# Unit 7 Exponential Functions

Content Area: **Mathematics**
Course(s):
Time Period: **Marking Period 4**
Length: **2-3 weeks**
Status: **Published**

## Brief Summary of Unit

Most of the functions studied so far have involved a variable being raised to a power. The variable is the base and the exponent is constant. For exponential functions, the roles are reversed; the base is constant and the exponent varies. Students will spend time looking back on exponent knowledge from Algebra, and building that knowledge into solving equations with a variable in the exponent. They will also determine the differences between exponential growth and decay, and how to apply these functions to real-life problems.

**Revision Date:** July 2024

## Standards

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| 9.2.12.CAP.3 | Investigate how continuing education contributes to one's career and personal growth. |
| L.KL.9–10.2.A | Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level. |
| 9.2.12.CAP.6 | Identify transferable skills in career choices and design alternative career plans based on those skills. |
| 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. |
| F.IF.C.8.b | Use the properties of exponents to interpret expressions for exponential functions. |
| A.SSE.A.2 | Use the structure of an expression to identify ways to rewrite it. |
| F.LE.A.1.a | Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. |
| 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. |
| A.SSE.B.3.c | Use the properties of exponents to transform expressions for exponential functions. |
| F.LE.B.5 | Interpret the parameters in a linear or exponential function in terms of a context. |
| SL.PE.11–12.1.A | Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas. |

## Essential Questions

- How do exponential growth and decay apply to real-life situations?

- How do you apply transformations to the exponential parent function?
- How do you find the exponential equation for a complex set of data?
- How do you prove that a simple set of data has an exponential relationship?
- What are the differences between exponential growth and exponential decay?
- What are the distinguishing characteristics of an exponential graph?
- What exponential properties can be used to manipulate an equation to having a common base?
- What is Euler's number and what special role does it hold in the world of mathematics?

## Enduring Understandings

- Describe and graph transformations of exponential function.
- Solve exponential equations using a variety of methods.
- Use the natural base e and graph natural base functions.
- Write and graph exponential growth and decay functions.
- Write exponential functions to model sets of data.

## Students Will Know

- How to model exponential functions.
- How to simplify exponential expressions.
- How to solve exponential equations.
- Whether a function represents exponential growth or decay.

## Students Will Be Skilled At

- Describing transformations of exponential functions.
- Explaining the natural base e.
- Graphing natural base functions.
- Graphing transformations of exponential functions.
- Identifying and graphing exponential growth and decay functions.
- Simplifying natural base expressions.
- Solving exponential equations.
- Solving real-life problems using exponential growth and decay functions.
- Solving real-life problems using growth and decay functions.
- Using a common ratio to determine whether data can be represented by an exponential function.
- Using technology to find exponential models for sets of data.
- Writing an exponential function using two points.
- Writing exponential growth and decay functions.
- Writing functions that represent transformations of exponential functions.

## Evidence/Performance Tasks

Assessments

- Formative: Daily assessments using examples from class notes, NJSLA test bank problems, and/or Albert/AP Classroom assessments
- Summative: Teacher-created assessments, NJSLA test bank problems, Big Ideas Math online platform problems, Albert/AP Classroom and/or Big Ideas Math unit assessments
- Benchmark: IXL or teacher created diagnostic assessments in addition to unit assessments from Big Ideas Math
- Alternative Assessments: Student-centered activities such as scavenger hunts, various projects involving real world applications, and differentiated learning tasks in Khan Academy, DeltaMath, and IXL

- Answer essential questions
- Class discussion of daily topic
- Classwork and homework that assess the essential questions
- Provide alternative means of assessments for certain students
- Teacher Observation
- Tests and quizzes that assess the essential questions
- Written assignments that assess the essential questions that involves providing explanations

## Learning Plan

The following list is meant to create a day-to-day plan. Teachers are encouraged to slow down or condense days as appropriate to the student population in the class. Assessment(s) should be given when appropriate.

- First introduce the exponential function using multiple base numbers (ie: 2^x, 3^x, etc) and have students notice the pattern of the shape for this function. (You can do this either using graphing technology or by creating a table of values and graphing by hand.) Point out distinguishing characteristics, such as the horizontal asymptote and the point (0,1), as well as the shape rising from left to right. Next, introduce the exponential function using multiple fraction bases (ie: 1/2^x, 1/3^x, etc) and have students notice the pattern of the shape for this function. (You can do this either using graphing technology or by creating a table of values and graphing by hand.) Point out distinguishing characteristics, such as the horizontal asymptote and the point (0,1), as well as the shape falling from left to right. Name these graphs as exponential growth and decay, continuing to explore them.
- This day should focus on modeling real-life problems. This can include simply writing an exponential equation and then solving for a specific value, rewriting the exponential equation to find the rate of growth/decay, and solving compounding interest.
- Students will likely need additional time to practice writing equations from real-life models.
- Introduce the concept of the value e (Euler's Number) and apply this as the base of the exponential function. Using this as a parent function, apply all transformation rules previously discussed. At this point, also include the horizontal reflection, and refer back to the exponential decay problems. Practice

writing exponential equations based on given transformations or a given transformed graph.

- Apply the Property of Equality to exponential equations to solve for a variable in the exponent. Slowly build this skill to also include manipulating bases to be a common base then solving for the variable in the exponent.
- Students will likely need additional time to practice manipulating bases using their exponent skills. Use this time to also reinforce their factoring skills within these problems.
- Given a simple set of data, have students find the pattern that equally spaces out the output. Determine that it is a multiplied pattern, meaning that the data represents an exponential function with a common ratio. For a more complex set of data, encourage students to use technology and explore exponential regression to solve for the equation. Take this skill one step further by extrapolating another value from this equation.

## Materials

Core instructional materials:Core Book List including Big Ideas Math Algebra 2 2022

Supplemental materials: Khan Academy, Edia, and DeltaMath

- District approved textbook
- Graphing utility (online or calculator).
- Khan Academy
- Teacher created activiites
- Teacher created notes

## Suggested Strategies for Modifications

Possible accommodations/modification for Algebra 2