Unit 07 Exponents and Exponential Functions

Content Area: **Mathematics**
Course(s): **Algebra I**
Time Period: **March**
Length: **16**
Status: **Published**

Unit Overview:

This unit expands on students' understandings and skills related to exponential expressions. Also in this unit will focus on function notation and the relationship between f(x) and y, graphing functions by hand and on a graphing calculator, and exponential growth and decay. In this unit there will be word problem application to functions including graphs and tables. This unit will be a foundation for the continuation of functions covered in Algebra 2.

Enduring Understandings:

- An exponential function can model growth or decay of an initial amount.
- In a geometric sequence, the ratio of any term to its preceding term is a constant value.
- In the rules for these functions, the independent variable is an exponent.
- Some functions model an initial amount that is repeatedly multiplied by the same positive number.
- You can extend the idea of exponents to include zero and negative exponents.
- You can use a property of exponents to multiply powers with the same base.
- You can use properties of exponents to simplify a power raised to a power or a product raised to a power.
- You can use rational exponents to represent radicals.
- You can use the properties of exponents to divide powers with the same base.

Essential Questions:

- How can you represent numbers less than 1 using exponents?
- How can you simplify expressions involving exponents?
- What are the characteristics of exponential functions?

Standards/Indicators

MA.A-SSE.A.1	Interpret expressions that represent a quantity in terms of its context.
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.A-SSE.A.1a	Interpret parts of an expression, such as terms, factors, and coefficients.

MA.A-SSE.A.1b	Interpret complicated expressions by viewing one or more of their parts as a single entity.
MA.N-RN.A.2	Rewrite expressions involving radicals and rational exponents using the properties of exponents.
MA.F-IF.A.3	Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
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.F-IF.B.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
MA.A-SSE.B.3c	Use the properties of exponents to transform expressions for exponential functions.
MA.F-IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
MA.F-IF.C.7a	Graph linear and quadratic functions and show intercepts, maxima, and minima.
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.8	Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
MA.F-IF.C.8b	Use the properties of exponents to interpret expressions for exponential functions.
MA.F-IF.C.9	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
MA.F-BF.A.1	Write a function that describes a relationship between two quantities.
MA.F-BF.A.1a	Determine an explicit expression, a recursive process, or steps for calculation from a context.
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.A-CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
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.F-LE.A.1	Distinguish between situations that can be modeled with linear functions and with exponential functions.
MA.F-LE.A.1c	Recognize situations in which a quantity grows or decays by a constant percent 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.F-LE.B.5	Interpret the parameters in a linear or exponential function in terms of a context.
MA.A-REI.D.11	Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.

Student Learning Objectives (SLOs)

- To divide powers with the same base
- To evaluate and graph exponential functions
- To model exponential growth and decay
- To multiply powers with the same base
- To raise a power to a power
- To raise a product to a power
- To raise a quotient to a power
- To rewrite expressions involving radicals and rational expressions
- To simplify expressions involving zero and negative exponents
- To write and use recursive formulas for geometric sequences

Lesson Titles:

- Division Properties of Exponents
- Exponential Functions
- Exponential Growth and Decay
- Geometric Sequences
- More Multiplication Properties of Exponents
- Multiplying Powers with the Same Base
- Rational Exponents and Radicals
- Zero and Negative Exponents

Career Readiness, Life Literacies & Key Skills

TECH.9.4.2.CI.1	Demonstrate openness to new ideas and perspectives (e.g., 1.1.2.CR1a, 2.1.2.EH.1, 6.1.2.CivicsCM.2).
TECH.9.4.2.CI.2	Demonstrate originality and inventiveness in work (e.g., 1.3A.2CR1a).
TECH.9.4.2.CT.3	Use a variety of types of thinking to solve problems (e.g., inductive, deductive).
TECH.9.4.2.DC.1	Explain differences between ownership and sharing of information.
TECH.9.4.2.DC.2	Explain the importance of respecting digital content of others.
TECH.9.4.2.DC.3	Explain how to be safe online and follow safe practices when using the internet (e.g., 8.1.2.NI.3, 8.1.2.NI.4).
TECH.9.4.2.TL.2	Create a document using a word processing application.
TECH.9.4.2.TL.3	Enter information into a spreadsheet and sort the information.

Inter-Disciplinary Connections:

LA.RL.11-12.4	Determine the meaning of words and phrases as they are used in the text, including

	figurative and connotative meanings; analyze the impact of specific word choices on meaning and tone, including words with multiple meanings or language that is particularly fresh, engaging, or beautiful. (e.g., Shakespeare as well as other authors.)
LA.RST.9-10.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
LA.W.9-10.2	Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.
LA.W.9-10.2.A	Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
LA.WHST.9-10.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
LA.W.9-10.6	Use technology, including the Internet, to produce, share, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
9-12.HS-ETS1-4.5	Using Mathematics and Computational Thinking
9-12.HS-PS1-7.5	Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

Instructional Strategies, Learning Activities, and Levels of Blooms/DOK:

- #1- Blooms Knowledge - Remember previously learned information
- #2 - Blooms Comprehension - Demonstrate an understanding of facts
- #3 - Blooms Application - Apply Knowledge to actual situations
- #4 - Blooms Analysis - Break down objects or ideas into simpler parts and find evidence to support generalizations
- #5 - Blooms Synthesis - Compile component ideas into a new whole or propose alternative solutions
- #6 - Blooms Evaluation - Make and defend judgments based on internal evidence or external criteria
- Discussion on vocabulary including functions, domain, and range, exponential growth and decay
- Introduction, notes, and examples of exponential growth and decay tables and graphs
- Introduction, notes, and examples of multiplying monomials
- Introduction, notes, and examples on calculating the domain and range
- Introduction, notes, and examples on dividing monomials
- Introduction, notes, and examples on function notation relating equations, graphs, and data in a table
- Introduction, notes, and examples on graphing functions by hand and with a calculator
- Introduction, notes, and examples on simplifying negative and fractional exponents
- Introduction, notes, and examples on word problems involving functions
- review homework if need - answers posted on Google Classroom
- review warm up

- students will work individually
- tutoring during Delsea One

Modifications

This unit includes: zero and negative exponents, multiplying powers with the same base, multiplication properties of exponents, division properties of exponents, rewriting a base raised to a ratio in radical form

ELL Modifications:

- Acquire the help from the Foreign Language Department if possible
- Assess ELL students continuously using formative assessment methods
- Be flexible with time frames and deadlines
- During Delsea One - one on one with a student who speaks the same language
- Intentional scheduling/grouping with student/teacher who speaks the same language if possible
- Khan Academy offers lesson in several languages: https://es.khanacademy.org/
- Offer resources for specific topics in primary language (Youtube web resources)
- Repeat, reword, clarify
- The NEA Portal offers lessons in several languages: http://neaportal.k12.ar.us/index.php/algebra-1-en-espanol/
- tutoring during Delsea One
- Use google translator, especially for application problems
- Using technology, such as but not limited to: graphing calculator and desmos

IEP & 504 Modifications:

- Allow re-takes only after a tutoring session
- Assessments will allow for calculator use and/or other math tools
- Give assessments on mathxl that are from the interactive algebra 1; however, the homework/classwork on mathxl will be from algebra 1 to expose them to the material
- Higher level reasoning questions would have less weight than other questions or provide as extra credit questions to provide exposure to these questions but not something that will be a determinant to the student's ability to share knowledge of content
- if not in a co-teaching setting allowing time in the schedule for a special education teacher to consult with general education teachers on what specifically can be modified or how to paraphrase things in a different way specific to that lesson
- Keep updated videos on google classroom for reinforcement outside of the classroom
- Less questions overall or possibly break the test into two parts
- Modeling and showing several examples
- speaking to students privately when redirecting behaviors

- tutoring during Delsea One
- Upload several youtubes on the concepts that are in this specific unit
- Use a colored highlighter to highlight the variable that needs to be isolated

G&T Modifications:

- Allow to go ahead on concepts on mathxl
- Ask students' higher level questions that require students to look into causes, experiences, and facts to draw a conclusion or make connections to other areas of learning
- Employ differentiated curriculum to keep interest high
- Encourage students to make transformations- use a common task or item in a different way
- Flip the lessons to push further ahead
- Flip the lessons using videos of more in depth work
- Include more in depth problems involving application
- Invite students to explore different points of view on a topic of study and compare the two
- Provide more rigorous problems; either off the NJ State website or from the Pearson Algebra 2 textbook (available on mathxl)
- tutoring during Delsea One
- Videos that offer extra practice and examples in all areas are posted on google classroom and taken from: mathispower4u

At Risk Modifications

- Refer students to Organizational Management
- Require Delsea One tutoring
- Stay in contact with parents/guardians and guidance counselors on student progress
- tutoring during Delsea One

Alternate Assessment

Performance tasks

Project-based assignments

Problem-based assignments

Presentations

Formative Assessment:

- Connecting previous lessons
- Connecting vocabulary with root words
- Discussion including vocab review/recall
- Evaluate the understanding of the lesson
- Guided review
- Homework/classwork
- Mathxlforschool
- NJSLA Math type of question
- Pass out of class
- SAT question of the day
- Skill need for the lesson
- Teacher observation
- Think-pair-share
- Turn to your partner and discuss
- Use What You Know - type of question
- Video clip
- Warm up review
- White Boards

Benchmark Assessment

Skills-based assessment- math practice

Summative Assessment:

- Benchmark Assessment
- Marking Period Assessment
- Quiz on Division properties of exponents
- Quiz on Exponential Functions
- Quiz on Exponential Growth and Decay
- Quiz on More Multiplication properties of exponents
- Quiz on Multiplying powers with the same base
- Quiz on Rational exponents and radicals
- Quiz on Zero and Negative Exponents
- Unit test on Exponents and Exponential Functions

Resources & Materials:

- Colored pencils/highlighters
- Google Slides
- Mathispower4u video clip to introduce or demonstrate concepts
- Pearson 2015 Algebra 1 Textbook
- Teacher generated worksheets
- White board paddles

Technology:

- Chromebooks
- Desmos
- Edpuzzle
- Equatio
- Google Classroom
- Google Forms
- Graphing Calculator
- Mathway
- Mathxlforschool
- PearDeck
- Remind
- Video Clips

TECH.8.1.12.A	Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.
TECH.8.1.12.A.4	Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results.
TECH.8.1.12.A.CS1	Understand and use technology systems.
TECH.8.1.12.A.CS2	Select and use applications effectively and productively.