

Introduction to Exponential Functions

General Outcome: Develop algebraic and graphical reasoning through the study of relations.

SO5. Solve problems that involve exponential equations. [C, CN, PS, R, T]

- 5.1 Determine the solution of an exponential equation in which the bases are powers of one another; e.g., $2^{x-1} = 4^{x-2}$.
- 5.2 Determine the solution of an exponential equation in which the bases are not powers of one another; e.g., $2^{x-1} = 3^{x+1}$.
- 5.3 Solve problems that involve the application of exponential equations to loans, mortgages and investments.
- 5.4 Solve problems that involve logarithmic scales, such as the Richter scale and the pH scale.

SO6. Represent data, using exponential and logarithmic functions, to solve problems. [C, CN, PS, T, V]

- 6.1 Describe, orally and in written form, the characteristics of an exponential or logarithmic function by analyzing its graph.
- 6.2 Describe, orally and in written form, the characteristics of an exponential or logarithmic function by analyzing its equation.
- 6.3 Match equations in a given set to their corresponding graphs.
- 6.4 Graph data, and determine the exponential or logarithmic function that best approximates the data.
- 6.5 Interpret the graph of an exponential or logarithmic function that models a situation, and explain the reasoning.
- 6.6 Solve, using technology, a contextual problem that involves data that is best represented by graphs of exponential or logarithmic functions, and explain the reasoning

Mathematical Processes

- **Connections [CN]** Students are expected to make *connections* among mathematical ideas, other concepts in mathematics, everyday experiences and other disciplines
- **Problem Solving [PS]** Students are expected to develop and apply new mathematical knowledge through *problem solving*
- **Reasoning [R]** Students are expected to develop mathematical *reasoning*
- **Visualization [V]** Students are expected to develop *visualization* skills to assist in processing information, making connections and solving problems
- **Technology [T]** Students are expected to select and use technology as a tool for learning and for solving problems

Real World Applications

Additional physical world data sets that model the exponential function:

- National debt data,
- AIDS data,
- Money Growth and Investments,
- Ball bouncing,
- Creation of/and Analyzing Exponential Scatterplots in Excel or on a graphing calculator,
- Richter Scale, earthquakes,
- Bacteria Growth,
- Medicine in Blood Stream
- Population Growth

Prerequisite Skills

1. [Laws of Exponents Worksheet](#) -- Rumbolt

Exploring the Characteristics of Exponential Functions

Achievement Indicators:

6.1 Describe, orally and in written form, the characteristics of an exponential or logarithmic function by analyzing its graph.

Lesson Links:

- [Click here](#) for a Notebook version of ERLC Lesson Link. Please use this lesson as a framework for your own teaching environment.
- [Click here](#) for a pdf version of the same ERLC Lesson Link.

Videos:

- Exploring the Characteristics of Exponential Functions -- [Youtube Link](#)
- Graphing Exponential Functions: Useful Patterns from Thinkwell Precalculus -- [Youtube Link](#)

Additional Resources to Support this Lesson

- Purple Math: [Exponential Functions: Introduction](#)

Discovery Based Learning

Classroom Starter -- Crittenden

As an intro investigation, I like to talk about the fable of the inventor of chess. Apparently he was given the option of whatever prize he wanted. He wanted one grain of rice for the first square on the board, 2 for the second, 4 for the next and so on. The grains of rice doubled for each square on the chess board.

The adjustment I make is I change it to pennies instead of rice, and offer the choice between the chess board prize or 1 billion dollars. You could even change this to 1 quadrillion dollars, and it's still not even close! Most students jump at the 1 billion dollars prize until they start playing with the numbers, and see how quickly the numbers grow.

If you keep it as a rice problem, you could talk about the plausibility of his demand. How large would a pile of this much rice be? What would this do to the Indian economy?

1. [Click here](#) to download "Exploring What Exponential Functions Look Like" -- McInnes
2. [Algebra 2: Graphing Exponentials](#) -- Nspired Learning Math Classroom

Students will investigate the graphs of the family of exponential functions $f(x) = b^x$. As a result, students will:

- Infer why the conditions $b > 0$ and $b \neq 0$ are necessary.
- Determine how the value of b affects the increasing or decreasing behavior of the function.
- Determine the y-intercept, domain, and range.
- Describe the end behavior.
- State the equation of the asymptote.

Relating the Characteristics of an Exponential Function to Its Equation

Achievement Indicators:

- 6.2 Describe, orally and in written form, the characteristics of an exponential or logarithmic function by analyzing its equation.
- 6.3 Match equations in a given set to their corresponding graphs.

Lesson Links:

- [Click here](#) for a Notebook version of ERLC Lesson Link. Please use this lesson as a framework for your own teaching environment.
- [Click here](#) for a pdf version of the same ERLC Lesson Link.

Videos:

- Relating the Characteristics of an Exponential Function to Its Equation ([Youtube Link](#))

Solving Exponential Equations

Achievement Indicators:

- 5.1 Determine the solution of an exponential equation in which the bases are powers of one another; e.g., $2^{x-1} = 4^{x-2}$.
- 5.2 Determine the solution of an exponential equation in which the bases are not powers of one another; e.g., $2^{x-1} = 3^{x+1}$

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Assessment for Learning

1. [Solving Exponential Equations Sheet](#) -- Rumbolt
2. [DO NOW Worksheet](#) (Word Doc)

Modelling Data Using Exponential Functions

Achievement Indicators:

- 6.4 Graph data, and determine the exponential or logarithmic function that best approximates the data.
- 6.5 Interpret the graph of an exponential or logarithmic function that models a situation, and explain the reasoning.
- 6.6 Solve, using technology, a contextual problem that involves data that is best represented by graphs of exponential or logarithmic functions, and explain the reasoning.

Lesson Links:

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- [Click here](#) for a pdf version of the same ERLC Lesson Link.

Videos:

- Modelling Data Using Exponential Functions -- [Youtube Link](#)

Discovery Based Learning

1. **PBS** -- [Math Line](#)

Objective: The objectives of this lesson are for students to explore the patterns of exponential models in tables, graphs, and symbolic forms and to apply what they have learned to make predictions in a real situation.

2. **Contract For Employment** -- Y. Chang

Objective: The idea is that you tell students they are going to work at job where they get paid \$0.01 the first day, then double that each subsequent day. You tell them they will work for 30 days total and ask them to make predictions about how much money they will make by the end.

Links for the activity that the idea is from as well as a handout given to students so that they could organize their work.

- [Activity Link](#)
- [Student Worksheet](#)

Assessment for Learning

1. [Ipad Convincing](#) -- Mini Performance Task
2. Donald Trump Problem -- Jayce Eifler

DONALD TRUMP PROBLEM

You're sitting in math class, minding your own business, when in walks Donald Trump. He's made it big and now he has a job offer for you.

He doesn't give you too many details and mentions something about danger. He's says something about needing you for 31 days. You're not really paying too much attention, until he says the following:

"You have a decision to make about your payment method. I can either pay you:

1. One cent on the first day, two cents on the second day, and double your salary every day thereafter for 31 days; or
2. Exactly \$1,000,000."

Using what you have learned today, you need to make a decision. Which payment method do you prefer? Which offer is the best choice? Make sure you show any work and explain your reasoning for your decisions.

Financial Applications Involving Exponential Functions

Achievement Indicators:

- 5.1 Determine the solution of an exponential equation in which the bases are powers of one another; e.g., $2x-1 = 4x-2$.
- 5.2 Determine the solution of an exponential equation in which the bases are not powers of one another; e.g., $2x-1 = 3x+1$.
- 5.3 Solve problems that involve the application of exponential equations to loans, mortgages and investments.

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Assessment for Learning

1. Facebook Performance Assessment with Student Exemplars -- [Click here](#)
2. [Birthday Money Task](#) (Word Doc)

Unit Shared Resources

Unit Notes:

1. [Exponential Functions Unit Notes](#) -- Allen