Unit 5 Functions

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Course(s): **Algebra 1**
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Algebra 1

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

Algebra 1, Grade 8

Unit 5: Functions

Belleville Board of Education

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Unit Overview

- This unit is about representing relations in different ways, recognizing and graphing linear functions, quadratic functions, exponential functions, absolute value functions, piecewise functions, finding the inverse of a relation and a linear function.
- The students should learn how to represent relations as sets of ordered pairs, tables, mappings, and graphs; recognize and graph linear functions, quadratic functions, exponential functions, absolute value functions, piecewise functions; find the inverse of a relation and a linear function.

Enduring Understanding

- Interpret and represent system of equations/inequalities to model real-world situation.
- Select a solution from a variety of ways and explain the solution based on this model.
- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Attend to precision.
- Look for and make use of structure.

- Look for and express regularity in repeated reasoning.

Essential Questions

- How can you represent and describe functions?
- What are discrete and continuous functions?
- How can functions describe real-world situations?
- What do different representations of functions (words, tables,ordered pairs, and graphs) tell us about the relationships?
- What are the characteristics of exponential,quadratic, absolute value functions?
- How do you write,graph, and interpret an exponential decay and exponential growth function?
- What are the characteristics of real-life relationships that can be modeled with exponential functions?

Exit Skills

By the end of Unit 5 Students Should be able to:

- Represent relations in graphs, mappings, and tables.
- Find the domain, range, and inverse of a relation.
- Determine whether a relation is a function.
- Compare and contrast discrete and continuous functions.
- Interpret graphs of functions.

- Graph linear equations.
- Find function values and use function notation.
- Graph equations that represent functions.
- Find the intercepts and zeros of linear equations.
- Write equations that represent functions.
- Identify and represent patterns that describe linear functions.
- Identify and represent patterns that describe nonlinear functions.
- Evaluate and graph exponential functions.
- Solve problems involving exponential growth and decay using technology.
- To analyze the characteristics of graphs of quadratic functions.
- Graph quadratic functions of the form y = ax2 + bx + c.
- Identify and graph special functions(absolute value, step, piecewise-linear).
- Focus on linear, quadratic, and exponential functions, including sequences, and also explore absolute value, step, and piecewise-defined functions.
- Interpret functions given graphically, numerically, symbolically, and verbally.
- Translate between representations.
- Understand the limitations of various representations. Students build on and extend their understanding of integer exponents to consider exponential functions.
- Perform transformations of functions.
- Find the inverse of a relation and linear function.
- Find inverses of real-world functions.
- Model with functions.

New Jersey Student Learning Standards (NJSLS)

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.F-IF.A.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. 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 $y = f(x)$.
MA.K-12.2	Reason abstractly and quantitatively.
MA.N-RN.A.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.
MA.F-IF.A.2	Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.F-IF.A.3	Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
MA.N-RN.A.2	Rewrite expressions involving radicals and rational exponents using the properties of exponents.

MA.A-SSE.A.2	Use the structure of an expression to identify ways to rewrite it. 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 $(x^2 - y^2)(x^2 + y^2)$.
MA.K-12.4	Model with mathematics.
MA.F-IF.B.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.
MA.K-12.5	Use appropriate tools strategically.
MA.S-ID.B.6a	Fit a function to the data (including with the use of technology); use functions fitted to data to solve problems in the context of the data.
MA.K-12.6	Attend to precision.
MA.A-SSE.B.3b	Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
MA.F-IF.B.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.
MA.S-ID.B.6c	Fit a linear function for a scatter plot that suggests a linear association.
MA.K-12.7	Look for and make use of structure.
MA.S-ID.C.7	Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
MA.F-IF.C.7a	Graph linear and quadratic functions and show intercepts, maxima, and minima.
MA.F-IF.C.7b	Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
MA.F-IF.C.7e	Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
MA.F-IF.C.8a	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.
MA.F-IF.C.8b	Use the properties of exponents to interpret expressions for exponential functions.
MA.F-BF.A.2	Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.
MA.F-BF.B.3	Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, 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.
MA.A-REI.B.4a	Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.
MA.F-LE.A.1	Distinguish between situations that can be modeled with linear functions and with exponential functions.
MA.A-REI.B.4b	Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.
MA.F-LE.A.1a	Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
MA.F-LE.A.1b	Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

MA.F-LE.A.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).
MA.A-REI.D.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).

Interdisciplinary Connections

Economics, Business, Finance, Literacy, and Science

LA.SL.8.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
LA.SL.8.1.B	Follow rules for collegial discussions and decision-making, track progress toward specific goals and deadlines, and define individual roles as needed.
LA.SL.8.1.C	Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas.
LA.SL.8.1.D	Acknowledge new information expressed by others, and, when warranted, qualify or justify their own views in light of the evidence presented.

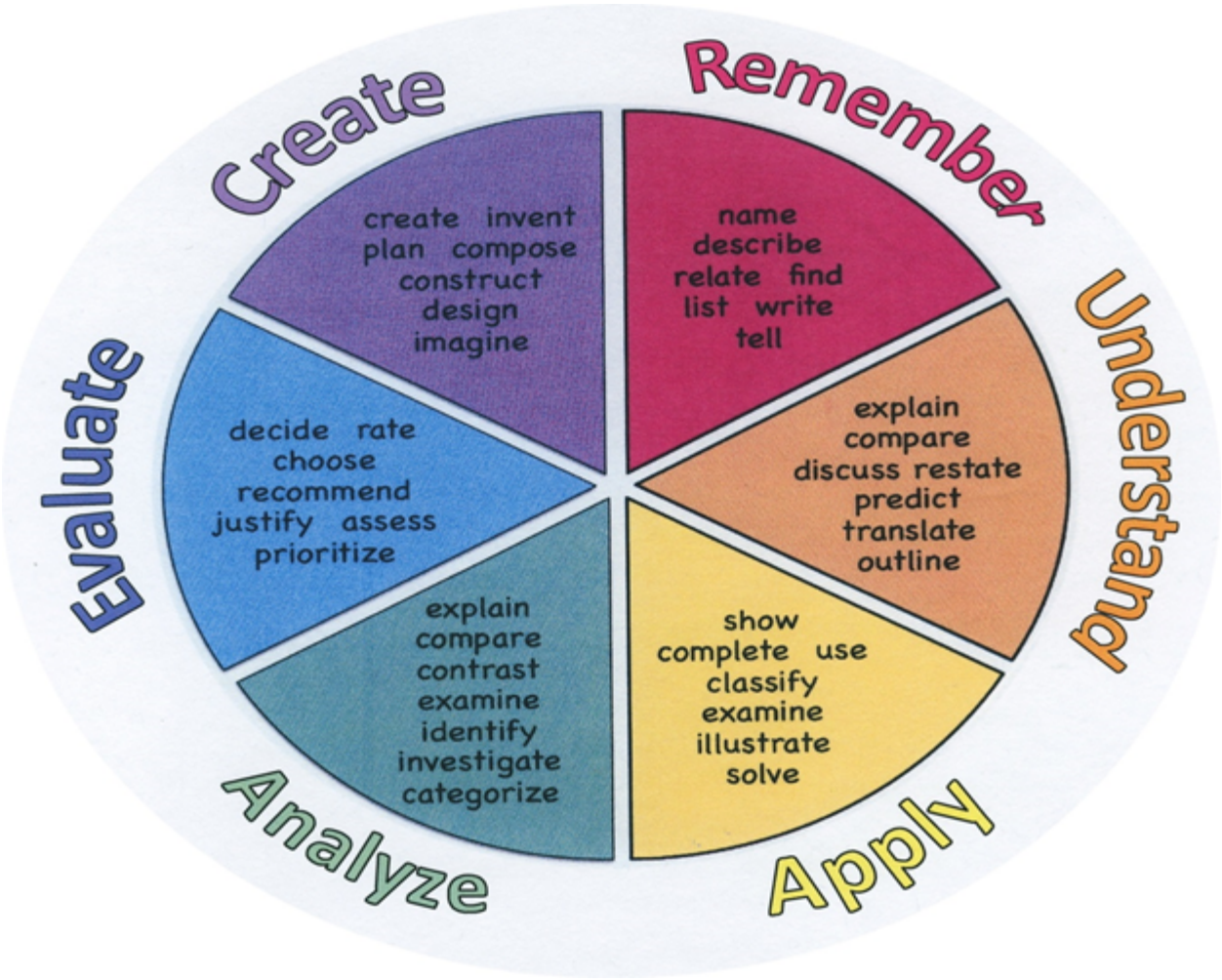
Learning Objectives

Students will be able to:

- Represent relations by graphs, mappings,ordered pairs, and tables.
- Find the domain, range, and inverse of a relation by interactions with the domain and range of a function .
- Determine whether a relation is a function by analyzing the domain and range of a function.
- Compare and contrast discrete and continuous functions by using their properties.
- Interpret graphs of functions by evaluating the parameters.
- Graph linear and quadratic equations using a graphing calculator.
- Find function values and use function notation.
- Find the intercepts and zeros of linear equations by reading a graph or solving an equation.
- Write equations that represent functions by identifying patterns that describe linear and nonlinear functions..
- Evaluate and graph exponential functions by creating a table.
- Explore and solve problems involving exponential growth and exponential decay functions.
- Analyze the characteristics of graphs of quadratic functions.
- Identify and graph special functions(absolute value, step, piecewise-linear).
- Perform transformations of functions by using special rules .

- Find the inverse of a relation and linear function by solving y=f(x) for x and switching the x and y.
- Find inverses of real-world functions.
- Model with functions by exploring and illustrating functions' behavior in projects.

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

Real World applications of Functions:

https://www.illustrativemathematics.org/content-standards/HSA/CED/A/1/tasks/581

http://threeacts.mrmeyer.com/fallingglowsticks/

https://robertkaplinsky.com/work/in-n-out-100-x-100/

Functions:

https://betterlesson.com/lesson/449120/what-s-your-function

Sample of Differentiating Instruction in Algebra(Functions)

http://www.prufrock.com/Assets/ClientPages/pdfs/Differentiating_Instruction_Algebra.pdf

Textbook, eAssessment, supplemental materials:

https://my.mheducation.com/login

AI Assessment and Learning System:

https://www.aleks.com/

Mindset:

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

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

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:

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

Algebra Tools - Algebra:

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

Misc Mathematics materials:

http://www.mathnstuff.com/

Algebra Kahoots:

https://kahoot.com/explore/collections/math-kahoot-algebra/

Assessment Evidence - Checking for Understanding (CFU)

- Linear vs. Nonlinear Functions https://create.kahoot.it/details/linear-vs-nonlinear-functions/50064fea-1c7f-4a2b-b356-089d6706b1b8 (formative assessment)
- Do Nows (formative assessment)
- Homework problems (formative assessment)
- Class group projects and presentations (alternative assessments)
- Benchmark #3 (summative assessment)

- Admit Tickets
- Common Benchmarks
- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer

- KWL Chart
- Learning Center Activities
- Quizzes
- Red Light, Green Light
- Study Guide
- Teacher Observation Checklist
- Think, Pair, Share
- Unit review/Test prep
- Unit tests
- Written Reports

Primary Resources & Materials

Glencoe McGraw-Hill Algebra1 2014

Glencoe McGraw-Hill Algebra1 2010

Practice Glencoe Algebra1

Study Guide Glencoe Algebra1

Ancillary Resources

Glencoe Algebra 1 Tutor: Personal Tutor and Spanish Tutor

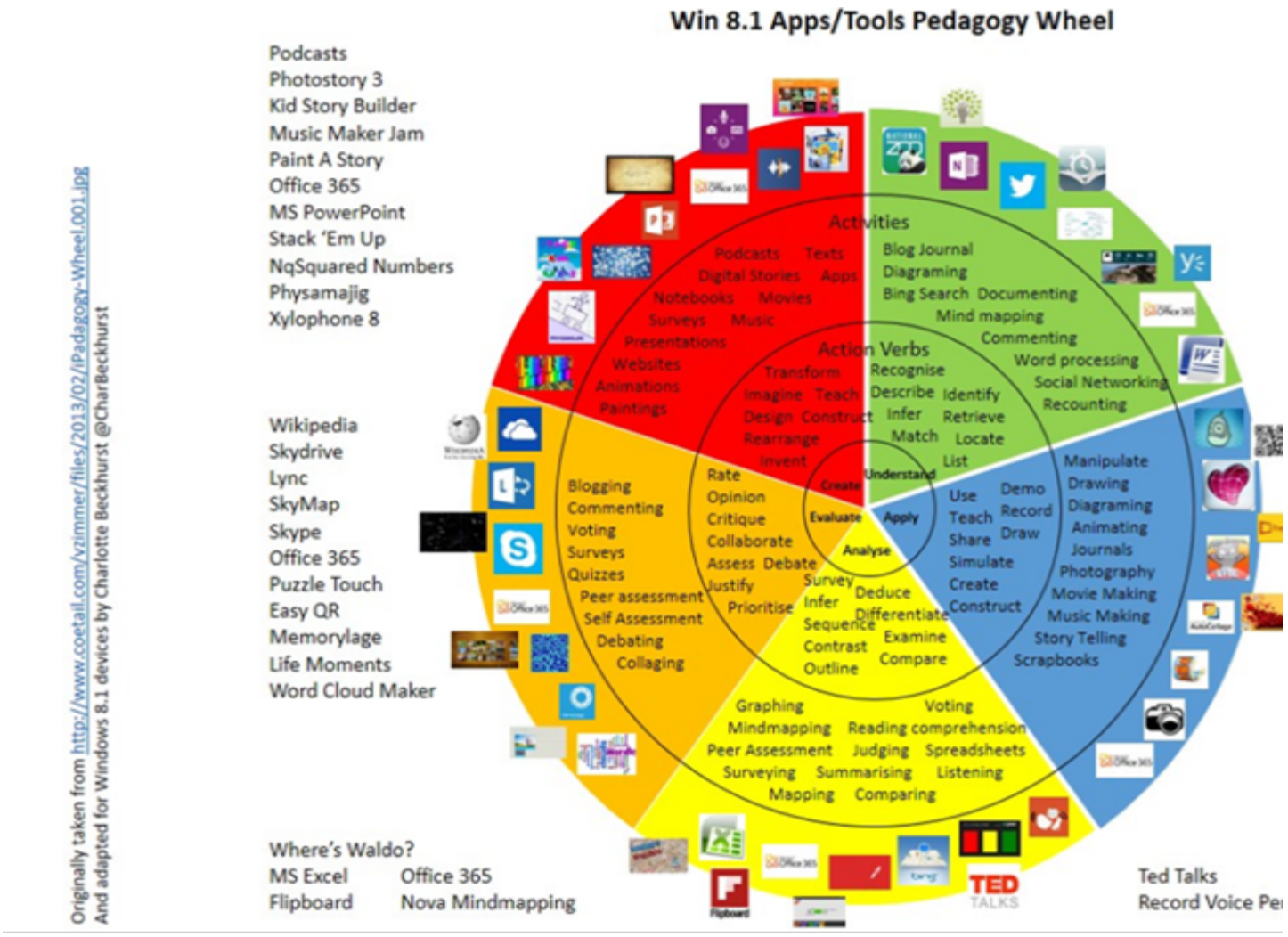
Glencore Algebra 1 Geometer's Sketchpad

ALEKS

Glencoe Algebra 1 Glencoe Mathematics Secondary Series

Technology Infusion

- Betterlesson.com https://betterlesson.com/lesson/417515/piecewise-and-step-functions?from=search
- Youtube
- Khan academy
- Edulastic
- Google Docs
- Office 365
- Google Slides
- PodCasts
- Google Sheets
- Google Classroom
- Wikipedia
- Skype
- Twitter
- Ted Talks
- QR Barcode Generator
- Calculator/Graphic calculator
- desmos.com
- geogebra.org



Alignment to 21st Century Skills & Technology

- English Language Arts;
- Mathematics;
- Science and Scientific Inquiry

- Social Studies
- Economics
- Technology

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP7	Employ valid and reliable research strategies.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP11	Use technology to enhance productivity.
CAEP.9.2.8.B.2	Develop a Personalized Student Learning Plan with the assistance of an adult mentor that includes information about career areas of interest, goals and an educational plan.
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.
TECH.8.1.12.C.CS4	Contribute to project teams to produce original works or solve problems.
TECH.8.1.12.F.1	Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
TECH.8.2.12.D.CS2	Use and maintain technological products and systems.

21st Century Skills/Interdisciplinary Themes

- Communication and Collaboration
- Creativity and Innovation
- Critical thinking and Problem Solving
- Life and Career Skills

21st Century Skills

- Environmental Literacy
- Financial, Economic, Business and Entrepreneurial Literacy
- Health Literacy

Differentiation

Use of graphing calculator TI 84 to graph a family of exponential functions
Use of graphing calculator TI 84 to investigate similarities and differences among graphs
Quadratic Functions and Equations Foldable(McGraw Hill Algebra 1 textbook page 542)

- Small group assignments
- Extra time to complete assignments
- Pairing oral instruction with visuals
- Repeat directions
- Use manipulatives
- Study guides
- Scheduled breaks
- Rephrase written directions
- Additional time
- Preview content & concepts
- Student(s) work with assigned partner
- Visual presentation
- Large print edition
- Alternative formative and summative assessments
- Choice boards
- Multiple intelligence options
- Multiple texts
- Personal agendas
- Project-based learning
- Problem-based learning
- Stations/centers
- Varying organizers for instructions

- Think-Pair-Share

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

- Use of graphing calculator TI 84 to graph a family of exponential functions
- Use of graphing calculator TI 84 to investigate similarities and differences among graphs
- Quadratic Functions and Equations Foldable(McGraw Hill Algebra 1 textbook page 542)

- printed copy of board work/notes provided
- additional time for skill mastery
- assistive technology
- 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
- modified test content
- modified test length

- 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

English Language Learning (ELL)

- Quadratic Functions and Equations Foldable(McGraw Hill Algebra 1 textbook page 542)
- Use of graphing calculator TI 84 to graph a family of exponential functions
- Use of graphing calculator TI 84 to investigate similarities and differences among graphs

- 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 the number of answer choices on a multiple choice test
- tutoring by peers

At Risk

- Use of graphing calculator TI 84 to graph a family of exponential functions
- Use of graphing calculator TI 84 to investigate similarities and differences among graphs
- Quadratic Functions and Equations Foldable(McGraw Hill Algebra 1 textbook page 542)

- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning
- 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
- tutoring by peers
- using authentic assessments with real-life problem-solving
- using videos, illustrations, pictures, and drawings to explain or clarify

Talented and Gifted Learning (T&G)

- Activity-Evaluating Investment Plans:Averge Rate of Change of Exponential Functions(McGraw Hill Algebra 1 textbook page 444)

- 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: