CHAPTER

6 Exponential Functions

Vocabulary

asymptote
exponential decay
exponential growth
growth rate
half-life
rational number
tangent line

Curriculum Expectations

Exponential Functions

By the end of this course, students will:

1.1 determine, through investigation using a variety of tools and strategies, the value of a power with a rational exponent (i.e., $x^{\frac{m}{n}}$, where $x > 0$ and m and n are integers)

1.2 evaluate, with and without technology, numerical expressions containing integer and rational exponents and rational bases

1.3 graph, with and without technology, an exponential relation, given its equation in the form $y = a^x$ ($a > 0$, $a \neq 1$), define this relation as the function $f(x) = a^x$, and explain why it is a function

1.4 determine, through investigation, and describe key properties relating to domain and range, intercepts, increasing/decreasing intervals, and asymptotes for exponential functions represented in a variety of ways

1.5 determine, through investigation, the exponent rules for multiplying and dividing numeric expressions involving exponents, and the exponent rule for simplifying numerical expressions involving a power of a power, and use the rules to simplify numerical expressions containing integer exponents

1.6 distinguish exponential functions from linear and quadratic functions by making comparisons in a variety of ways, within the same context when possible

2.1 collect data that can be modelled as an exponential function, through investigation with and without technology, from primary sources, using a variety of tools, or from secondary sources, and graph the data

2.2 identify exponential functions, including those that arise from real-world applications involving growth and decay, given various representations (i.e., tables of values, graphs, equations), and explain any restrictions that the context places on the domain and range

2.3 solve problems using given graphs or equations of exponential functions arising from a variety of real-world applications by interpreting the graphs or by substituting values for the exponent into the equations

Chapter 6 Planning Chart

Section	Suggested Timing	Student Text Page(s)	Materials and Technology Tools
Chapter 6 Opener	10–15 min	276–277	
Prerequisite Skills	40–50 min	278-279	• graphing calculators
6.1 The Exponent Rules	60–70 min	280–287	• calculators
6.2 Evaluate Powers with Integer Exponents	60–70 min	288–295	• graphing calculators • computers with Internet access
6.3 Investigate Rational Exponents	60–70 min	296–304	• scientific or graphing calculators
6.4 Model Data with Exponential Functions	60–70 min	305–311	• 24 number cubes in a plastic container • grid paper • computers with Internet and E-STAT access • graphing calculators • slide rule (optional)
6.5 Exponential Functions and Their Properties	60–70 min	312–318	• graphing calculators • grid paper (optional)
6.6 Compare Linear, Quadratic, and Exponential Functions	60–70 min	319–325	• rulers • computers with *Fathom*™ • graphing calculators (optional) • spreadsheet software (optional)
6.7 Exponential Growth and Decay	60–70 min	326–333	• graphing and scientific calculators • grid paper (optional) • computers with *The Geometer's Sketchpad*® (optional)
Technology Extension: Exponential Regression on a Graphing Calculator	20 min	334–335	• graphing calculators
Chapter 6 Review	50–60 min	336–337	• scientific calculators
Chapter 6 Problem Wrap-Up	20 min	337	• graphing or scientific calculators (optional)
Chapter 6 Practice Test	40 min	338–339	• graphing or scientific calculators (optional)
Chapter 6 Task: Working with Realistic Exponential Functions	45-75 min	340–341	• grid paper and rulers • graphing calculators

Chapter 6 Blackline Masters Checklist

	BLM	Title	Purpose
Prerequisite Skills			
	BLM 6-1	Prerequisite Skills	Practice
	BLM 6-2	Prerequisite Skills Self-Assessment Checklist	Student Self-Assessment
6.1 The Exponent Rules			
	BLM 6-3	Section 6.1 The Exponent Rules	Practice
6.2 Evaluate Powers with Integer Exponents			
	BLM 6-4	Section 6.2 Evaluate Powers with Integer Exponents	Practice
	BLM 6-5	Section 6.2 Achievement Check Rubric	Assessment
6.3 Investigate Rational Exponents			
	BLM 6-6	Section 6.3 Investigate Rational Exponents	Practice
6.4 Model Data with Exponential Functions			
	BLM G-1	Grid Paper	Student Support
	BLM 6-7	Section 6.4 Model Data with Exponential Functions	Practice
6.5 Exponential Functions and Their Properties			
	BLM G-1	Grid Paper	Student Support
	BLM 6-8	Section 6.5 Exponential Functions and Their Properties	Practice
6.6 Compare Linear, Quadratic, and Exponential Functions			
	BLM 6-9	Section 6.6 Compare Linear, Quadratic, and Exponential Functions	Practice
	BLM 6-10	Section 6.6 Using a Computer Algebra System	Technology
6.7 Exponential Growth and Decay			
	BLM G-1	Grid Paper	Student Support
	BLM 6-11	Section 6.7 Exponential Growth and Decay	Practice
	BLM 6-12	Section 6.7 Achievement Check Rubric	Assessment
Chapter 6 Review			
	BLM 6-13	Chapter 6 Review	Practice
Chapter 6 Problem Wrap-Up			
	BLM 6-14	Chapter 6 Problem Wrap-Up Rubric	Assessment
Chapter 6 Practice Test			
	BLM 6-15	Chapter 6 Practice Test	Diagnostic Assessment
	BLM 6-16	Chapter 6 Test	Summative Assessment
	BLM 6-17	Chapter 6 Practice Test Achievement Check Rubric	Assessment
Chapter 6 Task: Working with Realistic Exponential Functions			
	BLM 6-18	Chapter 6 Task Rubric	Assessment
	BLM 6-19	Chapter 6 BLM Answers	Answers

Prerequisite Skills

Student Text Pages
278–279

Suggested Timing
40–50 min

Materials and Technology Tools
- graphing calculators

Related Resources
- BLM 6–1 Prerequisite Skills
- BLM 6–2 Prerequisite Skills Self-Assessment Checklist

Common Errors

- Some students may multiply bases when combining repeated multiplication into a single power, such as $2 \times 2 \times 2 = 8^3$.

R$_x$ Show that the left side does not simplify to the same answer as the right side.

- Some students may reverse x and y values when graphing.

R$_x$ Review graphing a relation using a table of values.

- Some students find horizontal translations confusing. For example, they think $y = 2(x - 3) + 1$ is a horizontal translation to the left, rather than to the right.

R$_x$ Review the effect on the graph of subtracting 3 from x before evaluating y.

- Some students evaluate formulas in several steps, such as **question 8, part c)**.

R$_x$ Remind students that a scientific or graphing calculator follows the correct order of operations, and demonstrate how the formula can be evaluated in a single step.

Accommodations

Perceptual–students can rewrite the formulas in **question 8** with the values in place of the variables before they evaluate them

Spatial–give students a blank coordinate grid to use for their graphs

Motor–provide a calculator with large buttons

Teaching Suggestions

- Consider allowing students to work in pairs or small groups. Groups could present a few of their solutions to the class.
- **Questions 7 to 9** provide a good opportunity to review proper calculator and graphing calculator skills and procedures. Students should be able to enter the formula correctly and obtain the final answer in one step. Students can check their answer to **question 9, part b)** by graphing the relation.
- Use **BLM 6–1 Prerequisite Skills** for remediation or extra practice. To further reinforce the concepts, you may wish to refer students to specific skills in the **Prerequisite Skills Appendix** on student text pages 420–435.

Assessment

- Assess student readiness to proceed by informal observation as students are working on the questions. A formal test is inappropriate since this material is not part of the curriculum to be covered by this chapter.
- Student self-assessment is also an effective technique; students can place a checkmark beside topics in the Prerequisite Skills in which they feel confident with the necessary skills. Use **BLM 6–2 Prerequisite Skills Self-Assessment Checklist** as a self-assessment for students.
- Remedial action can be taken in small groups or in a whole-class skills review.

Chapter Problem

- The Chapter Problem is introduced in the Chapter 6 opener. Have students discuss their understanding of the topic. You may wish to have students complete the Chapter Problem revisits that occur throughout the chapter. These questions are designed to help students move toward the Chapter 6 Problem Wrap-Up at the end of Chapter 6 Review.
- Alternatively, you may wish to assign the Chapter Problem questions when students have completed the chapter. The Chapter Problem can be used as a summative assessment.