

Unit 5 Functions

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Course(s): **Algebra 1H**
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Status: **Published**

Algebra 1 Honors

Department of Curriculum and Instruction



Belleville Public Schools

Curriculum Guide

Algebra 1 H, 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 the following types of functions: linear, quadratic, exponential, absolute value, and piecewise.
- The student will learn how to represent functions as sets of ordered pairs, tables, mappings and graphs
- The student will learn how to recognize and graph linear functions, quadratic functions, exponential functions, absolute value functions, and piecewise functions.
- The student will find the inverse of a relation and a linear function

Enduring Understanding

- Understand the real-world meaning of the parameters of functions.
- 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.
- To analyze the characteristics of graphs of quadratic functions.
- Graph quadratic functions of the form $y = ax^2 + bx + c$.

- 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.
- Compare and contrast linear and exponential functions, distinguishing between additive and multiplicative change.
- They interpret arithmetic sequences as linear functions and geometric sequences as 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)

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|-------------|---|
| 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.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 |

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| | statements that use function notation in terms of a context. |
| MA.F-IF.A.3 | Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. |
| MA.K-12.3 | Construct viable arguments and critique the reasoning of others. |
| MA.N-RN.A.2 | Rewrite expressions involving radicals and rational exponents using the properties of exponents. |
| MA.K-12.4 | Model with mathematics. |
| 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.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.F-IF.C.7a | Graph linear and quadratic functions and show intercepts, maxima, and minima. |
| MA.K-12.8 | Look for and express regularity in repeated reasoning. |
| 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.1 | Write a function that describes a relationship between two quantities. |
| 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 |

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| | 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

- Business
- Financing
- Literacy
- Science

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| 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 using 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

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/>

Graphing Calculator, Math Resources

<https://mathbits.com/>

Algebra Kahoots:

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

Real World applications of Functions:

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

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

<https://www.yummymath.com/2018/madden-glitch/>

Functions:

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

Sample of Differentiating Instruction in Algebra(Functions)

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)
- Benchmark #3 (summative assessment)
- Weekly quizzes (summative assessment)
- Create your own study guide (alternative assessment)
- Do Nows/ Homework checks (formative assessment)

- Admit Tickets
- Anticipation Guide
- Common Benchmarks
- Compare & Contrast
- Define
- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer
- KWL Chart
- Learning Center Activities
- Quizzes
- Red Light, Green Light
- Self- assessments
- Study Guide
- Teacher Observation Checklist
- Think, Pair, Share
- Unit review/Test prep
- Unit tests

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

Glencoe 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

Win 8.1 Apps/Tools Pedagogy Wheel



Originally taken from <http://www.coetail.com/vzimmer/files/2013/02/iPadagogy-Wheel.001.jpg>
And adapted for Windows 8.1 devices by Charlotte Beckhurst @CharlotteBeckhurst

Alignment to 21st Century Skills & Technology

- English Language Arts;
- Mathematics;
- Science and Scientific Inquiry
- Social Studies
- Economics
- Technology

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| 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. |
| TECH.8.1.12.A.3 | Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue. |
| TECH.8.1.12.B | Creativity and Innovation: Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology. |
| 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
- ICT (Information, Communications and Technology) Literacy
- Information Literacy

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
- highlighted text visual presentation
- modified assignment format
- modified test content
- modified test format
- modified test length
- preferential seating
- preview of content, concepts, and vocabulary
- Provide modifications as dictated in the student's IEP/504 plan
- secure attention before giving instruction/directions
- shortened assignments
- student working with an assigned partner
- Use open book, study guides, test prototypes

English Language Learning (ELL)

- 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)

- teaching key aspects of a topic. Eliminate nonessential information
- using videos, illustrations, pictures, and drawings to explain or clarify
- 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 work presented 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 students to correct errors (looking for understanding)
- 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 work presented 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 the number of answer choices on a multiple choice test
- 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:Average Rate of Change of Exponential Functions(McGraw Hill Algebra 1 textbook page 444)

- Advanced problem-solving
- Allow students to work at a faster pace
- 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
- 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: