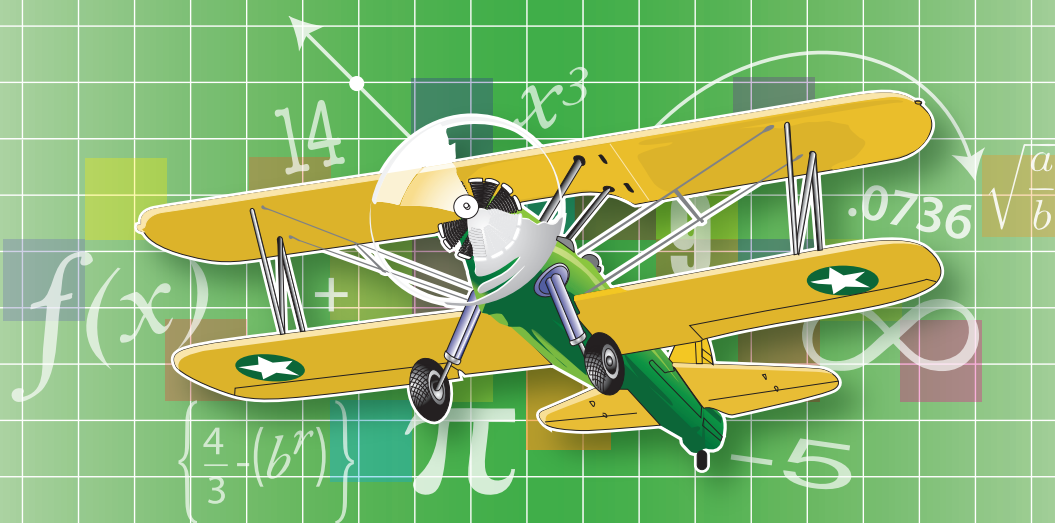# Algebra I & Mathematics I

Real Numbers

Pathways to Common Core Mathematics

Student Edition

Real Numbers in Real Situations

CENTER FOR MATHEMATICS, SCIENCE, AND TECHNOLOGY
Illinois State University

STEM
science, technology, engineering, mathematics

Real Numbers

Pathways to
Common Core
Mathematics

Algebra I & Mathematics I

Student Edition

**Real Numbers
in
Real Situations**

**CENTER FOR
MATHEMATICS, SCIENCE,
AND TECHNOLOGY**
Illinois State University

S T E M

Science Technology Engineering Mathematics

Real Numbers- Student Edition

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Rock River Environmental Services

US Bank

AW Anderson Agency

Lowes Distribution Center

Hulsebus Chiropractic

Rockford Memorial Hospital

Woodward Incorporated

McClure Engineering

Acument Global

Burpee Museum

Boone County Farm Bureau/
    Central Grain Company

Elite Tool and Wire

City of Rockford Engineering Dept.

Winnebago County Justice Building

City of Loves Park Public Works and
    Development Department

Giovanni's Restaurant

Chicago Rockford International Airport

Hopperstad Custom Hot Rod Shop

Welcome!

Welcome to *Real Numbers: Pathways to Common Core Mathematics*, a curriculum that provides unique and engaging mathematics learning experiences in *Algebra and Geometry.* Using mathematical modeling, students will learn math concepts through authentic, real-world applications.

At the beginning of each unit in this book, you will see a "big-picture" context for those applications anchored in U.S. Department of Education *Career Clusters and Pathways* (www.careerclusters.org). Each unit is also aligned with *Common Core State Standards for Mathematics* (www.corestandards.org). These units were created by mathematics educators based on visits to businesses in the community during which they explored ways in which mathematics is used in the real world.

The eight chapters of *Real Numbers* comprise the entirety of the content recommended by the *Common Core State Standards for Mathematics* for both the *Algebra I* and the *Mathematics I* courses. Chapters 1 through 4 are common to both courses. Chapters 5 and 6 are recommended for the Algebra I course only. Chapters 7 and 8 are recommended for the Mathematics I course only.

It should be noted that *Real Numbers* does not simply use the context provided by the Career Custer as the basis of a series of story problems. Instead, this curriculum teaches the content through its application. For example, students learn how to calculate ratios by being given the problem of mixing fertilizer for a golf course. This educational process is made possible through the use of *Learning Cycles*.

About the Learning Cycle

Every lesson in this book is organized into a learning cycle. A learning cycle consists of four parts; **Try It**, **Discuss It**, **Apply It**, and **Expand It**. In some cases, there may be multiple **Try It** sections, each followed by a **Discuss It** section. There is always one **Apply It** and **Expand It** section in each learning cycle.

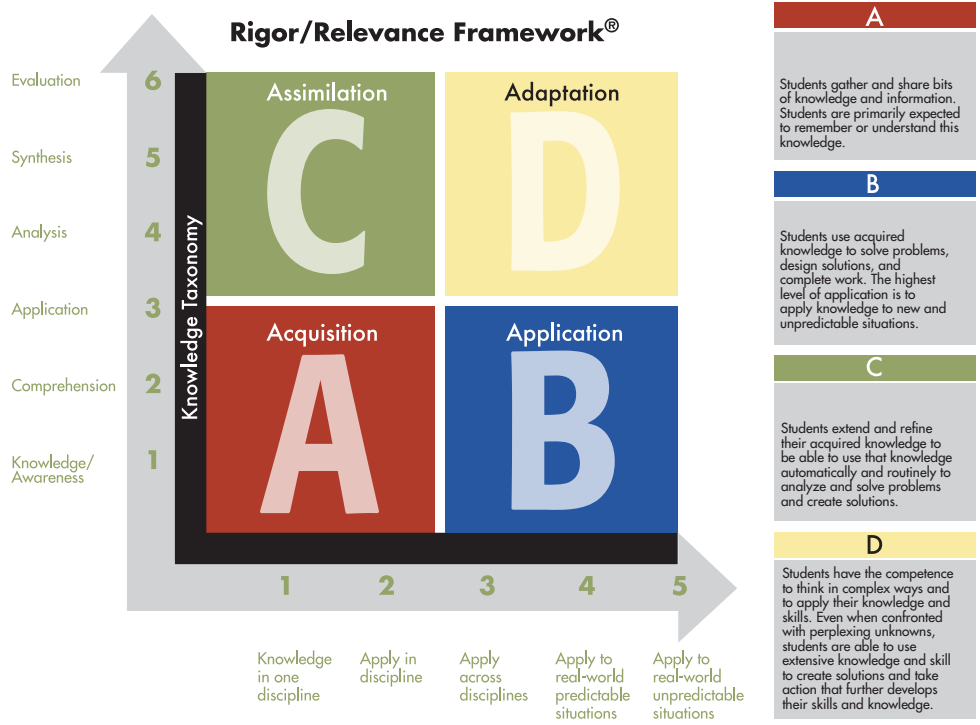| Section	Description	Student Role	Teacher Role
Try It *Remember and begin to understand* TRY IT	Students engage the content through an activity. They are required to build, gather data, look for patterns, etc. Students are prompted to remember previous learning and connect it to new concepts as their understanding grows.	Work in groups or individually, follow the written directions to accomplish the task, collect and record data, make predictions	Facilitate the learning activity. Provide necessary materials and tools. Ask questions, but do not answer them. Assure safe practices.
Discuss It *Understand and begin to apply* DISCUSS IT	A series of questions designed to clarify concepts and identify misconceptions. Assesses understanding and probes applications.	Complete the questions as assigned. This could be orally as a large group, written individually, or written as a group. Students compare data, form generalizations, write in journals.	Monitor student responses and ask clarifying questions. Assess understanding. Corrects misconceptions.
Apply It *Apply and begin to analyze* APPLY IT	Usually a continuation of an activity that requires the application of the concepts learned in the previous two sections. Requires analysis and evaluation of concepts.	Complete the assigned task, utilizing knowledge gained from the previous sections of the learning cycle.	Facilitate the activity. Provide necessary tools and materials. Monitor progress. Inject leading questions as appropriate. Assure safe practices. Corrects lingering misconceptions.
Expand It *Analyze and begin to evaluate and create* EXPAND IT	A few ideas for taking the concept further, possibly a different, but related, application. These tasks require analysis, evaluation, and creation of new applications and connections.	Use the ideas in this section as a foundation for further research.	These ideas provide opportunity for further study. Allow students to explore these concepts on their own. Many will be so interested in the topic that independent learning will occur without prompting.

Assessment

There are several ways to view assessment of student learning in mathematics. Many school districts have a very specific and rigid system of assessment utilizing regularly scheduled standardized tests consistent with state assessment strategies. Other districts are a bit more flexible utilizing teacher-written tests throughout the year culminating with state-mandated standardized testing for certain grades. Regardless of the local process, the lessons in the Real Numbers: Pathways to Common Core Mathematics can be quite useful.

1 All assessments are designed to indicate the level of understanding of a particular topic. When it is clear that a particular topic is not mastered, it makes little sense to teach it again using the same strategies. The lessons in this book provide an alternative. Many districts require that students pass Algebra I for graduation. Well over 70% of the students dropping out of high school claim it is because they cannot pass Algebra I. The lessons in this book address Algebra I content by utilizing student experiences and interests to help them realize the importance of mathematics and lead to passing the algebra graduation requirement.

2 The lessons in this book can be used as a pre-test. Perhaps when first addressing a topic, students are given a lesson from this text. As they progress through the learning cycle, misunderstandings become apparent. The teacher then knows what to cover in more depth. This could occur during the learning cycle or after it has been completed.

3 The lessons in this book can be used as a post-test. After receiving instruction on a particular topic, the corresponding learning cycle could be assigned. Successful completion of the activities could be used to determine mastery.

4 The teacher may decide to write assessments consistent with local policies that measure important objectives aligned with the philosophy of the learning cycle.

5 The teacher may decide to use the learning cycle as a means to teach important objectives that will be assessed using district or state standardized assessment tools.

6 The activities from the **Apply It** or the **Expand It** sections of the learning cycle could be developed into an assessment. A rubric could be created to describe and quantify the quality of work.

Importance of Real-World Connections

Engaging students in experiences that are connected to the real world is critically important to learning. In her publication, "How Children Learn," Stella Vosniadou discusses research that identifies key factors in effective teaching and learning, including:

- Learning becomes more meaningful when the lessons are applied to real-life situations.

- People learn best when they participate in activities that are perceived to be useful in real life and are culturally relevant.

- Learning requires the active, constructive involvement of the learner. [1]

Rigor/Relevance Framework®

International Center for Leadership in Education, http://www.leadered.com/rrr.html

A — Students gather and share bits of knowledge and information. Students are primarily expected to remember or understand this knowledge.

B — Students use acquired knowledge to solve problems, design solutions, and complete work. The highest level of application is to apply knowledge to new and unpredictable situations.

C — Students extend and refine their acquired knowledge to be able to use that knowledge automatically and routinely to analyze and solve problems and create solutions.

D — Students have the competence to think in complex ways and to apply their knowledge and skills. Even when confronted with perplexing unknowns, students are able to use extensive knowledge and skill to create solutions and take action that further develops their skills and knowledge.

Dr. Bill Daggett has provided strong leadership for relevance in education. His Rigor and Relevance Framework offers a compelling visual argument for authentic connections and rigorous curriculum.

[1] Vosniadou, Stella. How Children Learn. International Academy of Education. 2001. <http://tinyurl.com/6m82jvk>.

PATHWAYS TO COLLEGE & CAREER READINESS

CareerClusters™

One of the keys to improving student achievement is providing students with relevant contexts for studying and learning. Career Clusters™ do exactly this by linking school-based learning with the knowledge and skills required for success in the workplace. The National Career Clusters™ Framework is comprised of 16 Career Clusters™ and related Career Pathways to help students of all ages explore different career options and better prepare for college and career.

Each Career Cluster™ represents a distinct grouping of occupations and industries based on the knowledge and skills they require. The 16 Career Clusters™ and related Career Pathways provide an important organizing tool for schools to develop more effective programs of study (POS) and curriculum.
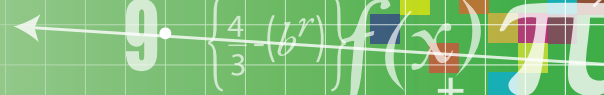
Quoted from: http://www.careertech.org/career-clusters/glance/careerclusters.html

Government & Public Administration
Governance
National Security
Foreign Service
Planning
Revenue & Taxation
Regulation
Public Management & Administration

Marketing
Marketing Management
Professional Sales
Merchandising
Marketing Communications
Marketing Research

Business Management & Administration
General Management
Business Information Management
Human Resources Management
Operations Management
Administrative Support

Information Technology
Network Systems
Information Support & Services
Web & Digital Communications
Programming & Software Development

Finance
Securities & Investments
Banking Services
Business Finance
Accounting
Insurance

Law, Public Safety, Corrections & Security
Correction Services
Emergency & Fire Management Services
Security & Protective Services
Law Enforcement Services
Legal Services

Transportation, Distribution & Logistics
Transportation Operations
Logistics Planning & Management Services
Warehousing & Distribution Center Operations
Facility & Mobile Equipment Maintenance
Transportation Systems/Infrastructure Planning, Management & Regulation
Health, Safety & Environmental Management
Sales & Service

Science, Technology, Engineering & Mathematics
Engineering & Technology
Science & Math

Manufacturing
Production
Manufacturing Production Process Development
Maintenance, Installation & Repair
Quality Assurance
Logistics & Inventory Control
Health, Safety & Environmental Assurance

Architecture & Construction
Design/Pre-Construction
Construction
Maintenance/Operations

Arts, Audio/Video Technology & Communications
Audio and Video Technology & Film
Printing Technology
Journalism & Broadcasting
Telecommunications
Performing Arts
Visual Arts

Human Services
Early Childhood Development & Services
Counseling & Mental Health Services
Family & Community Services
Personal Care Services
Consumer Services

Agriculture, Food & Natural Resources
Food Products & Processing Systems
Plant Systems
Animal Systems
Power, Structural & Technical Systems
Natural Resources Systems
Environmental Service Systems
Agribusiness Systems

Hospitality & Tourism
Restaurants & Food/Beverage Services
Lodging
Travel & Tourism
Recreation, Amusements & Attractions

Education & Training
Administration & Administrative Support
Professional Support Services
Teaching/Training

Health Science
Diagnostic Services
Support Services
Health Informatics
Therapeutic Services
Biotechnology Research & Development

① Essential Knowledge and Skills

② Health Sciences Technology

Business, Marketing and Computer Education

Technology and Engineering Education

Agricultural Education

Family and Consumer Sciences

Career Cluster Framework
① Essential Knowledge and Skills
② CTE Areas: Secondary (5)
③ Career Clusters (16)
④ Career Pathways (79)

June 8, 2009
http://www.careerclusters.org

Content and Context of Each Learning Cycle

Learning Cycle	Content	Context
Chapter 1	**Algebra I and Mathematics I**	
Chapter 1 Relationships Between Quantities *Come Fly With Me*	**Objectives** • Observe, collect, and record data in numerical and graphical forms. • Use conversions to solve problems. **Common Core Standards** QUANTITIES Reason quantitatively and use units to solve problems. N-Q-1, 2, 3	Rockford International Airport Rockford, IL Transportation
Chapter 1 Relationships Between Quantities *The Grass Is Always Greener*	**Objectives** • Analyze proportional relationships and percentages, and use them to solve real-world and mathematical problems • Use units, conversions, and unit rates to solve problems and make decisions • Determine the effects of changing parts of a whole **Common Core Standards** SEEING STRUCTURE IN EXPRESSIONS Interpret the structure of expressions. A-SSE 1a QUANTITIES Reason quantitatively and use units to solve problems. N-Q 1, 2	Elliot Golf Course, Rockford, IL Agriculture, Food, and Natural Resources
Chapter 1 Relationships Between Quantities *Functional Functions*	**Objectives** • Understand that a function is a rule that assigns to each input exactly one output **Common Core Standards** INTERPRETING FUNCTIONS Understand the concept of a function and use function notation F-IF 1	Woodward, Rockford, IL Manufacturing
Chapter 1 Relationships Between Quantities *Par for the Math Course*	**Objectives** • Use common area formulas to approximate the area of irregular shapes **Common Core Standards** QUANTITIES Reason quantitatively and use units to solve problems N-Q 1, 2, 3 GEOMETRY Apply geometric concepts in modeling situations G-MG 1	Elliot Golf Course, Rockford, IL Architecture and Construction

Learning Cycle	Content	Context
Chapter 1	**Algebra I and Mathematics I**	
Chapter 1 Relationships Between Quantities *Tips*	**Objectives** • Write expressions in equivalent forms to solve problems **Common Core Standards** SEEING STRUCTURE IN EXPRESSIONS Interpret the structure of expressions. A-SSE 1	Giovanni's Restaurant, Rockford, IL Agricultural, Food, and Natural Resources
Chapter 2	**Algebra I and Mathematics I**	
Chapter 2 Reasoning with Equations and Inequalities *Farming Revenue*	**Objectives** • Write equations from real-life situations. • Understand and explain verbally how to solve an equation. • Solve equations **Common Core Standards** CREATING EQUATIONS Create equations that describe numbers or relationships. A-CED 2	Boone County Farm Bureau/ Central Grain Company, Belvidere, IL Agriculture, Food, and Natural Resources
Chapter 2 Reasoning with Equations and Inequalities *Future of the Landfill*	**Objectives** • Understand how to calculate volume • Use ratios to predict quantities • Collect and organize data **Common Core Standards** REASONING WITH EQUATIONS AND INEQUALITIES Understand solving equations as a process of reasoning and explain the reasoning A-REI 1 Solve equations and inequalities in one variable A-REI 3 QUANTITIES Reason quantitatively and use unites to solve problems N-Q 1, 2	Rock River Environmental Services, Rockford, IL Architecture and Construction
Chapter 2 Reasoning with Equations and Inequalities *Life is a Highway*	**Objectives** • Write and solve inequalities **Common Core Standards** STATISTICS AND PROBABILITY Make inferences and justify conclusions from sample surveys, experiments, and observational studies S-IC 6 CREATING EQUATIONS Create a number of equations that describe numbers or relationships A-CED 1 REASONING WITH EQUATIONS AND INEQUALITIES Solve equations and inequalities in one variable A-REI 3	US Bank, Rockford, IL Finance

Learning Cycle	Content	Context
Chapter 2	**Algebra I and Mathematics I**	
Chapter 2 Reasoning with Equations and Inequalities *Open Campus?*	**Objectives** • Analyze a situation and determine constraints that affect the situation. • Set up and solve a system of linear inequalities. • Identify a set of solutions from a feasible region. **Common Core Standards** INTERPRETING FUNCTIONS Interpret functions that arise in applications in terms of the context. F-IF 4, 7 BUILDING FUNCTIONS Build a function that models a relationship between two quantities. F-BF 1 LINEAR, QUADRATIC, AND EXPONENTIAL MODELS Interpret expressions for functions in terms of the situation they model. F-LE 5 REASONING WITH EQUATIONS AND INEQUALITIES Represent and solve equations and inequalities graphically. A-REI 10, 12	Belvidere North High School Architecture
Chapter 2 Reasoning with Equations and Inequalities *Party Time*	**Objectives** • Determine a relationship. • Solve one step equations resulting from real world situations. • Determine independent and dependent variables **Common Core Standards** SEEING STRUCTURE IN EXPRESSIONS Interpret the structure of expressions. A-SSE 1 CREATING EQUATIONS Create equations that describe numbers or relationships. A-CED 1 INTERPRETING FUNCTIONS Analyze functions using different representations F-IF 7	Giovanni's Restaurant, Rockford, IL Finance
Chapter 3	**Algebra I and Mathematics I**	
Chapter 3 Linear and Exponential Relationships *Affordable on Any Budget*	**Objectives** • Interpret functions that arise in applications in terms of context • Construct and compare linear, quadratic and exponential models and solve problems • Interpret expressions for functions in terms of the situation they model **Common Core Standards** SEEING STRUCTURE IN EXPRESSIONS Interpret the structure of expressions A-SSE 1b	US Bank, Rockford, IL Finance

Learning Cycle	Content	Context
Chapter 3	**Algebra I and Mathematics I**	
Chapter 3 Linear and Exponential Relationships *Fuel Valve Metering Ports*	**Objectives** • Observe, collect, and record data in numerical and graphical forms. • Compare linear, quadratic, and exponential models of fuel valve openings. **Common Core Standards** FUNCTIONS Construct and compare linear, quadratic, and exponential models and solve problems F-LE 1a-c, 2, 3, 4	Woodward, Loves Park, IL Manufacturing
Chapter 3 Linear and Exponential Relationships *Eating The Trees*	**Objectives** • Observe, collect, and record data in numerical and graphical forms. • Use the principle of half-life to determine how long it will take for the emerald ash borer to eradicate all the ash trees in the Midwest. **Common Core Standards** LINEAR, QUADRATIC, AND EXPONENTIAL MODELS Interpret expressions for functions in terms of the situation they model. F-LE 5	Elliot Golf Course, Rockford, IL Agriculture, Food and Natural Resources
Chapter 3 Linear and Exponential Relationships *Spaghetti Bridge*	**Objectives** • Write an equation of a best fit line of a set of data • Use that equation to analyze the situation **Common Core Standards** CREATING EQUATIONS Create equations that describe numbers or relationships A-CED 2 Represent and solve equations and inequalities graphically A-REI 10 LINEAR, QUADRATIC, AND EXPONENTIAL MODELS Interpret functions that arise in applications in terms of the context F-IF 4, 5 Build a function that models a relationship between two quantities F-BF 1 Interpret expressions for functions in terms of the situation they model F-LE 5	McClure Engineering, Rockford, IL Architecture and Construction
Chapter 3 Linear and Exponential Relationships *Teen Driving Premiums*	**Objectives** • Understand the properties of functions: $f(x) \pm g(x) = (f \pm g)(x)$ • Solve problems using the addition and subtraction of functions **Common Core Standards** INTERPRETING FUNCTIONS	AW Anderson Agency Loves Park, IL Finance …continued on next page

Learning Cycle	Content	Context
Chapter 3	**Algebra I and Mathematics I**	*…continued*
Chapter 3 Linear and Exponential Relationships *Spaghetti Bridge*	Understand the concept of a function and use function notation F-IF 1, 2 Analyze functions using different representations F-IF 9 BUILDING FUNCTIONS Build a function that models a relationship between two quantities F-BF 1a-c	McClure Engineering, Rockford, IL Architecture and Construction
Chapter 4	**Algebra I and Mathematics I**	
Chapter 4 Descriptive Statistics *Teen Policy Costs*	**Objectives** • Understand the properties of functions • Add and subtract functions **Common Core Standards** CREATING EQUATIONS Create equations that describe numbers or relationships A-CED 1 LINEAR, QUADRATIC, AND EXPONENTIAL MODELS Understand the concept of a function and use function notation F- IF 1a-c, 2, 3	AW Anderson Agency Loves Park, IL Finance
Chapter 4 Descriptive Statistics *Parking Lot Math*	**Objectives** • Gather and record data • Understand how random samples can be applied to the population • Explore bivariate statistics • Display statistical data appropriately **Common Core Standards** INTERPRETING CATEGORICAL AND QUANTITATIVE DATA Summarize, represent, and interpret data on two categorical and quantitative variables. S-ID 5 Understand and evaluate random processes underlying statistical experiments. S-IC 1 Understand independence and conditional probability and use them to interpret data. S-CP 4	Belvidere North High School Belvidere, IL Manufacturing
Chapter 4 Descriptive Statistics *How Long Will You Wait?*	**Objectives** • Compute measures of central tendency and variance • Analyze data and make decisions based on measures of variance **Common Core Standards** INTERPRETING CATEGORICAL AND QUANTITATIVE DATA Summarize, represent, and interpret data on a single count or measurement. S-ID 2, 4	Giovanni's Restaurant, Rockford, IL Customer Service–Hospitality

Learning Cycle	Content	Context
Chapter 4	**Algebra I and Mathematics I**	
Chapter 4 Descriptive Statistics *Under New Management*	**Objectives** • Summarize, represent, and interpret data on two quantitative variables • Interpret linear models and use the model to make predictions • Interpret the meaning of weighted variables in an equation • Construct a line of best fit **Common Core Standards** INTERPRETING CATEGORICAL & QUANTITATIVE DATA Summarize, Represent, and interpret data on two categorical and quantitative variables. S-ID 6 Interpret linear models. S-ID 7 SEEING STRUCTURE IN EXPRESSIONS Interpret the structure of expressions. A-SSE 1a	Rockford Ice Hogs Rockford, IL Finance
Chapter 4 Descriptive Statistics *Gender Health*	**Objectives** • Create a frequency chart and histogram • Compare and contrast data • Analyze data and graphs • Use data in order to support an argument **Common Core Standards** INTERPRETING CATEGORICAL AND QUANTITATIVE DATA Summarize, represent, and interpret data on two categorical and quantitative variables. S-ID 5 Understand and evaluate random processes underlying statistical experiments. S-IC 1 Understand independence and conditional probability and use them to interpret data. S-CP 4	Rockford Memorial Hospital Rockford, IL Health Science
Chapter 5	**Algebra I only**	
Chapter 5 Expressions and Equations *Dino-Mite*	**Objectives** • Create and solve systems of equations • Understand the systems of equations using graphs and tables **Common Core Standards** REASONING WITH EQUATIONS AND INEQUALITIES Understand solving equations as a process of reasoning and explain the reasoning A-REI 6, 11	Burpee Museum, Rockford, IL Research and Development, Natural Sciences Pathway

Learning Cycle	Content	Context
Chapter 5	**Algebra I only**	
Chapter 5 Expressions and Equations *Medication Math*	**Objectives** • Identify independent and dependent variables in order to graph linear relationships • Create equations that describe numbers or relationships **Common Core Standards** QUANTITIES Reason quantitatively and use units to solve problems N-Q 2 CREATING EQUATIONS Create equations that describe numbers or relationships A-CED 1 INTERPRETING FUNCTIONS Analyze functions using different representations F-IF 7a-e	Rockford Memorial Hospital Rockford, IL Health Sciences
Chapter 5 Expressions and Equations *Bicycle Math*	**Objectives** • Collect information and write equations. • Rearrange formulas to give formulas new meanings. **Common Core Standards** CREATING EQUATIONS Create equations that describe numbers or relationships. A-CED 4	City of Loves Park Loves Park, IL Transportation
Chapter 5 Expressions and Equations *Ballroom Math*	**Objectives** • Use Algebra tiles to factor polynomials in the form $x^2 + bx + c$. **Common Core Standards** SEEING STRUCTURE IN EXPRESSIONS Write expressions in equivalent forms to solve problems. A-SSE-3a Perform arithmetic operations on polynomials. A-APR-1	Giovanni's Restaurant, Rockford, IL Architecture/Construction
Chapter 6	**Algebra I only**	
Chapter 6 Quadratic Functions and Modeling *Latitude Adjustment*	**Objectives** • Research weather data and create a scatter plot of data • Look at quadratic regression lines and examine the parts of the quadratic equation **Common Core Standards** CREATING EQUATIONS Create equations that describe numbers or relationships A-CED 1	Chicago Rockford International Airport Rockford, IL Transportation

Learning Cycle	Content	Context
Chapter 6	**Algebra I only**	
Chapter 6 Quadratic Functions and Modeling *Kick The Football*	**Objectives** • Interpret functions that arise in applications in terms of a context • Analyze functions using different representations • Build a function that models a relationship between two quantities **Common Core Standards** CREATING EQUATIONS Create equations that describe numbers or relationships A-CED 2,3, 4 INTERPRETING FUNCTIONS Interpret functions that arise in applications in terms of the context F-IF 4	Belvidere North High School Belvidere, IL Research and Development
Chapter 6 Quadratic Functions and Modeling *Plastic Money*	**Objectives** • Represent a set of data in a table, graph, and function form • Identify a non-linear equation by analyzing the data • Explore the different types of functions **Common Core Standards** LINEAR, QUADRATIC, AND EXPONENTIAL MODELS Construct and compare linear, quadratic, and exponential models and solve problems F-LE 1a-c, 2 Interpret expressions for functions in terms of the situation they model F-LE 5	US Bank, Rockford, IL Finance
Chapter 6 Quadratic Functions and Modeling *Waste Not*	**Objectives** • Given data, determine the difference between a linear and exponential function • Given data, write an equation for an exponential function **Common Core Standards** FUNCTIONS Build a function that models a relationship between two quantities. F-BF 1a-c, 2	Rock River Environmental Services, Rockford, IL Architecture and Construction
Chapter 6 Quadratic Functions and Modeling *Students vs. Zombies*	**Objectives** • Construct exponential models using different bases. • Interpret expressions for functions in terms of situations they model. **Common Core Standards** BUILDING FUNCTIONS Build a function that models a relationship between two quantities. F-BF 1a-c, 2	Rockford Memorial Hospital Rockford, IL Health Science

Learning Cycle	Content	Context
Chapter 7	**Mathematics I only**	
Chapter 7 Congruence, Proof, and Constructions *Let's Ship Something Together*	**Objectives** • Experiment with transformations in the plane • Understand congruence in terms of rigid motions **Common Core Standards** CONGRUENCE Experiment with transformations in the plane G-CO 5 Understand congruence in terms of rigid motions G-CO 6	Lowes Distribution Center Rockford, IL Transportation, Distribution and Logistics
Chapter 7 Congruence, Proof, and Constructions *Fly Me Away*	**Objectives** • Connecting algebra and geometry through coordinates • Use coordinates to prove simple geometric theorems algebraically **Common Core Standards** CONGRUENCE Experiment with transformations in the plane. G-CO 5	Rockford International Airport Rockford, IL Transportation
Chapter 7 Congruence, Proof, and Constructions *How Aligned Is Your Spine?*	**Objectives** • Construct parallel and perpendicular lines. **Common Core Standards** CONGRUENCE Make geometric constructions. G-CO 12	Hulsebus Chiropractic Rockford, IL Health Science
Chapter 7 Congruence, Proof, and Constructions *Custom Hot Rod Shop*	**Objectives** • Form a deductive argument	Hopperstad Customs, Belvidere, IL Transportation
Chapter 7 Congruence, Proof, and Constructions *Taxi! Taxi!*	**Objectives** • Constructing convincing arguments • Forming hypothesis • Generalizing patterns	City of Rockford Engineering Department, Rockford, IL Transportation

Learning Cycle	Content	Context
Chapter 8	**Mathematics I only**	
Chapter 8 Connecting Algebra and Geometry *CAD/CAM Project*	**Objectives** • Locate points on a coordinate plane and write them as ordered pairs **Common Core Standards** FUNCTIONS Define, evaluate, and compare functions. 8.F 1 CONGRUENCE Experiment with transformations in the plane G-CO2	Elite Tool and Wire Rockford, IL Manufacturing
Chapter 8 Connecting Algebra and Geometry *Are You Square?*	**Objectives** • Use the Pythagorean Theorem to model real world problems. **Common Core Standards** QUANTITIES Reason quantitatively and use units to solve problems. N-Q 1, 3 SIMILARITY, RIGHT TRIANGLES, AND TRIGONOMETRY Define trigonometric ratios and solve problems involving right triangles. G-SRT 8 GEOMETRY Understand and apply the Pythagorean Theorem. 8.G.7	McClure Engineering Rockford, IL Architecture & Construction
Chapter 8 Connecting Algebra and Geometry *Piles of Tiles*	**Objectives** • Use measurements to calculate surface area • Apply concept of surface area to real-life situation **Common Core Standards** QUANTITIES Reason quantitatively and use units to solve problems. N-Q 3	Belvidere North High School Belvidere, IL Architecture and Construction
Chapter 8 Connecting Algebra and Geometry *Elbow Room*	**Objectives** • Find arc length • Find the area of a sector • Find the area of geometric shapes **Common Core Standards** QUANTITIES Reason quantitatively and use units to solve problems. N-Q 1, 2, 3 MODELING WITH GEOMETRY Apply geometric concepts in modeling situations G-MG 2 Find arc lengths and areas of sectors of circles. G-C 5	Giovanni's Restaurant, Rockford, IL Architecture and Construction Agriculture, Food, and Natural Resources

Algebra I & Mathematics I

Real Numbers

Pathways to Common Core Mathematics

Teacher Edition

Real Numbers in Real Situations

CENTER FOR MATHEMATICS, SCIENCE, AND TECHNOLOGY
Illinois State University

ILLINOIS STATE UNIVERSITY
18 57
Gladly we learn and teach

STEM
science, technology, engineering, mathematics

S T E M

Science Technology Engineering Mathematics

Real Numbers

Printed in the United States of America.

COMMON CORE Standards

QUANTITIES
Reason quantitatively and use units to solve problems.
N-Q 1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
N-Q 2 Define appropriate quantities for the purpose of descriptive modeling.
N-Q 3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Standards for Math Practice

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 structures.
8. Look for and express regularity in repeated reasoning.

Relationships Between Quantities

Come Fly with Me!

Teacher Edition

Illinois Pathway: Transportation

Objectives

- **Observe, collect, and record data in numerical and graphical forms.**
- **Use conversions to solve problems.**

Introduction

Pilots need to know whether they are going to make it to their destination without having to refuel. There are many factors that can determine what type of plane they will fly. *Show the following video clip to get the students interested in the topic and the various single-engine planes that are available. **http://www.youtube.com/watch?v=B1wj5W-CdqU***

TRY IT

1 Research four different types of four-seater single engine airplanes and collect data on the following: speed in knots, maximum range in nautical miles, and usable fuel. Fill in table below. (knot = nautical miles/hr)

One website that is a good source for the needed data is:

http://planes.findthebest.com/d/c/Propeller-Plane

knot = nautical miles/hr

2 Calculate the gal/hr of each airplane by using the data you collected on speed, max range and usable fuel. (Use the knowledge that knots are nm/hr, max range is nautical miles and usable fuel is gallons.)

Plane Type	Speed (knots)	Max Range	Usable Fuel	Gallons/hr

3 Create a graphical representation below using the plane type and gal/hr.

Graphs will vary.

DISCUSS IT

1 When comparing the planes in your bar graph, which plane was the most economical to fly? Least economical?
Answers will vary.

2 Which plane would you choose to fly? Why or why not?
Answers will vary.

TRY IT

1 Make a graphical representation to represent the four planes' gal/hr and speed.
Graphs will vary.

2 Which is the dependent and independent variable? Does it matter?
Independent: speed, Dependent: gal/hr

DISCUSS IT

1 Did you find any relationship between gal/hr and speed? If so, what kind?
A negative relationship

2 Do you notice a trend?
As speed increases, gal/hr decreases

3   Based on your graph, estimate the speed of an airplane if you only want to use 22 gal/hr.

Answers will vary.

TRY IT

3

1 Choose one of your airplanes from your table above.

2 Place a point on the y-axis to indicate the airspeed.

Groundspeed is how fast the plane is actually moving if you tracked it with a radar gun from the ground. Airspeed is the speed that the airspeed indicator says on the plane. Airspeed and groundspeed are the same if there is no wind.

3 Zero on the x-axis means no wind. The positive x represents a tailwind (*wind blowing same direction you are flying*) and a negative x is a headwind (*wind blowing the opposite direction you are flying*).

4 Plot your groundspeed (*the speed over the ground either adding or subtracting the wind*) at various head or tail wind speeds. Use increments of 10.
Insert your coordinate graph below.

Graphs will vary.

DISCUSS IT

3

1 What does the slope of the line tell you?

The change in the groundspeed.

2 At what point does your plane fly backwards? Explain.

When -x > y

APPLY IT

1   Get a sectional map from your teacher. Using the given scale on the map, determine the distance between two airports.
Answers will vary.

2   Choose one of your airplanes from the **Try It 1** section to fly from one airport to the other using the given sectional map. Using the information for that airplane, find how many hours it will take to travel and how much fuel will be used for the trip.
Answers will vary.

3   Your teacher will give you a website that pilots use to determine wind speed and direction at various altitudes.

http://aviationweather.gov/products/nws/chicago

   a   The first column is a list of airport codes. Find your origin and your destination.
      Answers will vary.

   b   The columns labeled 3000, 6000, 9000, etc. are the altitudes. You cannot fly over 12500 ft. without oxygen.

   c   The first two numbers represent the direction the wind is coming from. For this example we are not going to worry about wind direction.

   d   The next two numbers are the wind speed in knots. Average the wind speed for your origin and your destination airports.

   e   The final two digits indicate the temperature in Celsius.

4   Using your average wind speed as a head wind, calculate how this affects your time and fuel consumption.
Answers will vary.

5   Use your average wind speed as a tail wind. Calculate how this affects your time and fuel consumption.
Answers will vary.

6   What was your reasoning for choosing your airplane? Justify your choice quantitatively.
Answers will vary.

Come Fly with Me!

EXPAND IT

1   Research one jet that gives the usable fuel in pounds/hr. List the jet you chose and how much usable fuel it can hold.
Answers will vary.

2   Determine the pounds/hr and convert it to gallons/hr.
Answers will vary.

3   If you were given the same amount of gallons of gasoline for your automobile, how many miles could you drive on the same amount that was used for the jet?
Answers will vary.

4   How many times could you travel back and forth between the same airports in your automobile?
Answers will vary.