

LessonTitle: Integer Inquiry 2 Operating and Estimating (\times , \div) with Integers Pre 1.8	
Utah State Core Standard and Indicators Pre-Algebra Standards 1 Process Standards 1-4	
Summary	
In this lesson, students use the calculator and/or a Geometer's Sketchpad sketch to derive the rules for multiplying and dividing with integers. Please note the area model for multiplication—it provides great background for coordinate grid quadrants as well as models for multiplication and factoring of polynomials.	
Enduring Understanding	Essential Questions
Integers, the collection of whole positive and negative numbers and zero, are used everywhere in our world.	How are integers used in our world? How can you explain the rules of multiplication and division using integers?
Skill Focus	Vocabulary Focus
<ul style="list-style-type: none"> • Operating on integers and variables (\times, \div) • Problem Solving 	
Assessment	
Materials: Computers with Geometer's Sketchpad and sketches from Exploring Algebra with the Geometer's Sketchpad , TI-73 Calculators Sketchpad,	
Launch	
Explore	
Summarize	
<ul style="list-style-type: none"> • In what contexts are integers used in our world? • What are the rules for operating (\times, \div) using integers? • Why is multiplication of a negative integer by a negative integer a positive solution? • Why is multiplication of a negative integer by a positive integer a negative solution? 	
Apply	

Directions: Use the starters prepared below.

Multiplying and dividing integers is also difficult to teach in a meaningful way. Teachers and students resort to memorization of rules. Even though the rules for multiplication and division are simpler than those for addition and subtraction, students frequently confuse the addition and subtraction rules with the multiplication and division rules.

Therefore, we have speculated it would be most valuable for students to once again develop their own rules using inquiry on the calculator and using Geometer's sketchpad followed by application within appropriate contexts.

Allow students to think and develop their own rules using the calculator. Then move on to Geometer's sketchpad to reinforce and clarify the rules. The Geometer Sketchpad investigation involves multiplication only. The teacher should make the point that division with integers is multiplication in reverse and uses the same principles as multiplication with integers.

Day 1

Starter Activity:

The coldest place in Utah is Middlesink, near Logan. One day the temperature there was -17 degrees. You drive from Middlesink to Salt Lake where the temperature is 30 degrees. What is the change in temperature?

Day 2

Starter Activity:

You are old enough to gamble and you go to Las Vegas. You start with \$1000 and win \$500 playing the slot machines. You are able to continue playing, using your credit card, but unfortunately you spend too long at the black jack table and then lose \$2000 playing black jack.

- a) Write the problem that represents this situation.**

- b) What is the integer that represents the amount of money you end up with?**

Day 3

You go into a business partnership with three partners. Your business loses \$65,000.

- a) How much has each partner lost?**

- b) Write the integer (rounded to the nearest dollar) that represents this amount.**

Calculator Inquiry

Multiplying and Dividing Integers



While multiplying and dividing integers with the calculator, be certain to watch what happens to the positive and negative numbers. You will be writing some rules when you finish.

Problem	Calculator Answer
$6 * 3$	
$- 8 * 3$	
$3 * (-7)$	
$- 4 * (- 6)$	
$(-2) * (-46)$	
$18 \div 3$	
$- 28 \div 3$	
$56 \div (- 7)$	
$- 48 \div (- 6)$	
$- 5 * (- 8)$	

What have we learned from the calculator about multiplying and dividing integers?

- 1.
- 2.
- 3.
- 4.

Geometer's Sketchpad Inquiry

Multiplying Integers

*Multiplication can be modeled using addition of groups or repeated addition. Open the sketch **Multiplication Models.gsp** from the folder 1_Fundamentals. This sketch opens to the page grouping (see the tabs at the lower left corner of the sketch).*

1) Use the sketch, make the arrows move to model this problem. $3 * 3 = \underline{\quad}$
Draw the number line which shows the answer to $3 * 3$ below.

2) Write the multiplication problem for the following sentences. Then draw the number line solution below.

- Put together 4 groups of three. Multiplication problem is _____
Solution is:
- Put together three groups of -3. Multiplication problem is _____
Solution is:
- Put together one group of - 8. Multiplication problem is _____
Solution is:
- Put together the opposite of two groups of 3. You might think of the problem as subtract or take away two groups of 3. Multiplication problem is _____
Solution is :
- Put together the opposite of three groups of 5. You might think of the problem as subtract or take away three groups of 5. Multiplication problem is _____
Solution is:
- Put together the opposite of two groups of -3. You might think of the problem as subtract or take away two groups of -3. Multiplication problem is _____
Solution is:

3) Multiplication can also be modeled using the area of rectangles. **Go to the area page by clicking on its tab at the lower left of the window.** Drag the arrows to observe the area model for multiplication.

- a) Observe the multiplication as area sheet. Look at quadrant 1. Complete the pattern—fill in the multiplication facts in the empty squares in the table (instead of writing $3 \times 4 = 12$, just write the answers—12, 16, 12 etc.) Explain how area and multiplication relate.

- b) Draw and shade in the area for -4×4 in **quadrant 2**. Fill in the multiplication facts. What patterns do you observe in the facts and the table?
- c) Draw and shade in the area for -4×-4 in **quadrant 3**. Fill in the multiplication facts. What patterns do you observe in the facts and the table?
- d) Draw and shade in the area for 4×-4 in **quadrant 4**. Fill in the multiplication facts. What patterns do you observe in the facts and the table?
- e) Model the following problems. Develop a hypothesis about the rules for multiplication with integers. Try a few more problems—test your hypothesis,
- $5 * 3 = \underline{\hspace{2cm}}$
 - $-5 * 3 = \underline{\hspace{2cm}}$
 - $-5 * -3 = \underline{\hspace{2cm}}$
 - $-5 * 3 = \underline{\hspace{2cm}}$
- f) What are your rules for multiplying with integers?
- g) Observe the quadrants. How would you describe the quadrants as related to multiplication of integers.

Multiplication as Area

