

Vertical Progression:

6 th Grade	<p>ELG 6.5 Apply and extend previous understandings of arithmetic to algebraic expressions.</p> <ul style="list-style-type: none"> ○ 6.EE.A.1 Write and evaluate numerical expressions involving whole-number exponents.
7 th Grade	<p>ELG 7.4 Solve real-life and mathematical problems using numerical and algebraic expressions and equations.</p> <ul style="list-style-type: none"> ○ 7.EE.B.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. ○ 7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. ○ 7.EE.B.4a Solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach.
8 th Grade	<p>ELG 8.2 Work with radicals and integer exponents.</p> <ul style="list-style-type: none"> ○ 8.EE.A.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$. ○ 8.EE.A.2 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. ○ 8.EE.A.3 Use numbers expressed in the form of a single digit times a whole-number 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 times 10⁸ and the population of the world as 7 times 10⁹, and determine that the world population is more than 20 times larger. ○ 8.EE.A.4 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.
Algebra 1	<p>ELG.MA.HS.N.2 Solve equations and inequalities in one variable.</p> <ul style="list-style-type: none"> ○ A-REI.B.4 Solve quadratic equations in one variable. ○ A-REI.B.4.a Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form. ○ A-REI.B.4.b Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.
Algebra 2	<p>ELG.MA.HS.A.9 Extend the properties of exponents to rational exponents.</p> <ul style="list-style-type: none"> ○ N-RN.A.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. ○ N-RN.A.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.

Students will demonstrate command of the ELG by:

- Applying the properties of integer exponents to generate equivalent expressions.
- Evaluating square roots and cube roots of small perfect squares and cubes.
- Using square root and cube root symbols when solving equations.
- Writing numbers in scientific notation.
- Identifying how many times larger one number written in scientific notation is than another.
- Performing operations on numbers which are written in scientific notation.
- Understanding scientific notation shown on a calculator or other technology.

Vocabulary:

- | | | |
|----------------|------------------|-----------------------|
| • cube root | • perfect square | • scientific notation |
| • irrational | • radical | • square root |
| • perfect cube | • root | |

Sample Instructional/Assessment Tasks:

1) Standard(s): 8.EE.A.1

Source: <http://louisianabelieves.com/docs/default-source/louisiana-teacher-leaders/handout-g8-m1-mid-module-assessment.pdf?sfvrsn=2>

Item Prompt:

- Jill writes $2^3 \cdot 4^3 = 8^6$ and the teacher marked it wrong. Explain Jill's error.
- Find n so that the number sentence below is true:

$$2^3 \cdot 4^3 = 2^3 \cdot 2^n = 2^9$$
- Use the definition of exponential notation (expanded form) to demonstrate why $2^3 \cdot 4^3 = 2^9$ is true.
- You write $7^5 \cdot 7^{-9} = 7^{-4}$. Keisha challenges you, "Prove it!" Show why your answer is correct without using the law for multiplying exponents.

Correct Answer(s)

- Jill multiplied the base numbers and added the exponents. You can only add exponents if the bases are the same.
- $n=6$
- Student uses expanded notation to show that it is true.
- Student provides a logical progression to show that it is true. For example,

$$7^5 \cdot 7^{-9} = \frac{7^5}{7^9} = \frac{7 \cdot 7 \cdot 7 \cdot 7 \cdot 7}{7 \cdot 7 \cdot 7} = \frac{7}{7} \cdot \frac{7}{7} \cdot \frac{7}{7} \cdot \frac{7}{7} \cdot \frac{1}{7 \cdot 7 \cdot 7 \cdot 7} = \frac{1}{7^4} = 7^{-4}$$

2) Standard(s): 8.EE.A.4

Source: Illustrative Mathematics

Item Prompt:

This headline appeared in a newspaper.

Every day 7% of Americans eat at Giantburger restaurants

Decide whether this headline is true using the following information.

- There are about 8×10^3 Giantburger restaurants in America.
- Each restaurant serves on average 2.5×10^3 people every day.
- There are about 3×10^8 Americans.

Explain your reasons and show clearly how you figured it out.

Solution:

If there are about 8×10^3 Giantburger restaurants in America and each restaurant serves about 2.5×10^3 people every day, then about

$$8 \times 10^3 \cdot 2.5 \times 10^3 = 20 \times 10^6 = 2 \times 10^7$$

people eat at a Giantburger restaurant every day.

Since there are about 3×10^8 Americans, the percent of Americans who eat at a Giantburger restaurant every day can be computed by dividing the number of restaurant patrons by the total number of people:

$$2 \times 10^7 \div 3 \times 10^8 = \frac{2}{3} \times 10^{-1}$$

Since

$$\frac{2}{3} \times 10^{-1} = \frac{2}{3} \times \frac{1}{10} = \frac{2}{30} = \frac{1}{15} = 0.0\overline{66},$$

our estimate is that $6\frac{2}{3}\%$ of Americans eat a Giantburger restaurant every day, which is reasonably close to the claim in the newspaper.