Unit 2: Proportionality and Linear Relationships

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Title Section

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

Math Pre-Algebra, GRADE 7

Proportionality and Linear Relationships

Belleville Board of Education

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Unit Overview

Unit 2: Students will analyze proportional relationships and use them to solve real-world mathematical problems.

From this unit students will be able to use proportional relationships to solve problems that model and represent situations, and understand the connections between relationships of data, lines, and linear equations. Students will use and create graphs to determine linear relationships. Students will use formulas to determine missing values. Students will learn to use proportional reasoning through the applications in familiar, real-world situations involving ratios, proportions and percents where they will write and solve problems. Students will model the use of scale drawings by measuring a creating scale drawing from real world situations involving direct and indirect measurement. Students will explore consumer applications using price increase/decrease, sales, tax tips, discounts, interest, commissions and unit rates.

Enduring Understanding

Upon completion of this section, students will understand .....

that fractions, decimals, and percents can be used to represent equivalent forms of the same value.

that unit rates allow comparisons between ratios of like and different units.

that proportional relationships represent how quantities relate to each other.

scale drawings are used to represent objects that are too big or too small to be drawn actual size.

proportional relationships can be used to solve percent problems.

the difference between percent increase and decrease.

simple and compound interest.

expressions can be used to reason about and represent situations.

variables can have different meanings depending on the context of the problems.

variables can be used to write expressions for values that are unknown.

why you would rewrite an expression in terms of the context of the situation.

how to write algebraic equations and inequalities.

the connection between equalities and inequalities.

some real -word problems can have a range of solutions(inequalities).

tables and graphs can be used to represent, analyze, and solve real-world problems related to linear equations.

if a set of ordered pairs is or is not a function

the constant of proportionality

that negative exponents are not negative number values

Essential Questions

On completion of this unit students will be able to understand;

How can ratios and proportions be used to solve real-world problem?

How can we draw or model real world objects?

How can you use proportional relationships to solve real-world percent problems?

What is the difference between percent increase and percent decrease?

What does it mean to evaluate algebraic expressions ?

How can you rewrite expressions to help you solve problems?

How does the solution to an equation differ from the solution to an inequality?

What type of real life situations can be represented by a linear equation?

How are equations and inequalities used to model and solve real-world problems?

How are linear functions used to model proportional relationships?

What are some ways in which functions and relations can be represented?

How are linear functions used to model proportional relationships?

How do you graph a linear function using a table?

How can equations, graphs, word descriptions, and tables describe a function?

How can you use a graph to show the relationship between two variables that vary directly?

What is the constant of proportionality?

Exit Skills

Upon completion of this section, students will be able to;

Express ratios as fractions in simplest form.

Find and compare unit rates.

Convert rates between units of measurements.

Use an equation to describe proportional relationships.

Identify and analyze proportional relationships.

Solve proportions.

Solve problems involving scale drawings and similar figures.

Write and solve percent problems.

Find percent increase and decrease.

Find markup price and discounted price.

Find simple and compound interest.

Use the distributive property.

Simplify algebraic expressions.

Add and subtract linear expressions.

Model real world problems with linear expressions.

Solve equation using Multiplication & Addition Properties.

Solve two step equations.

Solve problems in form $p(x+q)=r$.

Solve equations with variables on both sides.

Model real world problems with equations and solve them.

Write inequalities and graph on number line.

Use Addition and Subtraction Properties of Inequality to solve inequalities.

Solve Inequalities by multiplying or dividing

Solve multi-step equations and inequalities.

Model real world problems with inequalities and solve them.

Determine whether a relation is a function.

Write a function in function notation.

Solve linear functions in two variables.

Graph linear functions using ordered pairs.

Identify direct variation.

Find a constant of proportionality for a linear relationship.

New Jersey Student Learning Standards (NJSLS)

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.7.RP.A	Analyze proportional relationships and use them to solve real-world and mathematical problems.
MA.7.RP.A.1	Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.7.RP.A.2	Recognize and represent proportional relationships between quantities.
MA.7.RP.A.2a	Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.
MA.K-12.4	Model with mathematics.
MA.7.RP.A.2b	Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.
MA.7.RP.A.2c	Represent proportional relationships by equations.
MA.K-12.5	Use appropriate tools strategically.
MA.7.RP.A.2d	Explain what a point (x, y) on the graph of a proportional relationship means in terms of

	the situation, with special attention to the points (0, 0) and (1, r) where r is the unit rate.
MA.7.RP.A.3	Use proportional relationships to solve multistep ratio and percent problems.
MA.K-12.7	Look for and make use of structure.
MA.8.EE.C	Analyze and solve linear equations and pairs of simultaneous linear equations.
MA.8.EE.C.7	Solve linear equations in one variable.
MA.7.NS.A.2	Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers.
MA.7.NS.A.2c	Apply properties of operations as strategies to multiply and divide rational numbers.
MA.7.NS.A.3	Solve real-world and mathematical problems involving the four operations with rational numbers.
MA.7.EE	Expressions and Equations
MA.7.EE.A.1	Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.
MA.7.EE.A.2	Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related.
MA.7.EE.B	Solve real-life and mathematical problems using numerical and algebraic expressions and equations.
MA.7.EE.B.3	Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.
MA.7.EE.B.4	Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.
MA.7.EE.B.4a	Solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach.
MA.7.EE.B.4b	Solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem.

Interdisciplinary Connections

STEM/STEAM

Business

Economics

Statistics

Science

LA.RL.7.4	Determine the meaning of words and phrases as they are used in a text, including figurative and connotative meanings; analyze the impact of rhymes and other repetitions of sounds (e.g., alliteration) on a specific verse or stanza of a poem or section of a story or drama.
LA.W.7.1	Write arguments to support claims with clear reasons and relevant evidence.
LA.SL.7.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.
LA.L.7.1	Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
LA.L.7.2.B	Spell correctly.
LA.L.7.6	Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.

Learning Objectives

The student will be able to .....

Compute unit rates associated with ratios of fractions, lengths, and other quantities measured in like or different units

Recognize proportional and non proportional relationships and represent proportional relationships between quantities.

Compare two different proportional relationships.

Graph proportional relationships, interpreting the constant of proportionality.

Solve problems involving scale drawings of geometric figures.

Estimate percents.

Use proportional relationships and percent equation to solve percent problems.

Solve problems involving percent of change

Compute a discount or markup and the resulting sale price after a discount or markup.

Compute simple and compound interest.

Simplify algebraic expressions using Distributive Property and concept of like terms

Add and subtract linear expressions.

Solve linear equations and inequalities in one variable and be able to justify each step in the process and the solution.

Write linear equations and inequalities in one variable and use them to solve problems.

Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

Determine whether a relation is a function.

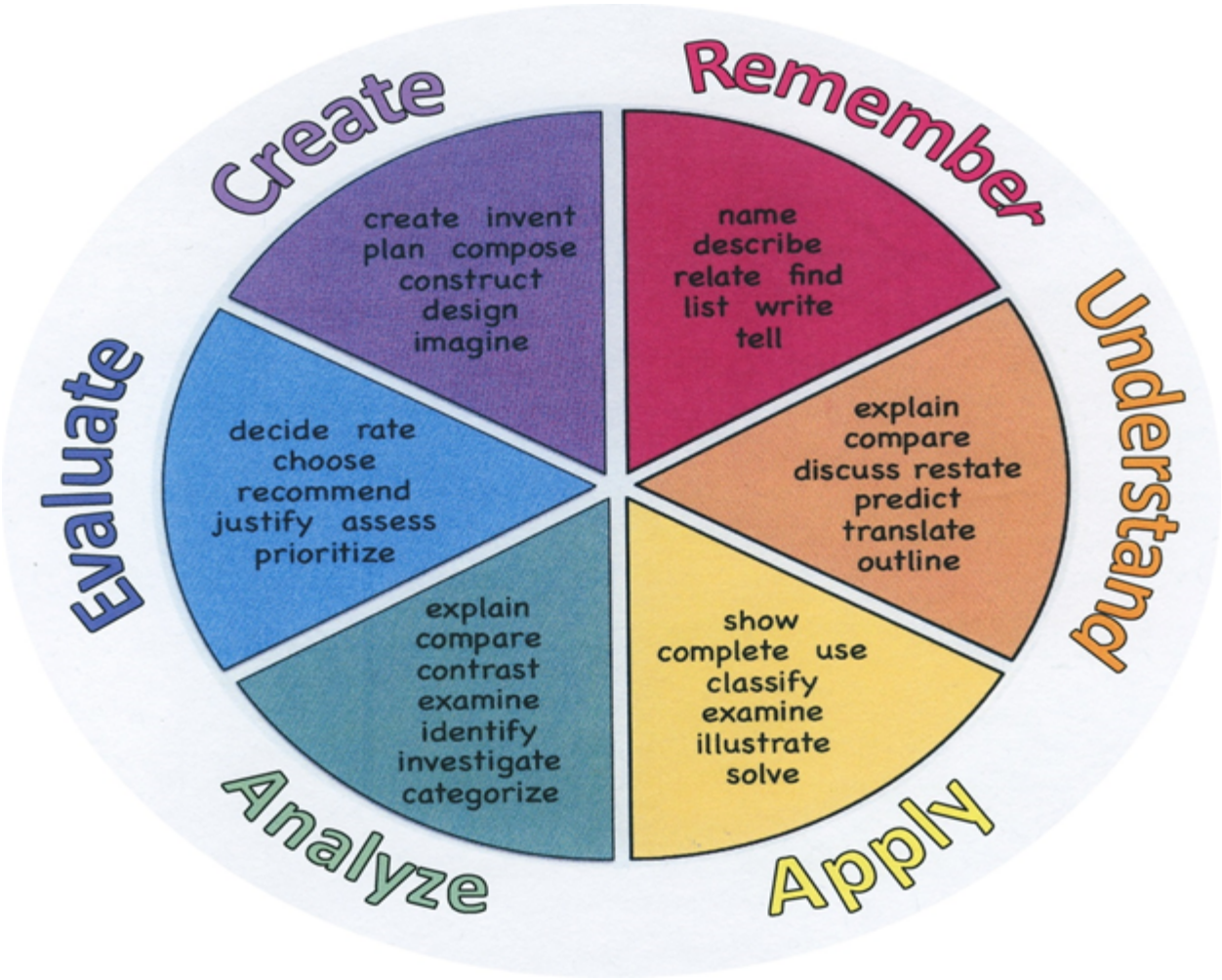
Represent a linear relationship using a table of values.

Graph a linear equation by using 2 or more points.

Solve problems using direct variation and determine the constant of proportionality

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Remember	Understand	Apply	Analyze	Evaluate	Create
Choose	Classify	Choose	Categorize	Appraise	Combine
Describe	Defend	Dramatize	Classify	Judge	Compose
Define	Demonstrate	Explain	Compare	Criticize	Construct
Label	Distinguish	Generalize	Differentiate	Defend	Design
List	Explain	Judge	Distinguish	Compare	Develop
Locate	Express	Organize	Identify	Assess	Formulate
Match	Extend	Paint	Infer	Conclude	Hypothesize
Memorize	Give Examples	Prepare	Point out	Contrast	Invent
Name	Illustrate	Produce	Select	Critique	Make
Omit	Indicate	Select	Subdivide	Determine	Originate
Recite	Interrelate	Show	Survey	Grade	Organize
Select	Interpret	Sketch	Arrange	Justify	Plan
State	Infer	Solve	Breakdown	Measure	Produce
Count	Match	Use	Combine	Rank	Role Play
Draw	Paraphrase	Add	Detect	Rate	Drive
Outline	Represent	Calculate	Diagram	Support	Devise
Point	Restate	Change	Discriminate	Test	Generate
Quote	Rewrite	Classify	Illustrate		Integrate
Recall	Select	Complete	Outline		Prescribe
Recognize	Show	Compute	Point out		Propose
Repeat	Summarize	Discover	Separate		Reconstruct
Reproduce	Tell	Divide			Revise
	Translate	Examine			Rewrite
	Associate	Graph			Transform
	Compute	Interpolate			
	Convert	Manipulate			
	Discuss	Modify			
	Estimate	Operate			
	Extrapolate	Subtract			
	Generalize				
	Predict				



Suggested Activities & Best Practices

Activity#1: Students research a situation that represents a constant of proportionality and create a graph and poster to demonstrate.

Activity #2: Students create their own restaurant menu. Then create three "bills" of at least 5 items and must determine the amount of sales tax for each.

Activity #3: "The Bank of Me" Students create their own fictitious bank and demonstrate the interest earned for three different accounts with different times and interest rates displayed in a poster.

Textbook, eAssessment, supplemental materials:

https://my.mheducation.com/login

Inquiry Labs textbook - p. 230, 248, 268, 286, 297, 314, 330,344,353403,418

AI Assessment and Learning System:

https://www.aleks.com/

Learner-Centererd Classroom lessons:

https://betterlesson.com/common_core

Video Math Lessons:

https://www.virtualnerd.com/

Mindset:

https://www.youtube.com/watch?v=3icoSeGqQtY

http://www.youcubed.org/wp-content/uploads/Positive-Classroom-Norms2.pdf

Math Discourse:

https://mrorr-isageek.com/start-a-math-fight/

Teaching Strategies for Improving Algebra Knowledge in Middle and High School Students:

https://ies.ed.gov/ncee/wwc/PracticeGuide/20

Coaching Corner:

https://sites.google.com/belleville.k12.nj.us/thecoachingcorner/home

Algebra Tools - Functions:(Refer to problems included in the pre-requisite skills in this document)

https://www.state.nj.us/education/aps/cccs/math/NJISTFunctions.pdf

Algebra Tools - Algebra:(Refer to problems included in the pre-requisite skills in this document)

https://www.state.nj.us/education/aps/cccs/math/NJISTAlgebra.pdf

Misc Mathematics materials:

http://www.mathnstuff.com/

Order of Operations Kahoot:

https://create.kahoot.it/details/order-of-operations/e38e26d8-ee8a-484b-83b9-c22f78f32a61

Scientific Notation Kahoot:

https://create.kahoot.it/details/scientific-notation/4a841be2-d3e0-46ec-b724-09b8921c434a

Constant of proportionality:

https://www.maneuveringthemiddle.com/how-to-teach-proportional-relationships/

Assessment Evidence - Checking for Understanding (CFU)

Activity #1: Entrance Ticket: Student receive 2 cards; one a random multi-step equation to solve and the other a solution to another problem. After solving their equation they must find the student who has the corresponding answer card to their problem, and the student who has the equation that matches up to their second solution card.-formative assessment

Activity #2 : Exit ticket: List the formula for simple or compound interest. Each student pulls out from a stack an interest amount and a time. Students must solve the formula using that information.-formative assessment

Unit tests-summative assessment

Web-based assessment-alternate assessment

Students research a situation that represents a constant of proportionality and create a graph and poster to demonstrate.-benchmark assessment

- Admit Tickets
- Anticipation Guide
- Common Benchmarks
- Compare & Contrast
- Create a Multimedia Poster
- Define
- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer
- Illustration
- Journals
- KWL Chart
- Learning Center Activities
- Multimedia Reports
- Outline

- Question Stems
- Quickwrite
- Quizzes
- Red Light, Green Light
- Self- assessments
- Study Guide
- Surveys
- Teacher Observation Checklist
- Think, Write, Pair, Share
- Top 10 List
- Unit review/Test prep
- Unit tests
- Web-Based Assessments
- Written Reports

Primary Resources & Materials

Math Accelerated-A Pre-Algebra Program 2017 - McGraw-Hill

Math Accelerated-A Pre-Algebra Program 2017 - Digital Resources - McGraw-Hill

Ancillary Resources

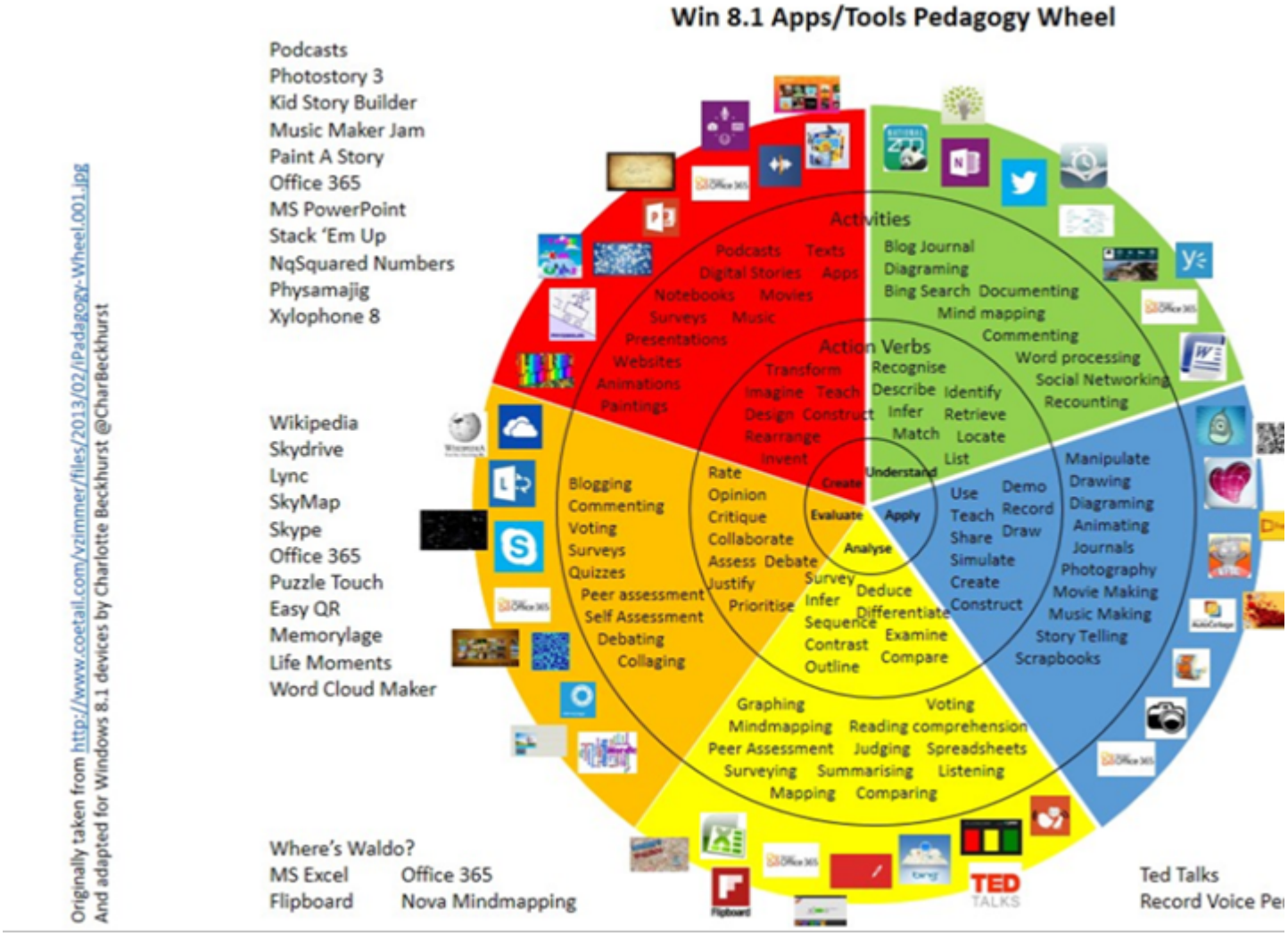
Glencoe McGraw-Hill Algebra 1 2014

Technology Infusion

Activity: Student use the Internet to research prices of their favorite grocery products. Student then determine the unit rates of the products, and create a poster to demonstrate the concept.

- Calculator/Graphing calculator
- Google Classroom
- McGraw-Hill Education
- Desmos.com
- geogebra.org
- Youtube
- Khan academy
- MS Excel

- Office 365
- MS Word
- PodCasts
- MS Powerpoint
- Wikipedia
- Skype
- Twitter
- Ted Talks
- Flipgrid



Alignment to 21st Century Skills & Technology

- STEM/STEAM
- English, Language Arts
- World languages
- Arts
- Statistics
- Economics

- Science
- Geography
- Social Studies
- Computer Science

CRP.K-12.CRP1.1	Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.
CRP.K-12.CRP2.1	Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.
CRP.K-12.CRP3.1	Career-ready individuals understand the relationship between personal health, workplace performance and personal well-being; they act on that understanding to regularly practice healthy diet, exercise and mental health activities. Career-ready individuals also take regular action to contribute to their personal financial well-being, understanding that personal financial security provides the peace of mind required to contribute more fully to their own career success.
CRP.K-12.CRP4.1	Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.
CRP.K-12.CRP5.1	Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organization, and the environment. They are aware of and utilize new technologies, understandings, procedures, materials, and regulations affecting the nature of their work as it relates to the impact on the social condition, the environment and the profitability of the organization.
CRP.K-12.CRP6.1	Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.
CRP.K-12.CRP7.1	Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies. They use reliable research process to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices in their workplace situation.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.

CAEP.9.2.8.B.1	Research careers within the 16 Career Clusters ® and determine attributes of career success.
CAEP.9.2.8.B.3	Evaluate communication, collaboration, and leadership skills that can be developed through school, home, work, and extracurricular activities for use in a career.
CAEP.9.2.8.B.6	Demonstrate understanding of the necessary preparation and legal requirements to enter the workforce.
TECH.8.1.8.A.1	Demonstrate knowledge of a real world problem using digital tools.
TECH.8.1.8.A.3	Use and/or develop a simulation that provides an environment to solve a real world problem or theory.
TECH.8.1.8.A.4	Graph and calculate data within a spreadsheet and present a summary of the results.
TECH.8.1.8.A.CS1	Understand and use technology systems.
TECH.8.1.8.A.CS2	Select and use applications effectively and productively.
TECH.8.1.8.B.CS1	Apply existing knowledge to generate new ideas, products, or processes.
TECH.8.1.8.B.CS2	Create original works as a means of personal or group expression.

21st Century Skills/Interdisciplinary Themes

- STEM/STEAM
- English, Language Arts
- World languages
- Arts
- Statistics
- Economics
- Science
- Geography
- Social Studies
- Computer Science

21st Century Skills

STEM/STEAM

Global and Environmental Awareness

Problem Solving Skills

Personal Literacy

Business

Differentiation

Activity #1: Scale Drawings: Students use a simple object with pre-drawn grids to enlarge with scale factors of whole numbers.

Differentiations available as per the particular needs of individual students as per teacher assessment:

Differentiations:

- Small group instruction
- Small group assignments
- Extra time to complete assignments
- Pairing oral instruction with visuals
- Repeat directions
- Use manipulatives
- Center-based instruction
- Token economy
- Study guides
- Teacher reads assessments allowed
- Scheduled breaks
- Rephrase written directions
- Multisensory approaches
- Additional time
- Preview vocabulary
- Preview content & concepts
- Story guides
- Behavior management plan
- Highlight text
- Student(s) work with assigned partner
- Visual presentation
- Assistive technology
- Auditory presentations
- Large print edition
- Dictation to scribe
- Small group setting

Hi-Prep Differentiations:

- Alternative formative and summative assessments
- Choice boards
- Games and tournaments
- Group investigations
- Guided Reading
- Independent research and projects
- Interest groups
- Learning contracts
- Leveled rubrics
- Literature circles
- Multiple intelligence options
- Multiple texts
- Personal agendas
- Project-based learning
- Problem-based learning
- Stations/centers
- Think-Tac-Toes
- Tiered activities/assignments
- Tiered products
- Varying organizers for instructions

Lo-Prep Differentiations

- Choice of books or activities
- Cubing activities
- Exploration by interest
- Flexible grouping
- Goal setting with students
- Jigsaw
- Mini workshops to re-teach or extend skills
- Open-ended activities
- Think-Pair-Share
- Reading buddies
- Varied journal prompts
- Varied supplemental materials

Special Education Learning (IEP's & 504's)

Activity #1: Modify problems for interest rates, student use only whole number values for interest rate and length of time.

Activity #2: Create a step-by-step foldable study guide for working with expressions and equations

Options available as per the particular needs of individual students as per teacher assessment:

- printed copy of board work/notes provided
- additional time for skill mastery
- assistive technology
- behavior management plan
- Center-Based Instruction
- check work frequently for understanding
- computer or electronic device utilizes
- extended time on tests/ quizzes
- have student repeat directions to check for understanding
- highlighted text visual presentation
- modified assignment format
- modified test content
- modified test format
- modified test length
- multi-sensory presentation
- multiple test sessions
- preferential seating
- preview of content, concepts, and vocabulary
- Provide modifications as dictated in the student's IEP/504 plan
- reduced/shortened reading assignments
- Reduced/shortened written assignments
- secure attention before giving instruction/directions
- shortened assignments
- student working with an assigned partner
- teacher initiated weekly assignment sheet
- Use open book, study guides, test prototypes

English Language Learning (ELL)

Activity: Students create an illustrated study guide for solving expressions and equations.

Possible options available as per the particular needs of individual students as per teacher assessment:

- teaching key aspects of a topic. Eliminate nonessential information
- using videos, illustrations, pictures, and drawings to explain or clarif
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning;
- allowing students to correct errors (looking for understanding)
- allowing the use of note cards or open-book during testing
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using computer word processing spell check and grammar check features
- using true/false, matching, or fill in the blank tests in lieu of essay tests

At Risk

Activity: Students choose a high ticket item they would like to purchase for themselves and research the current price on the internet. Using the interest formula, determine how long it would take them to reasonable save up for that item.

- allowing students to correct errors (looking for understanding)
- teaching key aspects of a topic. Eliminate nonessential information
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning
- allowing students to select from given choices
- allowing the use of note cards or open-book during testing
- collaborating (general education teacher and specialist) to modify vocabulary, omit or modify items to reflect objectives for the student, eliminate sections of the test, and determine how the grade will be determined prior to giving the test.
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- marking students' correct and acceptable work, not the mistakes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using authentic assessments with real-life problem-solving
- using true/false, matching, or fill in the blank tests in lieu of essay tests

- using videos, illustrations, pictures, and drawings to explain or clarify

Talented and Gifted Learning (T&G)

Activity#1: Students research the price of a car they would like to purchase. Student research 3 current bank advertisements from the interest rates and time lengths on car loans and determine which one would be the least expensive option.

Activity #2: Candy Wrapper scale drawings- students bring in a candy wrapper, and draw a grid on it. Students determine what scale the want to use and re-draw the image on a new grid using the scale factor.

Possible options available as per the particular needs of individual students as per teacher assessment:

- Above grade level placement option for qualified students
- Advanced problem-solving
- Allow students to work at a faster pace
- Cluster grouping
- Complete activities aligned with above grade level text using Benchmark results
- Create a blog or social media page about their unit
- Create a plan to solve an issue presented in the class or in a text
- Debate issues with research to support arguments
- Flexible skill grouping within a class or across grade level for rigor
- Higher order, critical & creative thinking skills, and discovery
- Multi-disciplinary unit and/or project
- Teacher-selected instructional strategies that are focused to provide challenge, engagement, and growth opportunities
- Utilize exploratory connections to higher-grade concepts
- Utilize project-based learning for greater depth of knowledge

Sample Lesson

Using the template below, please develop a **Sample Lesson** for the first unit only.

Unit Name:

NJSLS:

Interdisciplinary Connection:

Statement of Objective:

Anticipatory Set/Do Now:

Learning Activity:

Student Assessment/CFU's:

Materials:

21st Century Themes and Skills:

Differentiation/Modifications:

Integration of Technology: