD) **Mathematical Practices** • Reason abstractly and quantitatively • Construct viable arguments and critique the reasoning of others • Look for and make use of structure **Teaching Examples:** • Explain why the equation $\frac{x}{2} + \frac{7}{3} = 5$ has the same solutions as the equation 3x + 14 = 30. Does this mean that $\frac{x}{2} + \frac{7}{3} =$ is equal to 3x + 14? • Show that x = 2 and x = –3 are solutions to the equation $x^2 + x = 6$. Write the equation in a form that shows these are the only solutions, explaining each step in your reasoning. • Transform 2x – 5 = 7 to 2x = 12 and tell what property of equality was used. Solution $2x - 5 = 7$ $2x - 5 + 5 = 7 + 5$ Addition property of equality $2x = 12$ (TUSD)	TEACHER NOTES See instructional strategies in the introduction • *Learn as general principle, master linear equations.* • *Challenge students to justify each step of solving an equation. Transforming 2x - 5 = 7 to 2x =12 is possible because 5 = 5, so adding the same quantity to both sides of an equation makes the resulting equation true as well. Each step of solving an equation can be defended, much like providing evidence for steps of a geometric proof.* • *Provide examples for how the same equation might be solved in a variety of ways as long as equivalent quantities are added or subtracted to both sides of the equation, the order of steps taken will not matter.* (ODE)	RESOURCE NOTES See resources in the introduction Textbooks • *Algebra 1,* McDougal Littell Chapters 3 • *Exploration in Core Math,* Holt Mc Dougal Technology • Graphing calculators • Graphing software, including dynamic geometry software • *Computer* Algebra Systems • Computer software that generate graphs of functions • Computer software that generates graphs for visually examining solutions to equations, particularly rational and radical Materials • *Algebra* tiles • *Area models* • Examples of radical equations that do and do not result in the generation of extraneous	ASSESSMENT NOTES REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS See assessments in the introduction

This curriculum was developed based on the Common Core State Standards utilizing examples and strategies from various websites including Tucson, Arizona, Ohio, and New Jersey.

ALGEBRA I CURRICULUM Grades 8-9

Curriculum Writers: Amanda Bednarczyk, David Mellor, and Melissa Silverio

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		Academic vocabulary • Completing the square • Complex solutions • Discriminant • Elimination/linear combinations • Equation • Extraneous solutions • Factoring • Half=plane • Inequality • Laws of exponents • Point of intersection • Quadratic formula • Radical • Solution • Square roots • Substitution • System **Assessment problems** A-REI.1 • Properties: Properties of equality (Algebra - H.4) • Problem solving: Weighted averages: word problems (Algebra - O.5) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I3AREI.aspx (p.1.)		solutions should be prepared for exploration	
ALGEBRA **Reasoning with Equations and Inequalities (A-REI)** Solve equations and inequalities in one variable Use **Mathematical Practices** to 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	**M**	**Students** A-REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. **Major content** **Essential knowledge and skills** • Equations and inequalities are solved using properties of operations, equality, and inequality, which can justify each step of the process. • Laws of exponents can be used to solve simple exponential equations. • Determine and justify whether a solution to an equation or inequality is correct • Explain how operations performed on real numbers affect the relationship between the quantities in an inequality. **Mathematical Practices** • Reason abstractly and quantitatively • Look for and make use of structure • Look for and express regularity in repeated reasoning **Teaching Examples:** • Solve for the variable: • $3x > 9$ • $ax + 7 = 12$, when a = 2 • $\frac{3+x}{7} = \frac{x-9}{4}$ • Solve for x: $\frac{2}{3}x + 9 < 18$ (TUSD) A-REI.4 Solve quadratic equations in one variable. **Major content** a. 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.	TEACHER NOTES See instructional strategies in the introduction • *Linear inequalities; literal equations that are linear in the variables being solved for; quadratics with real solutions* • *There are two major reasons for discussing the topic of inequalities along with equations: First, there are analogies between solving equations and inequalities that help students understand them both. Second, the applications that lead to equations almost always lead in the same way to inequalities.* • *In grades 6-8, students solve and graph linear equations and inequalities. Graphing experience with inequalities is limited to*	RESOURCE NOTES See resources in the introduction Textbooks • *Algebra 1,* McDougal Littell Chapters 3,6,7 • *Exploration in Core Math,* Holt Mc Dougal Technology • Graphing calculators • Graphing software, including dynamic geometry software • *Computer* Algebra Systems • Computer software that generate graphs of functions • Graphing utilities to explore the effects of changes in parameters of equations on their graphs Materials • *Algebra* tiles • *Area models* • Examples of real-world	ASSESSMENT NOTES See assessments in the introduction REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS • Anecdotal records • Charts/data collection • Conferencing • Exhibits • Interviews • Graphic organizers • Journals • Mathematical Practices • Modeling ★ • Multiple Intelligences assessments, e.g.

This curriculum was developed based on the Common Core State Standards utilizing examples and strategies from various websites including Tucson, Arizona, Ohio, and New Jersey.

<table>
<tr><th>CATEGORIES, DOMAINS, CLUSTERS</th><th>UNIT</th><th>STANDARDS/BENCHMARKS
North Smithfield School Department</th><th>INSTRUCTIONAL STRATEGIES</th><th>RESOURCES</th><th>ASSESSMENTS</th></tr>
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<td></td>
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<td>
Derive the quadratic formula from this form. A-REI.4a

b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation.

Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b. A-REI.4b

<u>Essential knowledge and skills</u>
• Solving quadratic equations by a variety of methods including: inspecting, graphing, taking square roots, factoring, completing the square, quadratic formula.
• Determine the best method for solving quadratic equation.
• Determine why some quadratic equations have extraneous and/or complex solutions. (ODE) (TUSD)
<table>
<tr><th>Value of Discriminant</th><th>Nature of Roots</th><th>Nature of Graph</th></tr>
<tr><td>$b^2 - 4ac = 0$</td><td>1 real root</td><td>intersects x-axis once</td></tr>
<tr><td>$b^2 - 4ac > 0$</td><td>2 real roots</td><td>intersects x-axis twice</td></tr>
<tr><td>$b^2 - 4ac < 0$</td><td>2 complex roots</td><td>does not intersect x-axis</td></tr>
</table>
<u>Mathematical Practices</u>
• Reason abstractly and quantitatively
• Construct viable arguments and critique the reasoning of others
• Model with mathematics ★
• Use appropriate tools strategically
• Look for and make use of structure
• Look for and express regularity in repeated reasoning

<u>Teaching Examples:</u>
• Are the roots of $2x^2 + 5 = 2x$ real or complex? How many roots does it have? Find all solutions of the equation.
  ○ What is the nature of the roots of $x^2 + 6x + 10 = 0$? Solve the equation using the quadratic formula and completing the square. How are the two methods related?
• Projectile motion problems, in which the initial conditions establish one of the solutions as extraneous within the context of the problem.
  ○ An object is launched at 14.7 meters per second (m/s) from a 49-meter tall platform. The equation for the object's height s at time t seconds after launch is $s(t) = -4.9t^2 + 14.7t + 49$, where s is in meters. When does the object strike the ground? (TUSD)
<u>Solution</u>: $0 = -4.9t^2 + 14.7t + 49$
$0 = t^2 - 3t - 10$
$0 = (t + 2)(t - 5)$
</td>
<td>
graphing on a number line diagram. Despite this work, some students will still need more practice to be proficient. It may be beneficial to remind students of the most common solving techniques, such as converting fractions from one form to another, removing parentheses in the sentences, or multiplying both sides of an equation or inequality by the common denominator of the fractions. Students must be aware of what it means to check an inequality's solution. The substitution of the end points of the solution set in the original inequality should give equality regardless of the presence or the absence of an equal sign in the original sentence. The substitution of any value from the rest of the solution set should give a correct inequality.
• Careful selection of examples and exercises is needed to provide students with meaningful review and to introduce other important concepts, such as the use of properties and applications of solving
</td>
<td>
situations that lend themselves to writing equations that model the contexts.

• Tables, graphs and equations of real-world applications that apply quadratic and exponential functions
</td>
<td>
 Role playing - bodily kinesthetic
 Graphic organizing - visual
 Collaboration - interpersonal
• Oral presentations
• Problem/Performance based/common tasks
• Real-life applications involving graphing
• Rubrics/checklists (mathematical practice, modeling)
• Tests and quizzes
• Technology
• Think-alouds
• Writing genres
 Argument
 Information
</td>
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</table>

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		Academic vocabulary • Completing the square • Complex solutions • Discriminant • Elimination/linear combinations • Equation • Extraneous solutions • Factoring • Half=plane • Inequality • Laws of exponents • Point of intersection • Quadratic formula • Radical • Solution • Square roots • Substitution • System **Assessment problems A-REI.3** • Solve equations: Model and solve equations using algebra tiles (Algebra - J.1) • Solve equations: Write and solve equations that represent diagrams (Algebra - J.2) • Solve equations: Solve one-step linear equations (Algebra - J.3) • Solve equations: Solve two-step linear equations (Algebra - J.4) • Solve equations: Solve advanced linear equations (Algebra - J.5) • Solve equations: Solve equations with variables on both sides (Algebra - J.6) • Solve equations: Identities and equations with no solutions (Algebra - J.7) • Solve equations: Solve linear equations: word problems (Algebra - J.8) • Solve equations: Solve linear equations: mixed review (Algebra - J.9) • Single-variable inequalities: Identify solutions to inequalities (Algebra - K.3) • Single-variable inequalities: Solve one-step linear inequalities: addition and subtraction (Algebra - K.4) • Single-variable inequalities: Solve one-step linear inequalities: multiplication and division (Algebra - K.5) • Single-variable inequalities: Solve one-step linear inequalities (Algebra - K.6) • Single-variable inequalities: Graph solutions to one-step linear inequalities (Algebra - K.7) • Single-variable inequalities: Solve two-step linear inequalities (Algebra - K.8) • Single-variable inequalities: Graph solutions to two-step linear inequalities (Algebra - K.9) • Single-variable inequalities: Solve advanced linear inequalities (Algebra - K.10) • Single-variable inequalities: Graph solutions to advanced linear inequalities (Algebra - K.11) • Single-variable inequalities: Graph compound inequalities (Algebra - K.12) • Single-variable inequalities: Write compound inequalities from graphs (Algebra - K.13) • Single-variable inequalities: Solve compound inequalities (Algebra - K.14) • Single-variable inequalities: Graph solutions to compound inequalities (Algebra - K.15) • Algebra review: Solve linear equations (Geometry - A.6) • Algebra review: Solve linear inequalities (Geometry - A.7) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I3AREI.aspx • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.te.1.0arei.i.088_v1.pdf (p.2) **Assessment problems A-REI.4** • Quadratic equations: Complete the square (Algebra - BB.6) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-II/II-3-A-REI-4.aspx • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.hmofc.a.268_v1.pdf	*linear equations and inequalities. Stress the idea that the application of properties is also appropriate when working with equations or inequalities that include more than one variable, fractions and decimals. Regardless of the type of numbers or variables in the equation or inequality, students have to examine the validity of each step in the solution process.* • *Solving equations for the specified letter with coefficients represented by letters (e.g., when solving for* $A = \frac{1}{2} h (b_1$ *is* $+ b_2)$ *when solving for* b_2 *similar to solving an equation with one variable. Provide students with an opportunity to abstract from particular numbers and apply the same kind of manipulations to formulas as they did to equations. One of the purposes of doing abstraction is to learn how to evaluate the formulas in easier ways and use the techniques across mathematics and science.* (ODE) •		

ALGEBRA I CURRICULUM Grades 8-9

Curriculum Writers: Amanda Bednarczyk, David Mellor, and Melissa Silverio

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
ALGEBRA **Reasoning with Equations and Inequalities (A-REI)** Analyze and solve linear equations and pairs of simultaneous linear equations. **8.EE** Use **Mathematical Practices** to 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	**M**	**Students** 8.EE-8 Analyze and solve pairs of simultaneous linear equations. **Major content** a. 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-8a b. 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-8b c. 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.* 8.EE-8c **Essential knowledge and skills** • The solution to a system of linear equations in two variables is the point/ ordered pair on a graph where the two lines will intersect. • The solution to a system of linear equations in two variables is the point/ ordered pair that satisfies both equations. • System of linear questions can be solved algebraically to find the point of intersection and then checked graphically. **Teaching Examples:** • Sample problem @ http://www.tusd1.org/contents/distinfo/curriculum/index.asp, grade 8 mathematics pp 15-17 (TUSD) **Mathematical Practices** • Make sense of problems and persevere in solving them • Reason abstractly and quantitatively • Construct viable arguments and critique the reasoning of others • Model with mathematics ★ • Use appropriate tools strategically • Attend to precision • Look for and make use of structure • Look for and express regularity in repeated reasoning **Academic vocabulary** • Base • Cube • Cube Root • Exponent • Exponential form • Perfect Square • Power • Radical • Scientific notation • Square • Square root	TEACHER NOTES See instructional strategies in the introduction • *Problems should be structured so that students also experience equations that represent parallel lines and equations that are equivalent. This will help them to begin to understand the relationships between different pairs of equations: When the slope of the two lines is the same, the equations are either different equations representing the same line (thus resulting in many solutions), or the equations are different equations representing two not intersecting, parallel, lines that do not have common solutions.* • *System-solving in Grade 8 should include estimating solutions graphically, solving using substitution, and solving using elimination. Students again should gain experience by developing conceptual skills using models that develop into abstract skills of formal solving of equations. Provide opportunities for students to change*	RESOURCE NOTES See resources in the introduction Textbooks • *Algebra 1,* McDougal Littell Chapter 7 • *Exploration in Core Math,* Holt Mc Dougal • *HM Algebra 1* • HM Curriculum Companion book Technology • SMART Board's new tools for solving equations • Graphing calculators Materials • Index cards with equations/graphs for matching and sorting	ASSESSMENT NOTES See assessments in the introduction REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS • Anecdotal records • Charts/data collection • Conferencing • Exhibits • Interviews • Graphic organizers • Journals • Mathematical Practices • Modeling ★ • Multiple Intelligences assessments, e.g. □ Role playing - bodily kinesthetic □ Graphic organizing - visual □ Collaboration - interpersonal • Oral presentations • Problem/Performance based/common tasks • Real-life applications

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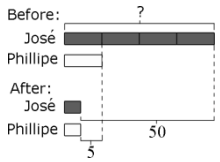
CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		Assessment problems 8.EE-8 • Systems of linear equations: Is (x, y) a solution to the system of equations? (Eighth grade - Y.1) • Systems of linear equations: Solve a system of equations by graphing (Eighth grade - Y.2) • Systems of linear equations: Find the number of solutions to a system of equations by graphing (Eighth grade - Y.4) • Systems of linear equations: Find the number of solutions to a system of equations (Eighth grade - Y.5) • Systems of linear equations: Classify a system of equations by graphing (Eighth grade - Y.6) • Systems of linear equations: Classify a system of equations (Eighth grade - Y.7) • Systems of linear equations: Solve a system of equations using substitution (Eighth grade - Y.8) • Systems of linear equations: Solve a system of equations using elimination (Eighth grade - Y.10) • Systems of linear equations: Solve a system of equations by graphing: word problems (Eighth grade - Y.3) • Systems of linear equations: Solve a system of equations using substitution: word problems (Eighth grade - Y.9) • Systems of linear equations: Solve a system of equations using elimination: word problems (Eighth grade - Y.11)	*forms of equations (from a given form to slope-intercept form) in order to compare equations* (ODE)		involving graphing • Rubrics/checklists (mathematical practice, modeling) • Tests and quizzes • Technology • Think-alouds • Writing genres ▫ Argument ▫ Information
ALGEBRA **Reasoning with Equations and Inequalities (A-REI)** Solve systems of equations Use **Mathematical Practices** to 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	**A**	**Students** 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. **Additional content** **Essential knowledge and skills** • A system of linear equations can have one solution, infinitely many solutions, or no solution. • A system of linear equations can be solved graphically, algebraically using elimination/linear combination, substitution, or modeling. • Multiplying both sides of an equation by a non-zero constant does not change the solution to the equation. • Elimination/linear combination is a method of solving a system of linear equations in which the equations are added together in order to eliminate a variable. • In elimination/linear combination you may need to multiply one or both of the equations by a non-zero constant in order to be able to eliminate one **Mathematical Practices** • Reason abstractly and quantitatively • Construct viable arguments and critique the reasoning of others	TEACHER NOTES See instructional strategies in the introduction • *Linear-linear and linear-quadratic* • *The focus of this standard is to provide mathematics justification for the addition (elimination) and substitution methods of solving systems of equations that transform a given system of two equations into a simpler equivalent system that has the same solutions as the original.*	RESOURCE NOTES See resources in the introduction Textbooks • *Algebra 1,* McDougal Littell Chapter • *Exploration in Core Math,* Holt Mc Dougal • *HM Algebra 1* • HM Curriculum Companion book Technology • SMART Board's new tools for solving equations • Graphing calculators Materials	ASSESSMENT NOTES See assessments in the introduction REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS • Anecdotal records • Charts/data collection • Conferencing • Exhibits

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
regularity in repeated reasoning		of the variables. • Substitution is a method of solving a system of equations where one equation is solved for a variable and then that expression is substituted into the other equation for that variable, in order to eliminate that variable **Teaching Examples:** • Find x and y using elimination and then using substitution. ▪ 3x + 4y = 7 ▪ –2x + 8y = 10 • Given that the sum of two numbers is 10 and their difference is 4, what are the numbers? Explain how your answer can be deduced from the fact that the two numbers, x and y, satisfy the equations x + y = 10 and x – y = 4. (TUSD)	• *The Addition and Multiplication Properties of Equality allow finding solutions to certain systems of equations. In general, any linear combination, m(Ax + By) + n(Cx + Dy) = mE +nF, of two linear equations Ax + By = E and Cx + Dy = F* • *intersecting in a single point contains that point. The multipliers m and n can be chosen so that the resulting combination has only an x-term or only a y-term in it. That is, the combination will be a horizontal or vertical line containing the point of intersection.* • *In the proof of a system of two equations in two variables, where one equation is replaced by the sum of that equation and a multiple of the other equation, produces a system that has the same solutions, let point (x1, y_1) be a solution of both equations:* *$Ax_1 + By_1 = E$ (true)* *$Cx_1 + Dy_1 = F$ (true)* • *Replace the equation Ax + By = E with Ax + By + k(Cx + Dy) on its left side and with E + kF on its right side.*		• Interviews • Graphic organizers • Journals • Mathematical Practices • Modeling ★ • Multiple Intelligences assessments, e.g. ▫ Role playing - bodily kinesthetic ▫ Graphic organizing - visual ▫ Collaboration - interpersonal • Oral presentations • Problem/Performance based/common tasks • Real-life applications involving graphing • Rubrics/checklists (mathematical practice, modeling) • Tests and quizzes • Technology • Think-alouds • Writing genres ▫ Argument ▫ Information
	A	A-REI.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. **Additional content** **Essential knowledge and skills** • Solving a system of equations algebraically yields an exact solution; solving by graphing yields an approximate solution. **Teaching Examples:** • José had 4 times as many trading cards as Phillipe. After José gave away 50 cards to his little brother and Phillipe gave 5 cards to his friend for his birthday, they each had an equal amount of cards. Write a system to describe the situation and solve the system.  • Solve the system of equations: x+ y = 11 and 3x – y = 5. Use a second method to check your answer. • Solve the system of equations: x – 2y + 3z = 5, x + 3z = 11, 5y – 6z = 9. • The opera theater contains 1,200 seats, with three **Mathematical Practices** • Reason abstractly and quantitatively • Model with mathematics ★ • Use appropriate tools strategically • Attend to precision • Look for and make use of structure • Look for and express regularity in repeated reasoning			

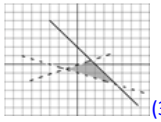
CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		different prices. The seats cost $45 per seat, $50 per seat, and $60 per seat. The opera needs to gross $63,750 on seat sales. There are twice as many $60 seats as $45 seats. How many seats at each price need to be sold? (TUSD)	*The new equation is Ax + By + k(Cx + Dy) = E + kF.* • *Show that the ordered pair of numbers (x_1, y_1) is a solution of this equation by replacing (x_1, y_1) in the left side of this equation and verifying that the right side really equals E + kF: Ax + By + k(Cx + Dy) = E + kF (true)* • *Systems of equations are classified into two groups, consistent or inconsistent, depending on whether or not solutions exist. The solution set of a system of equations is the intersection of the solution sets for the individual equations. Stress the benefit of making the appropriate selection of a method for solving systems (graphing vs. addition vs. substitution). This depends on the type of equations and combination of coefficients for corresponding variables, without giving a preference to either method.* (ODE)		
	A	A-REI.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. **Additional content** • *For example, find the points of intersection between the line y = –3x and the circle $x^2 + y^2 = 3$.* **Essential knowledge and skills** • A system of a linear equation and a quadratic equation can be solved algebraically using substitution or graphically by finding the points of intersection. **Teaching Examples:** • Find the points of intersection between the line y = –3x and the circle $x^2 + y^2 = 3$ algebraically. • Two friends are driving to the Grand Canyon in separate cars. Suzette has been there before and knows the way but Andrea does not. During the trip Andrea gets ahead of Suzette and pulls over to wait for her. Suzette is traveling at a constant rate of 65 miles per hour. Andrea sees Suzette drive past. To catch up, Andrea accelerates at a constant rate. The distance in miles (d) that her car travels as a function of time in hours (t) since Suzette's car passed is given by $d = 3500t^2$. Write and solve a system of equations to determine how long it takes for Andrea to catch up with Suzette. • Include systems that lead to work with fractions. For example, finding the intersections between $x^2+y^2=1$ and $y = \frac{(x+1)}{2}$ leads to the point $(\frac{3}{5}, \frac{4}{5})$ on the unit circle, corresponding to the Pythagorean triple $3^2+4^2=5^2$. (TUSD) **Mathematical Practices** • Reason abstractly and quantitatively • Model with mathematics ★ • Use appropriate tools strategically • Attend to precision • Look for and make use of structure • Look for and express regularity in repeated reasoning **Academic vocabulary** • Completing the Square • Complex solutions • Discriminant • Elimination/Linear Combinations • Equation • Extraneous solutions • Factoring • Half-Plane • Inequality • Laws of Exponents • Point of Intersection • Quadratic formula • Radical • Solution • Square roots • Substitution • System			

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		Assessment problems A-REI.5 • Systems of linear equations: Solve a system of equations using elimination (Algebra - U.10) • Systems of linear equations: Solve a system of equations using elimination: word problems (Algebra - U.11) • Systems of linear equations: Solve a system of equations using augmented matrices (Algebra - U.12) • Systems of linear equations: Solve a system of equations using augmented matrices: word problems (Algebra - U.13) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I3AREI.aspx **(p.3)** **Assessment problems A-REI.6** • Systems of linear equations: Is (x, y) a solution to the system of equations? (Algebra - U.1) • Systems of linear equations: Solve a system of equations by graphing (Algebra - U.2) • Systems of linear equations: Solve a system of equations by graphing: word problems (Algebra - U.3) • Systems of linear equations: Find the number of solutions to a system of equations by graphing (Algebra - U.4) • Systems of linear equations: Find the number of solutions to a system of equations (Algebra - U.5) • Systems of linear equations: Classify a system of equations by graphing (Algebra - U.6) • Systems of linear equations: Classify a system of equations (Algebra - U.7) • Systems of linear equations: Solve a system of equations using substitution (Algebra - U.8) • Systems of linear equations: Solve a system of equations using substitution: word problems (Algebra - U.9) • Systems of linear equations: Solve a system of equations using elimination (Algebra - U.10) • Systems of linear equations: Solve a system of equations using elimination: word problems (Algebra - U.11) • Systems of linear equations: Solve a system of equations using augmented matrices (Algebra - U.12) • Systems of linear equations: Solve a system of equations using augmented matrices: word problems (Algebra - U.13) • Systems of linear equations: Solve a system of equations using any method (Algebra - U.14) • Systems of linear equations: Solve a system of equations using any method: word problems (Algebra - U.15) • Algebra review: Solve systems of linear equations (Geometry - A.8) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I3AREI.aspx • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.cr.2.oarei.a.032_v1.pdf (p.4)			

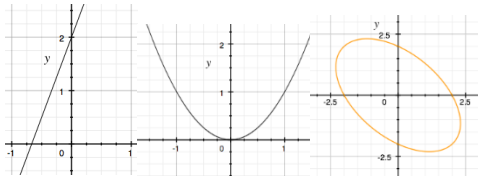
ALGEBRA I CURRICULUM Grades 8-9

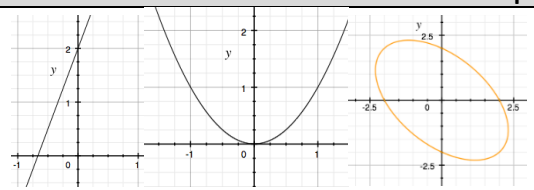
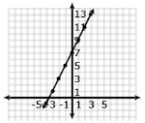
Curriculum Writers: Amanda Bednarczyk, David Mellor, and Melissa Silverio

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		Assessment problems A-REI.7 • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-II/II-3-A-REI-7.aspx			
ALGEBRA **Reasoning with Equations and Inequalities (A-REI)** Represent and solve equations and inequalities graphically Use **Mathematical Practices** to 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	**M**	**Students** 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). **Major content** **Essential knowledge and skills** • The graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane. **Teaching Examples:** • Which of the following points would be on the graph of the equation 3x+4y=24 ? (a) (0, 6) (b) (-1, 7) (c) $(\frac{4}{3}, 5)$ (d) (3, 4) • Graph the equation and determine which of the following points are on the graph of $y = 3^x + 1$. (a) (2, 7) (b) $(-1, \frac{4}{3})$ (c) (2, 10) (d) (0, 1) (TUSD) **Mathematical Practices** • Reason abstractly and quantitatively • Model with mathematics ★ 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.★ **Major content** **Essential knowledge and skills** • Solving a system of equations algebraically yields an exact solution; solving by graphing or by comparing tables of values yields an approximate solution. • The solutions (solution set) of a linear inequality in two variables are represented graphically as a half-plane. **Teaching Examples:** • Given the following equations, determine the x value that results in an equal output for both functions. (TUSD) $f(x) = 3x - 2$ $g(x) = (x + 3)^2 - 1$ **Mathematical Practices** • Model with mathematics • Reason abstractly and quantitatively • Use appropriate tools strategically • Attend to precision	TEACHER NOTES See instructional strategies in the introduction r • *Linear and exponential; learn as general principle* • *Beginning with simple, real-world examples, help students to recognize a graph as a set of solutions to an equation. For example, if the equation y = 6x + 5 represents the amount of money paid to a babysitter (i.e., $5 for gas to drive to the job and $6/hour to do the work), then every point on the line represents an amount of money paid, given the amount of time worked.* • *Explore visual ways to solve an equation such as 2x + 3 = x – 7 by graphing the functions y = 2x + 3 and y = x – 7. Students should recognize that the intersection point of the lines is at (-10, -17). They should be able to verbalize that the intersection point means that when x = -10 is substituted into both sides of the equation, each side simplifies to a value of -17. Therefore, -*	RESOURCE NOTES See resources in the introduction Textbooks • *Algebra 1,* McDougal Littell Chapter • *Exploration in Core Math,* Holt Mc Dougal • *HM Algebra 1* • HM Curriculum Companion book Technology • SMART Board's new tools for solving equations • Graphing calculators Materials • Examples of real-world situations that involve linear functions and two-variable linear inequalities	ASSESSMENT NOTES See assessments in the introduction REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS • Anecdotal records • Charts/data collection • Conferencing • Exhibits • Interviews • Graphic organizers • Journals • Mathematical Practices • Modeling ★ • Multiple Intelligences assessments, e.g. ▫ Role playing - bodily kinesthetic ▫ Graphic organizing - visual ▫ Collaboration - interpersonal • Oral presentations • Problem/Performance based/common

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
	M	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. **Major content** **Essential knowledge and skills** • The solution set of a system of linear inequalities in two variables is the intersection of the corresponding half-planes. **Mathematical Practices** • Model with mathematics ★ • Use appropriate tools strategically **Teaching Examples:** • Graph the solutions: $y < 2x + 3$. • A publishing company publishes a total of no more than 100 magazines every year. At least 30 of these are women's magazines, but the company always publishes at least as many women's magazines as men's magazines. Find a system of inequalities that describes the possible number of men's and women's magazines that the company can produce each year consistent with these policies. Graph the solution set. • Graph the system of linear inequalities below and determine if (3, 2) is a solution to the system. $\begin{cases} x - 3y > 0 \\ x + y \le 2 \\ x + 3y > -3 \end{cases}$ ○ Solution:  (3, 2) is not an element of the solution set (graphically or by substitution). (TUSD) **Academic vocabulary** • Completing the Square • Complex solutions • Discriminant • Elimination/Linear Combinations • Equation • Extraneous solutions • Factoring • Half-Plane • Inequality • Laws of Exponents • Point of Intersection • Quadratic formula • Radical • Solution • Square roots • Substitution • System **Assessment problems** A-REI.10 • Relations and functions: Relations: convert between tables, graphs, mappings, and lists of points (Algebra - Q.1)	*10 is the solution to the equation. This same approach can be used whether the functions in the original equation are linear, nonlinear or both.* • *Using technology, have students graph a function and use the trace function to move the cursor along the curve. Discuss the meaning of the ordered pairs that appear at the bottom of the calculator, emphasizing that every point on the curve represents a solution to the equation.* • *Begin with simple linear equations and how to solve them using the graphs and tables on a graphing calculator. Then, advance students to nonlinear situations so they can see that even complex equations that might involve quadratics, absolute value, or rational functions can be solved fairly easily using this same strategy. While a standard graphing calculator does not simply solve an equation for the user, it can be used as a tool to approximate solutions.* • *Use the table function on a graphing calculator to solve equations. For example, to solve the equation $x^2 = x + 12$,*		tasks • Real-life applications involving graphing • Rubrics/checklists (mathematical practice, modeling) • Tests and quizzes • Technology • Think-alouds • Writing genres □ Argument □ Information

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		• Relations and functions: Complete a function table (Algebra - Q.6) • Relations and functions: Graph a function (Algebra - Q.9) • Relations and functions: Find points on a function graph (Algebra - Q.11) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I2AREI_000-1-.aspx (p.1.) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.sr.1.0arei.j.678_v1.pdf **Assessment problems** A-REI.11 • Systems of linear equations: Solve a system of equations by graphing (Algebra - U.2) • Systems of linear equations: Solve a system of equations by graphing: word problems (Algebra - U.3) • Systems of linear equations: Find the number of solutions to a system of equations by graphing (Algebra - U.4) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I2AREI_000-**1-.aspx (p.2)** **Assessment problems** A-REI.12 • Linear inequalities: Graph a linear inequality in two variables (Algebra - T.3) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I2AREI_000-1-.aspx (p.3.) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.sr.1.0arei.j.012_v1.pdf • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.te.1.0arei.j.087_v1.pdf	*students can examine the equations $y = x^2$ and $y = x + 12$ and determine that they intersect when $x = 4$ and when $x = -3$ by examining the table to find where the y-values are the same.* (ODE)		
FUNCTIONS **Interpreting functions (F-IF)** Define, evaluate, and compare functions. 8F Use **Mathematical Practices** to 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	**M**	**Students** 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.[1] **Major content** **Essential knowledge and skills** • A function is a rule that assigns each input exactly one output. • A graph of an equation is also the graph of that function consisting of inputs and the corresponding outputs. **Teaching Examples:** • The rule that takes x as input and gives x^2+5x+4 as output is a function. Using y to stand for the output we can represent this function with the equation $y = x^2+5x+4$, and the graph of the equation is the graph of the function. • Determine which if the following tables represent a **Mathematical Practices** • Reason abstractly and quantitatively • Attend to precision	TEACHER NOTES See instructional strategies in the introduction • *To determine whether a relationship is a function, students should be expected to reason from a context, a graph, or a table, after first being clear which quantity is considered the input and which is the output. When a relationship is not a function, students should produce a counterexample: an "input value" with at*	RESOURCE NOTES See resources in the introduction Textbooks • *Algebra 1,* McDougal Littell Chapter • *Exploration in Core Math,* Holt Mc Dougal • *HM Algebra 1* Technology • SMART Board's new tools for solving equations • Graphing calculators	ASSESSMENT NOTES See assessments in the introduction REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS • Anecdotal records • Charts/data collection

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
6. Attend to precision 7. Look for and make use of structure 8. Look for and express regularity in repeated reasoning		function and explain why. Table A Input | Output 0 | 1 1 | 2 2 | 2 3 | 4 Table B Input | Output 0 | 0 1 | 2 1 | 3 4 | 5 Solution: A represents a function because for each input there is exactly one output. B does NOT represent a function because the input 1 has two outputs (2 and 3). Explanation: ▪ A vertical line test can be preformed to determine whether a graph represents a function. By definition a function, each x value (input) of a function can have only one y value (output). If a vertical line is drawn for an x value then that line can only hit the graph at one point (that is one output). • Determine if the graph represents a function:  ○ Solution	*least two "output values." If the relationship is a function, the students should explain how they verified that for each input there was exactly one output. The "vertical line test" should be avoided because (1) it is too easy to apply without thinking, (2) students do not need an efficient strategy at this point, and (3) it creates misconceptions for later mathematics, when it is useful to think of functions more broadly, such as whether x might be a function of y.*	• Graphing software	• Conferencing • Exhibits • Interviews • Graphic organizers • Journals • Mathematical Practices • Modeling ★ • Multiple Intelligences assessments, e.g. □ Role playing - bodily kinesthetic □ Graphic organizing - visual □ Collaboration - interpersonal • Oral presentations • Problem/Performance based/common tasks • Real-life applications involving graphing • Rubrics/checklists (mathematical practice, modeling) • Tests and quizzes • Technology • Think-alouds • Writing genres □ Argument □ Information

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		 A & B are functions because the vertical line only hits the graph at one point no matter where you draw the line C is not a function because the vertical line hits the graph in two points.			
	M	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.* **Major content** **Essential knowledge and skills** • Functions can be represented algebraically, graphically, numerically in tables or by verbal descriptions. **Teaching Examples:** • 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. • Compare the two linear functions listed below and determine which equation represents a greater rate of change.  Function 2: The function whose input x and output y are related by y = 3x + 7 • Compare the two linear functions listed below and determine which has a negative slope. • Function 1: Gift Card ○ Samantha starts with $20 on a gift card for the book store. She spends $3.50 per week to buy a magazine. Let y be the amount remaining as a function of the number of weeks x y 0 20 1 16.50 **Mathematical Practices** • Make sense of problems and persevere in solving them • Reason abstractly and quantitatively • Construct viable arguments and critique the reasoning of others • Model with mathematics ★ • Use appropriate tools strategically • Attend to precision • Look for and make use of structure • Look for and express regularity in repeated reasoning		

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		2 13.00 3 9.50 4 6.00 • Function 2: ○ The school bookstore rents graphing calculators for $5 per month. It also collects a non-refundable fee of $10.00 for the school year. Write the rule for the total cost (c) of renting a calculator as a function of the number of months (m). Solution: ○ Function 1 is an example of a function whose graph has negative slope. Samantha starts with $20 and spends money each week. The amount of money left on the gift card decreases each week. The graph has a negative slope of -3.5, which is the amount the gift card balance decreases with Samantha's weekly magazine purchase. ○ Function 2 is an example of a function whose graph has positive slope. Students pay a yearly nonrefundable fee for renting the calculator and pay $5 for each month they rent the calculator. This function has a positive slope of 5 which is the amount of the monthly rental fee. An equation for Example 2 could be c = 5m + 10. (TUSD)			
	M	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. • *For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1),(2,4) and (3,9), which are not on a straight line.* **Major content** **Essential knowledge and skills** • Linear functions are represented by the equation y=mx+b and a straight line on a graph. **Teaching Examples:** ○ The function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line. **Mathematical Practices** • Reason abstractly and quantitatively • Model with mathematics ★ • Use appropriate tools strategically • Attend to precision • Look for and make			

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		○ Determine which of the functions listed below are linear and which are not linear and explain your reasoning. use of structure • $y = -2x^2 + 3$ non linear • $y = 2x$ linear • $A = \pi r^2$ non linear • $y = 0.25 + 0.5(x - 2)$ linear (TUSD) **Academic vocabulary** • Domain • Nonlinear • Range • Function • Function • Slope Intercept Form • Input • Output • Slope/Rate of Change • Linear function • Point Slope Form • Vertical line test **Assessment problems** 8.F.1 • Linear functions: Complete a function table (Eighth grade - V.3) • Linear functions: Find points on a function graph (Eighth grade - V.5) • Linear functions: Graph a line from a function table (Eighth grade - V.6) **Assessment problems** 8.F.2 • Linear functions: Write a rule for a function table (Eighth grade - V.4) • Linear functions: Graph a line from a function table (Eighth grade - V.6) • Linear functions: Graph a line from an equation (Eighth grade - V.7) • Nonlinear functions: Identify linear and nonlinear functions (Eighth grade - W.1) **Assessment problems** 8.F.3 • Linear functions: Graph a line from an equation (Eighth grade - V.7) • Nonlinear functions: Identify linear and nonlinear functions (Eighth grade - W.1)			
FUNCTIONS **Interpreting functions (F-IF)** Understand the concept of a function and use function notation Use **Mathematical Practices** to 1. Make sense of problems and persevere in solving them 2. Reason abstractly and quantitatively	**M**	**Students** F-IF.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. **Major content** If *f* is a function and *x* is an element of its domain, then *f*(*x*) denotes the output of *f* corresponding to the input *x*. The graph of *f* is the graph of the equation *y* = *f*(*x*). **Essential knowledge and skills** • A function is a rule that assigns each input exactly one output. • In function notation, f(x) denotes that f is a function of x. • The set of all inputs (x) for a function is called the domain; the set of all outputs (f(x)) for a function is **Mathematical Practices** • Reason abstractly and quantitatively	TEACHER NOTES See instructional strategies in the introduction • *Learn as general principle; focus on linear and exponential and on arithmetic and geometric sequences* • *Provide applied contexts in which to explore functions. For example, examine the amount of*	RESOURCE NOTES See resources in the introduction Textbooks • *Algebra 1,* McDougal Littell Chapter • *Exploration in Core Math,* Holt Mc Dougal • *HM Algebra 1* Technology • SMART Board's new tools for solving equations	ASSESSMENT NOTES See assessments in the introduction REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS • Anecdotal records

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
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		called the range. • The domain and range of a function can be expressed as a set of numbers using set notation, an inequality, or as a graphed solution. • The graph of a function f is the graph of the equation y = f(x). • For example, the rule that takes x as input and gives x^2+5x+4 as output is a function. Using y to stand for the output we can represent this function with the equation $y = x^2+5x+4$, and the graph of the equation is the graph of the function. Students are expected to use function notation such as ○ $f(x) = x^2+5x+4$. **Teaching Examples:** ○ Determine which of the following tables represent a function and explain why. **Table A** x | f(x) 0 | 0 1 | 2 1 | 3 4 | 5 Solution: Table A function because for each element in the domain there is exactly one element in the range. **Table B** x | f(x) 0 | 1 1 | 2 2 | 2 3 | 4 Solution: Table B does NOT represent a function because when x = 1, there are two values for f(x): 2 and 3. (TUSD)	*money earned when given the number of hours worked on a job, and contrast this with a situation in which a single fee is paid by the "carload" of people, regardless of whether 1, 2, or more people are in the car.* • *Use diagrams to help students visualize the idea of a function machine. Students can examine several pairs of input and output values and try to determine a simple rule for the function.* • *Rewrite sequences of numbers in tabular form, where the input represents the term number (the position or index) in the sequence, and the output represents the number in the sequence.* • *Help students to understand that the word "domain" implies the set of all possible input values and that the integers are a set of numbers made up of {…-2, -1, 0, 1, 2, …}.* • *Distinguish between relationships that are not functions and those that are functions (e.g., present a table in which one of the input values results in multiple outputs to contrast with a functional relationship). Examine*	• Graphing calculators • Graphing software • Diagrams or drawings of function machines, as well as tables and graphs.	• Charts/data collection • Conferencing • Exhibits • Interviews • Graphic organizers • Journals • Mathematical Practices • Modeling ★ • Multiple Intelligences assessments, e.g. □ Role playing - bodily kinesthetic □ Graphic organizing - visual □ Collaboration - interpersonal • Oral presentations • Problem/Performance based/common tasks • Real-life applications involving graphing • Rubrics/checklists (mathematical practice, modeling) • Tests and quizzes • Technology • Think-alouds • Writing genres □ Argument □ Information
	M	F-IF.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. **Major content** **Essential knowledge and skills** • Algebraic equations, written in function notation, can be used to evaluate functions for a given input. • For a function f(x), f(a) represents the value of the **Mathematical Practices** • Reason abstractly and quantitatively			

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		function when x = a. ○ Examples: ○ If $f(x) = x^2 + 4x - 12$, find $f(2)$. ○ Let $f(x) = 2(x+3)^2$. Find $f(3)$, $f(-\frac{1}{2})$, $f(a)$, and $f(a-h)$. ○ If P(t) is the population of Tucson t years after 2000, interpret the statements P(0) = 487,000 and P(10)-P(9) = 5,900. (TUSD)	*graphs of functions and non-functions, recognizing that if a vertical line passes through at least two points in the graph, then y (or the quantity on the vertical axis) is not a function of x (or the quantity on the horizontal axis).*		
	M	F-IF.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. **Major content** • *For example, the Fibonacci sequence is defined recursively by* ▪ *f(0) = f(1) = 1* ▪ *f(n+1) = f(n) +f(n-1) for n ≥1.* **Essential knowledge and skills** • Sequences are functions that have a discrete domain, which is a subset of the integers. • A recursive sequence is a sequence in which each term is built upon the previous term. **Mathematical Practices** • Look for and express regularity in repeated reasoning **Teaching Examples:** • The Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≥ 1. (TUSD) **Academic vocabulary** • Amplitude • Arithmetic Sequence • Average Rate of Change • End Behavior • Exponential Function • Fibonacci Sequence • Function • Geometric Sequence • Input/Domain • Linear Function • Maxima • Midline • Minima • Output/Range • Period • Piecewise Function • Point-Slope Form • Quadratic Function • Recursive • Sequence • Slope-Intercept Form • Standard Form • Trigonometric Function • Vertex Form • x-intercept • y-intercept **Assessment problems F-IF.1** • Relations and functions: Domain and range of relations (Algebra - Q.2) • Relations and functions: Identify independent and dependent variables (Algebra - Q.3) • Relations and functions: Identify functions (Algebra - Q.4) • Relations and functions: Identify functions: vertical line test (Algebra - Q.5)			

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		• Absolute value functions: Domain and range of absolute value functions (Algebra - DD.2) • Radical functions and equations: Domain and range of radical functions (Algebra - FF.2) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I2FIF.aspx • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.sr.1.00fif.k.082_v1.pdf (p.1) **Assessment problem s F-IF.2** • Relations and functions: Complete a function table (Algebra - Q.6) • Relations and functions: Evaluate function rules I (Algebra - Q.7) • Relations and functions: Evaluate function rules II (Algebra - Q.8) • Exponential functions: Evaluate an exponential function (Algebra - X.1) • Quadratic equations: Complete a function table: quadratic functions (Algebra - BB.2) • Absolute value functions: Complete a function table: absolute value functions (Algebra - DD.1) • Radical functions and equations: Evaluate a radical function (Algebra - FF.1) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I2FIF.aspx • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.hmofc.a.268_v1.pdf • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.tuitn.a.298_v1.pdf (p.2) **Assessment problem s F3** • Number sequences: Identify arithmetic and geometric sequences (Algebra - P.1) • Number sequences: Arithmetic sequences (Algebra - P.2) • Number sequences: Geometric sequences (Algebra - P.3) • Number sequences: Evaluate variable expressions for number sequences (Algebra - P.4) • Number sequences: Write variable expressions for arithmetic sequences (Algebra - P.5) • Number sequences: Write variable expressions for geometric sequences (Algebra - P.6) • Number sequences: Number sequences: mixed review (Algebra - P.7)F.3 • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I2FIF.aspx (p.3)			
FUNCTIONS **Interpreting functions (F-IF)** Use functions to model relationships between quantities. 8F Use **Mathematical Practices** to 1. Make sense of problems and persevere in solving them	M	**Students** 8.F.4 Construct a function to model a linear relationship between two quantities. **Major content** 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. **Essential knowledge and skills** • Linear functions are functions that have a constant rate of change (slope) and an initial value. • The initial value of a linear function is the place **Mathematical Practices** • Make sense of problems and persevere in solving	• *TEACHER NOTES* • *See instructional strategies in the introduction* • *In Grade 8, students focus on linear equations and functions. Nonlinear functions are used for comparison.* • *Instructional Strategies* • *Students will need many opportunities and examples to figure out*	RESOURCE NOTES See resources in the introduction Textbooks • *Algebra 1,* McDougal Littell Chapter • *Exploration in Core Math,* Holt Mc Dougal • *HM Algebra 1* Technology • SMART Board's new tools	ASSESSMENT NOTES See assessments in the introduction REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS

<table>
<tr><th>CATEGORIES, DOMAINS, CLUSTERS</th><th>UNIT</th><th>STANDARDS/BENCHMARKS
North Smithfield School Department</th><th>INSTRUCTIONAL STRATEGIES</th><th>RESOURCES</th><th>ASSESSMENTS</th></tr>
<tr>
<td>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</td>
<td></td>
<td>where the line will intersect the vertical axis or the y-intercept.
• Linear functions are represented as verbal descriptions, tables, graphs and equations that are all related by the same rate of change (slope) and initial value.

<u>Teaching Examples:</u>
• The table below shows the cost of renting a car. The company charges $45 a day for the car as well as charging a one-time $25 fee for the car's navigation system (GPS).Write an expression for the cost in dollars, c, as a function of the number of days, d.

<table>
<tr><th>Days (d)</th><th>Cost © in dollars</th></tr>
<tr><td>1</td><td>70</td></tr>
<tr><td>2</td><td>115</td></tr>
<tr><td>3</td><td>160</td></tr>
<tr><td>4</td><td>205</td></tr>
</table>

<u>Solution:</u> Students might write the equation c = 45d + 25 using the verbal description or by first making a table.
• When scuba divers come back to the surface of the water, they need to be careful not to ascend too quickly. Divers should not come to the surface more quickly than a rate of 0.75 ft per second. If the divers start at a depth of 100 feet, the equation d = 0.75t – 100 shows the relationship between the time of the ascent in seconds (t) and the distance from the surface in feet (d).
○ Will they be at the surface in 5 minutes? How long will it take the divers to surface from their dive?
○ Make a table of values showing several times and the corresponding distance of the divers from the surface. Explain what your table shows. How do the values in the table relate to your equation? (TUSD)

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). Major content</td>
<td>them
• Reason abstractly and quantitatively
• Construct viable arguments and critique the reasoning of others
• Model with mathematics ★
• Use appropriate tools strategically
• Attend to precision
• Look for and make use of structure
• Look for and express regularity in repeated reasoning</td>
<td>the meaning of y = mx + b. What does m mean? What does b mean? They should be able to "see" m and b in graphs, tables, and formulas or equations, and they need to be able to interpret those values in contexts. For example, if a function is used to model the height of a stack of n paper cups, then the rate of change, m, which is the slope of the graph, is the height of the "lip" of the cup: the amount each cup sticks above the lower cup in the stack. The "initial value" in this case is not valid in the context because 0 cups would not have a height, and yet a height of 0 would not fit the equation. Nonetheless, the value of b can be interpreted in the context as the height of the "base" of the cup: the height of the whole cup minus its lip.
• Use graphing calculators and web resources to explore linear and non-linear functions. Provide context as much as possible to build understanding of slope and y-intercept in a graph, especially for those patterns that do not start with an initial value of 0.</td>
<td>for solving equations
• Graphing calculators
Graphing software
• Graphing calculators
• Graphing software for computers, including dynamic geometry software
• Data-collecting technology, such as motion sensors, thermometers, CBL's, etc.
• Graphing applets online</td>
<td>• Anecdotal records
• Charts/data collection
• Conferencing
• Exhibits
• Interviews
• Graphic organizers
• Journals
• Mathematical Practices
• Modeling ★
• Multiple Intelligences assessments, e.g.
□ Role playing - bodily kinesthetic
□ Graphic organizing - visual
□ Collaboration - interpersonal
• Oral presentations
• Problem/Performance based/common tasks
• Real-life applications involving graphing
• Rubrics/checklists (mathematical practice, modeling)
• Tests and quizzes
• Technology
• Think-alouds
• Writing genres
□ Argument
□ Information</td>
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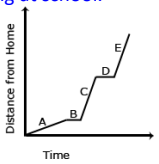
CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		Sketch a graph that exhibits the qualitative features of a function that has been described verbally. **Essential knowledge and skills** • Real world functional relationships between two quantities can be represented using verbal descriptions and graphs **Teaching Examples:** • The graph below shows a student's trip to school. This student walks to his friend's house and, together, they ride a bus to school. The bus stops once before arriving at school.  Describe how each part A-E of the graph relates to the story. (TUSD) **Mathematical Practices** • Reason abstractly and quantitatively • Construct viable arguments and critique the reasoning of others • Model with mathematics ★ • Use appropriate tools strategically • Attend to precision • Look for and make use of structure **Academic vocabulary** • Domain • Function • Input • Linear function • Nonlinear function • Output • Point Slope Form • Range • Slope Intercept Form • Slope/Rate of Change • Vertical **Assessment problems 8.F.4** • Ratios and proportions: Rate of change (Eighth grade - H.11) • Ratios and proportions: Constant rate of change (Eighth grade - H.12) • Proportional relationships: Find the constant of variation: graphs (Eighth grade - I.2) • Proportional relationships: Find the constant of variation: word problems (Eighth grade - I.3) • Proportional relationships: Write an equation for a proportional relationship (Eighth grade - I.5) • Proportional relationships: Proportional relationships: word problems (Eighth grade - I.6) • Linear functions: Write a rule for a function table (Eighth grade - V.4) • Linear functions: Linear function word problems (Eighth grade - V.8) • Linear functions: Find the slope of a graph (Eighth grade - V.9) • Linear functions: Find slope from two points (Eighth grade - V.10) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I2FIF.aspx (p.4) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-II/II-2-F-IF-4.aspx (p.1) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.cansb.a.051_v1.pdf	• *Give students opportunities to gather their own data or graphs in contexts they understand. Students need to measure, collect data, graph data, and look for patterns, then generalize and symbolically represent the patterns. They also need opportunities to draw graphs (qualitatively, based upon experience) representing real-life situations with which they are familiar. Probe student thinking by asking them to determine which input values make sense in the problem situations.* (ODE)		

ALGEBRA I CURRICULUM Grades 8-9

Curriculum Writers: Amanda Bednarczyk, David Mellor, and Melissa Silverio

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		Assessment problems 8.F.5 • Linear functions: Linear function word problems (Eighth grade - V.8)			
FUNCTIONS **Interpreting functions (F-IF)** Interpret functions that arise in applications in terms of the context Use **Mathematical Practices** to 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	**M**	**Students** F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include:* • *intercepts;* • *intervals where the function is increasing, decreasing, positive, or negative;* ○ *relative maximums and minimums;* • *symmetries; end behavior; and periodicity.*★ **Major content** **Essential knowledge and skills** • Key features of a graph or table may include intercepts, intervals in which the function is increasing, decreasing or constant, intervals in which the function is positive, negative or zero, symmetry, maxima, minima, and end behavior. • Given a verbal description of a relationship that can be modeled by a function, a table or graph can be constructed and used to interpret key features of that function. **Teaching Examples:** • A rocket is launched from 180 feet above the ground at time t = 0. The function that models this situation is given by $h = -16t^2 + 96t + 180$, where t is measured in seconds and h is height above the ground measured in feet. ○ What is a reasonable domain restriction for t in this context? ○ Determine the height of the rocket two seconds after it was launched. ○ Determine the maximum height obtained by the rocket. ○ Determine the time when the rocket is 100 feet above the ground. ○ Determine the time at which the rocket hits the ground. ○ How would you refine your answer to the first question based on your response to the second and fifth questions? • Compare the graphs of $y = 3x^2$ and $y = 3^x$. • Let $f(x) = -x^2 - 5x + 1$. Graph the function and identify end behavior and any intervals of constancy, increase, and decrease. **Mathematical Practices** • Reason abstractly and quantitatively • Model with mathematics ★ • Use appropriate tools strategically • Attend to precision	TEACHER NOTES See instructional strategies in the introduction • *Linear, exponential, and quadratic* • *Flexibly move from examining a graph and describing its characteristics (e.g., intercepts, relative maximums, etc.) to using a set of given characteristics to sketch the graph of a function.* • *Examine a table of related quantities and identify features in the table, such as intervals on which the function increases, decreases, or exhibits periodic behavior.* • *Recognize appropriate domains of functions in real-world settings. For example, when determining a weekly salary based on hours worked, the hours (input) could be a rational number, such as 25.5. However, if a function relates the number of cans of soda sold in a machine to the money generated, the domain must consist of whole numbers.* • *Given a table of values, such as the height of a*	RESOURCE NOTES See resources in the introduction Textbooks • *Algebra 1*, McDougal Littell Chapter 10 • *Exploration in Core Math*, Holt Mc Dougal • *HM Algebra 1* Technology • SMART Board's new tools for solving equations • Graphing calculators • Graphing software • Graphing calculators to generate graphical, tabular, and symbolic representations of the same function for comparison. • Tables, graphs, and equations of real-world functional relationships	ASSESSMENT NOTES See assessments in the introduction REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS • Anecdotal records • Charts/data collection • Conferencing • Exhibits • Interviews • Graphic organizers • Journals • Mathematical Practices • Modeling ★ • Multiple Intelligences assessments, e.g. ▯ Role playing - bodily kinesthetic ▯ Graphic organizing - visual ▯ Collaboration - interpersonal • Oral presentations • Problem/Performanc

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		• It started raining lightly at 5am, then the rainfall became heavier at 7am. By 10am the storm was over, with a total rainfall of 3 inches. It didn't rain for the rest of the day. Sketch a possible graph for the number of inches of rain as a function of time, from midnight to midday. (TUSD)	*plant over time, students can estimate the rate of plant growth. Also, if the relationship between time and height is expressed as a linear equation, students should explain the meaning of the slope of the line. Finally, if the relationship is illustrated as a linear or non-linear graph, the student should select points on the graph and use them to estimate the growth rate over a given interval.*		e based/common tasks • Real-life applications involving graphing • Rubrics/checklists (mathematical practice, modeling) • Tests and quizzes • Technology • Think-alouds • Writing genres □ Argument □ Information
	M	F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. • *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*★ **Major content** **Essential knowledge and skills** • Find the domain and range of radical and absolute value functions • The meaning of the key features of a graph or table, such as domain, range, rate of change and intercepts, can be interpreted in the context of a problem. • The intervals over which a function is increasing, decreasing or constant, positive, negative or zero are subsets of the function's domain. • The appropriate domain for a function describing a real-life situation may be smaller than the largest possible domain **Teaching Examples:** • Find the domain and range of the absolute value function y=2|x-5|-4. • Find the domain and range y= $\sqrt{3-4}$ (TUSD) **Mathematical Practices** • Model with mathematics • Reason abstractly and quantitatively • Attend to precision			
	M	F.IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.★ **Major content** **Essential knowledge and skills** • The average rate of change of a function y = f(x) over an interval [a,b] is $\frac{\Delta y}{\Delta x}=\frac{f(b)-f(a)}{b-a}$ **Mathematical Practices** • Model with mathematics • Reason abstractly and quantitatively • Use appropriate tools			

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS

Teaching Examples: strategically

- The average rate of change of a function y = f(x) over an interval [a,b] is $\frac{\Delta y}{\Delta x} = \frac{f(b)-f(a)}{b-a}$
  In addition to finding average rates of change from functions given symbolically, graphically, or in a table, students may collect data from experiments or simulations (ex. falling ball, velocity of a car, etc.) and find average rates of change for the function modeling the situation.
- Use the following table to find the average rate of change of g over the intervals [-2, -1] and [0,2]:

x	G(x)
-2	2
-1	-1
0	-4
2	-10

- The table below shows the elapsed time when two different cars pass a 10, 20, 30, 40 and 50 meter mark on a test track.
  - For car 1, what is the average velocity (change in distance divided by change in time) between the 0 and 10 meter mark? Between the 0 and 50 meter mark? Between the 20 and 30 meter mark? Analyze the data to describe the motion of car 1.
  - How does the velocity of car 1 compare to that of car 2? (TUSD)

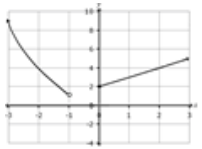
	Car 1	Car 2
d	T	t
10	4.472	1.742
20	6.325	2.899
30	7.746	3.831
40	8.944	4.633
50	10	5.348

Academic vocabulary

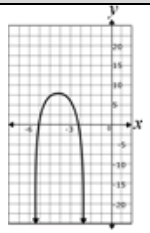
Assessment problems F.IF.4

- Direct and inverse variation: Identify proportional relationships (Algebra - R.1)
- Direct and inverse variation: Find the constant of variation (Algebra - R.2)
- Direct and inverse variation: Graph a proportional relationship (Algebra - R.3)

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		• Direct and inverse variation: Identify direct variation and inverse variation (Algebra - R.6) • Linear functions: Slope-intercept form: find slope and y-intercept (Algebra - S.4) • Linear functions: Standard form: find x- and y-intercepts (Algebra - S.10) • Linear functions: Slopes of parallel and perpendicular lines (Algebra - S.17) • Quadratic equations: Characteristics of quadratic functions (Algebra - BB.1) • Functions: linear, quadratic, exponential: Identify linear, quadratic, and exponential functions from graphs (Algebra - CC.1) • Functions: linear, quadratic, exponential: Identify linear, quadratic, and exponential functions from tables (Algebra - CC.2) • Absolute value functions: Graph an absolute value function (Algebra - DD.3) • Rational functions and expressions: Rational functions: asymptotes and excluded values (Algebra - GG.1) • Lines in the coordinate plane: Slopes of lines (Geometry - E.2) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I2FIF.aspx (p.4) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-II/II-2-F-IF-4.aspx • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.cansb.a.051_v1.pdf (p.1) **Assessment problems F.IF.5** • Absolute value functions: Domain and range of absolute value functions (Algebra - DD.2) • Radical functions and equations: Domain and range of radical functions (Algebra - FF.2) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I2FIF.aspx (p.3) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-II/II-2-F-IF-4.aspx (p.2) **Assessment problems F.IF.6** • Direct and inverse variation: Find the constant of variation (Algebra - R.2) • Linear functions: Find the slope of a graph (Algebra - S.2) • Linear functions: Find slope from two points (Algebra - S.3) • Linear functions: Slope-intercept form: find slope and y-intercept (Algebra - S.4) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I2FIF.aspx (p.6) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-II/II-2-F-IF-4.aspx (p.3) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.cr.1.00fif.l.614_v1.pdf			
FUNCTIONS **Interpreting functions (F-IF)** Analyze functions using different representations Use **Mathematical Practices** to 1. Make sense of problems and	**S**	**Students** F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★ **Supporting content** a. Graph linear and quadratic functions and show intercepts, maxima, and minima. (F.IF.7a) b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. (F.IF.7b)	TEACHER NOTES See instructional strategies in the introduction • *Linear, exponential, quadratic, absolute value, step, piecewise-defined* • *Explore various families*	RESOURCE NOTES See resources in the introduction Textbooks • *Algebra 1,* McDougal Littell Chapter • *Exploration in Core Math,* Holt Mc Dougal • *HM Algebra 1*	ASSESSMENT NOTES See assessments in the introduction REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
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	**S**	c. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. (F.IF.7e) **Essential knowledge and skills** • To graph a function you can create a table of values, analyze the equation, or use a graphing calculator. • Key features of a graph or table may include intercepts, intervals in which the function is increasing, decreasing or constant, intervals in which the function is positive, negative or zero, symmetry, maxima, minima, and end behavior. **Mathematical Practices** • Model with mathematics • Use appropriate tools strategically • Attend to precision **Teaching Examples:** • Graph the function f(x) = |x – 3| + 5 and describe key characteristics of the graph • Graph the function f(x) = 2^x by creating a table of values. Identify the key characteristics of the graph. • Sketch the graph and identify the key characteristics of the function described below. $F(x)=\begin{cases} x+2 \text{ for } x \geq 0 \\ -x^2 \text{ for } x < -1 \end{cases}$ Solution:  (TUSD) F.IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. **Supporting content** a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. (F.IF.8a) b. Use the properties of exponents to interpret expressions for exponential functions. ○ *For example, identify percent rate of change in functions such as:* ▪ $y = (1.02)^t$ ▪ $y = (0.97)^t$ ▪ $y = (1.01)^{12t}$ ▪ $y = (1.2)^{t/10}$ *and classify them as representing exponential growth or decay.* (F.IF.8b) **Essential knowledge and skills** **Mathematical Practices**	*of functions and help students to make connections in terms of general features. For example, just as the function $y = (x + 3)^2 – 5$ represents a translation of the function $y = x$ by 3 units to the left and 5 units down, the same is true for the function $y = \|x + 3\| - 5$ as a translation of the absolute value function $y = \|x\|$.* • *Discover that the factored form of a quadratic or polynomial equation can be used to determine the zeros, which in turn can be used to identify maxima, minima and end behaviors.* • *Use various representations of the same function to emphasize different characteristics of that function. For example, the y-intercept of the function $y = x^2 - 4x – 12$ is easy to recognize as (0, -12). However, rewriting the function as* • *$y = (x – 6)(x + 2)$ reveals zeros at (6, 0) and at (-2, 0). Furthermore, completing the square allows the equation to be written as $y = (x – 2)^2 – 16$, which shows that the vertex (and minimum point) of the parabola is at (2, -16).*	Technology • SMART Board's new tools for solving equations • Graphing calculators • Graphing software • Graphing utilities on a calculator and/or computer can be used to demonstrate the changes in behavior of a function as various parameters are varied. • Real-world problems, such as maximizing the area of a region bound by a fixed perimeter fence, can help to illustrate applied uses of families of functions.	SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS • Anecdotal records • Charts/data collection • Conferencing • Exhibits • Interviews • Graphic organizers • Journals • Mathematical Practices • Modeling ★ • Multiple Intelligences assessments, e.g. ▫ Role playing - bodily kinesthetic ▫ Graphic organizing - visual ▫ Collaboration - interpersonal • Oral presentations • Problem/Performance based/common tasks • Real-life applications involving graphing • Rubrics/checklists (mathematical practice, modeling) • Tests and quizzes • Technology • Think-alouds • Writing genres ▫ Argument

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		• A linear function can be written in point-slope, slope-intercept or standard form. • A quadratic function can be written in vertex or standard form. • Factoring a quadratic function will help to determine the zeros. • Completing the square will help determine the vertex of the graph. • For a function of the form $f(t)=a\times b^t$, if b>1 the function represents exponential growth; if b<1 the function represents exponential decay. **Teaching Examples:** • Factor the following quadratic to identify its zeros: $x^2 + 2x - 8 = 0$ • Complete the square for the quadratic and identify its vertex: $x^2 + 6x + 19 = 0$ • Identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)12t$, $y = (1.2)^{t/10}$, and classify them as representing exponential growth or decay. (TUSD) • Reason abstractly and quantitatively • Look for and make use of structure			▯ Information
	S	F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). **Supporting content** ○ *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.* **Essential knowledge and skills** • Match graphs with tables or equations with which they might represent and justify your reasoning. **Teaching Examples:** • Given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum. • Examine *the functions below. Which function* has the larger maximum? How do you know? Function A $f(x)=-2x^2-8x+20$ **Mathematical Practices** • Attend to precision • Look for and make use of structure			

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		 Function B (TUSD)			

Academic vocabulary

- Amplitude
- Arithmetic Sequence
- Average Rate of Change
- End Behavior
- Exponential Function
- Fibonacci Sequence
- Function
- Geometric Sequence
- Input/Domain
- Linear Function
- Maxima
- Midline
- Minima
- Output/Range
- Period
- Piecewise Function
- Point-Slope Form
- Quadratic Function
- Recursive
- Sequence
- Slope-Intercept Form
- Standard Form
- Trigonometric Function
- Vertex Form
- x-intercept
- y-intercept

Assessment problems F.IF.7

- Linear functions: Slope-intercept form: graph an equation (Algebra - S.5)
- Linear functions: Standard form: graph an equation (Algebra - S.11)
- Linear functions: Point-slope form: graph an equation (Algebra - S.14)
- Quadratic equations: Characteristics of quadratic functions (Algebra - BB.1)
- Lines in the coordinate plane: Graph a linear equation (Geometry - E.3)
- Absolute value functions: Graph an absolute value function (Algebra - DD.3)
- Rational functions and expressions: Rational functions: asymptotes and excluded values (Algebra - GG.1)
- Exponential functions: Match exponential functions and graphs (Algebra - X.2)
- http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I2FIF.aspx (p.7)
- http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-II/II-2-F-IF-7.aspx (p.1)

Assessment problems F.IF.8

- Quadratic equations: Characteristics of quadratic functions (Algebra - BB.1)
- Quadratic equations: Solve a quadratic equation by factoring (Algebra - BB.5)
- Quadratic equations: Complete the square (Algebra - BB.6)
- Quadratic equations: Solve a quadratic equation by completing the square (Algebra - BB.7)
- http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-II/II-2-F-IF-7.aspx (p.2)
- http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.cr.1.00fif.m.274_v1.pdf (p.2)

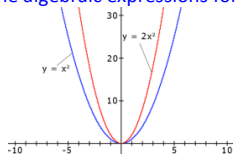
ALGEBRA I CURRICULUM Grades 8-9

Curriculum Writers: Amanda Bednarczyk, David Mellor, and Melissa Silverio

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		Assessment problems F.IF9 • Quadratic equations: Characteristics of quadratic functions (Algebra - BB.1) • Functions: linear, quadratic, exponential: Identify linear, quadratic, and exponential functions from graphs (Algebra - CC.1) • Functions: linear, quadratic, exponential: Identify linear, quadratic, and exponential functions from tables (Algebra - CC.2) • Rational functions and expressions: Rational functions: asymptotes and excluded values (Algebra - GG.1) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I2FIF.aspx (p.3) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-II/II-2-F-IF-7.aspx (p.3)			
FUNCTIONS **Building Functions (F-BF)** Build a function that models a relationship between two quantities Use **Mathematical Practices** to 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	**S**	**Students** F-BF.1 Write a function that describes a relationship between two quantities.★ **Supporting content** a. Determine an explicit expression, a recursive process, or steps for calculation from a context. (F-BF.1a) b. Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function t* (F-BF.1b) **Essential knowledge and skills** • A function is a relationship between two quantities. • The function representing a given situation may be a combination of more than one standard function. • Standard functions may be combined through arithmetic operations. **Teaching Examples:** • You buy a $10,000 car with an annual interest rate of 6 percent compounded annually and make monthly payments of $250. Express the amount remaining to be paid off as a function of the number of months, using a recursion equation. • A cup of coffee is initially at a temperature of 93º F. The difference between its temperature and the room temperature of 68º F decreases by 9% each minute. Write a function describing the temperature of the coffee as a function of time. (TUSD) **Mathematical Practices** • Make sense of problems and persevere in solving them • Reason abstractly and quantitatively • Model with mathematics ★ • Use appropriate tools strategically • Attend to precision • Look for and make use of structure • Look for and express regularity in repeated reasoning F-BF.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.★	TEACHER NOTES See instructional strategies in the introduction • *linear, exponential, and quadratic* • *Provide a real-world example (e.g., a table showing how far a car has driven after a given number of minutes, traveling at a uniform speed), and examine the table by looking "down" the table to describe a recursive relationship, as well as "across" the table to determine an explicit formula to find the distance traveled if the number of minutes is known.* • *Write out terms in a table in an expanded form to help students see what is happening. For example, if the y-values are 2, 4, 8, 16, they could be written as 2, 2^2,2^3, 2^4, etc., so that students recognize that 2 is being used multiple*	RESOURCE NOTES See resources in the introduction Textbooks • *Algebra 1,* McDougal Littell Chapter • *Exploration in Core Math,* Holt Mc Dougal • *HM Algebra 1* Technology • SMART Board's new tools for solving equations • Graphing calculators • Graphing software Materials • Hands-on materials (e.g., paper folding, building progressively larger shapes using pattern • Visuals available to assist students in seeing relationships are featured at the National Library of Virtual Manipulatives as well as The National Council of Teachers of Mathematics, Illuminations	ASSESSMENT NOTES See assessments in the introduction REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS • Anecdotal records • Charts/data collection • Conferencing • Exhibits • Interviews • Graphic organizers • Journals • Mathematical Practices • Modeling ★ • Multiple Intelligences assessments, e.g. □ Role playing - bodily

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		Essential knowledge and skills • Arithmetic and geometric sequences can be written both recursively and with an explicit formula. • A recursive formula for a sequence describes how to determine the next term from the previous term(s). • An explicit formula for a sequence describes how to determine any term in the sequence. • Arithmetic sequences can be described by linear functions. • Geometric sequences can be described by exponential functions. • Sequences model situations in which the domain is a set of integers. **Teaching Examples:** • Generate the 5^{th}-11^{th} terms of a sequence if $A_1 = 2$ and $A_{(n+1)} = (A_n)^2 - 1$ • Use the formula: $A_n = A_1 + d(n - 1)$ where d is the common difference to generate a sequence whose first three terms are: -7, -4, and -1. • There are 2,500 fish in a pond. Each year the population decreases by 25 percent, but 1,000 fish are added to the pond at the end of the year. Find the population in five years. Also, find the long-term population. • Given the formula $A_n = 2n - 1$, find the 17^{th} term of the sequence. What is the 9^{th} term in the sequence 3, 5, 7, 9, ? • Given $a_1 = 4$ and $a_n = a_n\text{-}1 + 3$, write the explicit formula. (TUSD) **Mathematical Practices** • Model with mathematics ★ • Use appropriate tools strategically • Look for and express regularity in repeated reasoning **Academic vocabulary** • Domain • Even/odd function • Expand/contract • Explicit formula • Exponential function • Inverse • Linear function • Quadratic function • Range • Rate of change • Recursive formula • Transformation • Translate **Assessment problems F-BF.1** • Number sequences: Write variable expressions for arithmetic sequences (Algebra - P.5) • Number sequences: Write variable expressions for geometric sequences (Algebra - P.6) • Direct and inverse variation: Write inverse variation equations (Algebra - R.7)	*times as a factor.* • *Focus on one representation and its related language – recursive or explicit – at a time so that students are not confusing the formats.* • *Provide examples of when functions can be combined, such as determining a function describing the monthly cost for owning two vehicles when a function for the cost of each (given the number of miles driven) is known.* • *Using visual approaches (e.g., folding a piece of paper in half multiple times), use the visual models to generate sequences of numbers that can be explored and described with both recursive and explicit formulas. Emphasize that there are times when one form to describe the function is preferred over the other.* (ODE)		kinesthetic ▫ Graphic organizing - visual ▫ Collaboration - interpersonal • Oral presentations • Problem/Performance based/common tasks • Real-life applications involving graphing • Rubrics/checklists (mathematical practice, modeling) • Tests and quizzes • Technology • Think-alouds • Writing genres ▫ Argument ▫ Information

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		• Direct and inverse variation: Write and solve inverse variation equations (Algebra - R.8) • Functions: linear, quadratic, exponential: Write linear, quadratic, and exponential functions (Algebra - CC.3) • Relations and functions: Evaluate function rules II (Algebra - Q.8) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I2FBF.aspx (p.2) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-II/II-2-F-BF-1.aspx (p.2) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.te.1.00fbf.n.227_v1.pdf (p.2) **Assessment problems F-BF.2** • Number sequences: Arithmetic sequences (Algebra - P.2) • Number sequences: Geometric sequences (Algebra - P.3) • Number sequences: Number sequences: mixed review (Algebra - P.7) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I2FBF.aspx (p.2) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.cr.1.00fbf.n.275_v1.pdf (p.2) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.cr.1.00fbf.n.276_v1.pdf (p.2) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.hmofc.a.268_v1.pdf (p.2)			
FUNCTIONS **Building Functions (F-BF)** Build new functions from existing functions Use **Mathematical Practices** to 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	**A**	**Students** F-BF.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.* **Additional content** **Essential knowledge and skills** • f(x) + k will translate the graph of the function f(x) up or down by k units. • k f(x) will expand or contract the graph of the function f(x) vertically by a factor of k. If k<0 the graph will reflect across the x-axis. • f(kx) will expand or contract the graph of the function f(x) horizontally by a factor of k. If k<0 the graph will reflect across the y-axis. • f(x + k) will translate the graph of the function f(x) left or right by k units. • If f(-x) = f(x) then the function is even, therefore its graph is symmetrical across the y-axis. • If f(-x) = - f(x) then the function is odd, therefore its graph is symmetrical across the origin **Mathematical Practices** • Reason abstractly and quantitatively • Model with mathematics ★ • Use appropriate tools strategically • Look for and make use of structure	TEACHER NOTES See instructional strategies in the introduction • *Use graphing calculators or computers to explore the effects of a constant in the graph of a function. For example, students should be able to distinguish between the graphs of $y = x^2$, $y = 2x^2$, $y = x^2 + 2$, $y = (2x)^2$, and $y = (x + 2)^2$. This can be accomplished by allowing students to work with a single parent function and examine numerous parameter changes to make generalizations.* • *Distinguish between even and odd functions*	RESOURCE NOTES See resources in the introduction Textbooks • *Algebra 1,* McDougal Littell Chapter • *Exploration in Core Math,* Holt Mc Dougal • *HM Algebra 1* Technology • SMART Board's new tools for solving equations • Graphing calculators • Graphing software • Graphing calculator that can be used to explore the effects of parameter changes on a graph	ASSESSMENT NOTES See assessments in the introduction REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS • Anecdotal records • Charts/data collection • Conferencing • Exhibits • Interviews • Graphic organizers

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		Teaching Examples: • Compare the graphs of f(x)=3x with those of g(x)=3x+2 and h(x)=3x -1 to see that parallel lines have the same slope AND to explore the effect of the transformation of the function, f(x)=3x such that g(x)=f(x)+2 and h(x)=f(x) – 1. • Explore the relationship between f(x)=3x, g(x)= 5x, and $h(x) = \frac{1}{2}x$ with a calculator to develop a relationship between the coefficient on x and the slope. • Describe the effect of varying the parameters a, h, and k on the shape and position of the graph f(x) = $ab^{(x+h)}$ + k, orally or in written format. What effect do values between 0 and 1 have? What effect do negative values have? • Is f(x) = x^3 - $3x^2$ + 2x + 1 even, odd, or neither? Explain your answer orally or in written format. • Compare the shape and position of the graphs of *f(x) =x^2* and *g(x)=$2x^2$*, and explain the differences in terms of the algebraic expressions for the functions.  • Describe the effect of varying the parameters *a, h,* and *k* have on the shape and position of the graph of f(x) = $a(x-h)^2$ + k. (TUSD) F-BF.4 Find inverse functions. a. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. ○ *For example, f(x) =2 x^3 or f(x) = $\frac{(x+1)}{(x-1)}$ for x ≠1.* (F-BF.4a) **Essential knowledge and skills** • Two functions f and g are inverses of one another if for all values of x in the domain of f, f(x)=y and g(y)=x. • Not all functions have an inverse. **Teaching Examples:** • For the function *h(x)* = 3(x – 2), defined on the domain of all real numbers, find the inverse function if it exists or explain why it doesn't exist. **Mathematical Practices** • Reason abstractly and quantitatively • Model with mathematics ★ • Use appropriate tools strategically • Look for and make use of structure	*by providing several examples and helping students to recognize that a function is even if f(-x) = f(x) and is odd if f(-x) = -f(x). Visual approaches to identifying the graphs of even and odd functions can be used as well.* • *Provide examples of inverses that are not purely mathematical to introduce the idea. For example, given a function that names the capital of a state, f(Ohio) = Columbus. The inverse would be to input the capital city and have the state be the output, such that f^{-1} (Denver) = Colorado.* (ODE)		• Journals • Mathematical Practices • Modeling ★ • Multiple Intelligences assessments, e.g. □ Role playing - bodily kinesthetic □ Graphic organizing - visual □ Collaboration - interpersonal • Oral presentations • Problem/Performance based/common tasks • Real-life applications involving graphing • Rubrics/checklists (mathematical practice, modeling) • Tests and quizzes • Technology • Think-alouds • Writing genres □ Argument □ Information

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		• Graph *h(x)* and $h^{-1}(x)$ and explain how they relate to each other graphically for a linear function. • Consider simple situations where the domain of the function must be restricted in order for the inverse to exist, such as $f(x) = x^2$, $x>0$. (TUSD) **Academic vocabulary** • Domain • Even/odd function • Expand/contract • Explicit formula • Exponential function • Inverse • Linear function • Quadratic function • Range • Rate of change • Recursive formula • Transformation • Translate **Assessment problems F-BF.3** • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I2FBF.aspx (p.3) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-II/II-2-F-BF-3.aspx (p.1) **Assessment problems F-BF.4** • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-II/II-2-F-BF-3.aspx (p.2) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.te.2.00fbf.b.046_v1.pdf (p.2)			
FUNCTIONS **Linear, Quadratic, and Exponential Models★ (F-LE)** Construct and compare linear, quadratic, and exponential models and solve problems Use **Mathematical Practices** to 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	**S**	**Students** F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions. **Supporting content** a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. (F.LE.1a) b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. (F.LE.1b) c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. (F.LE.1c) **Essential knowledge and skills** • Linear functions grow by equal differences over equal intervals. • Exponential functions grow by equal factors over equal intervals. • Students can investigate functions and graphs modeling different situations involving simple and **Mathematical Practices** • Construct viable arguments and critique the reasoning of others • Model with mathematics ★	TEACHER NOTES See instructional strategies in the introduction • *Compare tabular representations of a variety of functions to show that linear functions have a first common difference (i.e., equal differences over equal intervals), while exponential functions do not (instead function values grow by equal factors over equal x-intervals).* • *Apply linear and exponential functions to real-world situations. For example, a person earning $10 per hour*	RESOURCE NOTES See resources in the introduction Textbooks • *Algebra 1,* McDougal Littell Chapter • *Exploration in Core Math,* Holt Mc Dougal • *HM Algebra 1* Technology • SMART Board's new tools for solving equations • Graphing calculators • Graphing software • Graphing calculators or computer software that generate graphs and tables of functions. A	ASSESSMENT NOTES See assessments in the introduction REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS • Anecdotal records • Charts/data collection • Conferencing • Exhibits • Interviews

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
6. Attend to precision 7. Look for and make use of structure 8. Look for and express regularity in repeated reasoning		compound interest. Students can compare interest rates with different periods of compounding (monthly, daily) and compare them with the corresponding annual percentage rate. Spreadsheets and applets can be used to explore and model different interest rates and loan terms • Use appropriate tools strategically • Look for and make use of structure • Look for and express regularity in repeated reasoning **Teaching Examples:** • A cell phone company has three plans. Graph the equation for each plan, and analyze the change as the number of minutes used increases. When is it beneficial to enroll in Plan 1? Plan 2? Plan 3? 1. $59.95/month for 700 minutes and $0.25 for each additional minute, 2. $39.95/month for 400 minutes and $0.15 for each additional minute, and 3. $89.95/month for 1,400 minutes and $0.05 for each additional minute. • A computer store sells about 200 computers at the price of $1,000 per computer. For each $50 increase in price, about ten fewer computers are sold. How much should the computer store charge per computer in order to maximize their profit? • A couple wants to buy a house in five years. They need to save a down payment of $8,000. They deposit $1,000 in a bank account earning 3.25% interest, compounded quarterly. How much will they need to save each month in order to meet their goal? • Sketch and analyze the graphs of the following two situations. What information can you conclude about the types of growth each type of interest has? ○ Lee borrows $9,000 from his mother to buy a car. His mom charges him 5% interest a year, but she does not compound the interest. ○ Lee borrows $9,000 from a bank to buy a car. The bank charges 5% interest compounded annually. (TUSD)	*experiences a constant rate of change in salary given the number of hours worked, while the number of bacteria on a dish that doubles every hour will have equal factors over equal intervals.* • *Provide examples of arithmetic and geometric sequences in graphic, verbal, or tabular forms, and have students generate formulas and equations that describe the patterns.* • *Use a graphing calculator or computer program to compare tabular and graphic representations of exponential and polynomial functions to show how the y (output) values of the exponential function eventually exceed those of polynomial functions.* • *Have students draw the graphs of exponential and other polynomial functions on a graphing calculator or computer utility and examine the fact that the exponential curve will eventually get higher than the polynomial function's graph. A simple example would be to compare the graphs (and tables) of the functions $y=x^2$ and $y=2x$ to find that the y*	graphing tool such as the one found at nlvm.usu.edu is one option • Examples of real-world situations that apply linear and exponential functions to compare their behaviors .	• Graphic organizers • Journals • Mathematical Practices • Modeling ★ • Multiple Intelligences assessments, e.g. □ Role playing - bodily kinesthetic □ Graphic organizing - visual □ Collaboration - interpersonal • Oral presentations • Problem/Performance based/common tasks • Real-life applications involving graphing • Rubrics/checklists (mathematical practice, modeling) • Tests and quizzes • Technology • Think-alouds • Writing genres □ Argument □ Information
	S	F.LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). **Supporting content**			

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		Essential knowledge and skills • Linear functions have an additive recursive pattern; exponential functions have a multiplicative recursive pattern. • Linear and exponential functions can be constructed given a graph, a description of a relationship, or a set of input-output pairs (which may be given in a table **Mathematical Practices** • Model with mathematics ★ • Look for and express regularity in repeated reasoning **Teaching Examples:** • Determine an exponential function of the form $f(x) = ab^x$ using data points from the table. Graph the function and identify the key characteristics of the graph. x | f(x) 0 | 1 1 | 3 3 | 27 • Sara's starting salary is $32,500. Each year she receives a $700 raise. Write a sequence in explicit form to describe the situation. • Solve the equation $2^x = 300$. Possible solution using a graphing calculator: enter $y = 2^x$ and $y = 300$ into a graphing calculator and find where the graphs intersect, by viewing the table to see where the function values are about the same. (TUSD)	*values are greater for the exponential function when x > 4.* • *Use technology to solve exponential equations such as $3(10^x) = 450$. (In this case, students can determine the approximate power of 10 that would generate a value of 150.) Students can also take the logarithm of both sides of the equation to solve for the variable, making use of the inverse operation to solve.* (ODE)		
	S	F.LE.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. **Supporting content** **Essential knowledge and skills** • An exponential growth model will eventually exceed in quantity any linear or quadratic growth model. **Mathematical Practices** • Reason abstractly and quantitatively **Teaching Examples:** • Contrast the growth of the functions $f(x)=3^x$, $f(x)=3^x$ and $f(x) = x^2 + 3$. (TUSD)			

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		Academic vocabulary • Even/odd function • Explicit formula • Exponential function • Growth/decay rate • Interest rate • Linear function • Principal • Quadratic function **Assessment problems F.LE.1** • Functions: linear, quadratic, exponential: Identify linear, quadratic, and exponential functions from graphs (Algebra - CC.1) • Functions: linear, quadratic, exponential: Identify linear, quadratic, and exponential functions from tables (Algebra - CC.2) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I2FLE.aspx (p.1) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.er.4.00fle.e.566_v1.pdf (p.1) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.tuitn.a.298_v1.pdf (p.1) **Assessment problems F.LE.2** • Number sequences: Write variable expressions for arithmetic sequences (Algebra - P.5) • Number sequences: Write variable expressions for geometric sequences (Algebra - P.6) • Relations and functions: Write a rule for a function table (Algebra - Q.12) • Linear functions: Slope-intercept form: write an equation (Algebra - S.7) • Linear functions: Point-slope form: write an equation from a graph (Algebra - S.15) • Linear functions: Point-slope form: write an equation (Algebra - S.16) • Exponential functions: Match exponential functions and graphs (Algebra - X.2) • Functions: linear, quadratic, exponential: Write linear, quadratic, and exponential functions (Algebra - CC.3) • Lines in the coordinate plane: Equations of lines (Geometry - E.4) • Lines in the coordinate plane: Equations of parallel and perpendicular lines (Geometry - E.6) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I2FLE.aspx (p.2) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.hmofc.a.268_v1.pdf (p.2) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.tuitn.a.298_v1.pdf (p.2) **Assessment problems F.LE.3** • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I2FLE.aspx (p.3) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-II/II-2-F-LE-3.aspx (p.3) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.er.4.00fle.e.566_v1.pdf (p.3)			
FUNCTIONS **Linear, Quadratic, and Exponential Models★**	**S**	**Students** F-LE.5 Interpret the parameters in a linear or exponential function in terms of a context. **Supporting content**	TEACHER NOTES See instructional strategies in the introduction	RESOURCE NOTES See resources in the introduction	ASSESSMENT NOTES See assessments in the introduction

ALGEBRA I CURRICULUM Grades 8-9

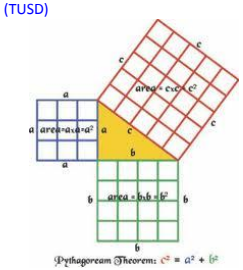
Curriculum Writers: Amanda Bednarczyk, David Mellor, and Melissa Silverio

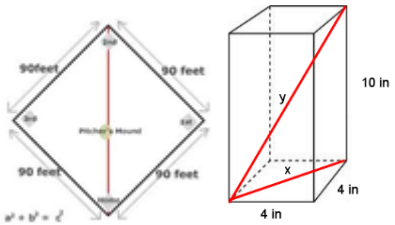
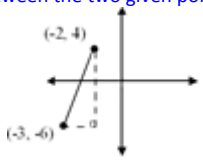
CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
(F-LE) Interpret expressions for functions in terms of the situation they model Use **Mathematical Practices** to 1. Make sense of problems and persevere in solving 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		**Essential knowledge and skills** • A given situation will set parameters for any linear or exponential function that models the situation. **Teaching Examples:** • The total cost for a plumber who charges $50 for a house call and $85 per hour would be expressed as the function y = 85x + 50. If the rate were raised to $90 per hour, how would the function change? • The equation $y = 8{,}000(1.04)^x$ models the rising population of a city with 8,000 residents when the annual growth rate is 4%. ○ What would be the effect on the equation if the city's population were 12,000 instead of 8,000? ○ What would happen to the population over 25 years if the growth rate were 6% instead of 4%? • A function of the form $f(n) = P(1 + r)^n$ is used to model the amount of money in a savings account that earns 5% interest, compounded annually, where n is the number of years since the initial deposit. What is the value of r? What is the meaning of the constant P in terms of the savings account? Explain either orally or in written format. (TUSD) **Mathematical Practices** • Reason abstractly and quantitatively • Model with mathematics ★ **Academic vocabulary** • Even/odd function • Explicit formula • Exponential function • Growth/decay rate • Interest rate • Linear function • Principal • Quadratic function **Assessment problems F-LE.5** • Solve equations: Solve linear equations: word problems (Algebra - J.8) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I2FLE.aspx (p.4) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.er.4.00fle.e.566_v1.pdf (p.4) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.tuitn.a.298_v1.pdf (p.4)	• *Linear and exponential of form f(x) = bx + k* • *Use real-world contexts to help students understand how the parameters of linear and exponential functions depend on the context. For example, a plumber who charges $50 for a house call and $85 per hour would be expressed as the function y = 85x + 50, and if the rate were raised to $90 per hour, the function would become y = 90x + 50. On the other hand, an equation of* $y = 8{,}000(1.04)^x$ *could model the rising population of a city with 8,000 residents when the annual growth rate is 4%. Students can examine what would happen to the population over 25 years if the rate were 6% instead of 4% or the effect on the equation and function of the city's population were 12,000 instead of 8,000.* (ODE)	Textbooks • *Algebra 1,* McDougal Littell Chapter • *Exploration in Core Math,* Holt Mc Dougal • *HM Algebra 1* Technology • SMART Board's new tools for solving equations • Graphing calculators • Graphing software • Graphing calculators or computer software that generates graphs and tables of functions. • Examples of real-world situations that apply linear and exponential functions to examine the effects of parameter changes. • Web sites and other sources that provide raw data, such as the cost of products over time, population changes, *etc.*	REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS • Anecdotal records • Charts/data collection • Conferencing • Exhibits • Interviews • Graphic organizers • Journals • Mathematical Practices • Modeling ★ • Oral presentations • Problem/Performance based/common tasks • Real-life applications involving graphing • Rubrics/checklists Tests and quizzes • Technology • Think-alouds
GEOMETRY **Geometric Measurement and**	**M**	**Students** 8.G.6 Explain a proof of the Pythagorean Theorem and its converse. **Major content**	TEACHER NOTES See instructional strategies in the introduction	RESOURCE NOTES See resources in the introduction	ASSESSMENT NOTES See assessments in the introduction

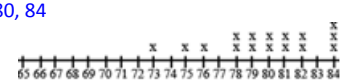
This curriculum was developed based on the Common Core State Standards utilizing examples and strategies from various websites including Tucson, Arizona, Ohio, and New Jersey.

ALGEBRA I CURRICULUM Grades 8-9

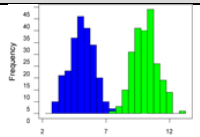
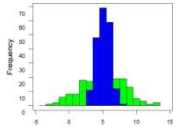
Curriculum Writers: Amanda Bednarczyk, David Mellor, and Melissa Silverio

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
Dimension (8.G) Understand and apply the Pythagorean theorem (8G) Use **Mathematical Practices** to 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		**Essential knowledge and skills** • Pythagorean Theorem states that for a right triangle the sum of the square of the two legs is equal to the square of the hypotenuse. ($a^2+b^2 = c^2$) • The converse of the Pythagorean Theorem states that if the sum of the squares of the smaller sides in a triangle equals the square of the third side, then the triangle must be a right triangle. **Teaching Examples:** • Pythagorean Theorem: Students should verify, using a model, that the sum of the squares of the legs is equal to the square of the hypotenuse in a right triangle. (TUSD)  • Image from: myastrologybook.com • Converse of Pythagorean Theorem: Students should also understand that if the sum of the squares of the 2 smaller legs of a triangle is equal to the square of the third leg, then the triangle is a right triangle. (TUSD) **Mathematical Practices** • Construct viable arguments and critique the reasoning of others • Model with mathematics ★ • Attend to precision • Look for and make use of structure	• *Connect to radicals, rational exponents, and irrational numbers* • *Previous understanding of triangles, such as the sum of two side measures is greater than the third side measure, angles sum, and area of squares, is furthered by the introduction of unique qualities of right triangles. Students should be given the opportunity to explore right triangles to determine the relationships between the measures of the legs and the measure of the hypotenuse. Experiences should involve using grid paper to draw right triangles from given measures and representing and computing the areas of the squares on each side. Data should be recorded in a chart allowing for students to conjecture about the relationship among the areas within each triangle.* • *The Pythagorean Thereom should be applied to finding the lengths of segments on a coordinate grid, especially those segments that do not follow the vertical or*	Textbooks • *Algebra 1*, McDougal Littell Chapter • *Exploration in Core Math*, Holt Mc Dougal • *HM Algebra 1* Technology • SMART Board's new tools for solving equations • Graphing calculators • Graphing software	REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS • Anecdotal records • Charts/data collection • Conferencing • Exhibits • Interviews • Graphic organizers • Journals • Mathematical Practices • Modeling ★ • Multiple Intelligences assessments, e.g. ▫ Role playing - bodily kinesthetic ▫ Graphic organizing - visual ▫ Collaboration - interpersonal • Oral presentations • Problem/Performance based/common tasks • Real-life applications involving graphing • Rubrics/checklists (mathematical practice, modeling)
	M	8.G.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions **Major content** **Essential knowledge and skills** • If a triangle is a right triangle, Pythagorean theorem can be used to find a missing side length or hypotenuse. • Real world problems in both two and three dimensions that involve right triangles can be solved using Pythagorean theorem. • Through authentic experiences and exploration, students should use the Pythagorean Theorem to solve problems. Problems can include working in both two and three dimensions. Students should be **Mathematical Practices** • Make sense of problems and persevere in solving them • Reason abstractly and quantitatively • Model with mathematics ★ • Use appropriate tools strategically			

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		familiar with the common Pythagorean triplets. (TUSD) • Attend to precision • Look for and make use of structure  • Image from: akhnatonsjournal.org	*horizontal lines, as a means of discussing the determination of distances between points. Contextual situations, created by both the students and the teacher, that apply the Pythagorean theorem and its converse should be provided. For example, apply the concept of similarity to determine the height of a tree using the ratio between the student's height and the length of the student's shadow. From that, determine the distance from the tip of the tree to the end of its shadow and verify by comparing to the computed distance from the top of the student's head to the end of the student's shadow, using the ratio calculated previously. Challenge students to identify additional ways that the Pythagorean Theorem is or can be used in real world situations or mathematical problems, such as finding the height of something that is difficult to physically measure, or the diagonal of a prism.* (ODE)		• Tests and quizzes • Technology • Think-alouds • Writing genres ▫ Argument ▫ Information
	M	8.G.8 Apply the Pythagorean Theorem to find the distance between two points in a coordinate system. **Major content** **Essential knowledge and skills** • The distance between two points on a coordinate plane can be found by drawing the vertical and horizontal lines from the points to create a right triangle and then applying the Pythagorean theorem. **Teaching Examples:** • Students will create a right triangle from the two points given (as shown in the diagram below) and then use the Pythagorean Theorem to find the distance between the two given points. (TUSD)  **Mathematical Practices** • Make sense of problems and persevere in solving them • Reason abstractly and quantitatively • Model with mathematics ★ • Use appropriate tools strategically • Attend to precision • Look for and make use of structure **Academic vocabulary** Adjacent angles Alternate interior angles Cone Congruent Corresponding angles Cylinder Dilation Exterior angles Hypotenuse			

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		Assessment problems 8.G.6 • Pythagorean theorem: Converse of the Pythagorean theorem: is it a right triangle? (Eighth grade - O.5) **Assessment problems 8.G.7** • Pythagorean theorem: Pythagorean theorem: find the length of the hypotenuse (Eighth grade - O.1) • Pythagorean theorem: Pythagorean theorem: find the missing leg length (Eighth grade - O.2) • Pythagorean theorem: Pythagorem theorem: find the perimeter (Eighth grade - O.3) • Pythagorean theorem: Pythagorean theorem: word problems (Eighth grade - O.4) **Assessment problems 8.G.8** • Coordinate graphs: Distance between two points (Eighth grade - P.4)			
STATISTICS AND PROBABILITY **Interpreting Categorical and Quantitative Data (S-ID)** Summarize, represent, and interpret data on a single count or measurement variable Use **Mathematical Practices** to 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	**A** **A**	**Students** S-ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots). **Additional content** **Essential knowledge and skills** • Sets of data can be represented on number lines via dot plots, histograms, and box plots, in order to look at and compare the overall shape of the data, measures of center and spread. **Teaching Examples:** • What measure of center or variability would best represent the data distribution for the height of basketball players on this team? Why? • Are there any extreme data points that may skew the data? Basketball Team – Height of Players in inches for 2010-2011 Season 75, 73, 76, 78, 79, 78, 79, 81, 80, 82, 81, 84, 82, 84, 80, 84 **Mathematical Practices** • Model with mathematics ★ • Use appropriate tools strategically  Height of Basketball Players (in) (TUSD) S-ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. **Additional content**	TEACHER NOTES See instructional strategies in the introduction • It *is helpful for students to understand that a statistical process is a problem-solving process consisting of four steps: formulating a question that can be answered by data; designing and implementing a plan that collects appropriate data; analyzing the data by graphical and/or numerical methods; and interpreting the analysis in the context of the original question. Opportunities should be provided for students to work through the statistical process. In Grades 6-8, learning has focused on parts of this process. Now is a good time to investigate a problem of interest to the students and follow*	RESOURCE NOTES See resources in the introduction Textbooks • *Algebra 1,* McDougal Littell Chapter • *Exploration in Core Math,* Holt Mc Dougal • *HM Algebra 1* Technology • SMART Board's new tools for solving equations • Graphing calculators • Graphing software • TI-84 and TI emulator • Quantitative Literacy Exploring Data module	ASSESSMENT NOTES See assessments in the introduction REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS • Anecdotal records • Charts/data collection • Conferencing • Exhibits • Interviews • Graphic organizers • Journals • Mathematical Practices • Modeling ★ • Multiple Intelligences assessments, e.g. Role playing - bodily

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		Essential knowledge and skills • The measure of center or variability that best interprets a data set will depend upon the shape of the data distribution and context of data collection **Teaching Examples:** • The two data sets below depict the housing prices sold in the King River area and Toby Ranch areas of Pinal County, Arizona. Based on the prices below, which price range can be expected for a home purchased in Toby Ranch? In the King River area? In Pinal County? ○ King River area {1.2 million, 242000, 265500, 140000, 281000, 265000, 211000} ○ Toby Ranch homes {5million, 154000, 250000, 250000, 200000, 160000, 190000} • Given a set of test scores: 99, 96, 94, 93, 90, 88, 86, 77, 70, 68, find the mean, median and standard deviation. Explain how the values vary about the mean and median. What information does this give the teacher? (TUSD) **Mathematical Practices** • Reason abstractly and quantitatively • Construct viable arguments and critique the reasoning of others • Model with mathematics ★ • Use appropriate tools strategically • Look for and make use of structure	*it through. The richer the question formulated, the more interesting is the process. Teachers and students should make extensive use of resources to perfect this very important first step. Global web resources can inspire projects.* • *Although this domain addresses both categorical and quantitative data, there is no reference in the Standards 1 - 4 to categorical data. Note that Standard 5 in the next cluster (Summarize, represent, and interpret data on two categorical and quantitative variables) addresses analysis for two categorical variables on the same subject. To prepare for interpreting two categorical variables in Standard 5, this would be a good place to discuss graphs for one categorical variable (bar graph, pie graph) and measure of center (mode).* • *Have students practice their understanding of the different types of graphs for categorical and numerical variables by constructing statistical posters. Note that a bar graph for categorical data may*		kinesthetic □ Graphic organizing - visual □ Collaboration - interpersonal • Oral presentations • Problem/Performance based/common tasks • Real-life applications involving graphing • Rubrics/checklists (mathematical practice, modeling) • Tests and quizzes • Technology • Think-alouds • Writing genres □ Argument □ Information
	A	S-ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). **Additional content** **Essential knowledge and skills** • Extreme data points (outliers) can affect the shape, measures of center, and spread of a given data set. **Teaching Examples:** • Comparing two data sets using a histogram. Not only can the shape of the distribution be observed, but so can the distribution's location and spread. Figure 16 shows how a mean has increased -- a transition from the distribution shown at the left (blue) to the one shown on the right (green). Figure 17 shows a different method of comparing distributions. The original data set (shown in green) has greater variability than the later data set (the blue histogram superimposed over the original data set). **Mathematical Practices**			

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		 Figure 16: Histogram of two data sets, one with increased mean  Figure 17: Histogram of two data sets, one with increased variability From: http://illuminae.info/matec/index.php?option=com_content&view=article&id=12:quality-tools-and-spc-charts&catid=9 **Academic vocabulary** • Causation • Correlation • Correlation coefficient • Data distribution • Distribution • Frequency • Interval • Line of best fit • Line of regression (residual) • Outliers • Quartile intervals • Scatter plot • Standard deviation • Two-way frequency tables **Assessment problems S-ID.1** • Charts and graphs: Create bar graphs, line graphs, and histograms (Algebra - N.2) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I4SID.aspx (p.1) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.sr.1.00sid.p.482_v1.pdf (p.1) **Assessment problems S-ID.2** • Statistics: Mean, median, mode, and range (Algebra - JJ.1) • Statistics: Quartiles (Algebra - JJ.2) • Statistics: Mean absolute deviation (Algebra - JJ.4) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I4SID.aspx (p.2) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.sr.1.00sid.p.084_v1.pdf (p.2) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.tuitn.a.298_v1.pdf (p.2) **Assessment problems S-ID.3** • Charts and graphs: Interpret box-and-whisker plots (Algebra - N.5) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I4SID.aspx (p.3)	*have frequency on the vertical (student's pizza preferences) or measurement on the vertical (radish root growth over time - days).* • *Measures of center and spread for data sets without outliers are the mean and standard deviation, whereas median and interquartile range are better measures for data sets with outliers.* • *Introduce the formula of standard deviation by reviewing the previously learned MAD (mean absolute deviation). The MAD is very intuitive and gives a solid foundation for developing the more complicated standard deviation measure.* • *Informally observing the extent to which two boxplots or two dotplots overlap begins the discussion of drawing inferential conclusions. Don't shortcut this observation in comparing two data sets.* • *As histograms for various data sets are drawn, common shapes appear. To characterize the shapes, curves are sketched through the midpoints of the tops of the histogram's rectangles. Of particular*		

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		• http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.te.1.00sid.p.242_v1.pdf (p.3) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.er.2.00sid.c.264_v1.pdf (p.3) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.tuitn.a.298_v1.pdf (p.3)	*importance is a symmetric unimodal curve that has specific areas within one, two, and three standard deviations of its mean. It is called the Normal distribution and students need to be able to find areas (probabilities) for various events using tables or a graphing calculator.* (ODE)		
STATISTICS AND PROBABILITY **Interpreting Categorical and Quantitative Data (8.SP)** Investigate patterns of association in bivariate data (8.SP) Use **Mathematical Practices** to 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	**S** **S**	**Students** 8.SP.1 Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. **Supporting content** Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association. **Essential knowledge and skills** • Data that is collected using two variables is called bivariate data. **Teaching Examples:** • http://www.tusd1.org/contents/distinfo/curriculum/index.asp - grade 8, p. p.44-45 **Mathematical Practices** • Reason abstractly and quantitatively • Model with mathematics ★ • Use appropriate tools strategically • Attend to precision • Look for and make use of structure 8.SP.2 Know that straight lines are widely used to model relationships between two quantitative variables. **Supporting content** 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. **Essential knowledge and skills** • Scatterplots can suggest a linear association/ relationships. **Teaching Examples:** • The capacity of the fuel tank in a car is 13.5 gallons. **Mathematical Practices** • Reason abstractly and quantitatively • Model with mathematics ★	TEACHER NOTES See instructional strategies in the introduction	RESOURCE NOTES See resources in the introduction • Textbooks • *Algebra 1,* McDougal Littell Chapter • *Exploration in Core Math,* Holt Mc Dougal • *HM Algebra 1* Technology • SMART Board's new tools for solving equations • Graphing calculators • Graphing software	ASSESSMENT NOTES See assessments in the introduction REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS • Anecdotal records • Charts/data collection • Conferencing • Exhibits • Interviews • Graphic organizers • Journals • Mathematical Practices • Modeling ★ • Multiple Intelligences assessments, e.g. Role playing -

<table>
<tr><th>CATEGORIES, DOMAINS, CLUSTERS</th><th>UNIT</th><th>STANDARDS/BENCHMARKS
North Smithfield School Department</th><th>INSTRUCTIONAL STRATEGIES</th><th>RESOURCES</th><th>ASSESSMENTS</th></tr>
<tr>
<td></td>
<td>S</td>
<td>
The table below shows the number of miles traveled and how many gallons of gas are left in the tank. Describe the relationship between the variables. If the data is linear, determine a line of best fit. Do you think the line represents a good fit for the data set? Why or why not? What is the average fuel efficiency of the car in miles per gallon? (TUSD)
<table>
<tr><td colspan="6">Miles Traveled</td></tr>
<tr><td>0</td><td>75</td><td>120</td><td>160</td><td>250</td><td>300</td></tr>
<tr><td colspan="6">Gallons Used</td></tr>
<tr><td>0</td><td>2.3</td><td>4.5</td><td>5.7</td><td>9.7</td><td>10.7</td></tr>
</table>

Use appropriate tools strategically
Attend to precision
Look for and make use of structure

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.

For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height. Supporting content

<u>Essential knowledge and skills</u>

If a scatterplot suggests a linear relationship, then a line of best fit can be drawn and a linear equation can be created to model the relationship between the bivariate data.
An equation of a line of best fit can be used to interpret and solve problems in the context of bivariate measurement data.

<u>Teaching Examples:</u>

In a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.
Given data from students' math scores and absences, make a scatterplot.

<u>Mathematical Practices</u>

Reason abstractly and quantitatively
Model with mathematics ★
Use appropriate tools strategically
Attend to precision
Look for and make use of structure

</td>
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bodily kinesthetic
Graphic organizing - visual
Collaboration - interpersonal

Oral presentations
Problem/Performance based/common tasks
Real-life applications involving graphing
Rubrics/checklists (mathematical practice, modeling)
Tests and quizzes
Technology
Think-alouds
Writing genres
Argument
Information

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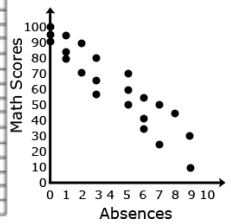
CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS

Absences	Math Scores
3	65
5	50
1	95
1	85
3	80
6	34
5	70
3	56
0	100
7	24
8	45
2	71
9	30
0	95
6	55
6	42
2	90
0	92
5	60
7	50
9	10
1	80



a. Draw a line of best fit, paying attention to the closeness of the data points on either side of the line.

b. From the line of best fit, determine an approximate linear equation that models the given data (about $y = -\frac{25}{3}x + 95$

c. Students should recognize that 95 represents the y intercept and $-\frac{25}{3}$ represents the slope of the line.
Students can use this linear model to solve problems. For example, through substitution, they can use the equation to determine that a student with 4 absences should expect to receive a math score of about 62. They can then compare this value to their line. (TUSD)

S

8.SP.4 Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table.

Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. **Supporting content**

- *For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?*

Essential knowledge and skills

- Scatterplots and two-way frequency tables are used

Mathematical Practices

- Reason abstractly

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		to show patterns of association and relationships between bivariate categorical data. **Teaching Examples:** a. Collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores? b. The table illustrates the results when 100 students were asked the survey questions: Do you have a curfew? and Do you have assigned chores? Is there evidence that those who have a curfew also tend to have chores? Curfew / Chores: Yes: Yes 40, No 10; No: Yes 10, No 40 Solution: Of the students who answered that they had a curfew, 40 had chores and 10 did not. Of the students who answered they did not have a curfew, 10 had chores and 40 did not. From this sample, there appears to be a positive correlation between having a curfew and having chores. (TUSD) **Academic vocabulary** • Bivariate Data • Clustering • Frequency • Line of best fit • Linear association • Linear model • Negative association • Nonlinear association. • Outliers • Positive association • Relative Frequency • Scatterplot • Slope • Two-way Table **Assessment problems 8.SP.1** • Charts and graphs: Scatter plots (Eighth grade - N.13) **Assessment problems 8.SP.2** **Assessment problems 8.SP.3** • Ratios and proportions: Constant rate of change (Eighth grade - H.12) • Linear functions: Graph a line from an equation (Eighth grade - V.7) • Linear functions: Linear function word problems (Eighth grade - V.8) • Linear functions: Find the slope of a graph (Eighth grade - V.9)	and quantitatively • Construct viable arguments and critique the reasoning of others • Model with mathematics ★ • Use appropriate tools strategically • Attend to precision • Look for and make use of structure		

ALGEBRA I CURRICULUM Grades 8-9

Curriculum Writers: Amanda Bednarczyk, David Mellor, and Melissa Silverio

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		Assessment problems 8.SP.4 • Charts and graphs: Interpret stem-and-leaf plots (Eighth grade - N.8) • Charts and graphs: Interpret histograms (Eighth grade - N.9) • Charts and graphs: Create histograms (Eighth grade - N.10) • Charts and graphs: Create frequency charts (Eighth grade - N.11)			
STATISTICS AND PROBABILITY **Interpreting Categorical and Quantitative Data (S-ID)** Summarize, represent, and interpret data on two categorical and quantitative variables Use **Mathematical Practices** to 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	**S**	**Students** S-ID.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data. **Supporting content** **Essential knowledge and skills** • Two-way frequency tables can be used to interpret joint, marginal and conditional relative frequencies of categorical data. • Two-way frequency tables and scatter plots of categorical data can be used to identify possible associations and trends in the data. **Teaching Examples:** • Two-way Frequency Table A two-way frequency table is shown below displaying the relationship between age and baldness. We took a sample of 100 male subjects, and determined who is or is not bald. We also recorded the age of the male subjects by categories Two-way Frequency Table Bald / Age (<45, >45) / Total No: 35, 11, 46 Yes: 24, 30, 54 Total: 59, 41, 100 Two-way Relative Frequency Table Bald / Age (<45, >45) / Total No: 0.35, .11, 0.46 Yes: 0.24, 0.30, 0.54 Total: 0.59, 0.41, 1.00 The relative frequencies in the body of the table are called conditional relative frequencies. (TUSD) **Mathematical Practices** • Make sense of problems and persevere in solving them • Reason abstractly and quantitatively • Construct viable arguments and critique the reasoning of others • Model with mathematics ★ • Use appropriate tools strategically • Look for and express regularity in repeated reasoning	TEACHER NOTES See instructional strategies in the introduction • *Linear focus; discuss general principle* • *In this cluster, the focus is that two categorical or two quantitative variables are being measured on the same subject.* • *In the categorical case, begin with two categories for each variable and represent them in a two-way table with the two values of one variable defining the rows and the two values of the other variable defining the columns. (Extending the number of rows and columns is easily done once students become comfortable with the 2x2 case.) The table entries are the joint frequencies of how many subjects displayed the respective cross-classified values. Row totals and column totals constitute the marginal frequencies. Dividing joint or marginal frequencies by the total*	RESOURCE NOTES See resources in the introduction Textbooks • *Algebra 1,* McDougal Littell Chapter • *Exploration in Core Math,* Holt Mc Dougal • *HM Algebra 1* Technology • SMART Board's new tools for solving equations • Graphing calculators • Graphing software • TI-84 and TI emulator • Quantitative Literacy Exploring Data module	ASSESSMENT NOTES See assessments in the introduction REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS • Anecdotal records • Charts/data collection • Conferencing • Exhibits • Interviews • Graphic organizers • Journals • Mathematical Practices • Modeling ★ • Multiple Intelligences assessments, e.g. ▫ Role playing - bodily kinesthetic ▫ Graphic organizing - visual ▫ Collaboration - interpersonal • Oral presentations • Problem/Performance based/common

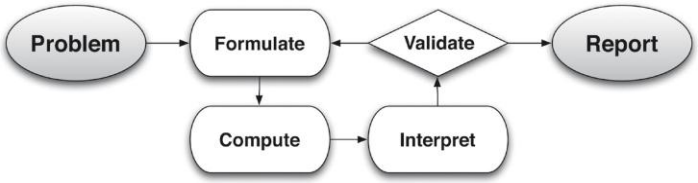
CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
	S	S-ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. **Supporting content** a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. *Use given functions or choose a function suggested by the a context.* *Emphasize linear, quadratic, and exponential models.* (S-ID.6a) b. Informally assess the fit of a function by plotting and analyzing residuals. (S-ID.6b) c. Fit a linear function for a scatter plot that suggests a linear association. (S-ID.6c) **Essential knowledge and skills** • Scatter plots of data sets can be used to identify the type of function that best represents the shape of the data (linear, quadratic or exponential). • Residuals (lines of regressions) are drawn on scatter plots in order to informally assess the fit of a function to a data set. • If a scatter plot has a linear association, then a line of best fit can be drawn to interpret the data set. **Teaching Examples:** • Measure the wrist and neck size of each person in your class and make a scatter plot. Find the least squares regression line. Calculate and interpret the correlation coefficient for this linear regression model. Graph the residuals and evaluate the fit of the linear equation. Use the line of best fit to predict the wrist size for a person not in your class. (TUSD) **Mathematical Practices** • Reason abstractly and quantitatively • Construct viable arguments and critique the reasoning of others • Model with mathematics ★ • Use appropriate tools strategically • Look for and make use of structure • Look for and express regularity in repeated reasoning **Academic vocabulary** **Assessment problems S-ID.5** • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I4SID.aspx (p.4) **Assessment problems S-ID.6** • Charts and graphs: Interpret a scatter plot (Algebra - N.6) • Charts and graphs: Scatter plots: line of best fit (Algebra - N.7) • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I4SID.aspx (p.5) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.0corn.a.412_v1.pdf (p.5) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.tuitn.a.298_v1.pdf (p.5)	*number of subjects define relative frequencies (and percentages), respectively. Conditional relative frequencies are determined by focusing on a specific row or column of the table. They are particularly useful in determining any associations between the two variables.* • *In the numerical or quantitative case, display the paired data in a scatterplot. Note that although the two variables in general will not have the same scale, e.g., total SAT versus grade-point average, it is best to begin with variables with the same scale such as SAT Verbal and SAT Math. Fitting functions to such data will avoid difficulties such as interpretation of slope in the linear case in which scales differ. Once students are comfortable with the same scale case, introducing different scales situations will be less problematic.* (ODE)		tasks • Real-life applications involving graphing • Rubrics/checklists (mathematical practice, modeling) • Tests and quizzes • Technology • Think-alouds • Writing genres □ Argument □ Information

ALGEBRA I CURRICULUM Grades 8-9

Curriculum Writers: Amanda Bednarczyk, David Mellor, and Melissa Silverio

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
STATISTICS AND PROBABILITY **Interpreting Categorical and Quantitative Data (S-ID)** Interpret linear models Use **Mathematical Practices** to 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	M M	**Students** S-ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. **Major content** **Essential knowledge and skills** • If a scatter plot has a linear association, then a linear model can be drawn and used to identify and interpret the meaning of the slope (constant rate of change) and the intercept (constant term) between the data sets. **Teaching Examples:** • Lisa lights a candle and records its height in inches every hour. The results recorded as (time, height) are (0, 20), (1, 18.3), (2, 16.6), (3, 14.9), (4, 13.2), (5, 11.5), (7, 8.1), (9, 4.7), and (10, 3). Express the candle's height (h) as a function of time (t) and state the meaning of the slope and the intercept in terms of the burning candle. Solution: ○ h = -1.7t + 20 ○ Slope: The candle's height decreases by 1.7 inches for each hour it is burning. ○ Intercept: Before the candle begins to burn, its height is 20 inches. (TUSD) **Mathematical Practices** • Make sense of problems and persevere in solving them • Reason abstractly and quantitatively • Model with mathematics ★ • Use appropriate tools strategically • Attend to precision S-ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit. **Major content** **Essential knowledge and skills** • Technology is used to compute and interpret the correlation coefficient (the slope) of a linear model. **Teaching Examples:** • Collect height, shoe-size, and wrist circumference data for each student. Determine the best way to display the data. Answer the following questions: Is **Mathematical Practices** • Model with mathematics ★ • Use appropriate tools strategically • Look for and express regularity in repeated reasoning	TEACHER NOTES See instructional strategies in the introduction • *In this cluster, the key is that two quantitative variables are being measured on the same subject. The paired data should be listed and then displayed in a scatterplot. If time is one of the variables, it usually goes on the horizontal axis. That which is being predicted goes on the vertical; the predictor variable is on the horizontal axis.* • *Note that unlike a two-dimensional graph in mathematics, the scales of a scatterplot need not be the same, and even if they are similar (such as SAT Math and SAT Verbal), they still need not have the same spacing. So, visual rendering of slope makes no sense in most scatterplots, i.e., a 45 degree line on a scatterplot need not mean a slope of 1.* • *Often the interpretation of the intercept (constant term) is not meaningful in the*	RESOURCE NOTES See resources in the introduction Textbooks • *Algebra 1,* McDougal Littell Chapter • *Exploration in Core Math,* Holt Mc Dougal • *HM Algebra 1* Technology • SMART Board's new tools for solving equations • Graphing calculators • Graphing software • TI-84 and TI emulator • Quantitative Literacy Exploring Data module	ASSESSMENT NOTES See assessments in the introduction REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM • FINAL EXAM • COMMON PROBLEMS/UNITS SUGGESTED FORMATIVE/ SUMMATIVE ASSESSMENTS • Anecdotal records • Charts/data collection • Conferencing • Exhibits • Interviews • Graphic organizers • Journals • Mathematical Practices • Modeling ★ • Multiple Intelligences assessments, e.g. □ Role playing - bodily kinesthetic □ Graphic organizing - visual □ Collaboration - interpersonal • Oral presentations • Problem/Performance based/common

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
		there a correlation between any two of the three indicators? Is there a correlation between all three indicators? What patterns and trends are apparent in the data? What inferences can be made from the data? (TUSD)	*context of the data. For example, this is the case when the zero point on the horizontal is of considerable distance from the values of the horizontal variable, or in some case has no meaning such as for SAT variables.* • *To make some sense of Pearson's r, correlation coefficient, students should recall their middle school experience with the Quadrant Count Ratio (QCR) as a measure of relationship between two quantitative variables.* • *Noting that a correlated relationship between two quantitative variables is not causal (unless the variables are in an experiment) is a very important topic and a substantial amount of time should be spent on it.* (ODE)		tasks • Real-life applications involving graphing • Rubrics/checklists (mathematical practice, modeling) • Tests and quizzes • Technology • Think-alouds • Writing genres Argument Information
	M	S-ID9 Distinguish between correlation and causation. **Major content** **Essential knowledge and skills** • A correlation does not necessarily mean there is causation **Teaching Examples:** • Diane did a study for a health class about the effects of a student's end-of-year math test scores on height. Based on a graph of her data, she found that there was a direct relationship between students' math scores and height. She concluded "doing well on your end-of-year math tests makes you tall." Is this conclusion justified? Explain any flaws in Diane's reasoning. (TUSD) **Mathematical Practices** • Construct viable arguments and critique the reasoning of others • Model with mathematics ★ • Attend to precision **Academic vocabulary** **Assessment problems S-ID.7** • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I4SID.aspx (p.6) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.tuitn.a.298_v1.pdf (p.6) **Assessment problems S-ID.8** • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I4SID.aspx (p.7) • http://www.ode.state.or.us/wma/teachlearn/commoncore/mat.hs.pt.4.tuitn.a.298_v1.pdf (p.7) **Assessment problems S-ID.9** • http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-I/I4SID.aspx (p.8)			
6. MODELING ★ 6.1 Choosing and using appropriate mathematics and statistics to analyze empirical		**Students** 6.1.1 Understand and use **descriptive modeling** which simply describes the phenomena or summarizes them in a compact form. Graphs of observations are a familiar descriptive model - for example, graphs of global temperature and atmospheric CO_2 over time.	TEACHER NOTES See instructional strategies in the introduction	RESOURCE NOTES See resources in the introduction Textbooks • *Algebra 1,* McDougal Littell Chapter	ASSESSMENT NOTES See assessments in the introduction REQUIRED COMMON ASSESSMENTS • MID-TERM EXAM

CATEGORIES, DOMAINS, CLUSTERS	UNIT	STANDARDS/BENCHMARKS North Smithfield School Department	INSTRUCTIONAL STRATEGIES	RESOURCES	ASSESSMENTS
situations		6.1.2 Understand that **analytical modeling** seeks to explain data on the basis of deeper theoretical ideas, albeit with parameters that are empirically based; for example, exponential growth of bacterial colonies (until cut-off mechanics such as pollution or starvation intervene) follows a constant reproduction rate. Functions are an important tool for analyzing such problems. 6.1.3 Use graphing utilities, spreadsheets, computer algebra systems, and dynamic geometry software as powerful tools that can be used to model purely mathematical phenomena (e.g. the behavior of polynomials) as well as physical phenomena. 6.1.4 Understands and use the basic **modeling cycle** ★: • **Problem:** Identifying variables in the situation and selecting those that represent essential features • **Formulate**: formulating a model by creating and selecting geometric, graphical, tabular, algebraic or statistical representations that describe relationships between the variables • **Compute:** analyzing and performing operations on these relationships to draw conclusions • **Interpret**: interpreting the results of the mathematics in terms of the original situation • **Validate:** validating the conclusions by comparing them with the situation, and then either improving the model or, if it is acceptable • **Report**: reporting on the conclusions and the reasoning behind them. 		• *Exploration in Core Math,* Holt Mc Dougal • *HM Algebra 1* Technology • SMART Board's new tools for solving equations • Graphing calculators • Graphing software	• FINAL EXAM • COMMON PROBLEMS/UNITS