MISSISSIPPI DEPARTMENT OF EDUCATION
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MISSISSIPPI
EXEMPLAR
Units & Lessons
MATHEMATICS

Grade 6

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MISSISSIPPI DEPARTMENT OF EDUCATION

P.O. Box 771 | Jackson, MS | 39205-0771
Tel (601) 359-2586
www.mde.k12.ms.us
Twitter: @MissDeptEd

Acknowledgements

Mississippi Exemplar Units and Lessons Project Leads

The Mississippi Department of Education gratefully acknowledges the following individuals for their leadership in the development of the Mississippi Exemplar Units and Lessons.

Dr. Nathan Oakley
Chief Academic Officer

Devin Boone
Office of Professional Development Program Manager

Barbara Bowen
ELA Professional Development Coordinator

Elise Brown
Math Professional Development Coordinator

Wendy Clemons
Office of Professional Development Executive Director

Dana Danis
Office of Secondary Education ELA Curriculum Specialist

Dr. Marla Davis
Office of Secondary Education Bureau Director

Joyce Greer
Office of Early Childhood Instructional Specialist

Kristi Higginbotham
Special Education Professional Development Coordinator

Dr. Felicia Jackson-Stewart
ELA Professional Development Coordinator

Ashley Kazery
ELA Professional Development Coordinator

Kristina Livingston
Professional Development Coordinator Director

Celeste Maugh
Math Professional Development Coordinator

Tanjanikia McKinney
Science Professional Development Coordinator

Jennifer Nance
Office of Secondary Education Office Director II

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Mississippi Exemplar Units and Lessons Developers and Contributors

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Kimberlee Alexander
Greenville Public School District

Teresa Amacker
Ocean Springs School District

Terwinda T. Banks
Canton Public School District

Ebony Bealer
Harrison County School District

Kate Boteler
Madison County School District

Lydia Boutwell
MDE Early Childhood Consultant

Jeannie Brock
Benton County School District

Elisa Bryant
Lafayette County School District

Melissa Buck
MDE Literacy Coach

Leigh Ann Cheeseman
MDE Literacy Coach

Cindy Christian
Rankin County School District

Nicole Cockrell
Madison County School District

Angela Davis
MDE Literacy Coach

Samantha Edwards
South Panola School District

Beverly Farr
DeSoto County School District

Lisa Hamrick
Pascagoula – Gautier School District

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Mississippi Exemplar Units and Lessons Developers and Contributors

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Roxanne Harper
Brookhaven School District

Jessica Holyfield
Rankin County School District

Melanie Irby
Pearl Public School District

Lisa Lairy
West Point Consolidated School District

Shirley Massey
MDE Literacy Coach

Catrice Mitchell
Hinds County School District

Brenda Nelson
Gulfport School District

Cyndi Parker
Harrison County School District

Allison Ruhl
Madison County School District

Rebecca Russell
Rankin County School District

Kelly Smith
MDE Literacy Coach

Leigh Ann Smith
Lauderdale County School District

Nicole Smith
Jones County School District

Lori Stringer
MDE Literacy Coach

Katie Szabo
Lafayette County School District

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Mississippi Exemplar Units and Lessons Developers and Contributors

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Lydia Boutwell
MDE Early Childhood Consultant

Courtney D. Brown
Jackson Public School District

Ashley Boyd
DeSoto County School District

Toni Canizaro
Clinton Public School District

Tracy Catchings
Vicksburg-Warren School District

Susan Craddieth
Columbus Municipal School District

Alesheia Cunningham
DeSoto County School District

Savannah Evans
Lamar County School District

Fanchon Freeman
Clarksdale Municipal School District

Beth Fulmer
Math Curriculum Consultant

Jennifer Gaston
Coffeeville School District

Kathleen Hamilton
Marshall County School District

Rachael Hayes-Magee
Biloxi Public School District

Caroline Heblich
DeSoto County School District

Susan Jarvis
Ocean Springs School District

Veronica Jefferies
Vicksburg-Warren School District

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Mississippi Exemplar Units and Lessons Developers and Contributors

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Jeyakumar Jeyaraj
East Jasper Consolidated School District

Melissa Lowe
Lauderdale County School District

Lucy Ann Martin
Jackson Public School District

Lynda Mathieu
George County School District

Bonnie Maready
DeSoto County School District

Kimberly B. McKinney
West Point Consolidated School District

Hertensia V. Mixon
DeSoto County School District

Shalaan Oliver-Hendricks
Columbus Municipal School District

Amy Shelly
Special Education Professional Development Coordinator

TaShara Smith-Shoemaker
Hattiesburg Public School District

Mariella Simons
MDE Consultant

Ashleigh Syverson
Harrison County School District

David H. Taylor II
Laurel School District

Jennifer C. Wilson
Rankin County School District

Introduction

Mission Statement

The Mississippi Department of Education (MDE) is dedicated to student success, including the improvement of student achievement in English Language Arts (ELA) and mathematics in order to produce citizens who are capable of making complex decisions, solving complex problems, and communicating fluently in a global society. The Mississippi College- and Career-Readiness Standards (MS CCRS) provide a consistent, clear understanding of what students are expected to know and be able to do by the end of each grade level or course. The standards are designed to be robust and relevant to the real world, reflecting the knowledge and skills that students need for success in college and careers and to compete in the global economy. The goal of the MDE is to provide educators with the training and resources to understand and implement the MS CCRS effectively.

Purpose

In efforts to facilitate implementation and promote understanding of the MS CCRS for ELA and mathematics, the W. K. Kellogg Foundation generously awarded the MDE a grant to secure a cadre of effective educators to develop the MS CCRS Exemplar Units for teachers. Specifically, a group of highly-effective Mississippi educators developed exemplar instructional units and lessons aligned to the MS CCRS for ELA and mathematics. The MS CCRS Exemplar Units address difficult-to-teach standards as determined by teachers and are designed to serve as exemplar models for instructional units, lessons, and resources. The MS CCRS Exemplar Units have been vetted through nationally renowned vendors to ensure exemplar quality.

Design Overview

The MS CCRS Exemplar Units for ELA and mathematics address grade-level specific standards for Pre-Kindergarten-8th grade, as well as for Algebra, English I, and English II. The overall unit plan is described in the first section of the ELA and math units. This section includes the unit title, a suggested time frame, the grade level MS CCRS addressed and assessed, a unit overview with essential questions and a summary of lesson tasks, and the culminating/performance task description and rubric.

Though the math and ELA overall unit plan designs are very similar, some design aspects differ in order to accommodate the respective requirements of each content area. For mathematics, the first section also provides a segment designated for the Standards for Mathematical Practices (SMPs) addressed in the unit. For ELA, the first section also includes a text set with links to texts (if in the public domain) and a fresh/cold-read task.

The second section of each unit includes lesson plans. Within the lesson plans, provided are lesson-specific MS CCRS, suggested time frames, learning targets, guiding questions, required resources and materials, vocabulary terms and instructional strategies, teacher directions, instructional supports for students, enrichment activities, student handouts, assessments (formative, summative, pre-, and self-), and additional resources to aid in the implementation of the lessons.

Implementation

The intention of the MS CCRS Exemplar Units for ELA and mathematics is to provide educators with resources to understand and implement the MS CCRS effectively. The implementation of the MS CCRS Exemplar Units for ELA and mathematics is voluntary. Additionally, the MDE will provide ongoing support for implementation of the MS CCRS Exemplar Units with initial regional trainings followed by site-specific support through our regional service delivery model. For regional and site-specific training, please contact the MDE Office of Professional Development.

Grade Level	Unit Title	Duration
6	"Let's Express Ourselves" Understanding Numerical and Algebraic Expressions	14 Days

Mississippi College- and Career-Readiness Standards for Mathematics	Standards for Mathematical Practice
Focus: **6.EE.1** Write and evaluate numerical expressions involving whole- number exponents. **6.EE.2** Write, read, and evaluate expressions in which letters stand for numbers. **a.** Write expressions that record operations with numbers and with letters standing for numbers. **b.** Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity. **Additional:** **6.EE.2c.** Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). **6.EE.3.** Apply the properties of operations to generate equivalent expressions. *For example, apply the distributive property to the expression 3(2+x) to produce the equivalent expression 6 + 3x; apply the distributive property to the expression 24x + 18y to produce the equivalent expression 6(4x + 3y); apply properties to y + y + y to produce the equivalent expression 3y.* **6.SP.4.** Display numerical data in plots on a number line, including dot plots, histograms, and box plots.	**SMP.1** Make sense of problems and persevere in solving them. **SMP.2** Reason abstractly and quantitatively **SMP.3** Construct viable arguments and critique the reasoning of others. **SMP.4** Model with mathematics **SMP.5** Use appropriate tools strategically. **SMP.6** Attend to precision. **SMP.7** Look for and make use of structure. **SMP.8** Look for and express regularity in repeated reasoning.

Unit Overview

Throughout this unit, students will expand their understanding of evaluating numerical expressions using the order of operations that include brackets, parentheses, exponents, and each of the four operations to develop an understanding of algebraic expressions and equations. Students will learn equivalent expressions by relating algebraic expressions to arithmetic and properties of arithmetic (commutative, associative, and distributive). Students will identify and explain why two expressions are equivalent. Applying prior knowledge from Grade 5, where whole number exponents were used to express powers of ten, students will examine exponents and carry out the order of operations of exponents in numerical expressions. Over the course of the unit, students will write, interpret, and use expressions and equations that can be evaluated when replacing the variable with a given number. Through the performance task "Why Are So Many Wrong?" students' abilities to evaluate expressions, critique the reasoning of others, and analyze data through the use of social media will be assessed.

Essential Questions:

- How can I write and evaluate an expression that represents real-life situations?
- Why is it important to have a standard order of operations?
- How does changing the order of operations affect the outcome when finding the value of an expression?

Lesson Tasks

Lesson 1: Introduction to Exponents
Students create models to represent exponential expressions, evaluate area and perimeter with exponents, write area and perimeter calculations in standard form, exponential form, and expanded form.

Lesson 2: Introduction to Exponents
Students create a foldable to serve as a study guide for unit vocabulary. Students will explore how whole-number exponents appear in numerical and algebraic expressions. Students work with a partner to evaluate whole numbers and fractions with whole-number exponents writing them in standard, expanded, and exponential form.

Lesson 3: Order of Operations with Exponents
Students evaluate numerical expressions using the order of operations involving whole numbers and whole-number exponents. Students discover how the placement of parentheses in numerical expressions affects the value of the expression. Students will create posters showing their work and justifying answers.

Lesson 4: Laws of Operations
Students write and evaluate numerical expressions with parentheses and whole-number exponents following the order of operations. Students participate in a gallery walk with previous day's posters and critique the work of other students. Students participate in an Around the World activity solving numerical expressions with immediate feedback from the teacher.

Lesson 5: Small Groups/Stations: Exponents and Order of Operations
Students will work in small groups/stations to practice skills taught in Lessons 1-4. Students will complete the following stations: 1) 4 x 4 Square, 2) Birthday Math Expression, 3) Krypto as Order, 4) Hot Potato, 5) Find the Teacher's Mistakes, and 6) Exponents Galore.

Lesson 6: Algebraic Expressions
Students create a foldable for the parts of an algebraic expression. Students use sentence strip holders and Algebraic Expression Cards to identify parts of algebraic expressions and play Expression Charades with a partner.

Lesson 7: Evaluate Numeric and Algebraic Expressions Work Stations
Students work individually and in pairs to practice skills taught in this unit. Students will complete the following stations: 1) Writing Algebraic Expressions Scavenger Hunt, 2) Write algebraic and numeric expressions for volume of cubes and area of squares, 3) write and compare algebraic expressions with similar wording but different values, and 4) complete a self-evaluation for skills learned in this unit.

Lesson 8: Culminating Performance Task – Why Are So Many Wrong?
Students review writing numerical expressions with "My Favorite No." Students demonstrate their knowledge of the order of operations and solving expressions by answering questions about Professor Pete's blog. Students will reply to a comment and write a comment of their own. Students will write an expression of their own containing 7 parts, make and evaluate predictions based on 350 replies to their expression, and create a histogram showing their data. Students will be given a scoring rubric to evaluate their work.

Performance/Culminating Task

Why Are So Many Wrong?
The performance task invites students to examine the blog of Professor Pete that shows an expression he posted on social media and his analysis of the 865 responses and/or comments he received. Students will evaluate and answer questions about the information based on the order of operations. Students will compose two comments – one in response to an existing comment and a new one of their own. These will not be posted. As an extension, students will create an expression containing 6 parts. They will make projections about the responses of 350 hypothetical respondents, evaluate the responses, and create a graph (line, bar, circle, pictograph, or dot plot) based on the hypothetical responses.

Standards Assessed: 6:EE.1, 6.EE.2a, 6.EE.2b

Rubric for Performance Task:

Level	Mastery Level	Evaluate Reasoning using knowledge of order of operations	Algebra Vocabulary in discussion context	Generating an Expression using all required components	Visual Representation of Predicted Responses
4	Exemplifying Mastery	Accurately answer 5 questions to evaluate reasoning.	Both comments: • Use vocabulary correctly. • Are mathematically accurate. • Reference the order of operations.	Expression is written with all 6 components.	Graph provides 4 reasonable responses for the problem provided and is easy to read.
3	Approaching Mastery	Accurately answer 4 questions to evaluate reasoning.	Both comments contain 2 criteria.	Expression is written with 4-5 components.	Graph provides 3 reasonable responses for the problem provided and is easy to read.
2	Developing Mastery	Accurately answer 2-3 questions to evaluate reasoning.	Both comments contain 1 criterion.	Expression is written with 2-3 components.	Graph provides 2 reasonable responses for the problem provided.
1	Not Representing Mastery	Accurately answer 1 question to evaluate reasoning.	Only one comment contains 1 criterion and the other has none of the criteria.	Expression is written with fewer than 2 components.	Graph provides 1 reasonable response for the problem provided.
0	No Evidence of Mastery	No questions are answered accurately.	Comments either not included or not complete.	Expression is missing.	Graph is missing or unintelligible.

Lesson 1: Introduction to Exponents

Focus Standard: 6.EE.1

Additional Standard: 6.EE.2c

Standards for Mathematical Practice: SMP.3, SMP.4, SMP.7

Estimated Time: 60 min

Resources and Materials:

- Document camera
- Color tiles
- Centimeter cubes
- Personal white boards-1 per student
- Dry erase markers-1 per student
- Scissors
- Sticky-notes
- Handout 1.1: I Can Statements – Standards of Focus
- Handout 1.2: The Power of Exponents – Area & Volume
- Handout 1.3: The Power of Exponents – Length Cards
- Handout 1.4: Exponents Practice Homework
- Rational Expressions: http://www.rationalexpressions.blogspot.com/2013/11/exponents-without-repeated.html
- Practice with Exponents: https://www.ixl.com/math/grade-6/write-multiplication-expressions-using-exponents

Learning Target:

Students will create models to represent exponential expressions, evaluate numbers with exponents and write numbers in standard form, exponential form, and expanded form.

Guiding Questions:

- What pattern is evident when numbers with exponents are evaluated?
- How are exponents useful in real-world situations?

Vocabulary

Academic Vocabulary:

- Base
- Cubed
- Exponent
- Expanded form
- Exponential form
- Power
- Squared
- Standard form

Instructional Strategies for Academic Vocabulary:

☐ Introduce words in a mathematical context.
☐ Model how to use the words in discussion.

Symbol	Type of Text and Interpretation of Symbol
	Instructional support and/or extension suggestions for students who are EL, have disabilities, or perform well below the grade level and/or for students who perform well above grade level.
✓	Assessment (Pre-assessment, Formative, Self, or Summative)

Instructional Plan

Understanding Lesson Purpose and Student Outcomes:
Students will create models to represent exponential expressions, evaluate area and volume with exponents, and write area and volume calculations in standard form, exponential form, and expanded form.

Anticipatory Set/Introduction to the Lesson:

Display a set of blocks (see above) using a document camera (SMP.4).
Note: If a document camera is not available, display the above picture.

Give students 5 minutes to determine the number of cubes in the seventh figure if the pattern were to continue. Allow students to share solutions with other members of their group. Students compare answers and approaches for solving the problem (SMP.3).

Note: Students should be able to defend the method they used to complete the pattern, and groups should be able to agree upon a final solution.

One student from each group records the answer on the board. Discuss student answers and address any misconceptions that became present in the activity.

For students who are EL, have disabilities, or perform well below the grade-level:

- Provide manipulatives or visuals for students to create the figures and extend the pattern.

Extensions for students with high interest or working above grade level:

- Provide sticky notes to record the exponential expression that represents each figure.
- Allow students the opportunity to work on more challenging figures.

Activity 1: **Modeling Exponents with Manipulatives**
Review the picture from the Anticipatory Set.
Discuss how to find area by multiplying the length by the width.

T: The first figure in the pattern has only one cube.
This means that it has an area of 1 unit by 1 unit, or 1 square unit, or 1 unit squared.
There are four cubes in the second figure.
What can we determine about its area by the picture?

Possible responses include: The area is 4 square units. There are 4 units in the whole square.

T: The third figure in the pattern has 9 cubes.
Are you noticing any pattern in the set of figures?
Look at the fourth figure. What do all the shapes have in common?

Possible solutions: They are all squares. The squares are growing/increasing.

Note: Using prior knowledge, students should be able to calculate the number of cubes in the figures as the pattern continues (SMP.7).

T: As the pattern continues, the squares are increasing.
This pattern represents exponents in terms of square units.
The second figure has an area of 4 square units or 4 units squared.
This can be solved by multiplying 2 x 2 to find the area of the square.
The second figure has an area of 4 square units or 4 units squared.

Explain the remaining figures in the pattern by stating that $3 \times 3 = 3^2$, or 9 square units and that $4 \times 4 = 4^2$, or 16 square units.
Write this on an anchor chart showing how to calculate the area for each of the 4 figures.
Explain that 3x3 is called expanded form, 3^2 is called exponential form, and 9 is called standard form.

Distribute color tiles to students.

T: Use six 1-inch color tiles to make a length.
What is the length including the unit? (6 in)
Create a square with a length and width of six 1-inch color tiles.

What is the total number of color tiles? (36)
What is the area of the square? (36 square in)
What multiplication number sentence can you write to show this? (6x6)
Write 6 x 6 in exponential form. (6^2)

Students use color tiles to create 3 more squares with different lengths from the ones already used. On their personal white boards, students write the length of the square, expanded, exponential, and standard form to show the total number of color tiles they used.

Introduce cubed figures by displaying a picture of a building that looks like a cube.
Tell students the building is 20 feet tall, 20 feet wide, and 20 feet long.
Review the meaning of volume – how much space an object takes up.
Students talk with a neighbor to determine the multiplication expression used to find the total volume of the building. (20x20x20)
Discuss students' responses and correct any misconceptions.

T: Use three centimeter cubes to make a length.
What is the length including the unit? (3 cm)
Create a square with a length and width of 3 cm
What is the total number of blocks? (9 cm)
Make a cube by adding two more layers of 9 cm cubes on top of the first layer.
How many centimeter cubes did you use? (27)
What multiplication number sentence can you write to show this? (3x3x3)
Can you write that in a shorter form using an exponent? (3^3)

Students create three more cubes. Students write on their white boards the length, width and height of the cube, expanded, exponential, and standard form to show the total number of centimeter cubes they used, and write an expression using an exponent.

Note: Rational Expressions provides the teacher with additional support in using manipulatives when working with squared and cubed numbers.

Give students **Handout 1.1 I Can Statements- Standards of Focus**. Explain to students that every day they at the end of the day,

they should check their growth with the I Can statements and problems.

Activity 2: Exponents Practice
Review the meaning of each column heading:

- Expanded Form – how many times the base is multiplied (the expanded form of 3^2 is 3 x 3)
- Exponential Form – a base number written with an exponent (3^2)
- Standard Form– the value of the product ($3^2 = 9$, 9 is the Standard Form/Product)

Distribute **Handout 1.2: The Power of Exponents – Area & Volume** to each student. Have students work in pairs to complete the activity. Distribute **Handout 1.3: The Power of Exponents - Length Cards** and scissors to each student pair. Instruct students to cut out the length cards and work with a partner to complete the Exponents Practice for Area and Volume.

- ✓ Student pairs use the length cards to calculate area and volume, writing the length, expanded form, exponential form, and standard form.

Note: This discussion will be useful in the upcoming lessons involving equivalent expressions. Provide students with additional support and opportunities to Practice with Exponents.

For students who are EL, have disabilities, or perform well below the grade-level:

- Students use color tiles and centimeter cubes to model the squares and cubes.

Extensions for students with high interest or working above grade level:

- Find the length of a square or the volume of a cube given the standard form of the area or volume.

Reflection and Closing:

- ✓ Ask students to look at **Handout 1.1 I Can Statements: Standards of Focus** to check any progress they made today.
- ✓ Review Activity 2 with the class.

Prompting questions:

- What patterns do you see?
- Which affected the value of the product more: the value of the base or the value of the exponent?
- Which form is more efficient: expanded form or exponential form and why?

✓ **Exit Ticket**

The yard at Lee's school, McGyver Middle School, is a square with a side length of 34 feet. Lee's bedroom forms a cube with a side length of 12 ft. Which is greater, the area of the playground at Lee's school or the volume of his bedroom? Write your calculations for both area and volume in expanded, exponential, and standard form.

For students who are EL, have disabilities, or perform well below the grade-level:

- Provide side lengths with lesser values.
- Students can use an anchor chart to review or notes previously taken.

Homework

Students complete **Handout 1.4: Exponents Practice Homework**.

Handout 1.1: I Can Statements – Standards of Focus (*6.EE.1, 6.EE.2a, 6.EE.2b*)

Standard	***Topic***	***I Can:***	***Example:***	***Student Assessment***	***Teacher Assessment***
6.EE.1	Simplifying expressions	*I can simplify expressions with exponents*	Simplify each of these: A. 5^3 B. $(\frac{1}{2})^4$ C. 1^7 D. 4^0		
6.EE.1	Simplifying expressions	*I can simplify expressions with all 4 operations, exponents, and grouping symbols.*	Which of these are equivalent to 20? Select the two correct responses. A. $2(3)^2 - 16$ B. $4(5-2) + 2^3$ C. $5 + 5\ (9 - 7)$ D. $(8 + 2)^2$ E. $4^2 + 10 \div 5 \cdot 2$		
6.EE.2a	Writing expressions	*I can use symbols and numbers in place of words used in a mathematical expression.*	Express these using math: a. The quotient of a number and 7 b. Twice the sum of 8 and a number c. Four less than the product of nine and a number		
6.EE.2a	Writing expressions	*I can use symbols and numbers in place of words used in a mathematical expression.*	Which of these could be expressed as 2x – 5? Choose all that apply. **A**. 5 less than twice a number **B**. Two times x, subtracted from 5. **C**. The difference of two x and 5 **D**. The product of two, five and x		
6.EE.2a	Writing expressions	*I can use words in place of numbers and symbols used in a mathematical expression.*	Express using words: A. $\frac{x+5}{4}$ B. 5(m + n) C. 4m – 3 D. 10 + 3(x – y)		
6.EE.2b	Algebraic Terms	*I can identify parts of an expression using correct terms*	Tara correctly says that in the expression 7(x + 4), "x + 4" is used as both a sum and as a factor. Explain her reasoning..		
6.EE.2b	Algebraic Terms.	*I can identify parts of an expression using correct terms*	In this expression, $\boldsymbol{4x^3 + 9\ (x - 2)}$, identify the: a. factors b. exponent c. coefficient d. difference		

Handout 1.1: I Can Statements – Standards of Focus (*6.EE.1, 6.EE.2a, 6.EE.2b*) **KEY**

Standard	***Topic***	***I Can:***	***Example:***	***Student Assessment***	***Teacher Assessment***
6.EE.1	Simplifying expressions	*I can simplify expressions with exponents*	Simplify each of these: A. 5^3 125 B. $(½)^4$ $\frac{1}{16}$ C. 1^7 1 D. 4^0 1		
6.EE.1	Simplifying expressions	*I can simplify expressions with all 4 operations, exponents, and grouping symbols.*	Which of these are equivalent to 20? Select the two correct responses. B and E A. $2(3)^2 – 16$ B. $4(5-2) + 2^3$ C. $5 + 5 (9 – 7)$ D. $(8 + 2)^2$ E. $4^2 + 10 ÷ 5 \cdot 2$		
6.EE.2a	Writing expressions	*I can use symbols and numbers in place of words used in a mathematical expression.*	Express these using math: a. The quotient of a number and 7 $n ÷ 7$ or $\frac{n}{7}$ (preferred form) b. Twice the sum of 8 and a number $2(8 + n)$ or $2(n + 8)$ c. Four less than the product of nine and a number $9 \cdot n – 4$ or $9n – 4$(preferred form)		
6.EE.2a	Writing expressions	*I can use symbols and numbers in place of words used in a mathematical expression.*	Which of these could be expressed as $2x – 5$? Choose all that apply. A and C **A**. 5 less than twice a number $2x - 5$ **B**. Two times x, subtracted from 5. $5 - 2x$ **C**. The difference of two x and 5 $2x - 5$ **D**. The product of two, five and x $(2)(x)(5)$		
6.EE.2a	Writing expressions	*I can use words in place of numbers and symbols used in a mathematical expression.*	Express using words: A. $\frac{x + 5}{4}$ B. $5(m + n)$ C. $4m – 3$ D. $10 + 3(x – y)$ Some possibilities are: A. the sum of x and 5 divided by 4 B. 5 times the sum of m and n) C. 3 less than the product of 4 and m D. 10 more than 3 times the difference of x and y		
6.EE.2b	Algebraic Terms	*I can identify parts of an expression using correct terms*	Tara correctly says that in the expression $7(x + 4)$, "$x + 4$" is used as both a sum and as a factor. Explain her reasoning. It is a sum because it is 2 terms (x and 4) being added together. It is a factor because it is being multiplied by 7.		
6.EE.2b	Algebraic Terms.	*I can identify parts of an expression using correct terms*	In this expression, $\boldsymbol{4x^3 + 9 (x - 2)}$, identify the: a. factors 4, x^3, 9, $(x – 2)$ b. exponent 3 c. coefficient 4 d. difference $(x – 2)$		

Handout 1.2: The Power of Exponents - Area

Name:_____ Date: _____

Directions: Each player turns over a card and uses that for the length of the square. Write and calculate the area in expanded form, exponential form, and standard form for each length.

Length of Square	Expanded Form	Exponential Form	Standard Form (Area with Unit)

Handout 1.2: The Power of Exponents – Volume

Directions: Each player turns over a card and uses that for the length of the square. Write and calculate the volume in expanded form, exponential form, and standard form for each length.

Length of Cube	Standard Form	Expanded Form	Standard Form (Volume with Unit)

Handout 1.3: The Power of Exponents - Length Cards

3 mm	4 mm	5 mm
6 in	2.3 in	8 in
9 ft	10 ft	$\frac{2}{5}$ ft
12 cm	13 cm	14 cm
15 m	16 m	1.7 m
$\frac{1}{8}$ yd	3.1 yd	$\frac{1}{2}$ yd
2.01 in	20 ft	3 yd
40 mL	$\frac{3}{4}$ mL	6 mL

Handout 1.4: Exponents Practice Homework

Name:_____ Date: _____

Directions: Complete the chart by filling in the missing values.

Exponential Form	Expanded Form	Standard Form
5^2		
	3x3x3	
		$1000\ mL^3$
		$144\ ft^2$
	7x7x7x7	
2^5		

Handout 1.4: Exponents Practice Homework - Key

Name:_____ Date: _____

Directions: Complete the chart by filling in the missing values.

Exponential Form	Expanded Form	Standard Form
5^2	5 x 5	25
3^3	3x3x3	27
10^3	10x10x10	1000 mL^3
12^2	12x12	144 ft^2
7^4	7x7x7x7	2401
2^5	2x2x2x2x2	32

Lesson 2: Introduction to Exponents

Focus Standard: 6.EE.1

Additional Standard: 6.EE.2c

Standards for Mathematical Practice: SMP.3, SMP.5, SMP.6, SMP.7, SMP.8

Estimated Time: 60 minutes

Resources and Materials:

- Copy paper for Exponent Vocabulary 6-Door Foldable or vocabulary notebook
- 1 red dot cube and 1 green dot cube per pair of students
- Personal white boards-1 per student
- Dry erase markers-1 per student
- Handout 2.1: Exponents
- Handout 2.2: Exploring Squares
- Write Numerical Expressions Involving Whole Number Exponents: https://learnzillion.com/lesson_plans/8408-write-numerical-expressions-involving-whole-number-exponents

Learning Target:
Students will write and evaluate numerical expressions involving whole-number exponents.

Guiding Questions:

- What is the difference between an algebraic expression and a numerical expression?
- How are standard form and exponential form related?

Vocabulary

Academic Vocabulary:

- Base
- Cubed
- Exponent
- Numeric expression
- Power
- Repeated multiplication
- Squared

Instructional Strategies for Academic Vocabulary:

☐ Introduce words in a mathematical context.
☐ Model how to use the words in discussion.
☐ Read and discuss the meaning of word in a mathematical context

Symbol	Type of Text and Interpretation of Symbol
	Instructional support and/or extension suggestions for students who are EL, have disabilities, or perform well below the grade level and/or for students who perform well above grade level.
✓	Assessment (Pre-assessment, Formative, Self, or Summative)

Instructional Plan

Understanding Lesson Purpose and Student Outcomes: Students will create a foldable graphic organizer as they are introduced to new vocabulary. Students will write and evaluate numerical expressions involving whole-number exponents.

Anticipatory Set/Introduction to the Lesson

Display this numeric expression on the board before students arrive: $2^5 + 2 \times 2.5$

Instruct students to use prior knowledge of order of operations to find its value. Give students 5 minutes to work. Have students share solutions with other members of their group. In their group, students compare answers and approaches for solving the problem (SMP.3). One student from each group records the answer on the board. Discuss student answers and address any misconceptions that became present in the activity.

Note: Students should be able to defend the method they used to solve the expression, and groups should be able to agree upon a final solution.

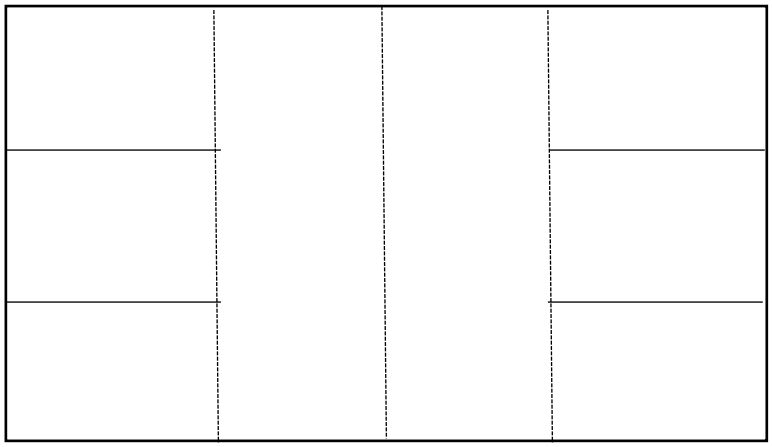
For students who are EL, have disabilities, or perform well below the grade-level:

- Students begin the activity by working with a partner or small group.
- Students use notes from previous lessons regarding exponents.

Extensions for students with high interest or working above grade level:

- Students thoroughly explain the reason for applying the exponent first in this equation.

Activity 1: **Exponent Vocabulary Foldable**



Distribute copy paper for vocabulary foldable. Model for students how to fold the paper and how it is used for organizing the vocabulary words. Encourage students to restate the definitions in their own words.

T: Turn your paper landscape style.
Fold the paper in half, hamburger style (see dotted lines).
Open the paper up and fold the outer edges to the center fold (see long dashed lines).
Cut as indicated by the solid lines. You have created 6 flaps, one for each vocabulary word.
Write one vocabulary word on the outside of one flap.
On the inside of each flap, write the corresponding definition.
In the center section, write an example of the vocabulary word.

Note: Teacher can use the foldable technique with other vocabulary words throughout the unit or use a vocabulary notebook.

For students who are EL, have disabilities, or perform well below the grade-level:

- Provide students with paper that is already folded if the activity of creating the foldable will cause delays for the student.

Vocabulary Words:

- Numeric expression: a mathematical phrase involving only numbers and one or more operational symbols.
- Base: a number that is to be raised to a power; the factor in the repeated multiplication problem.
- Exponent: number above the base; tells you how many times the base is being used as a factor.
- Power: an action in multiplication given the power to multiply a duplicate value times another value.
- Squared: when you multiply a number by itself.
- Cubed: when a number is used as factor three times in a multiplication problem.

Activity 2: Evaluating Numerical Expressions with Exponents

Highlight the part of the numeric expression in the warm-up problem that has the same number being used as a factor five times: 2 x 2 x 2 x 2 x 2.

T: Writing repeated multiplication like this uses a lot of paper. Instead, we can write an expression with an Exponent, 2 x 2 x 2 x2 x 2 can be written as 2^5 and read as 'two raised to the fifth power.'
The parts of this term are as follows: 2 is the base and 5 is the exponent or power to which the base is being raised.
The base is the number that is being used as a factor repeatedly.
The exponent is the number of times that the base is being multiplied by itself.

Instruct students to use dry erase boards to write examples of repeated multiplication in exponential notation (SMP.8). Record examples on the board. Discuss several examples and ask students to determine if the examples are written correctly in exponential notation. Prompt students to look at their vocabulary foldable and identify the vocabulary term that relates to each component of the term.

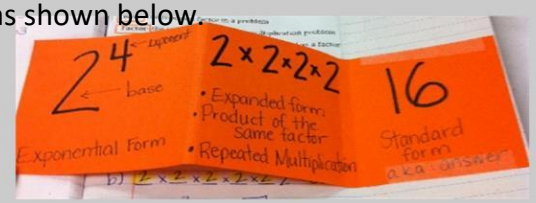
Create an anchor chart, labeling each part of the term with the appropriate vocabulary word. This will remain on display for the remainder of the unit. Students critique the examples and identify if any mistakes have been made (SMP.3).

Display $(\frac{1}{2})^2$. Instruct students to write this expression in expanded form on their personal white boards. $(\frac{1}{2} \times \frac{1}{2}$ Check for accuracy and discuss any misconceptions.

Note: A common misconception students make in this lesson is that 2^3 is equal to 2 x 3, rather than 2 x 2 x 2 or $(\frac{1}{2})^2$ is equal to $\frac{1}{2}$ x 2 because they multiply the base and the exponent. Provide the students with several examples to help them understand the purpose of the exponent. Another common misconception is that the exponent tells the number of multiplication signs.

For students who are EL, have disabilities, or perform well below the grade-level:

- Students create a second foldable to reinforce concepts of exponents. Students use the foldable as a study tool, as shown below.



Extensions for students with high interest or working above grade level:

- Students look to explain a quick way to apply an exponent to the fraction, without repeated multiplication.

Activity 3: Rolling the Dice with Exponents

Distribute **Handout 2.1: Exponents** and a set of red and green dot cubes (SMP.5).

Note: If you do not have red and green dot cubes, use one of these alternatives:

1. use any 2 different colored dot cubes
2. use 1 cube – first roll is the base and the second roll is the exponent
3. one partner rolls the base number and the other partner rolls the exponent

T: You and a partner need a red and a green dot cube. The red cube will be the base and the green cube will be the exponent. Take turns rolling the cubes. Record the base and the exponent and then write the exponential expression. After you have recorded 10 numbers, find the expanded form of each exponential expression and calculate the value.

- ✓ Have students roll the cubes to create exponential expressions and calculate the values of the exponential expressions (SMP.6).

When students finish the table, they discuss their findings within their groups (SMP.7).

Reflection and Closing:

Discuss the student results and highlight the following points by asking:

- What was the largest value each team generated? The lowest value?
- Which makes an exponential expression grow faster: a large base or a large exponent?
- How does 3^2 compare to 3 x 2?

Revisit new vocabulary and add new words to word wall for the unit.

- ✓ Instruct students to review the definitions from Activity #1 with a partner and complete this exit ticket **Handout 2.2: Exit Ticket** (SMP.7).

What is the value of 6^3 = _____

What is the missing exponent in this expression: 4– = 256

What is the missing base in this expression: ^{6} = 729

Key: $6^3 = 216$ $4^4 = 256$ $3^6 = 243$

Homework

Students complete **Handout 2.3: Homework Squares**.

For students who are EL, have disabilities, or perform well below the grade-level:

- Students use graph paper to illustrate the animal pens – one square equals one unit.

Handout 2.1: Exponents

Name:_____ Date: _____

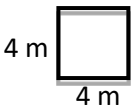
Partners need a red and a green dot cube. The red cube will be the base and the green cube will be the exponent. Take turns rolling the cubes. Record the base and the exponent and then write the exponential expression. After you have recorded 10 numbers, find the standard form of each exponential expression and calculate the value.

Base (red cube)	Exponent (green cube)	Exponential Form	Expanded Form	Value

Handout 2.2: Exploring Squares

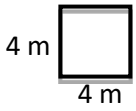
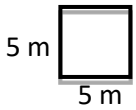
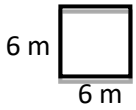
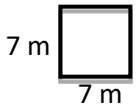
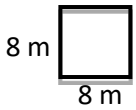
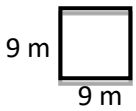
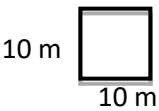
Name:_____ Date: _____

Minia knows that square animal pens are the most economical for the space they provide. Can you provide a table for Minia that shows the areas of square pens that have between 4 meters and 10 meters of fence on each side?

Side Length	Pen Picture	Equation	Area
4 meters		$4 \times 4 = 4^2$	$16m^2$
5 meters			
6 meters			
7 meters			
8 meters			
9 meters			
10 meters			

Exploring Squares Answer Key

Minia knows that square animal pens are the most economical for the space they provide. Can you provide a table for Minia that shows the areas of square pens that have between 4 meters and 10 meters of fence on each side?

Side Length	Pen Picture	Equation	Area
4 meters		$4 \times 4 = 4^2$	$16m^2$
5 meters		$5 \times 5 = 5^2$	$25m^2$
6 meters		$6 \times 6 = 6^2$	$36m^2$
7 meters		$7 \times 7 = 7^2$	$49m^2$
8 meters		$8 \times 8 = 8^2$	$64m^2$
9 meters		$9 \times 9 = 9^2$	$81m^2$
10 meters $100m^2$		$10 \times 10 = 10^2$	$100m^2$

Lesson 3: Order of Operations with Exponents

Focus Standard: 6.EE.2

Additional Standards: 6.EE.1, 6.EE.3

Standards for Mathematical Practice: SMP.2, SMP.3, SMP.4, SMP.7

Estimated Time: 60 minutes

Materials and Resources:

- Chart paper
- White boards-1 per student
- Dry erase markers-1 per student
- Markers
- Copy paper for Exponent Vocabulary 6-Door Foldable or vocabulary notebook
- Index cards
- Handout 3.1: Watch Out for Parentheses Task
- Order of Operations Expressions Game: http://www.shodor.org/interactivate/activities/OrderOfOperationsFou/
- My Favorite No: https://www.teachingchannel.org/videos/class-warm-up-routine
- Watch Out for Parentheses Task: https://www.illustrativemathematics.org/content-standards/tasks/1136

Learning Targets:

- Students will evaluate numerical expressions involving whole-number exponents.
- Students will use order of operations to solve numerical expressions involving whole numbers.
- Students will evaluate the placement of parentheses in numerical expressions as they affect the value of the expression.

Guiding Questions:

- Why do we need a specific order to solve numerical expressions?
- What are the steps in the order of operations?
- Does the placement of parentheses in an expression affect the value of the expression?

Vocabulary	
Academic Vocabulary: • Evaluate • Exponent • Numeric expression • Order of operations	**Instructional Strategies for Academic Vocabulary:** ☐ Introduce words in a mathematical context. ☐ Model how to use the words in discussion. ☐ Read and discuss the meaning of word in a mathematical context

Symbol	Type of Text and Interpretation of Symbol
	Instructional support and/or extension suggestions for students who are EL, have disabilities, or perform well below the grade level and/or for students who perform well above grade level.
✓	Assessment (Pre-assessment, Formative, Self, or Summative)

Instructional Plan

Understanding Lesson Purpose and Student Outcomes: Students will be introduced to simplifying expressions with exponents using the order of operations.

Anticipatory Set/Introduction to the Lesson:
Display the following on the board before students arrive:
Sam and Julio both found the value of the expression $3 + 6^2$.

Sam:	$3 + 6^2$	Julio:	$3 + 6^2$
	9^2		$3 + 36$
	81		39

Ask students who is correct, Sam or Julio? Let students discuss their answers and conclude who is correct by comparing the work of Sam and Julio (SMP.3).

Activity 1: Order of Operations

Introduce new vocabulary words and have students create a vocabulary foldable (see lesson 2, activity 1 for instructions) or record new vocabulary words in their vocabulary notebook.

- Evaluate: to find the value of an algebraic expression by replacing variables with numbers.
- Order of Operations: the rules that tell which operation to perform first when more than one operation is used (see above).

T: If we want to solve $3 + 2^5 - 4 \div 2$ using the order of operations, when do you think we need to evaluate the 2^5?"

Note: Students should make the connection that exponents must be evaluated before adding and subtracting because students multiply to find the value of the number with an exponent.

T: An exponent applies to its immediate base. How would you evaluate 2^5? (2 x 2 x 2 x 2 x 2 = 32)

Note: A misconception students have about exponents is that they multiply the base times the exponent (2x5). Remind students that the exponent indicates how many times the base is used as a factor in a repeated multiplication problem.

Display:

Example 1: $2 + 5^3$

Example 2: $(2+5)^3$

T: Do you think these two expressions have the same value? Why or why not? Turn and Talk to your partner to respond.

✓ Have students work with partners to discuss the differences in the two examples, evaluate the expressions, and decide on an answer (SMP.2).

Demonstrate how to solve each example and answer any questions. Present additional examples to clarify student understanding. Allow students to use response boards to display answers.

Note: Teachers often refer to the saying "Please Excuse My Dear Aunt Sally" when teaching order of operations. It is risky to use this phrase because students will look at it as a six-step process, when really there are only four steps.

Tell students the following order is preferred over the expression Please Excuse My Dear Aunt Sally:

1. Grouping symbols (parentheses), [brackets], {braces} – from the inside out
2. Exponents
3. Multiplication and division – from left to right in the order they appear
4. Addition and subtraction – from left to right in the order they appear

Create an anchor chart for the order of operations as it appears above and have students copy the order of operations in their math notebook. Write the following on the anchor chart:

$2+ (3-1) \times 3^2$

Demonstrate how to evaluate the expression following the order of operations:

Numerical Expression	$2+ (3-1) \times 3^2$
Step 1: $(3 - 1) = 2$	$2 + 2 \times 3^2$
Step 2: $3^2 = 9$	$2 + 2 \times 9$
Step 3: $2 \times 9 = 18$	$2 + 18$
Step 4: $2 + 18 = 20$	20

The value of the expression $2+ (3-1) \times 3^2$ is 20.

Note: A common mistake would be to add 2 + 2 before multiplying 2 x 9.

T: Would we get the same value if we do the addition before the multiplication?
What value would we get if we did the addition first? (36)
Why is it important to have an order of operations? (answers will vary)

Write the following on the board: $[8(4 - 1) + 2] + 3^3 \div 3$. Explain that since there are brackets with multiple computations, we must use the order of operations within the brackets first. Demonstrate how to evaluate the expression following the order of operations:

Numerical Expression $[8(4 - 1) + 2] + 3^3 \div 3$	
Step 1: (4 - 1) = 3	$[8(3) + 2] + 3^3 \div 3$
Step 2: 8(3) = 24	$[24 + 2] + 3^3 \div 3$
Step 3: [24+2] = 26	$26 + 3^3 \div 3$
Step 4: $3^3 = 27$	$26 + 27 \div 3$
Step 5: $27 \div 3 = 9$	$26 + 9$
Step 6: $26 + 9 = 35$	35

The value of the numerical expression $[8(4 - 1) + 2] + 3^3 \div 3$ is 35.

Activity 2: Parentheses in Expressions – "My Favorite No"

Note: To prepare for this activity, watch a video that demonstrates My Favorite No being used.

Distribute index cards or half sheets of paper. Display this expression: $46 – (26 - 2 + 8) \div 2^3 \times 3$. Give students 5 minutes to evaluate the expression. Instruct students to show each step of their calculations.

- ✓ At the end of the time collect the students' work being careful not to reveal the students' names. Go through the cards identifying those that have the work done correctly as "Yes" and those that have errors as "No". Look for misconceptions (these will be called "My favorite no") such as the following:
  - Adding 2 + 8 before you subtract 2 from 26
  - Exponent: Multiplying 2 x 3 instead of 2x2x2
  - Subtracting 24 from 46 before adding 8
  - Subtracting 32 from 46 before doing exponents then division and multiplication
  - Multiplying before dividing
  - Not understanding that the last operation they will do is subtracting from 46.

Select one card solved using a misconception to be your "Favorite No." Copy the incorrect work for the problem on the board without changing it. Facilitate an open discussion about why the work is not correct. If a student says the work or answer you displayed is incorrect, have them offer a reason why it is incorrect and have them tell how they would correct it (SMP.3).

For students who are EL, have disabilities, or perform well below the grade-level:

- Supply students with multiplication charts to assist with applying the operations.

Note: If time allows, show more than one misconception.

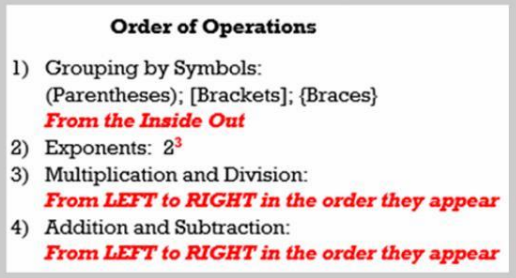
Activity 3: Watch Out for Parentheses

Distribute **Handout 3.1: Watch Out for Parentheses Task.** Instruct students to work independently to evaluate each expression and explain if any parentheses can be removed from the expressions without changing the values. Tell students to discuss their answers with their elbow buddy and critique their responses (SMP.3). Put students in groups to create a poster displaying their work for finding the value of each numerical expression and their answer and justification for the question (SMP.4). Tell students they will use the posters for a Gallery Walk in tomorrow's lesson.

Note: Students should be able to recognize the structure of the expressions and understand the purpose of the parentheses (SMP.7).

For students who are EL, have disabilities, or perform well below the grade-level:

- Students will use an order of operations card during the activity.



Extensions for students with high interest or working above grade level:

- Allow students to play an ~~Order of Operations Expressions Game~~ if they finish their work early. This game can be used as an enrichment tool in this lesson for the students who have a strong foundation in the skill and can move forward. The game can also be used to differentiate presentation of the lesson. Before students begin the activity, set it up to your specifications.

Reflection and Closing:

- ✓ Ask students to look at **Handout 1.1 I Can Statements: Standards of Focus** to check any progress they made today.
- ✓ Review Activity 3 with the class using prompting questions.
  Prompting Questions:
  - Does moving the parentheses in a numerical expression change the value of the expression?
  - Why is it important to have a standard order for evaluating numerical expressions?
  - What is the Order of Operations?
- ✓ Distribute 2 index cards to each student. Instruct students to create 2 numerical expressions with multiple operations using parentheses and exponents. Instruct students to write each expression on a separate index card and write their name on the card. Tell students to exchange one card with a Crosstown Companion and then exchange the other card with a different Crosstown Companion.

Homework
✓ On the index cards students received from their two crosstown companions, have students find the value of the 2 numerical expressions showing all the steps they used to solve the expression on the card. Have students write their names on the card.

Handout 3.1: Watch Out for Parentheses Task

Name:_____ Date: _____

Evaluate the following expressions.

A. $2[5 + (3)(2) + 4]$

B. $2[(5 + 3)(2+4)]$

C. $2[5 + 3(2 + 4)]$

Can the parentheses in any of these expressions be removed without changing the value the expression? Justify your answer with words and/or calculations.

_____

_____

_____

_____

Retrieved from: https://www.illustrativemathematics.org/content-standards/tasks/1136

Handout 3.1: Watch Out for Parentheses Task - Key

Solution

a. 2(5+(3)(2)+4). We may evaluate this expression in two ways:

Distributing the lead constant first:

2 · 5 + 2 · 3 · 2 + 2 · 4 = 10 + 12 + 8 = 30

or distributing the lead constant last:

2(5 +6 +4) = 2 ·15 = 30.

Either way, we should first multiply (3)(2) = 6 before adding any of the terms. The parentheses in the middle are not necessary. Instead of writing (3)(2) we can say 3 · 2.

b. Notice that in the expression 2((5+3)(2+4)), the outer set of parentheses are not necessary:

2((5 + 3)(2 + 4)) = 2(5 + 3)(2 + 4).

The other parentheses are necessary since they indicate that we should first perform the additions inside these parentheses:

2(5 +3)(2 +4) = 2(8)(6) = 96.

c. In this expression, we complete the operations from the inside out. The inner most addition must occur first, then the inner multiplication, then the secondary addition and finally the outer multiplication:
2[5 +3(2 +4)] = 2[5 + 3(6)] = 2[5 + 18] = 2[23] = 96.
The parentheses are necessary so that we add (2 + 4) first. Then the same parentheses act as a multiplication symbol for 3(2 + 4). Finally, the brackets are needed to ensure that 2 is multiplied by the total of the terms inside the parenthesis.

Retrieved from: https://www.illustrativemathematics.org/content-standards/tasks/1136

Lesson 4: Order of Operations with Exponents

Focus Standard: 6.EE.2

Additional Standards: 6.EE.1, 6.EE.3

Standards for Mathematical Practice: SMP.3, SMP.7

Estimated Time: 60 minutes

Materials and Resources:

- Scissors
- Glue
- Chart paper
- Sticky-notes
- Posters from previous lesson
- Stamp and stamp pad (for Around the World game)
- Handout 4.1: Around the World Problem and Posters
- Handout 4.2: Around the World Passport -1 per student

Learning Targets:

- Students will evaluate numerical expressions involving whole-number exponents.
- Students will use order of operations to solve numerical expressions

Guiding Questions:

- Why do we need a specific order to solve numerical expressions?
- What are the steps in the order of operations?
- Do brackets and parentheses always affect the value of an expression?

Vocabulary	
Academic Vocabulary: • Evaluate • Exponent • Numeric expression • Order of operations	**Instructional Strategies for Academic Vocabulary:** ☐ Introduce words in a mathematical context. ☐ Model how to use the words in discussion. ☐ Read and discuss the meaning of word in a mathematical context

Symbol	Type of Text and Interpretation of Symbol
	Instructional support and/or extension suggestions for students who are EL, have disabilities, or perform well below the grade level and/or for students who perform well above grade level.
✓	Assessment (Pre-assessment, Formative, Self, or Summative)

Instructional Plan

Understanding Lesson Purpose and Student Outcomes: Students will write and evaluate numerical expressions following the order of operations.

Anticipatory Set/Introduction to the Lesson

Write these numerical expressions on the board:

a. [36 – (4 x 7) + 8]5
b. 36 – 4 x 7 + 8 x 5
c. (36 – 4 x 7 + 8)5

✓ Instruct students to find the value for each of the 3 expressions. Allow 10 minutes to solve.

Facilitate whole group discussion using the following prompting questions.

- How do the brackets and parentheses affect the values of the expressions?
- What order of operations will we follow for the first expression?
- What order of operations will we follow for the second expression?
- What order of operations will we follow for the third expression?
- Did you get the same value for each?
- Why do you suppose they have different values?

Answer any questions and clarify any misconceptions about the order of operations.

Note: Students should be able to recognize the structure of the expressions and understand the purpose of brackets and parentheses (SMP.7).

Activity 1: Order of Operations Gallery Walk

Facilitate a Gallery Walk to review the posters from yesterday's lesson. Instruct students to place sticky notes on the posters with their comments and questions (SMP.3). The Gallery Walk is ended when groups return to their poster. Allow time for groups to read the comments on their poster considering the value of the comment and write an answer to the questions. Instruct groups to identify a spokesperson who will give a report about their work, comments, and questions received. Have students return to their seats and lead a whole group discussion to review the comments and questions clarifying any common misconceptions.

Activity 2: Around the World

Note: Before class, create posters using **Handout 4.1: Around the World Problem and Posters** by cutting out the locations along the dotted lines, gluing each to a blank piece of paper, and hanging the posters around the room.

- ✓ Distribute **Handout 4.2: Around the World Passports**.

Explain to students that they will work in groups of 3 or 4 and travel from one poster to the next. Individually, at each poster, students copy the numerical expression on their passport and find the value of the expression using the order of operations. When everyone in their group has found the value of the expression, have them compare, check work, and collaborate to

correct mistakes or misconceptions. When the entire group has the correct work, one person collects the passports for their team and brings them to the teacher to be stamped. If the passports are incorrect, the team will review their work, make changes, and bring the passports back to the teacher. When the passports are stamped, the team will move to another poster and repeat the process. To complete the activity, each team member must have all the cities on their passports stamped.

Note: This activity can be modified to include local cities and landmarks to provide students with exposure to areas they may likely visit.

For students who are EL, have disabilities, or perform well below the grade-level:

- Use the anchor charts and order of operations cards from Lesson 3.

Extensions for students with high interest or working above grade level:

- Students conduct research about the cities and create numerical expressions regarding the cities' populations.

Reflection and Closing:

- ✓ Ask students to look at **Handout 1.1 - I Can Statements: Standards of Focus** to check any progress they made today.
- ✓ Review Activity 1 with the class using prompting questions.
  Prompting questions:
  - Why do we need a specific order to solve numerical expressions?
  - What are the steps in the order of operations?
  - Do brackets and parentheses always affect the value of an expression?
- ✓ Have students complete an exit ticket where they create and evaluate a numerical expression with multiple operations.

Homework

No Homework

Handout 4.1: Around the World Posters

Paris

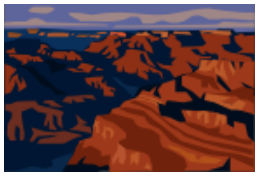
$(12-6)10\div4$

London

$5+(3\cdot2)-4^2\div8$

Dublin

$66\div(2^3-2)10$

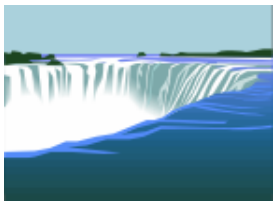


Grand Canyon

$6^2+(8-2)\div3-5\cdot2$

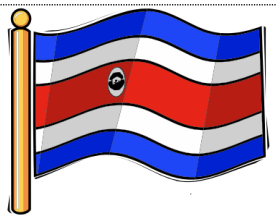
New York

$4\cdot(3^2-1)\div2$



Niagara Falls

$(5\cdot7)-(6+7)+(4^3-9)$



Costa Rica

$5 \cdot 8 - 12 \div 6 + 4^2$

Egypt

$(7+3) \cdot 4 \div 2 - 5 \cdot 6$

Beijing

$3 \cdot 11 + (26 \div 2) - 8$

Puerto Rico

$14 \cdot 5 \div (9 - 2)$

Chicago

$(12 - 9)10 + 13$

San Francisco

$22 + (8^2 - 2)2$

Handout 4.2: Around the World Passport

Name: Date: Block:	1. Paris
2. London	3. Dublin
4. Grand Canyon	5. New York

6. Niagara Falls	7. Costa Rica
8. Egypt	9. Beijing
10. Puerto Rico	11. Chicago
12. San Francisco	 You did it!!!

Handout 4.2: Around the World Passport Key

Name: Answer Key	1. Paris 15
2. London 9	3. Dublin 110
4. Grand Canyon 28	5. New York 16

6. Niagara Falls 77	7. Costa Rica 54
8. Egypt -10	9. Beijing 38
10. Puerto Rico 10	11. Chicago 43
12. San Francisco 146	 You did it!!!

Lesson 5: Small Groups/Stations – Exponents and Order of Operations

Focus Standards: 6.EE.1, 6EE.2

Standards for Mathematical Practice: SMP.1, SMP.3, SMP.6, SMP.7

Estimated Time: 120 min

Resources and Materials:

- Chart paper
- Index cards
- Copy paper
- Colored pencils
- Glue
- Handout 5.1: Order of Operations 4x4 Square
- Handout 5.2: Birthday Math Problem
- Handout 5.3: Krypto as Order
- Handout 5.4: Order of Operations Hot Potato
- Handout 5.5: Find the Teacher's Mistakes!
- Handout 5.6: Exponents Galore
- Handout 5.7: Krypto Math Rules

Learning Targets:

- Students will evaluate numerical expressions involving whole-number exponents.
- Students will evaluate numerical expressions using the order of operations.
- Students will identify and correct calculation errors when evaluating numerical expressions.

Guiding Questions:

- What pattern is evident in numbers with exponents?
- Why is it important to use a specific order when evaluating numerical expressions?

Vocabulary	
Academic Vocabulary: • Base • Cubed • Exponent • Numeric expression • Squared	**Instructional Strategies for Academic Vocabulary:** ☐ Model how to use the words in discussion. ☐ Read and discuss the meaning of word in a mathematical context ☐ Students write/discuss using the words

Symbol	Type of Text and Interpretation of Symbol
	Instructional support and/or extension suggestions for students who are EL, have disabilities, or perform well below the grade level and/or for students who perform well above grade level.
✓	Assessment (Pre-assessment, Formative, Self, or Summative)

Instructional Plan

Understanding Lesson Purpose and Student Outcomes: Students will evaluate exponential expressions, work in centers to complete stations to practice exponents and order of operations, and work independently to complete an exponent task.

Anticipatory Set/Introduction to the Lesson:
Display the following on the board:

A. $7 + 7 \times 2 + 2^2$ B. $5^2 - 12 - 12 + 4 = 25$
C. $2^3 \times 2 + 9 \div 3 - 2$ D. $5 \times 5^2 \div 5$

Instruct students to find which expressions have equivalent values and justify their answers (SMP.6). For those that do have equivalent values (A & D), ask students to see if they can do two or more operations simultaneously and still have a value of 25. Call on students to demonstrate their work on the board. Discuss students' work and clarify any misconceptions.

Activity 1: **Exponent/Order of Operations Stations**
Assign students to small groups and arrange centers and number of centers to fit your classroom.

- ✓ **Station 1 - Handout 5.1: Order of Operations 4 x 4 Square**. Students work independently to complete a 4x4 square. On scratch paper, students solve the numerical expressions on their cards (SMP.1). Students match the numerical expression sides with the corresponding value side of another square. Glue the completed 4x4 square to a piece of copy paper.

For students who are EL, have disabilities, or perform well below the grade-level:

- Students will use order of operations cards to help solve the numerical expressions.

Extensions for students with high interest or working above grade level:

- Students will create additional squares using blank squares that will connect with the outside edges.

Note: The template is the key as well. Before the lesson, cut out enough templets for each student.

- ✓ **Station 2 - Handout 5.2: Birthday Math Problem.** Students create a math problem where the solution is their birthday (month and day only). The students in the group will use the rubric to solve for each group member's birthday (SMP.3).

- ✓ **Station 3 - Handout 5.3: Krypto As Order.** Students write numerical expressions using the Order of Operations. Students will be given numbers to use for their numerical expressions and a target value. Students may use all four operations, exponents, parentheses, and brackets (SMP.6).

- ✓ **Station 4 - Handout 5.4: Order of Operations Hot Potato.** Distribute different colored pencils or pens to students. Students pass around a list of numerical expressions to find the value of the expression. Each student checks the work of a previous player and completes one step in the expression (SMP.3). Play continues until all the numerical expressions have been solved. Tell students to write their name with their colored pencil on the back of the Hot Potato page.

- ✓ **Station 5 – Handout 5.5: Find the Teacher's Mistakes!** Following the order of operations, students analyze the teacher's work for evaluating numerical expressions and identify steps that are incorrect. Students correctly evaluate the same expressions and show their calculations.

- ✓ **Station 6 – Handout 5.6: Exponents Galore** Students complete a worksheet using their knowledge of bases and exponents to solve problems (SMP.7).

Reflection and Closing:

- ✓ Ask students to look at **Handout 1.1 I Can Statements: Standards of Focus** to check any progress they made today.
- ✓ Facilitate a whole group discussion with prompting questions.
  Prompting questions:
  - Why is it important to show every step when evaluating numerical expressions?
  - Will you always get the same answer if you combine operations?

Exit Ticket

Tell students to complete the exit ticket and reflect on the week's activities.

3: List three things you learned this week.
2: List two questions you still have regarding this topic.
1: List one thing you would like to learn next week.

Homework
No homework.

Handout 5.1: Order of Operations 4x4 Square

ARI Curriculum Companion – Using Order of Operations and Exploring Properties

	$24 \div 5 + 3$			$44 \div 6^2 + 1$			$(36 + 4) \div 12$			$5^2 \div 2 + 4$	
43		$16 - 2 \cdot 6 + 1$	5		$5 \cdot 2 + 4 \div 2$	12		$(2^2 + 6) \div 5$	2		$(5 \cdot 2) + 3$
	15			8			11			2	
	$(6 - 2)^2 - 1$			$7 + 15 \div 3 - 4$			$21 - 5 \cdot 2$			$24 \div (6 \cdot 2)$	
52		$25 \div (4 + 1)$	5		$(2 \cdot 3)^2 - 25$	11		$(24 \div 6) + (2 \cdot 5)$	14		$(4 \cdot 7) - 6$
	8			16			8			37	
	$30 \div (1 + 4) + 2$			$4 \cdot 3 + 8 \div 2$			$24 \div 6 \cdot 2$			$(8 + 4) \cdot (1 + 2) + 1$	
28		$(5^2 + 3) \div 2$	14		$(6 - 2) \cdot 1 + 6$	10		$4 + 6^2 \div 2$	22		$2 \cdot 9^2 + 13$
	3			36			9			14	
	$6 - (2^2 - 1)$			$(30 \div 1) + (4 + 2)$			$8 + 4 \div (1 + 2 + 1)$			$36 \div 6 + 2 \cdot 4$	
31		$14 + 1 - 6 + 3$	13		$7 - (2 \cdot 6) + 2$	1		$6 + 5 \cdot 4 - 2$	24		$17 + 6 + 3$
	64			69			72			12	

Handout 5.2: Birthday Math Problem

Name:_____ Date: _____

Create a math problem where the solution is your birthday (month and day only). For instance, Carlos was born on January 31th (1/31). He could create the following math problem:

$$10^2 + 7(2 + 2) + 3$$
$$10^2 + 7(4) + 3$$
$$100 + 7(4) + 3$$
$$100 + 28 + 3$$
$$128 + 3$$
$$131$$

It must have each of the following:

• Parentheses	20 points
• Exponent	20 points
• Three different operations	20 points
• The answer MUST be your birthday.	15 points
• It must be neat!	10 points
• You must show your work.	10 points
• It must have your name.	5 points
• TOTAL:	100 points

Your Work Here:

Handout 5.3: Krypto as Order

Name:_____ Date: _____

There is a certain order in which operations must be performed when evaluating expressions. Solve the following Krypto challenges. Use the cards listed for each problem and write a numerical expression with the value of the target number. Explain your solution to a partner, and then record your solution below the challenge. Be sure to use the order of operations when writing your expressions. Use parentheses or other grouping symbols to make sure that your expression is correct!

1. Cards: 1, 2, 4, 5, 6
   Target Number: 7

   _____= 7

2. Cards: 1, 3, 7, 12, 20
   Target Number: 12

   _____= 12

3. Cards: 2, 3, 6, 9, 17
   Target Number: 17

   _____= 17

4. Cards: 2, 4, 9, 11, 22
   Target Number: 11

   _____= 11

5. Cards: 2, 6, 7, 17, 21
   Target Number: 14

   _____= 14

6. Cards: 2, 4, 5, 8, 16
   Target Number: 10

   _____= 10

7. Cards: 3, 3, 4, 12, 21
   Target Number: 7

   _____= 7

8. Cards: 2, 11, 15, 17, 24
   Target Number: 8

   _____= 8

9. Cards: 4, 7, 11, 15, 19
   Target Number: 17

   _____= 17

10. Cards: 3, 11, 18, 23, 25
    Target Number: 19

    _____= 19

Handout 5.3: Krypto as Order – Key

(These are only some of the possible solutions.)

Name:_____ Date: _____

There is a certain order in which operations must be performed when evaluating expressions. Solve the following Krypto challenges. Use the cards listed for each problem and write a numerical expression with the value of the target number. Explain your solution to a partner, and then record your solution below the challenge. Be sure to use the order of operations when writing your expressions. Use parentheses or other grouping symbols to make sure that your expression is correct!

1. Cards: 1, 2, 4, 5, 6
   Target Number: 7

   $(6 + 1)(2 + 4 – 5)$
   $6 – 5 + 4 + 2 \div 1$

   _____ = 7

2. Cards: 1, 3, 7, 12, 20
   Target Number: 12

   $12[20 \div (3 + 7) – 1]$
   $20 – 12 + 7 – 3 \cdot 1$

   _____ = 12

3. Cards: 2, 3, 6, 9, 17
   Target Number: 17

   $17[2 – 9 \div (6 + 3)]$

   _____ = 17

4. Cards: 2, 4, 9, 11, 22
   Target Number: 11

   $(22 – 11)(9 – 4 \cdot 2)$

   _____ = 11

5. Cards: 2, 6, 7, 17, 21
   Target Number: 14

   $21 – 17 + 6 \div 2 + 7$

   _____ = 14

6. Cards: 2, 4, 5, 8, 16
   Target Number: 10

   $16 \div (8 \cdot 2) + 4 + 5$
   $5(16 – 8 - 4 – 2)$

   _____ = 10

7. Cards: 3, 3, 4, 12, 21
   Target Number: 7

   $12 \div 3 + 21 \div 3 - 4$

   _____ = 7

8. Cards: 2, 11, 15, 17, 24
   Target Number: 8

   $11 – [15 \div (24 – 17 – 2)]$

   _____ = 8

9. Cards: 4, 7, 11, 15, 19
   Target Number: 17

   $11 – [19 \div (4 + 15)] + 7$

   _____ = 17

10. Cards: 3, 11, 18, 23, 25
    Target Number: 19

    $25 + 11 – 23 + 18 \div 3$

    _____ = 19

Handout 5.4: Order of Operations Hot Potato

Directions: Begin with numerical expression #1. First player calculates the first step then passes the page to the next player. The next player can either correct the previous work or continue with the next step. Each player checks the work of the previous players. When one expression has been solved, start on the next one.

#1) $13 + (7 \div 7) \cdot 6$	#6) $96 \div 6 + [97 - (12 \cdot 4)]$
#2) $19 + (27 \cdot 2) \div 3$	#7) $[(3^2 - 2 + 1)5] \cdot \frac{1}{2}$
#3) $85 - 6(3^2 - 2) + 1.8$	#8) $2.08 \cdot \frac{1}{4} \div 2 + 6$
#4) $12^2 \div 4 + 2 \cdot 5$	#9) $2(8^2 \div 4 \cdot \frac{1}{2})$
#5) $7 \cdot (9 + 3) + (8.8 \div 4)$	#10) $16 + [6\ (30 \div 5)]2$

1) $13 + (7 \div 7) \cdot 6$ $13 + 1 \cdot 6$ $13 + 6$ 19	#6) $96 \div 6 + [97 - (12 \cdot 4)]$ $96 \div 6 + [97 - 48]$ $96 \div 6 + 49$ $16 + 49$ 65
#2) $19 + (27 \cdot 2) \div 3$ $19 + 54 \div 3$ $19 + 18$ 37	#7) $[(3^2 - 2 + 1)5] \cdot \frac{1}{2}$ $[(9 - 2 + 1)5] \cdot \frac{1}{2}$ $[(7 + 1)5] \cdot \frac{1}{2}$ $[(8)5] \cdot \frac{1}{2}$ $40 \cdot \frac{1}{2}$ 20
#3) $85 - 6(3^2 - 2) + 1.8$ $85 - 6(9 - 2) + 1.8$ $85 - 6(7) + 1.8$ $85 - 42 + 1.8$ $43 + 1.8$ 44.8	#8) $2.08 \cdot \frac{1}{4} \div 2 + 6$ $0.52 \div 2 + 6$ $0.26 + 6$ 6.26
#4) $12^2 \div 4 + 2 \cdot 5$ $144 \div 4 + 2 \cdot 5$ $36 + 2 \cdot 5$ $36 + 10$ 46	#9) $2(8^2 \div 4 \cdot \frac{1}{2})$ $2(64 \div 4 \cdot \frac{1}{2})$ $2(16 \cdot \frac{1}{2})$ $2(8)$ 16
#5) $7 \cdot (9 + 3) + (8.8 \div 4)$ $7 \cdot (12) + (8.8 \div 4)$ $7 \cdot (12) + (2.2)$ $84 + 2.2$ 86.2	#10) $16 + [6\ (30 \div 5)]2$ $16 + [6\ (6)]2$ $16 + [36]2$ $16 + 72$ 88

Handout 5.4: Order of Operations Hot Potato - Key

Handout 5.5: Find the Teacher's Mistakes!

Name: _____ Date: _____

Directions: Find and circle all the mistakes for the expressions in the cells in the left column. In the right column, correctly evaluate the numerical expressions.

#1)	$133 \div (8 - 7) + 12$ $133 \div 1 + 12$ $133 \div 13$ $10\frac{3}{13}$	#1)
#2)	$(12- 2) \cdot 4^2 - 6$ $10 \cdot 4^2 – 6$ $10 \cdot 16 – 6$ $10 \cdot 10$ 100	#2)
#3)	$(4 + 36 \div 4) + 4^2 \div 2$ $(40 \div 4) + 4^2 \div 2$ $10 + 4^2 \div 2$ $10 + 16 \div 2$ $26 \div 2$ 13	#3)
#4)	$2 + (5 \cdot 4) - 7 + 2$ $2 + 20 - 7 + 2$ $22 – 7 + 2$ $22 – 9$ 13	#4)
#5)	$10 \cdot 2 + (5^3 \cdot 2) + 60 \div 10$ $10 \cdot 2 + (125 \cdot 2) + 60 \div 10$ $10 \cdot 2 + 250 + 60 \div 10$ $10 \cdot 2 + 310 \div 10$ $10 \cdot 312 \div 10$ $3120 \div 10$ 312	#5)

Handout 5.5: Find the Teacher's Mistakes! – Key (Mistakes are highlighted)

#1)	$133 \div (8 - 7) + 12$ $133 \div 1 + 12$ $133 \div 13$ $10\frac{3}{13}$	#1)	$133 \div (8 - 7) + 12$ $133 \div 1 + 12$ $133 + 12$ 145
#2)	$(12- 2) \cdot 4^2 - 6$ $10 \cdot 4^2 – 6$ $10 \cdot 16 – 6$ $10 \cdot 10$ 100	#2)	$(12- 2) \cdot 4^2 - 6$ $10 \cdot 4^2 – 6$ $10 \cdot 16 – 6$ $160 - 6$ 154
#3)	$(4 + 36 \div 4) + 4^2 \div 2$ $(40 \div 4) + 4^2 \div 2$ $10 + 4^2 \div 2$ $10 + 16 \div 2$ $26 \div 2$ 13	#3)	$(4 + 36 \div 4) + 4^2 \div 2$ $(4 + 9) + 4^2 \div 2$ $13 + 4^2 \div 2$ $13 + 16 \div 2$ $13 + 8$ 21
#4)	$2 + (5 \cdot 4) - 7 + 2$ $2 + 20 - 7 + 2$ $22 – 7 + 2$ $22 – 9$ 13	#4)	$2 + (5 \cdot 4) - 7 + 2$ $2 + 20 - 7 + 2$ $22 – 7 + 2$ $15 + 2$ 17
#5)	$10 \cdot 2 + (5^3 \cdot 2) + 60 \div 10$ $10 \cdot 2 + (125 \cdot 2) + 60 \div 10$ $10 \cdot 2 + 250 + 60 \div 10$ $10 \cdot 2 + 310 \div 10$ $10 \cdot 312 \div 10$ $3120 \div 10$ 312	#5)	$10 \cdot 2 + (5^3 \cdot 2) + 60 \div 10$ $10 \cdot 2 + (125 \cdot 2) + 60 \div 10$ $10 \cdot 2 + 250 + 60 \div 10$ $20 + 250 + 60 \div 10$ $20 + 250 + 6$ $270 + 6$ 276

Handout 5.6: Exponents Galore

Name:_____ Date: _____

Identify the base and exponent in each expression, write in expanded form, and find the value.

1. 15^2

Base = _____

Exponent = _____

Expanded form = _____

Standard form = _____

2. 7^5

Base = _____

Exponent = _____

Expanded form = _____

Standard form= _____

Solve the problems.

Jonna is making tiles for a mosaic. She notices a pattern of the area of the mosaic as she increases the side length.

3. These data can be shown in a table. Complete the table.

Length of Side	1	2	3	4	5	6
Area of Square	1	4	9			

4. Write an expression using an exponent to show the area of the mosaic if the length of the side is 8.

_____

5. What would the area of the mosaic be if the side length is 10 tiles?

_____

6. There is a mathematical meaning to the word *googol.* To represent a googol as a number, you write the digit 10 followed by 100 zeros. How can you represent a googol using an exponent?

_____

7. Tammy says that if *a* is a positive integer, a^3 is always greater than a^2. William says that is not true. Who is correct? Explain your answer.

_____

_____

8. What is the value of 10^1? _____

Handout 5.6: Exponents Galore - Key
Identify the base and the exponent in each expression.

1. 15^2

Base = 15

Exponent = 2

Expanded form = 15 x 15

Value = 125

2. 7^5

Base = 7

Exponent = 5

Expanded form = 7 x 7 x 7 x 7 x 7

Value = 16,807

Solve the problems.

Jonna is making tiles for a mosaic. She notices a pattern of the area of the tiles as she increases the side length.

3. These data can be shown in a table. Complete the table.

Number of hours	1	2	3	4	5	6
Number of bacteria	1	4	**9**	**16**	**25**	**36**

4. Write an expression using an exponent to show the area of the mosaic if the length of the side is 8.

8^2

5. What would the area of the mosaic be if the side length is 10 tiles??

100 sq tiles

6. There is a mathematical meaning to the word *googol.* To represent a googol as a number, you write the digit 10 followed by 100 zeros. How can you represent a googol using an exponent?

Answer 10^{100}

7. Tammy says that if *a* is a positive integer, a^3 is always greater than a^2. William says that is not true. Who is correct?

Answer William, because 1^3 and 1^2 are both equal to 1. One times one is equal to 1 – the Identity Property of Multiplication, regardless of the number of times it is multiplied by one .

8. What is the value of 10^1?

Answer 10

Handout 5.7: Krypto Math Rules

The game of Krypto is played with a deck of 52 cards: three each of the numbers 1 to 10, two each of the numbers 11 to 17, and one each of the numbers 18 to 25.

Sets of Krypto cards — including Primary Krypto (only numbers from 1 to 10) and the Fraction Supplement — can be purchased from MPH Games, Inc., P.O. Box 1125, Fairfield, CT 06432. They can also be ordered from Amazon and other online retailers.

Playing the Game

In the center of the table, deal five playing cards, number side up. Then turn over a sixth card which is the Target Card. Each player will add, subtract, multiply, or divide using each of the numbers on the five playing cards. Fractions, decimals, negative numbers, roots, and exponents are not permitted. Each card must be used once and only once to obtain a final solution equal to the number on the Target Card.

Example 1

Playing Cards: 2, 1, 2, 2, 3 Target Card: *20*

$2 + 1 = 3$
$3 \times 3 = 9$
$9 \times 2 = 18$
$18 + 2 = 20$

Notice that the numbers on all five playing cards were used once and only once to equal the target number.

Example 2

Playing Cards: 1, 3, 7, 1, 8 Target Card: *1*

$3 - 1 = 2$
$2 + 7 = 9$
$9 \div 1 = 9$
$9 - 8 = 1$

Example 3

Playing Cards: 24, 22, 23, 20, 21 Target Card: *1*

22 + 24 = 46
46 ÷ 23 = 2
2 + 20 = 22
22 – 21 = *1*

Krypto Strategies

There are many strategies that are helpful when playing Krypto. Several are given below, but you should try to find others.

Zero Strategy

When the number on the target card is equal to a number on a playing card, obtain a zero as one of the steps in the solution. Then, you can use the zero property of multiplication or the identity property of addition.

Examples of Zero Strategy

Playing Cards: 8, 10, 4, 8, 21 Target Card: *21*

8 – 8 = 0
0 × 10 = 0
0 × 4 = 0
0 + 21 = *1*

Even if the target number is not the same as one of the playing cards, zero can still be useful:

Playing Cards: 5, 2, 7, 21, 3 Target: *6*

7 × **3** =
21 – 21 =
0 + **2** =
2 × **3** =

One Strategy

Obtaining a one can also be helpful. Then, you can use the identity property of multiplication.
Example of One Strategy

Playing Cards: 6, 9, 5, 18, 3 Target Card: *14*

$18 \div 3 = 6$
$6 \div 6 = 1$
$1 \times 9 = 9$
$9 + 5 = 14$

Addition and Subtraction Strategy

Generally, it's easier to add and subtract than it is to multiply and divide. Therefore, looking for a solution that involves only addition and subtraction may allow to you find an answer more quickly.

Sometimes, it's not possible to find a solution that uses only addition and subtraction. Use this simple test:

1. Find the sum of all five values from the playing cards.
2. Compare the sum to the target number.
3. If one of them is odd and the other is even, then there is no solution that involves only addition and subtraction. But, if both are odd or both are even, there is a very good chance that a solution using only addition and subtraction exists.

Example of Addition and Subtraction Strategy

Playing Cards: 23, 5, 7, 9, 4 Target Number: *13*

- Sum of playing cards: 23 + 5 + 7 + 9 + 4 = 48 (even)
- Target number = 13 (odd)

The sum is even, and the target number is odd. Therefore, no solution exists that uses only addition and subtraction. Don't waste your time looking for one.

Playing Cards: 23, 5, 7, 9, 4 Target Number: *16*

- Sum of playing cards: 23 + 5 + 7 + 9 + 4 = 48 (even)
- Target number = 16 (even)

Both the sum and the target number are even, so it's likely that a solution involving only addition and subtraction exists. In fact, here is one such solution:

23 + 5 = 28
28 + 4 = 32
32 – 9 = 23
23 – 7 = *16*

Modification for Beginners

Use only the cards numbered 1 to 10. The game of Primary Krypto actually contains cards with those values only. As skill levels increase, add the numbers 11 to 25.

Unsolvable Hands

It is possible to be dealt a hand without a solution.

For example, a hand with playing cards 1, 2, 3, 1, 2 and a target card of 23 cannot be solved. (You can get close, with (1 + 2 + 1) × 2 × 3 = 24, but it's not possible to get 23.)

However, an unsolvable hand is *very* rare. There are over 3,000,000 possible sets of five playing cards, and approximately 1,000 do not have a solution. Consequently, the chance of being dealt a hand without a solution is about 1 in 3,000. Because there are so few unsolvable hands, if you don't find a solution quickly, keep trying!

Krypto Solutions can be found, if needed, online by searching for a Krypto Solver

Lesson 6: Algebraic Expressions

Focus Standards: 6:EE.2a, 6.EE.2b

Additional Standard: 6.EE.1

Standards for Mathematical Practice: SMP.4, SMP.7, SMP.8

Estimated Time: 60 minutes

Resources and Materials:

- Cardstock for sentence strip
- Copy paper for foldable
- Personal white boards-1 per student
- Dry erase markers-1 per student
- Scissors
- Glue
- Index card
- Handout 6.1: Writing Expressions
- Handout 6.2: Algebraic Expression Cards
- Handout 6.3: Expression Charades Cards

Learning Targets:

- Students will identify and use terms for mathematical operations.
- Students will translate words into algebraic expressions.

Guiding Questions:

- What is an algebraic expression?
- How can a variable be used in an algebraic expression?

Vocabulary

Academic Vocabulary:

- Algebraic expression
- Coefficient
- Constant
- Factor
- Quotient
- Term
- Variable

Instructional Strategies for Academic Vocabulary:

☐ Model how to use the words in discussion.
☐ Read and discuss the meaning of word in a mathematical context
☐ Students write/discuss using the words

Symbol	Type of Text and Interpretation of Symbol
	Instructional support and/or extension suggestions for students who are EL, have disabilities, or perform well below the grade level and/or for students who perform well above grade level.
✓	Assessment (Pre-assessment, Formative, Self, or Summative)

Instructional Plan

Understanding Lesson Purpose and Student Outcomes: Students will explore new vocabulary using thinking maps. Students will translate written language into algebraic expressions and practice creating algebraic expressions through a hands-on activity.

Anticipatory Set/Introduction to the Lesson:
Display these word categories:

A	B	C
backfield	arch	fake
end zone	herkie	paint
sack	backwards load in	drive
turnover	dismount	basket

Explain to students that certain words and terms are associated with certain activities or events. Ask students to identify what activity each category goes with (A: football, B: cheerleading, and C: basketball).

Ask students to name some words and phrases that they associate with electronic games or other activities related to their interests.

Note: Use terms for activities your students would be familiar with.

Activity 1: **Classifying Key Words in Operations, Teacher Guided Instruction**
Explain each vocabulary word using the algebraic expression $4n + 7$.

- A constant is a fixed value, a number on its own, whose value does not change. A constant may either be positive or negative. Based on the definition, what is the constant in this example? How do you know 7 is a constant?
- A variable is any letter or symbol that represents a changeable or unknown value.
  Based on the definition, what is the variable in this example? Do we know what $*n$ is?
- A coefficient is the number multiplied by the variable. It's located in front of the variable.
  Based on the definition, what is the coefficient in this example? Why is the coefficient 4?
- A term may consist of variables and coefficients, or constants. Terms are separated by the plus or minus signs.
  How many terms does the example have? What are the terms?
- An algebraic expression is one or more algebraic terms in a phrase. It can include variables, constants, and operating symbols, such as plus and minus signs. It's only a phrase, not the whole sentence, so it doesn't include an equal sign.
- Is the example an algebraic expression? Why?

Create an anchor chart of a 3-tab foldable while students make their own.
Distribute copy paper for vocabulary foldable. Model how to create the foldable and have students complete the foldable following the instructions as you discuss the vocabulary words. Encourage students to restate the definitions in their own words.

T: Turn your paper portrait style.
Fold the paper in half, hamburger style leaving about 1" at the bottom (See Figure A).
Cut as indicated by the red dotted lines. You have created 3 flaps. (See Figure A)
Fold the flaps in (See Figure B).
Write the algebraic expression across the outside of the 3 flaps (See Figure B).
Write one vocabulary word on the inside of each flap to match what is written on the outside (see Figure C).
On the inside of each flap, write the corresponding definition. Encourage students to use their own words.

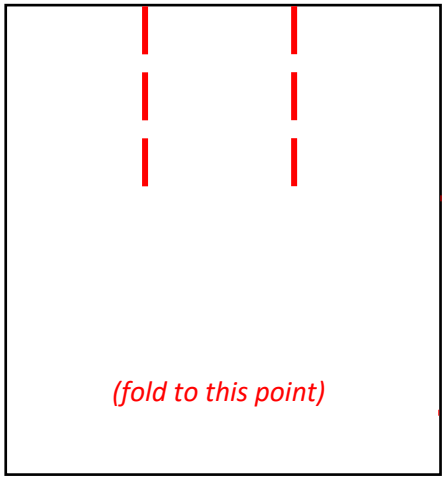


Figure A

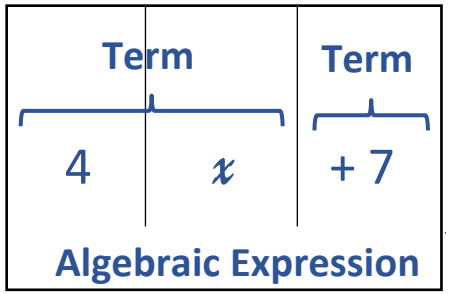


Figure B

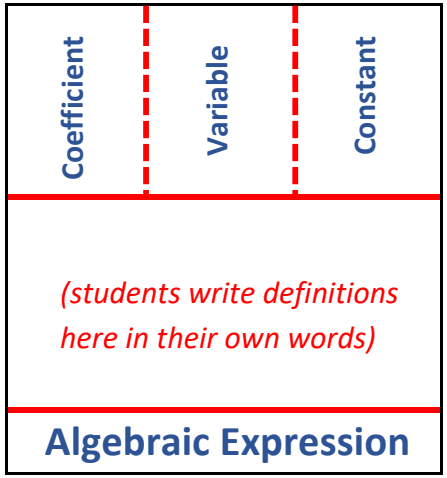


Figure C

Activity 2: Algebraic Expressions, Teacher Guided Instruction, Student Pair and Share

T: At the beginning of our lesson we identified common terms for football, cheerleading, basketball, and some of your own. In mathematics, we also have a common language that is particular to math (SMP.4). Specific words represent particular symbols or numbers. What words or phrases can be used to represent the math operations addition, subtraction, multiplication and division?

✓ Distribute **Handout 6.1: Writing Expressions**. Instruct students to complete the chart on the top of the handout while creating an anchor chart for the students' responses.

Possible key words include:

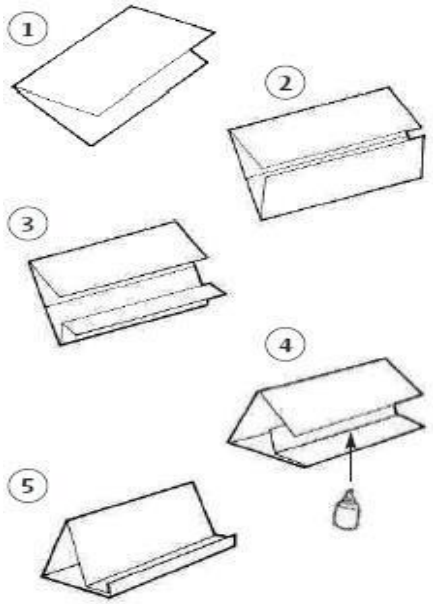
- Addition: sum, increase, plus, total, more, add
- Subtraction: difference between, subtract, fewer, decrease, minus, take from, difference, take away, reduce
- Multiply: multiplied by, product, groups of, times, double, twice
- Division: divided by, share, divide, share equally, divisible by, divide into, group

For students who are EL, have disabilities, or perform well below grade-level:

- Students will be able to have their personal chart available at their desk throughout the rest of the unit.

Distribute cardstock for sentence strip foldable. Model how to create a sentence strip foldable following the instructions:

- Fold your paper hamburger style (See Figure 1).
- Open the paper and fold the two outer edges toward the fold line. This forms a shutter fold (See Figure 2).
- Fold one of the inside edges of the shutter back to the outside fold. This fold forms a floppy L-tab (See Figure 3).
- Glue the floppy L-tab down to the base so that it forms a strong straight L-Tab (See Figure 4).
- Glue the other shutter side to the front of this L-tab. This forms a tent that is the backboard for the expression cards (See Figure 4).
- Fold the edge of the L-tab up one quarter to one-half inch to form a lip that will keep the student work from slipping off the holder (See Figure 5).



Distribute **Handout 6.2: Algebraic Expression Cards** and instruct students to cut them out on the dotted lines to create 10 cards to use for the following activity (SMP.8).

Instruct students to use their cards to create an algebraic expression for "7 and some more."

Possible answers:

$7 + n$ or $n + 7$

- ✓ Ask students to identify any constants, coefficients, variables, and/or terms in the algebraic expression by holding up the corresponding card.

Instruct students to use their cards to create an algebraic expression for "the product of 2 and another number."

Possible answers:

$2 \cdot n$ or $n \cdot 2$ or $2n$

- ✓ Ask students to identify any constants, coefficients, variables, and/or terms in the algebraic expression by holding up the corresponding cards.

Instruct students to use their cards to create an algebraic expression for "10 less than another number."

Possible answers:

$n - 10$ or $n + (-10)$

- ✓ Ask students to identify any constants, coefficients, variables, and/or terms in the algebraic expression by holding up the corresponding cards.

Instruct students to use their cards to create an algebraic expression for "10 divided into some groups."

Possible answers:

$10 \div n$ or $\frac{10}{n}$

- ✓ Ask students to identify any constants, coefficients, variables, and/or terms in the algebraic expression by holding up the corresponding cards.

Note: Have students look for patterns and make use of structure as they apply the terms for operations to writing algebraic expressions (SMP.7). If students make several mistakes on any of the given expressions, provide multiple opportunities for them to practice with the verbal expression.

- ✓ Instruct students to work with a partner. One student says an algebraic expression while the other students builds it with Algebraic Expression Cards and their Sentence Strip foldable. Change roles and repeat.

Activity 3: Expressions Charades, Partner Activity, Student Exploration
Distribute the **Handout 6.3: Expressions Charades Cards** one set per pair. Instruct students to cut out the cards and place the cards face down between them. Students turn over a card and race to display the algebraic expression with their dry erase boards. The first student to correctly display the algebraic expression gets a point. Students keep a tally of points, and the student with the most points when the cards have all been played is the winner.

- ✓ This game is an opportunity for students to analyze the structure of a sentence to translate it into a mathematical expression (SMP.7).

Reflection and Closing:
- ✓ Ask students to look at **Handout 1.1 I Can Statements: Standards of Focus** to check any progress they made today.

Recall the terms used for sports and gaming activities. Review the words used to express mathematical operations.

Exit Ticket:
- ✓ Distribute an index card to each student. Tell students to write an algebraic expression for seven less than three times a certain number and identify each part of the expression [3n -7 or 3n +(-7) or -7 + 3n] [3 – coefficient, n – variable, 7 or -7 – constant, and 3n -7 or 3n +(-7) or -7 + 3n - term].

Homework

Complete **Handout 6.1**: **Writing Expressions**

For students who are EL, have disabilities, or perform well below grade-level:
- Have students use Algebraic Expression Cards and sentence strips.

Extensions for students with high interest or working above grade level:
- Students will extend activity by creating algebraic expressions with 3 or more operations.

Handout 6.1: Writing Expressions

Name:_____ Date: _____

Words & phrases often suggest addition, subtraction, multiplication, & division.
Let's come up with some of those words

Addition or Subtraction		Multiplication or Division	

Homework

Ex. 1) Write each phrase as an algebraic *expression.*

a. The sum of four and *b*

b. 5 more than the difference of a number and 8

c. The product of 5 and a number plus 7.08.

d. 2 more than one half of a number

e. Six less than the sum of 3.7 and *m*

Handout 6.1: Writing Expressions – Key

This table will be filled in based on the responses in the lesson.

Addition or Subtraction		Multiplication or Division	

Ex. 1) Write each phrase as an algebraic *expression.*

a. The sum of four and *b*

$4 + b$ or $b + 4$

b. 5 more than the difference of a number and 8

$(n - 8) + 5$ or $5 + (n - 8)$

c. The product of 5 and a number plus 7.08.

$5(n + 7.08)$

d. 2 more than one half of a number

$\frac{1}{2}n + 2$ or $\frac{n}{2} + 2$

e. Six less than the sum of 3.7 and *m*

$(3.7 + m) - 6$

Handout 6.2: Algebraic Expression Cards

(	)
+	-
·	÷
2	7
10	*n*

4	**3**
6	**9**
12	**15**
8	**2**
14	**20**

Handout 6.3: Expression Charades Cards

10 shared equally by *y* groups	**The addition of 4 and half of *m***
The sum of 3 and *c*	**The product of 6 and *b***
4 times *a* plus 9	**The product of 12 and *t***

b divided by 3	12 decreased by the quotient of 15 divided by w
10 less than the product of 3 and k	f decreased by 2
8 more than the sum of v and 7	20 less than w

Lesson 7: Evaluate Numeric and Algebraic Expressions Work Stations

Focus Standards: 6.EE.2a, 6.EE.2b

Additional Standards: 6.EE.1, 6.EE.2c

Standards for Mathematical Practice: SMP.1, SMP.2, SMP.3, SMP.4, SMP.6

Estimated Time: 120 minutes

Resources and Materials:

- Four-Function calculators
- Chart paper for posters
- Scissors
- Handout 7.1: Algebraic Expressions Scavenger Hunt Posters
- Handout 7.2: Algebraic Expressions Scavenger Hunt Recording Sheet
- Handout 7.3: Algebraic & Numerical Expressions
- Handout 7.4: Do Words Make a Difference? Cards
- Handout 7.5: Do Words Make a Difference? Recording Sheet
- Handout 7.6: Self Evaluation
- Algebraic & Numerical Expressions worksheet: www.mathworksheetsland.com

Learning Targets:

- ✓ Students will translate verbal expressions to algebraic expressions.
- ✓ Students will apply order of operations to calculate volume and area.

Guiding Questions:

- Is the placement of parentheses important when translating a verbal expression to an algebraic expression?
- What formulas do we use for calculating volume and area?

Vocabulary	
Academic Vocabulary: • Algebraic expression • Coefficient • Constant • Exponent • Numerical expression • Term • Variable	**Instructional Strategies for Academic Vocabulary:** ☐ Model how to use the words in discussion. ☐ Read and discuss the meaning of word in a mathematical context ☐ Students write/discuss using the words

Symbol	Type of Text and Interpretation of Symbol
	Instructional support and/or extension suggestions for students who are EL, have disabilities, or perform well below the grade level and/or for students who perform well above grade level.
✓	Assessment (Pre-assessment, Formative, Self, or Summative)

Instructional Plan

Understanding Lesson Purpose and Student Outcomes: Students will translate verbal expressions to algebraic expressions during a scavenger hunt game and work stations as well as reflect on their understanding of algebraic expressions and exponents.

Anticipatory Set/Introduction to the Lesson:
Display this story: Miko rides his bike to and from school every day if it does not rain. Over a 3-week period he rode his bike 9 days. The letter *n* represents how far it is from his house to school. Choose each expression that represents how far Miko rode in 3 weeks. Display these algebraic expressions and tell students to write on their personal white board each expression that matches the story.

2(9*n*) 9·2*n* (9·2)*n* 9(2*n*) n(2+9) 9·*n* Correct answers include: 2(9*n*) 9(2*n*) 9·2*n*

- ✓ Have students present and justify their choices (SMP.3).

Note: Remind students that *n* represents the distance one-way so round trip is 2 *n*. This is a good opportunity to reinforce the commutative and associative properties.

Note: This lesson can be extended to two days depending on the conceptual mastery of the students.

Activity 1: Work Stations
Divide class into 4 groups. Tell students that they will be rotating through 4 different stations.

- ✓ **Station 1 Independent Practice: Writing Algebraic Expressions Scavenger Hunt**
  Before class, use **Handout 7.1: Algebraic Expressions Scavenger Hunt Posters** to make posters for the scavenger hunt. Distribute **Handout 7.2: Algebraic Expressions Scavenger Hunt Recording Sheet.** Show the posters to the students pointing out that each poster has a description of an algebraic expression and an algebraic expression. The two expressions on the posters do not match. Tell students they will start at any poster (no 2 students can start on the same poster). Instruct students to record the expression in the corresponding section of their sheet, find the poster that has matching expression, and write the name of the image on their recording sheet. Repeat these steps until they get back to the poster where they began. They will have solved all the expressions (SMP.6).

- ✓ **Station 2 Independent Practice: Algebraic and Numerical Expressions**
  Distribute Handout 7.3: Algebraic and Numerical Expressions. Tell students they will write an algebraic expression for 5 situations and write numerical expressions for the volume of two cubes and the area of three squares. Instruct students to calculate the volume and area for situation 6 & 7 and show all their calculations on the back of the handout (SMP.2).

- ✓ **Station 3 Independent Practice/Partners: Do Words Make a Difference?**
  Before class, print **Handout 7.4: Do Words Make a Difference? Cards** and cut out the cards. Distribute **Handout 7.5: Do Words Make a Difference Recording Sheet.** Place the "Words" cards in the center of the table. Tell students they will each draw a card from the stack. On their "Do Words Make a Difference? Recording Sheet, they will write algebraic expressions for the 2 situations on the card. Each pair of expressions will have similar, but different wording which leads to a different algebraic expression. Instruct students to used highlighters for this activity. Students highlight the parts of the two verbal expressions that vary in the same color. For example, the phrases "less than and less a" will be highlighted to denote they cause the change in the algebraic expression. They will write a sentence justifying their work. Tell them to exchange their card and the work with a partner and evaluate their partner's work, asking questions and clarifying any mistakes (SMP.3).

- ✓ **Station 4: Teacher Center: Self-Evaluation and Remediation**
  Distribute **Handout 7.6: Self-Evaluation** and tell students to complete the activity and respond to each of the "I Can" statements by choosing from these symbols:

  I can do it -  I need a more practice -  I still have questions - 

For students who are EL, have disabilities, or perform well below grade-level:

- Students will use their list of terms for the operations and their order of operations cards.

Extensions for students with high interest or working above grade level:

- Students will create additional cards and posters to add to stations 1 and 3.

Reflection and Closing:

- ✓ Review students' Scavenger Hunt Recording Sheets with students using 4-function calculators. Check for accuracy answer any questions, and clarify any misconceptions. Check for understanding for Station 3 by asking questions about creating algebraic expressions from words.
  Prompting Questions:

- What is the difference between "3 less than a number" and "3 less the number?"
- Can the placement of parentheses in an algebraic expression change the value?

Exit Ticket

✓ Instruct students to translate "*the product of a number and 5 increased by 10"* into an algebraic expression.

Homework

No homework.

Handout 7.1: Algebraic Expressions Scavenger Hunt Posters

 A number decreased by three times seventy $\frac{n}{45} + 70$	 Eight times a number increased by seventy $70 + \frac{5}{3}n$
 A number split into forty-five groups and then increased by seventy more $(n \div 3)70$	 One half of a number increased by three times the number $n - 3 \cdot 70$
 A number decreased by one fourth of seventy $(70 + n) + \frac{1}{3}n$	 Seventy more than five thirds of a number $n - \frac{1}{4}(70)$
 A number divided by three times seventy $8n + 70$	 Seventy and a number increased by one third of the number $\frac{1}{2}n + 3n$

Handout 7.2: Algebraic Expressions Scavenger Hunt Recording Sheet

Name:_____ Date_____

 A number decreased by three times seventy Expression:_____ Symbol:_____	 Eight times a number increased by seventy Expression:_____ Symbol:_____
 A number split into forty-five groups and then increased by seventy more Expression:_____ Symbol:_____	 One half of a number increased by three times the number Expression:_____ Symbol:_____
 A number decreased by one fourth of seventy Expression:_____ Symbol:_____	 Seventy more than five thirds of a number Expression:_____ Symbol:_____
 A number divided by three times seventy Expression:_____ Symbol:_____	 Seventy and a number increased by one third of the number. Expression: Symbol:_____

Handout 7.2: Algebraic Expressions Scavenger Hunt Recording Sheet Key

Name:_____ Date_____

 A number decreased by three times seventy Expression:_____***n* – 3 · 70**_____ Symbol:_____Stop Watch_____	 Eight times a number increased by seventy Expression:_____**8*n* + 70**_____ Symbol:_____Headphones_____
 A number split into forty-five groups and then increased by seventy more Expression:_____$\frac{n}{45}+70$_____ Symbol:_____Plane_____	 One half of a number increased by three times the number Expression:_____ ***n* ÷ 2 + 3 *n*** _____ Symbol:____Saturn_____
 A number decreased by one fourth of seventy Expression:_____$n - \frac{1}{4}(70)$_____ Symbol:_____Heart_____	 Seventy more than five thirds of a number Expression:_____$70 + \frac{5}{3}n$ _____ Symbol:_____Magnifying Glass_____
 A number divided by three times seventy Expression:_____***(n ÷3)70***_____ Symbol:_____Light Bulb_____	 Seventy and a number increased by one third of the number. Expression:_____$(70 + n) + \frac{1}{3}n$ _____ Symbol:_____Cake_____

Handout 7.3: Algebraic and Numerical Expressions

Name_____ Date:_____

Directions: Complete the following situations. Show your work on work paper and put your answers on the lines.

1. The king has 7 more crowns than the queen. The queen has *q* crowns. Write the expression that shows how many crowns king has. Ans:_____

2. Moore has 20 songs. His friend bought him *m* more songs. Write an expression that shows how many songs Moore has now. Ans:_____

3. There were *y* whales in the sea and 15 more whales came to the sea. Write an expression that shows how many whales are in the sea. Ans:_____

4. George earned 80 points in the subjects. Bruno earned *b* fewer points than George. Write an expression that shows how many extra points Bruno earned.
Ans:_____

5. Karen has *k* pens. Helen has 25 more pens than Karen. Write an expression for how many pens Helen has. Ans:_____

Calculate the following situations:

6. Find the volume of cube with the given sides:

a. 8 inches V = _____

b. $\frac{2}{3}$ yards V = _____

7. Find the area of square with the given sides:

a. $2\frac{1}{2}$ cm A = _____

b. 6 inches A = _____

c. 10 mm A = _____

Handout 7.3: Algebraic and Numerical Expressions – Key

1. The king has 7 more crowns than the queen. The queen has *q* crowns. Write the expression that shows how many crowns king has. **k + 7**

2. Moore has 20 songs. His friend bought him *m* more songs. Write an expression that shows how many songs Moore has now. **20 + m**

3. There were *y* whales in the sea and 15 more whales came to the sea. Write an expression that shows how many whales are in the sea. **y + 15**

4. George earned 80 points in the subjects. Bruno earned *b* fewer points than George. Write an expression that shows how many extra points Bruno earned. **80 – b**

5. Karen has *k* pens. Helen has 25 more pens than Karen. Write an expression for how many pens Helen has. **k + 25**

Calculate the following:

6. Find the volume of cube with the given sides:

a. 8 inches V = 8^3 inches = 512 inches^3

b. $\frac{2}{3}$ yards V = $\frac{8}{27}$ yards^3

1. Find the area of square with the given sides:

a. $\frac{3}{4}$ cm $A = (\frac{3}{4})^2 = \frac{9}{16}$ **cm²**

b. 6 inches **A = 6^2 = 216 in²**

c. 10 mm **A = 10^2 = 100 mm²**

Handout 7.4: Do Words Make a Difference? Cards

#1) Three less than a number squared. Three less a number squared.	#2) A number decreased by four times seven. Four times seven decreased by a number.
#3) Eight times a number divided by two. A number divided by two, eight times.	#4) A number decreased by one-fourth the number. One-fourth a number decreased by the number.

Handout 7.4: Do Words Make a Difference? Cards - Key

#1) Three less than a number squared. $n^2 - 3$ Three less a number squared. $3 - n^2$	#2) A number decreased by four times seven. $n - 4 \cdot 7$ Four times seven decreased by a number. $4 \cdot 7 - n$
#3) Eight times a number divided by two. $8n \div 2$ A number divided by two, eight times. $(n \div 2)8$	#4) A number decreased by one-fourth the number. $n - \frac{1}{4} n$ One-fourth a number decreased by the number. $\frac{1}{4} n - n$

Students explanations will vary.

Handout 7.5: Do Words Make a Difference? Recording Sheet

Name:_____ Date_____

Directions: Choose a card. Copy the words then write an algebraic expression. Repeat for the second set of words. Compare the expressions you wrote and identify what words caused you to write different expressions. Write a sentence to explain why the wording gave you two different expressions. Exchange cards and your recording sheet with a partner and check each other's work. If time allows, choose another card and repeat the process.

Card Number: _____

Verbal Expression 1: _____

Algebraic Expression 1: _____

Verbal Expression 2: _____

Algebraic Expression 2: _____

What verbal expressions or phrases caused the algebraic expressions to be different?

_____

_____

Why did the wording give you two different expressions? _____

_____

_____

Handout 7.6: Self-Evaluation

Name:_____ Date_____

<table>
<tr>
<td colspan="3">Exponents

Write 7^3 in expanded form and standard form.

Expanded: _____

Standard: _____</td>
<td colspan="3">Evaluate Numerical Expressions

$16 – (4^2 – 8 + 7) \div 5$

Answer: _____</td>
</tr>
<tr><td>I can do it</td><td>I need more practice</td><td>I still have questions</td><td>I can do it</td><td>I need more practice</td><td>I still have questions</td></tr>
<tr><td>  </td><td>  </td><td>  </td><td>  </td><td>  </td><td>  </td></tr>
<tr>
<td colspan="3">Write an Expression

Fifteen less than a number multiplied by itself three times

Answer: _____</td>
<td colspan="3">Name the Parts of an Expression

$3n -4^2 + 18 \div 9$

Constant(s)_____
Variable(s)_____
Coefficient(s)_____
Term(s)_____
Base(s)_____
Exponent(s) _____</td>
</tr>
<tr><td>I can do it</td><td>I need more practice</td><td>I still have questions</td><td>I can do it</td><td>I need more practice</td><td>I still have questions</td></tr>
<tr><td></td><td>  </td><td>  </td><td>  </td><td>  </td><td>  </td></tr>
</table>

Handout 7.6: Self-Evaluation - Key

<table>
<tr>
<td colspan="3">Exponents

Write 7^3 in expanded form and standard form.

Expanded:_____7 x 7 x 7_____

Standard:_____98_____</td>
<td colspan="3">Evaluate Numerical Expressions

$16 - (4^2 - 8 + 7) \div 5$
$16 - (16 - 8 + 7) \div 5$
$16 - (8 + 7) \div 5$
$16 - 15 \div 5$
$16 - 3$
13

Answer:_____13_____</td>
</tr>
<tr>
<td>I can do it</td><td>I need more practice</td><td>I still have questions</td>
<td>I can do it</td><td>I need more practice</td><td>I still have questions</td>
</tr>
<tr>
<td>  </td><td>  </td><td>  </td>
<td>  </td><td>  </td><td>  </td>
</tr>
<tr>
<td colspan="3">Write an Expression

Fifteen less than a number multiplied by itself three times

Answer:___$n^3 - 15$_____</td>
<td colspan="3">Name the Parts of an Expression

$3n - 4^2 + 18 \div 9$

Constant(s)_____18, 9_____
Variable(s)_____n_____
Coefficient(s)____3_____
Term(s)____$3n$, 4^2, 18_____
Base(s)_____4_____
Exponent(s)_____2_____</td>
</tr>
<tr>
<td>I can do it</td><td>I need more practice</td><td>I still have questions</td>
<td>I can do it</td><td>I need more practice</td><td>I still have questions</td>
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<td>  </td><td>  </td><td>  </td>
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</tr>
</table>

Lesson 8: Culminating Performance Task – Why Are So Many Wrong?

Focus Standards: 6.EE.1, 6.EE.2, 6.EE.2a, 6.EE.2b

Additional Standard: 6.SP.4

Standards for Mathematical Practice: SMP.2, SMP.3, SMP.4, SMP.6

Estimated Time: 60 – 120 minutes

Resources and Materials:

- Handout 8.1: Multiplication Tree
- Handout 8.2: Performance Task - Why Are So Many Wrong?
- Handout 8.3: Performance Task Rubric
- Professor Pete's Website: https://profpete.com/blog/2016/07/

Learning Targets:

- Students will write algebraic expressions to represent real-world and mathematical situations.
- Students will apply understanding of exponents, using the order of operations to solve expressions, analyze data to make predictions, draw conclusions from data, and create a graph to represent data in a performance task.

Guiding Questions:

- How can I translate verbal expressions into algebraic expressions?
- What difference does it make if we use an order of operations or not?

Vocabulary

Academic Vocabulary:	Instructional Strategies for Academic Vocabulary:
• Algebraic expression • Coefficient • Constant • Numeric expression • Term	☐ Model how to use the words in discussion. ☐ Read and discuss the meaning of word in a mathematical context ☐ Students write/discuss using the words

Instructional Plan

Understanding Lesson Purpose and Student Outcomes: Students complete the performance task to demonstrate understanding of the skills taught during this unit.

Anticipatory Set/Introduction to the Lesson: "My Favorite No"

Distribute large index cards or half sheets of paper. Display the following for students:
Two boys were playing in the park one day when they saw two girls each walking with three dogs. The park ranger had a box of doggie treats with 80 treats in the box. She gave each dog 3 treats. Write an expression to solve for how many treats the park ranger had left. Ans. $80 - (2^2 \cdot 3)2$ or a similar expression

✓ Assign students to groups and give them 10 minutes to complete their work. Allow more time if necessary. Remind students to use exponents whenever possible. Each group will submit one expression. At the end of the time collect the students' work and go through the cards identifying those that have the work done correctly as "Yes" and those that have errors as "No." Look for misconceptions and copy the incorrect work for the first problem on the board without changing it. Facilitate an open discussion about why the work is not correct. If a student says the work or answer you displayed is incorrect have them offer a reason why it is incorrect and tell how they would correct it (SMP.3).

✓ Ask students to look at **Handout 1.1 I Can Statements: Standards of Focus** to check any progress they have made throughout the unit. Discuss thoroughly.

Note: Refer to Lesson 3 for details on how to use "My Favorite No" for instruction.

For students who are EL, have disabilities, or perform well below the grade-level:

- Give students **Handout 8.1 Multiplication Tree** to use to organize their data.

Extensions for students with high interest or working above grade level:

- Give students an expression and tell them to write a story to describe the expression.

Activity 1: **Performance Task – Why Are So Many Wrong?**

Distribute **Handout 8.2 – Facebook Confusion, 8.3: Performance Task – Why Are So Many Wrong?** and **Handout 8.4: Performance Task Rubric.** Read the directions aloud.

✓ Explain that after they read and think about a Facebook post and replies to it, they will complete a performance task based on the information in the post. Explain the performance task as follows:
1. Answer questions about the information in the Facebook page Professor Pete has posted (SMP.2).
2. Reply to one of the comments posted on the page (SMP.3).
3. Post a new comment about why some people were incorrect (SMP.2).
4. Create an expression based on criteria listed in the handout (SMP.6).
5. Make predictions about the responses you would get if this expression were posted on social media (SMP.2, SMP.4).

Review **Handout 8.4: Performance Task Rubric** with the students answering questions and clarifying any misconceptions about what is expected of them.

For students who are EL, have disabilities, or perform well below the grade-level:

- Students can work in a small group with the teacher.

Reflection and Closing:
Have students share the comments they would have submitted on the Facebook page. Allow other students to reply to or critique the comments (SMP.3)

Homework

No homework.

Handout 8.1: Multiplication Tree

Name:_____ Date_____

2 Boys · 2 Girls

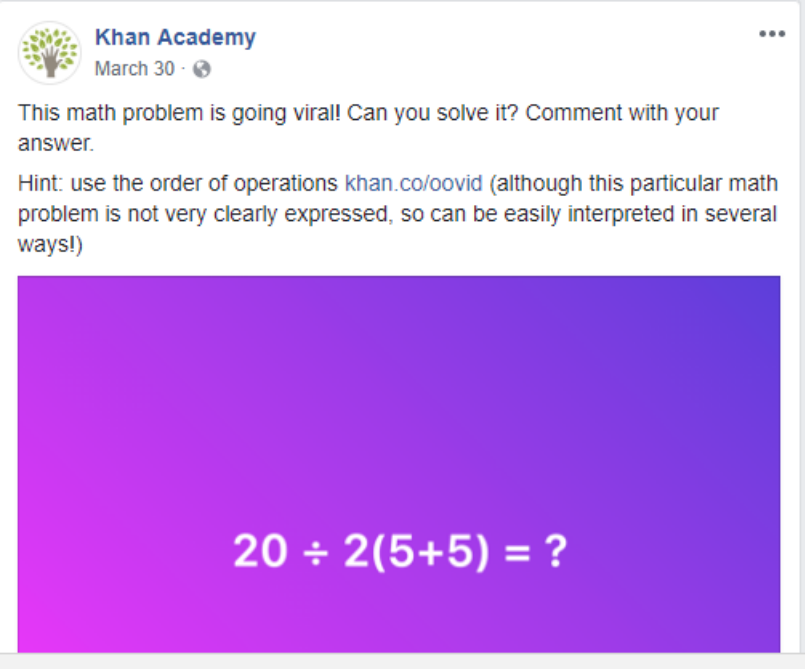
_____girls · _____dogs

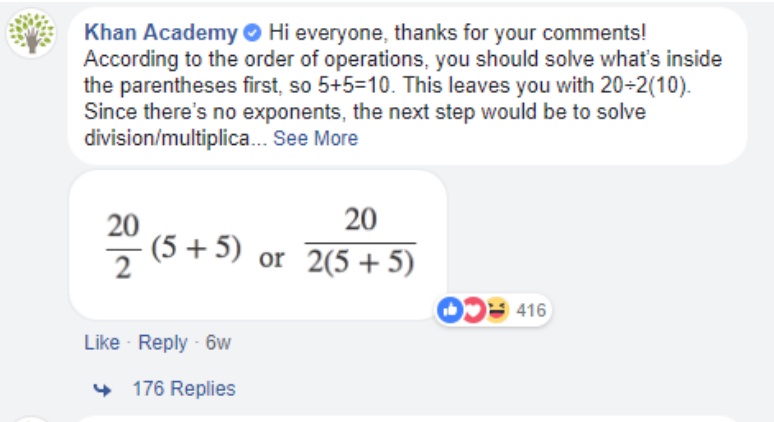
_____dogs · _____treats

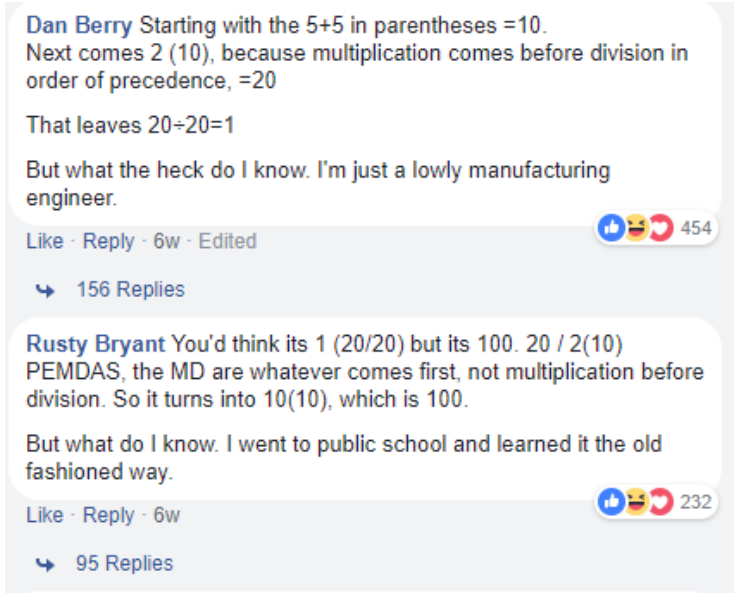
_____treats

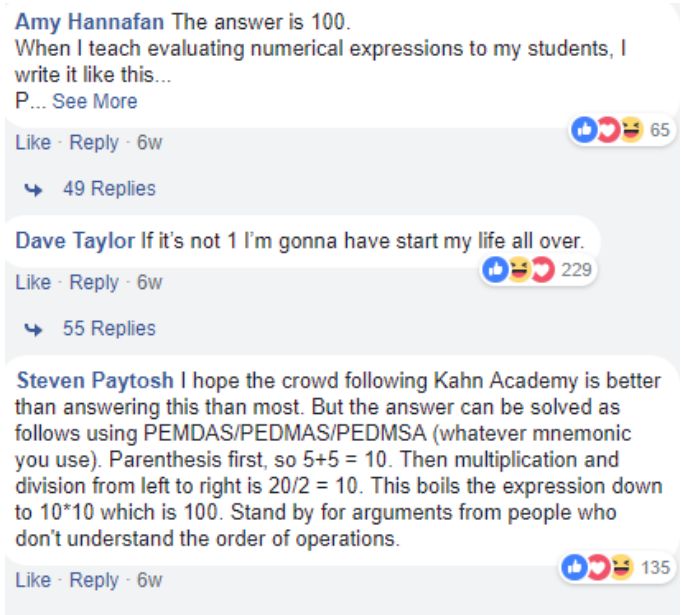
Facebook Confusion

The following is from a facebook post on Khan Academy's Facebook page. Read all of the posts and answer the questions.









Handout 8.3: Performance Task – Why Are So Many Wrong?

Name:_____ Date_____

Directions:

Part 1 -

1. Read the information about the Facebook posts in **Facebook Confusion**.
2. Answer the questions on page 2 of this handout.
3. Reply to one of the comments that were posted on this blog. Your comment should contain algebra and math vocabulary, be mathematically accurate and reference the order of operations. Record who you are replying to and your reply on page 2 of the handout.
4. Post a new comment of your own about why so many people were incorrect. Your comment should contain algebra and math vocabulary, be mathematically accurate and reference the order of operations. Record your new comment on page 2 of the handout.

Part 2 –

1. Create an expression that includes 7 criteria: brackets, parentheses, exponents and the four operations. Show your expression on page 3 of this document.
2. Make predictions about the types of answers you would get if you were to post your expression on a social media site and 350 people responded. Record your predictions on page 3 and 4.
3. Create a histogram to show your predictions. Histogram must include: title, axis labels, axis scales; accurate representation of data; and color.

For both sections, refer to the rubric, **Handout 8.4: Performance Task Rubric**, page 5, that will be used to grade your work.

Handout 8.3: Performance Task – Why Are So Many Wrong? Part 1

Name:_____ Date_____

Answer the following questions in the spaces provided. If you need more space, use a separate piece of paper and label it correctly. **20 ÷ 2(5 + 5)**

1. Which part of the problem above did everyone seem to agree should be done first? (Be specific). _____

_____

_____

_____

2. Which part of the problem above caused the disagreement (Be specific)._____

_____

_____

_____

3. Why do acronyms such as BODMAS and PEMDAS lead to confusion when solving algebraic expressions which have multiplication and division? _____

_____

_____

4. Rewrite the same problem. Use brackets to make the problem more clear._____

5. Why do you think it's important for all people to use the same order of operations when solving algebraic expressions? _____

_____

_____

_____

Reply to comment: Person replying to _____

My reply: _____

_____

_____

_____

My new comment: Name _____

My new comment:_____

_____

_____

_____

Handout 8.3: Performance Task – Why Are So Many Wrong? Part 2

Name:_____ Date_____

Directions:

1. Create an expression that includes brackets, parentheses, and each of the four operations.

_____

2. Show the correct solution in the box below.

Correct Solution:

3. List 3 incorrect answers people might get and show how they would calculate to get the incorrect answer.

Incorrect answer #1:	Incorrect answer #2:	Incorrect answer #3:

4. If you posted this expression to a social media website, and 350 people responded to your post, make predictions about the number of people who would get each answer, both incorrect and correct.

Number of Responses:

Correct Answer _____

Incorrect Answer #1: _____

Incorrect Answer #2: _____

Incorrect Answer #3: _____

5. Create a graph (circle, bar, line, pictograph, dot plot) to show your predictions. Show your graph below:

Handout 8.4: Performance Task Rubric

Level	Mastery Level	Evaluate Reasoning using knowledge of order of operations	Algebra Vocabulary in discussion context	Generating an Expression using all required components	Visual Representation of Predicted Responses
4	Exemplifying Mastery	Accurately answer 5 questions to evaluate reasoning.	Both comments: • Use vocabulary correctly. • Are mathematically accurate. • Reference the order of operations.	Expression is written with all 6 components.	Graph provides 4 reasonable responses for the problem provided and is easy to read.
3	Approaching Mastery	Accurately answer 4 questions to evaluate reasoning.	Both comments contain 2 criteria.	Expression is written with 4-5 components.	Graph provides 3 reasonable responses for the problem provided and is easy to read.
2	Developing Mastery (Bronze Medal)	Accurately answer 2-3 questions to evaluate reasoning.	Both comments contain 1 criterion.	Expression is written with 2-3 components.	Graph provides 2 reasonable responses for the problem provided.
1	Not Representing Mastery	Accurately answer 1 question to evaluate reasoning.	Only one comment contains 1 criterion and the other has none of the criteria.	Expression is written with fewer than 2 components.	Graph provides 1 reasonable response for the problem provided.
0	No Evidence of Mastery	No questions are answered accurately.	Comments either not included or not complete.	Expression is missing.	Graph is missing or unintelligible.

For training or questions regarding this unit,
please contact:

exemplarunit@mdek12.org