Unit 2: Exponents and Exponential Functions

Content Area: **Mathematics**
Course(s): **Mathematics**
Time Period: **Week 5**
Length: **4 Weeks**
Status: **Published**

Unit Overview

In this unit on exponents and exponential functions, students will learn and use the properties of exponents involving products and quotients. They learn how to apply the following properties: product of powers, power of a power, power of a product, quotient of powers, and power of a quotient property. Students will also use zero and negative exponents. They will read, write, and compute numbers in scientific notation and compute compound interest. Students will extend their knowledge of exponents to graphing and writing rules for exponential functions. They will also apply this knowledge to identify, graph, and write geometric sequences

Standards

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.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.A-SSE.B.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
MA.A-SSE.B.3c	Use the properties of exponents to transform expressions for exponential functions.
MA.8.EE.A.4	Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.
MA.A-SSE.B.4	Derive and/or explain the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems.
MA.F-LE.A.1	Distinguish between situations that can be modeled with linear functions and with exponential functions.
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.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.A.3	Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
MA.F-LE.B.5	Interpret the parameters in a linear or exponential function in terms of a context.

Essential Questions

- How can mathematical models be used to describe physical relationships?
- How can patterns, relations, and functions be used to best describe and explain real-life situations?
- How are patterns of change related to behavior of functions?
- How do graphs of linear functions differ from exponential functions?

Application of Knowledge and Skills...

Students will know that...

- 1. properties of exponents can be used to simplify exponential expressions
- 2. any number raised to a power of zero equals one
- 3. exponential functions are non-linear
- 4. scientific notation is an abbreviated way of writing very large and very small numbers
- 5. fractals are geometric figures that have self-similar patterns
- 6. compounding of interest can be modeled by exponential growth
- 7. a geometric sequence has a common ratio

Students will be able to:

- A. use properties of exponents involving products
- B. use the properties of exponents quotients
- C. recognize and draw the next stage in a fractal
- D. use zero and negative exponents.
- E. read and write numbers in scientific notation
- F. calculate compound interest
- G. write and graph exponential growth functions
- H. write and graph exponential decay functions
- I. recognize the difference in structure of a linear and exponential function
- J. identify, write, and graph geometric sequences

Assessments

- Communicator Practice Diagnostic: Other written assessments Students will complete one or two

problems to assess knowledge and skills learned during the class period

- Daily Warm-up Problems Diagnostic: Other written assessments Students will complete daily warm-up problems to assess readiness
- Exponents Quiz Formative: Written Test Students will use properties of exponents to solve problems with positive, negative, and zero exponents. They will also write numbers in scientific notation and calculate compound interest
- Unit Test Summative: Written Test Students will take a test on all material covered in the unit

Activities

Products and Powers

Students will use patterns to derive the product of powers and power of a power properties.

Investigating Quotients and Powers

Students will use patterns to derive the quotient of powers property.

Zero and Negative Exponents

Students will learn how to evaluate zero and negative exponents by using number patterns.

Scientific Notation and Technology

Students will use a graphing calculator to solve problems involving scientific notation.

Exploring Pluto
Students will use their knowledge of standard and scientific notation to answer questions about Pluto and our solar system.

Modeling an Exponential Growth Function Activity

Students will write and analyze an exponential growth function from an experiment of tossing pennies. They will compare it to a linear function.

Investigating Exponential Models Activity

Students will model an exponential decay function using scissors and pieces of string.

Creating Geometric Sequences Activity
Students will model a geometric pattern and sequence using triangles.

Relate Geometric Sequences to Exponential Functions
Students will identify, graph, and write geometric sequences.

Enrichment Project: Cooling Hot Water
Students will analyze the cooling factor of hot water and graph and interpret the results.

Activities to Differentiate Instruction

Mixed-ability grouping

Interactive Smart Board activities

Multi-Step Problem Solving

Math stations

Cooperative learning

Study guides (teacher and student completed)

Modify tests and homework as needed

Modified grading rubrics

Graphic organizers

Communicator response boards

Extended response questions

Challenge and enrichment homework, worksheets and enrichment project

Optional weekly challenge problems

Integrated/Cross-Disciplinary Instruction

Resources

McDougal Littell Algebra 1 textbook and resource materials

Website: www.classzone.com (see link)

Kuta Software

Algebra with Pizzazz

Punchline Algebra

Smart Exchange Website (see link)

Grade 8 Ask Math

American Diploma Project Algebra 1 End-of-Course Exam

- www.classzone.com
- exchange.smarttech.com/
- The Power of Algebra: Using Positive Exponents Video
- Fractals Video

21st Century Skills

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.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.CRP8.1	Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.
CRP.K-12.CRP11.1	Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks-personal and organizational-of technology applications, and they take actions to prevent or mitigate these risks.
CRP.K-12.CRP12.1	Career-ready individuals positively contribute to every team, whether formal or informal. They apply an awareness of cultural difference to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings.