Core Content

Cluster Title: Work with radicals and integer exponents.
Standard: Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example: $3^2 \times 3^{-5} = 3^{-3} = \frac{1}{3^3} = \frac{1}{27}$.
Concepts and Skills to Master
• Know the properties of integer exponents. • Apply the properties of integer exponents to simplify and evaluate numerical expressions.

Supports for Teachers

Critical Background Knowledge	
• Understand exponents as repeated multiplication. (6.EE.1) • Compute fluently with integers (add, subtract, and multiply).	
Academic Vocabulary	
exponent, base, power, integer	
Suggested Instructional Strategies	**Resources**
• Use repeated multiplication and division to informally derive the exponent rules. • Have students examine equivalent numerical expressions with exponents.	Birch, David. *The King's Chessboard.*
Sample Formative Assessment Tasks	
Skill-Based Task Simplify: $\frac{5^7}{5^3}$ $\left(\left((2)^2\right)^2\right)^2$ -5^0 $2^{-2} \cdot 4$	**Problem Task** Explain why $3^5 \cdot 3^2 = 3^7$ and not 9^7. Write three expressions equivalent to $3^2 \cdot 9^2$.

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Core Content

Cluster Title: Work with radicals and integer exponents.
Standard: Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.
Concepts and Skills to Master
• Evaluate the square roots of small perfect squares and cube roots of small perfect cubes. • Represent the solutions to equations using square root and cube root symbols. • Understand that all non-perfect square roots and cube roots are irrational.

Supports for Teachers

Critical Background Knowledge	
• Understand and use inverse operations to solve equations.	
Academic Vocabulary	
square, square root, $\sqrt{}$, cube, cube root, $\sqrt[3]{}$, radical	
Suggested Instructional Strategies	**Resources**
• Use the geometric representations of square area and cube volumes and their relation to the side length. • Use the idea of inverse operations to introduce the concept of roots.	
Sample Formative Assessment Tasks	
Skill-Based Task If a square has an area of 9/16 square inches, what is the length of a side? If a cube has a volume of 0.125 cubic meters, what are the dimensions of the cube?	**Problem Task** Is the square root of a number always smaller than the number itself? Explain.

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Core Content

Cluster Title: Work with radicals and integer exponents.
Standard: 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 3×10^8 and the population of the world as 7×10^9, and determine that the world population is more than 20 times larger.
Concepts and Skills to Master
• Estimate numbers as a product of a single digit and a power of ten. • Compare numbers expressed as a product of a single digit and a power of ten by a scale factor.

Supports for Teachers

Critical Background Knowledge	
• Understand properties of integer exponents. • Use and understand powers of ten and place value. • Estimate and round numbers.	
Academic Vocabulary	
powers of ten, estimate	
Suggested Instructional Strategies	**Resources**
• Use large and small real-life numbers (e.g. national debt). • Use base 10 blocks. • Write numbers as repeated multiplication or as the value of a power of 10 (e.g. $7 \cdot 10^3 \rightarrow 7 \cdot 1000$ *or* $7000 \rightarrow 7 \cdot 1000 \rightarrow 7 \cdot (10 \cdot 10 \cdot 10)$).	*Powersof10.com/film.* Eames Office, 2010.
Sample Formative Assessment Tasks	
Skill-Based Task The mass of the earth is 6×10^{24} kg. The mass of the moon is 7×10^{22} kg. How many times bigger is the mass of the earth than the mass of the moon? A proton has mass $2 \times 10^{-27} kg$ and an electron has mass $9 \times 10^{-31} kg$. How many times smaller is the electron than the proton?	**Problem Task** Provide two (2) original (not teacher-given) real-life situations that could be illustrated using powers of ten, one that describes a very small number and one that describes a very large number. Estimate how much larger one is than the other.

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Core Content

Cluster Title: Work with radicals and integer exponents.
Standard: 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.
Concepts and Skills to Master
• Add, subtract, multiply and divide with numbers expressed in scientific notation and decimal notation. • Represent very large and small quantities in scientific notation and use appropriate units. • Convert between decimal notation and scientific notation. • Interpret numbers expressed in scientific notation, including numbers generated by technology.

Supports for Teachers

Critical Background Knowledge	
• Use rules of exponents. • Understand powers of ten and place value.	
Academic Vocabulary	
scientific notation, decimal notation, power of ten, units of meaure	
Suggested Instructional Strategies	**Resources**
• Use examples found in science to create authentic reasons to use scientific notation.	
Sample Formative Assessment Tasks	
Skill-Based Task Evaluate and express your answers in scientific notation. • $3 \times 10^5 + 5.54 \times 10^7$ • $4.2 \times 10^{-2} - 7.4 \times 10^2$ • $(3 \times 10^8)(500)$ • $\frac{30}{1.5 \times 10^{-4}}$ Multiply 345,328,004 X 234 on your calculator and write the answer in scientific notation.	**Problem Task** Express your age at your last birthday in each of the following units: years, months, weeks, days, hours, minutes and seconds. Which values would be useful to write in scientific notation? Justify your reasoning. Compare your age to that of the 4.5 billion year old earth.

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