

Unit 3: The Algebra of Exponents and Roots

Dear Parents/Guardians,

Unit 3 introduces exponents and roots. In Lesson 1, students use patterns to develop an understanding of exponents and rules for exponentials. In Lesson 2, students explore ways to express very large and very small values, including scientific notation. In Lesson 3, students explore the inverse relationships between square numbers and square roots, and cube numbers and cube roots. They apply all that they have learned in the unit to simplify expressions and solve equations involving exponential numbers.

Rules for Exponentials

Students explore exponential relationships to make conjectures and develop exponential rules to simplify expressions.

Rule	Expanded Form	Exponential Form
Product Rule $x^a \cdot x^b = x^{a+b}$	$(6^3)(6^2)$ $= (6 \cdot 6 \cdot 6) \cdot (6 \cdot 6)$ $= 6^5$	$(6^3)(6^2)$ $= 6^{3+2}$ $= 6^5$
Power Rule $(x^a)^b = x^{a \cdot b}$	$(6^3)^2$ $= (6 \cdot 6 \cdot 6) \cdot (6 \cdot 6 \cdot 6)$ (2 sets) $= 6^6$	$(6^3)^2$ $= 6^{3 \cdot 2}$ $= 6^6$
Quotient Rule $\frac{x^a}{x^b} = x^{a-b}$	$\frac{6^5}{6^2}$ $= \frac{6 \cdot 6 \cdot 6 \cdot 6 \cdot 6}{6 \cdot 6}$ $= 6^3$	$\frac{6^5}{6^2}$ $= 6^{5-2}$ $= 6^3$

Scientific Notation

Students convert very large and very small quantities into scientific notation. Note that very large values typically have a positive exponent and very small values typically have a negative exponent.

	5,910,000,000	0.0000302
Write each as the product of a number (between 1 and 10) and a power of 10.	5.91×10^9	3.02×10^{-5}

Exponents and Roots

Students will explore relationships between exponents and roots.

Exponent	Root (which is inverse of the exponent)
x squared $\rightarrow x^2$ $8^2 = 64$	square root of x $\rightarrow \sqrt{x}$ $\sqrt{64} = 8$ or -8 $8 \times 8 = 64$ and $(-8)(-8) = 64$
x cubed $\rightarrow x^3$ $5^3 = 125$	cube root of x $\rightarrow \sqrt[3]{x}$ $\sqrt[3]{125} = 5$ $5 \times 5 \times 5 = 125$, but $(-5)(-5)(-5) \neq 125$

Students will apply their knowledge of exponents and roots to solve equations.

$x^2 = 16$ $x = 4$ or $x = -4$	$x^2 = 165$ $x = \sqrt{15}$ or $x = -\sqrt{15}$ Since the solution is not an integer, we leave it in root form.	$x^3 = \frac{8}{27}$ $x = \frac{2}{3}$
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GRADE 8

By the end of the unit, your student should know...

- The definitions of positive, negative, and zero exponents and their applications [Lesson 3.1]
- The product, power, and exponent rules and their applications [Lesson 3.1]
- Write large and small quantities in scientific notation and use them to solve problems [Lesson 3.2]
- Work with squares, square roots, cubes, and cube roots of rational numbers [Lesson 3.3]
- Solve equations involving expressions with exponents [Lesson 3.4]

Additional Resources

- For definitions and additional notes please refer to Student Resources at the end of this unit.
- For more on exponent rules: <https://tinyurl.com/mathtv-exponents>
- For more on scientific notation: <https://tinyurl.com/mathtv-scientific-notation>

