Algebra 1 Honors Unit 5: Exponential Relationships

Unit #:	APSDO-00017748	Duration:	4.0 Week(s)	Date(s)	

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Grade(s)
8, 8 (Honors), 9
Subject(s)
Mathematics

Unit Focus

In this unit, Honors students will use the properties of exponents to interpret expressions, use scientific notation to express large or small numbers and perform operations, and recognize an exponential pattern of change in a table and features of its graph. Honors students will evaluate exponential functions algebraically, compare exponential and linear models, and calculate growth and decay factors. They will independently write exponential equations, solve complex problems involving growth and decay (e.g., compound interest), and verify results using a graphing calculator. Honors students will understand growth and decay rates/factors, equations and apply domain and range appropriately. Primary instructional materials for this unit include Algebra I, Glencoe/McGraw Hill, 2014. Secondary resources will be added to ensure the complexity, sophistication, and authenticity of the types of problems for our Honors students.

Stage 1: Desired Results - Key Understandings

Standard(s)

Common Core
Mathematics: 8

- Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, 3^2 × 3^-5 = 3^-3 = (1/3)^3 = 1/27. *CCSS.MATH.CONTENT.8.EE.A.1*
- Use square root and cube root symbols to represent solutions to equations of the form x2 = p and x3 = p, where p is a positive rational number. Evaluate

Transfer

T1 (T50) Based on an understanding of any problem, initiate a plan, execute it and evaluate the reasonableness of the solution.
T2 (T53) Articulate how mathematical concepts relate to one another in the context of a problem or in the theoretical sense.
T3 (T51) Examine alternate methods to accurately and efficiently solve problems.
T4 (T52) Use appropriate tools strategically to deepen understanding of mathematical concepts.
T5 (T22) Describe and/or solve problems using algebraic expressions, equations, inequalities, and functions.
T6 (T23) Use functions or equations to model relationships among quantities.
T7 (T24) Classify, interpret, and compare functions or equations.

square roots of small perfect squares and cube roots of small perfect cubes. Know that sqrt2 is irrational. *CCSS.MATH.CONTENT.8.EE.A.2*

- Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. For example, the function A = s2 giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line. *CCSS.MATH.CONTENT.8.F.A.3*
- Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. For example, estimate the population of the United States as 3 times 108 and the population of the world as 7 times 109, and determine that the world population is more than 20 times larger. *CCSS.MATH.CONTENT.8.EE.A.3*
- 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 *CCSS.MATH.CONTENT.8.EE.A.4*
- Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a

Meaning

Understanding(s)

U1 (U204) Substituting a correct value(s) for an unknown makes the mathematical statement/relationship true.
U2 (U206) A function can represent how quantities in the real world relate to one another.
U3 (U202) The application of specific properties and order of operations can simplify expressions, solve equations, and combine functions.
U4 (U502) Effective problem solvers identify and apply an appropriate model, tool, or strategy.
U5 (U531) Models can distort or reveal patterns; therefore it is essential to recognize the appropriate representation.
U6 (U550) Attention to detail, such as specifying units of measure and labeling, leads to clarity in expressing mathematical information.

Essential Question(s)

Q1 (Q201) How can I represent this information in symbols/equations/models?
Q2 (Q202) What value(s) can I use/substitute to make this relationship true?
Q3 (Q203) What is the relationship between/among these values?
Q4 (Q207) How do I classify, interpret, and compare functions or equations? (Gr. 8-12)
Q5 (Q208) What function best models the data? How do its characteristics help me make predictions? (Gr. 8-12)
Q6 (Q503) What strategies/approaches are best for this problem?
Q7 (Q532) Which model best represents this problem?
Q8 (Q551) How precise do my quantities need to be for my calculations to be accurate?

Acquisition of Knowledge and Skill

Knowledge

Skill(s)

S1

use the properties of exponents to interpret expressions for exponential expressions

S2

use scientific notation to express large or small numbers and perform operations

S3

recognize an exponential pattern of change in a table and features of a graph

function that has been described verbally. *CCSS.MATH.CONTENT.8.F.B.5*

Mathematics: 9-12

- Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. *CCSS.MATH.CONTENT.HSF.LE.A.1.A*
- 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). *CCSS.MATH.CONTENT.HSF.LE.A.2*
- Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r)n as the product of P and a factor not depending on P. *CCSS.MATH.CONTENT.HSA.SSE.A.1.B*
- Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. *CCSS.MATH.CONTENT.HSF.LE.A.1.B*
- Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as y = (1.02)t, y = (0.97)t, y = (1.01)12t, y = (1.2)t/10, and classify them as representing exponential growth or decay. *CCSS.MATH.CONTENT.HSF.IF.C.8.B*
- Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. *CCSS.MATH.CONTENT.HSF.LE.A.3*

S4

evaluate exponential functions algebraically

S5

compare exponential and linear models

S6

calculate the growth and decay factor

S7

write an exponential growth and decay equation

S8

solve problems involving growth and decay (including but not limited to compounded interest continuously, *n* times per year, half-life, etc.)

S9

verify results using a graphical device

S10

understand rate of decay/growth vs decay/growth factor

S11

understand a growth vs. decay equation

S12

understand application of domain and range to exponential relationships

- Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. *CCSS.MATH.CONTENT.HSF.LE.A.1.C*
- Use the properties of exponents to transform expressions for exponential functions. For example the expression 1.15t can be rewritten as (1.151/12)12t = 1.01212t to reveal the approximate equivalent monthly interest rate if the annual rate is 15%. *CCSS.MATH.CONTENT.HSA.SSE.B.3.C*
- For exponential models, express as a logarithm the solution to abct = d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology. *CCSS.MATH.CONTENT.HSF.LE.A.4*
- Interpret the parameters in a linear or exponential function in terms of a context. *CCSS.MATH.CONTENT.HSF.LE.B.5*
- Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum. *CCSS.MATH.CONTENT.HSF.IF.C.9*
- Attend to precision. *CCSS.MATH.MP.6*
- Make sense of problems and persevere in solving them. *CCSS.MATH.MP.1*
- Model with mathematics. *CCSS.MATH.MP.4*