8th Grade Math; Unit 2 Lesson 1 Part 1
Key Standards addressed in this Lesson: CC8.EE.1, CC8.EE.2
Time allotted for this Lesson: 3 days

Key Concepts in Standards:

MCC8.EE.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions.

Evidence of Learning:

By the conclusion of this unit, students should be able to demonstrate the following competencies:

- use properties of integer exponents to evaluate and simplify numerical expressions containing exponents;
- apply the properties of integer exponents to generate equivalent numerical expressions;

Essential Question(s):

- When are exponents used and why are they important?
- How can I apply the properties of integer exponents to generate equivalent numerical expressions?
- How do I simplify and evaluate numeric expressions involving integer exponents?

Vocabulary: (Tier)

- **Exponent:** The number of times a base is used as a factor of repeated multiplication.

Concepts/Skills to Maintain:

- computation with whole numbers and decimals, including application of order of operations

Opening: Task

Few Folds Task Part 1 only from 8th Unit 2 frameworks **from www.georgiastandards.org**

Work Session:

- **Use Alien Attack Task to teach properties of exponents from www.georgiastandards.org**
- Teaching Example - attached – Could be adapted to be visual, graphic organizer, etc.
- Graphic Organizer for Properties of Exponents

- Video to use during work session to summarize rules: http://www.onlinemathlearning.com/exponent-rules.html

Other Possible Resources:

Holt Course 3 Text and Workbook correlated activities:

- Exponents Section 4-1
- Look for a Pattern in Integer Exponents Section 4-2
- Properties of Exponents Section 4-3

Glencoe Algebra Study Guide and Practice Workbook

- Section 8-2 Multiplying and Dividing Powers
- Section 8-3 Negative Exponents

The Outstanding Mathematics Guide-8th Grade Supplement

- Exponents page 27

On Core Mathematics

- Lesson 1-1

Coach Grade 8 (GPS Version)

- Lesson 1

Crosswalk Coach

- Lesson 5

Common Core Coach

- Lesson 3

Kutasoftware Guided Practice (lots of free worksheets available at http://www.kutasoftware.com/

Don't forget to use other related materials from your school!

Closing:

- TOD: Problem from http://www.kutasoftware.com
- Task: Exponential Exponents from 8th Grade Unit 2 Frameworks from the State at **www.georgiastandards.org**

Corresponding Task

Task: Nesting Dolls from the 8th grade Unit 2 frameworks from the GA Dept. of Education State Frameworks Grade 8 Unit 2 at www.georgiastandards.org

Highlight the Mathematical Practices that this lesson incorporates:

Make sense of problems and persevere in solving them	Reason abstractly and quantitatively	Construct viable arguments and critique the reasoning of others	Model with mathematics	Use appropriate tools strategically	Attend to precision	Look for and make sure of structure	Look for and express regularity in repeated reasoning

Graphic Organizer: Properties of Exponents

EXPONENTS

A^x

A is called the _____

x is called the _____

PROPERTIES OF EXPONENTS

8.1 – Multiplication Properties

When multiplying two bases that are the same, you _____ exponents.
Ex: $x^9 \cdot x^6 \cdot x^2 =$ _____

When raising a power to another power you _____ exponents
Ex: $(x^2)^5 =$ _____

To find the power of a product you _____ the exponent.
Ex: $(2x^2y^5)^3 =$ _____

8.2 – Division Properties

When dividing two bases that are the same, you _____ exponents.
Ex: $\frac{x^{13}}{x^2} =$ _____

To find the power of a quotient you _____ the exponent to the _____ and _____.
Ex: $\left(\frac{x^4}{y^2}\right)^3 =$ _____

8.3 – Zero and Negative Exponents

Any nonzero number raised to the "0" power is equal to _____
Ex: $(2x)^0 =$ _____

How do negative exponents become positive?
_____
_____
_____
_____
_____
_____
Ex: $\left(2x^0y^{-5}\right)^3$

Overview This exponents worksheet focuses on two of the main rules for exponents and asks students to apply both of these rules (see below) to various types of problems.

Exponent rule 1: multiplying exponents i.e. $x^a \bullet x^b = x^{a+b}$

Exponent rule 2:exponents of exponents i.e. $(x^a)^b = x^{a \bullet b}$

Questions range in difficulty and the concluding questions include higher level thinking about the rules of exponents in math.

Exponent Division - General Rule

$$\frac{x^a}{x^b} = x^{a-b}$$

$$\frac{4^3}{4^2} = 4^{3-2}$$
$$= 4^1$$
$$= 4$$

$$\frac{x^3}{x^2} = x^{3-2}$$
$$= x^1$$
$$= x$$

Negative "Exponents": Definition

$$x^{-b} = \frac{1}{x^b}$$

Exponents Worksheet

I. Directions: *Rewrite the each question below without the exponents and simplify.*

1) $2^2 \bullet 2^3 =$

2) $2^2 \bullet 2^4 =$

3) $2^2 \bullet 2^5 =$

4) $2^2 \bullet 2^6 =$

5) $2^3 \bullet 2^5 =$

6) $3^2 \bullet 3^3 =$

From Numbers to letters!

7) $x^2 \bullet x^3 =$

8) $x^4 \bullet x^3 =$

9) $x^{12} \bullet x^3 =$

10) $x^6 \bullet x^{20} =$

GENERAL SUMMARY: Fill in the blank: $X^a \bullet X^b = X^{a\_\_b}$

Part II
Directions:

11) $(x)^2 = \_\_ \bullet \_\_$

12) $(2^2)^2 =$

13) $(2^2)^3 =$

14) $(2^2)^4 =$

15) $(3^2)^3 =$

16) $(x^2)^3 =$

17) $(x^5)^2 =$

18) $(x^3)^4 =$

19) $(x^5)^4 =$

20) $(x^{10})^4 =$

GENERAL SUMMARY: Fill in the blank: $(X^a)^b = X^{a\_b}$

Putting It all Together!

III. Simplify:

21) $x^2 \bullet (x^2)^3 =$

22) $x^3 \bullet (x^5)^2 =$

23) $z^{12} \bullet (z^6)^5 =$

24) $z^3 \bullet (z^{11})^5 =$

25) Find the product of $(z^3)^2$ and $(z^3)^4$

26) $z^2 \bullet (z^3)^0 =$

Determine what number could replace the question mark

Example: $(x^{10})^2 = x^{17} \bullet x^{?}$ **Example2**: $(x^{12})^3 = x^{29} \bullet x^{?}$

27) $(x^2)^3 = x^2 \bullet x^{?}$

28) $(x^3)^2 = x^5 \bullet x^{?}$

29) $(x^5)^2 = x^3 \bullet x^{?}$

30) $(x^2)^{?} = x^4 \bullet x^{22}$

31) $(x^3)^{?} = x^5 \bullet x^7$

32) $(x^4)^{?} = x^5 \bullet x^{11}$

33) $(x^{?})^3 = x^2 \bullet x^{10}$

34) $(x^{?})^2 = x^5 \bullet x^{20}$

35) How many different pairs of integers could replace the question marks below?

$(x^{?})^{?} = x^2 \bullet x^6$

Think-Pair-Share

Mr. Morris gave the class a problem that was very similar to the questions above (27—34) so the students were asked to find a number that could replace the question mark.

The problem was: $(x^3)^0 = x^5 \bullet x^{?}$.

Jennifer says that the question mark should be replaced by 0.
John says that the question mark should be 1.
Joseph says that the question mark should be –5.
Mary says that the question is impossible to answer..

Who is correct? Explain why:

Explanation:

36) Is the following statement true? $(x^a)^b = (x^b)^a$ Why or why not?

Extension

Directions: *Determine the value of a in the equations below.*

1) $(x^{a})^{6} = x^{2} \bullet x^{10}$

2) $(x^{a+1})^{5} = x^{2} \bullet x^{13}$

3) $(x^{a+4})^{2} = x^{12} \bullet x^{4}$

4) $(x^{a+2})^{3} = x^{9} \bullet x^{6}$

5) $(x^{a})^{2} = x^{a} \bullet x^{1}$

6) $(x^{a+4})^{3} = x^{a} \bullet x^{14}$

7) $(x^{a+7})^{2} = x^{5a} \bullet x^{5}$

8) $(x^{a+7})^{0} = x^{5a}$

Simplify the following by first removing the negative signs and then removing the exponents.

1. 4^{-2}
2. 5^{-3}
3. 2^{-4}
4. 3^{-1}

Divide the following, leaving the answers with exponents.

1. $5^6 \div 5^2$
2. $\frac{8^7}{8^3}$

Simplify and perform the operation indicated.

1. $2^3 \times 3^2$
2. $6^2 \div 2^3$

Simplify and perform the operation indicated.

1. $3^2 - 2^3$
2. $5^2 + 3^3$
3. $4^2 + 9^3$
4. $2^3 - 2^2$

Multiply the following and leave the answers with exponents.

1. $(6^3)^2$
2. $(3^2)^4$
3. (5^4)

Exponent and Powers Quiz Grade 8 Math Unit 2 Lesson 1

Mark the correct answer.

1. 3^0 =

- a. 0
- b. 1
- c. 3

2. Which of the following has the greatest value?

- a. 5^{-2}
- b. $(-2)^0$
- c. 2^1

3. Which of the following is NOT equal to $\left(\frac{3}{4}\right)^0$?

- a. $\left(\frac{4}{3}\right)^0$
- b. 1^{23}
- c. 0^0

4. Which one of the expressions is NOT the same as 6^{-2}?

- a. $\frac{1}{6^{-2}}$
- b. $\left(\frac{1}{6}\right)^2$
- c. $\frac{1}{6^2}$

5. Simplify 4^{-2}

- a. -8
- b. $\frac{1}{16}$
- c. $\frac{1}{8}$

6. $3^2 \times 3^3 =$

- a. 3^5
- b. 3^6
- c. 9^5

7. $2^4 \times 2^3 =$

- a. 2^{12}
- b. 2^7
- c. 4^7

8. $7^{12} \div 7^3 =$

- a. 7^4
- b. 7^9
- c. 7^{15}

9. $(3^2)^8 =$

- a. 3^{16}
- b. 3^{10}
- c. 3^6

10. Simplify $8^3 \div 4^2$

- a. 2
- b. 3
- c. 32

11. Simplify $2^3 + 2^2$

- a. 10
- b. 12
- c. 32

12. Simplify $6^3 \div 4^2$

- a. $2\frac{1}{4}$
- b. 3
- c. $13\frac{1}{2}$

13. Express $(2^3)^{-2}$ using exponents.

- a. 2^{-6}
- b. 2^{-1}
- c. 2^5

14. Evaluate $(3^{-2})^{-1}$

- a. 9
- b. $\frac{1}{9}$
- c. $\frac{1}{27}$

15. Which power has the value 16?

- a. 8^2
- b. 4^{-2}
- c. $\left(\frac{1}{4}\right)^{-2}$