

Vertical Progression:

7 th Grade	<p>7.EE.A Use properties of operations to generate equivalent expressions.</p> <ul style="list-style-type: none"> ○ 7.EE.A.1 Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients. ○ 7.EE.A.2 Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. <p>7.EE.B 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.
8 th Grade	<p>8.EE.A 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, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$. <p>8.EE.B Understand the connections between proportional relationships, lines, and linear equations.</p> <ul style="list-style-type: none"> ○ 8.EE.B.5 Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.
Algebra 1	<p>ELG.MA.HS.A.1 Interpret the structure of expressions.</p> <ul style="list-style-type: none"> ○ A.SSE.1 Interpret expressions that represent a quantity in terms of its context.* ○ A.SSE.1.a Interpret parts of an expression, such as terms, factors, and coefficients. ○ A.SSE.1.b Interpret complicated expressions by viewing one or more of their parts as a single entity. <i>For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P.</i> ○ A.SSE.2 Use the structure of an expression to identify ways to rewrite it. <i>For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.</i> [numerical expressions and polynomial expressions in one variable].
Algebra 2	<p>ELG.MA.HS.A.1 Interpret the structure of expressions</p> <ul style="list-style-type: none"> ○ A.SSE.2 Use the structure of an expression to identify ways to rewrite it. <i>For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.</i> [polynomial (two variables), rational, or exponential expressions]

Students will demonstrate command of the ELG by:

- Explaining how an expression and its parts relate to the context of a problem.
- Re-writing an expression in different, equivalent forms, to reveal its properties (factors, difference/sum of squares, etc.)

Vocabulary:

- Associative
- Coefficient
- Commutative
- Distributive
- Equivalent
- Expression
- Factor
- Substitution
- Term

Sample Instructional/Assessment Tasks:

1) Standard(s): A-SSE.1.b

Source: Adapted From Illustrated Mathematics

<https://www.illustrativemathematics.org/content-standards/HSA/SSE/A/2/tasks/436>

Item Prompt: Mine is Bigger

Jeremy and Jamal are having an argument. Each claims his expression is bigger. Knowing that $P < Q$, decide who's expression is bigger. Briefly explain your reasoning in terms of P and Q .

	Jeremy	Jamal
a.	$P + Q$	$2P$
b.	$\frac{P}{P + Q}$	$\frac{P + Q}{2}$
c.	$\frac{(Q - P)}{2}$	$Q - \frac{P}{2}$
d.	$P + 50t$	$Q + 50t$
e.	$\frac{P}{P + Q}$	0.5
f.	$\frac{P}{Q}$	$\frac{Q}{P}$
g.	P^2	Q^2

Correct Answer:

- a. Jeremy
- b. Jamal
- c. Jamal
- d. Jamal
- e. Jamal
- f. Jamal
- g. Could be either. If $|Q| > |P|$, then Jamal's is bigger. Otherwise, Jeremy's is bigger.

2) Standard(s): A-SSE.1 , A-SSE.2

Source: Illustrated Mathematics

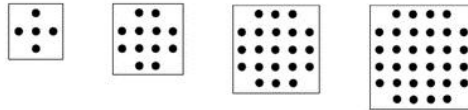
<https://www.illustrativemathematics.org/content-standards/HSA/SSE/A/2/tasks/21>

Item Prompt: Seeing Dots

Consider the algebraic expressions below:

$$(n + 2)^2 - 4 \quad \text{and} \quad n^2 + 4n$$

- a. Use the figures below to illustrate why the expressions are equivalent:



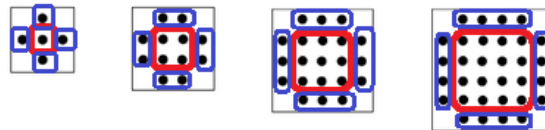
- b. Find some ways to algebraically verify the same result.

Correct Answer:

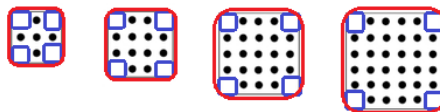
A geometric approach to the problem proceeds by identifying, somewhere in the n -th figure, the value n , and seeing two ways of looking at the dots, giving both $(n + 2)^2 - 4$ and $n^2 + 4n$. One such approach (among many) is below.

Let n be the number of the figure, with $n=1$ at the left. We count the dots in each figure in terms of n in two different ways. One represents $n^2 + 4n$ and the other represents $(n + 2)^2 - 4$.

Visualizing $n^2 + 4n$: n^2 is the inside full square (red). $4n$ is the four outside borders with n in each (blue).



Visualizing $(n + 2)^2 - 4$: Imagine the larger square (red) with the four corner dots removed (blue). Then $n + 2$ is the side length of the large square and $(n + 2)^2$ is the number of dots in the larger square. -4 is the number of corner dots removed.



Perhaps most directly, we have

$$\begin{aligned} &(n + 2)^2 - 4 \\ &(n + 2)(n + 2) - 4 \\ &(n^2 + 4n + 4) - 4 \\ &n^2 + 4n \end{aligned}$$

Alternatively, reversing the steps in this series of equalities is precisely the process of completing the square for the expression $n^2 + 4n$. Similarly, the left-hand side could be viewed as a difference of two squares, in which case we can reason:

$$\begin{aligned} &n^2 + 4n \\ &(n^2 + 4n + 4) - 4 \\ &(n + 2)^2 - 4 \end{aligned}$$