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| **Exploring Factoring as Undoing the Distributive Property**  |

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| PRE-PLANNING | PRIOR KNOWLEDGE  |
|  | * Know that terms are separated by addition and subtraction.
* Know that the distributive property lets you multiply a sum by multiplying each term separately and then adding the products.
* Know how to multiply expressions involving variables and exponents
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|  | LEARNING GOALS  |
|  | * Factor a common factor from a binomial or trinomial
* Recognize factoring as undoing the distributive property
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|  | Common Core Standards  | Common Core Practices |
|  | [CCSS.Math.Content.HSA.SSE.A.1.a](http://www.corestandards.org/Math/Content/HSA/SSE/A/1/a/)Interpret parts of an expression, such as terms, factors, and coefficients.[CCSS.Math.Content.HSA.SSE.A.2](http://www.corestandards.org/Math/Content/HSA/SSE/A/2/)Use the structure of an expression to identify ways to rewrite it. *For example, see x4 - y4 as (x2)2 - (y2)2, thus recognizing it as a difference of squares that can be factored as (x2 - y2)(x2 + y2)*. | 1. Make sense of problems and persevere in solving them4. Model with mathematics.7. Look for and make use of structure |
|  | MATERIALS  |
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| * Computers/tablets for each student
* “Exploring Factoring as Undoing the Distributive Property” Activity Sheet for each student (see below)
* PhET *Area Model Algebra* simulation:

<https://phet.colorado.edu/sims/html/area-model-algebra/latest/area-model-algebra_en.html?screens=3>* PhET *Area Model Algebra* game:

<https://phet.colorado.edu/sims/html/area-model-algebra/latest/area-model-algebra_en.html?screens=4>* Matrix Calculator

<http://onlinemschool.com/math/assistance/matrix/multiply1/>* Matrix by a Scalar Multiplication Site

 <http://www.coolmath.com/algebra/24-matrices/03-scalar-multiplication-01> |

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| LESSON CYCLE | **WARM-UP** *5 minutes* |
|  | Activate prior knowledge by reviewing the distributive property. Students should expand the following expressions:1. 4(2x2 + 6x + -5)
2. 9x(7 + 9x)
3. (-x – 3)8
4. – (x – 9)
 |
|  | **INTRO** *5 minutes* |
|  | *Teacher will…* | *Students will…* |
|  | * Solicit questions and observations from the class and write them on the board in two columns. Star any responses that are repeated by multiple students. Leave these on the board for the duration of the exploration.
* Distribute activity sheets.
* Project the simulation after open play. Have a student demonstrate something they tried and use that example to get all students on the same page about what numbers we are calling “factors” and what numbers we are calling the “product” while pointing to the sim. Also make sure students found the options to change the dimensions and show the partial products and total areas in different ways.
 | **Explore** the Area Model Algebra simulation and think of one to three questions or observations. (#1 on activity sheet)Share questions and observations and participate in teacher facilitated discussion. |
|  | **GUIDED EXPLORATION** *20 minutes* |
|  | *Teacher will…* | *Students will…* |
|  | * Circulate the room to be available for questions and ask probing/pushing questions, such as:
1. How did you verify your products? (They may have used the “total area of model” drop down or turned on the “partial products” and/or “area model calculations.”
2. If the simulation did not verify their product, ask them to explain why there is a discrepancy and what error(s) led to their mistake(s).
3. Ask a student to show how they modeled warm-up #3. Some may have used a 1x2. The actual expression is more of a 2x1, but the commutative property allows for both. If time permits, this is a worthwhile conversation.
* As students work on #3-4, circulate around the room and make sure the students connect the number of areas in the sim to the number of partial products.
* **#5 Pair-Share**: A common mistake students make is to think of factoring as pulling a number out instead of dividing every term by the factor. Because of this, students will often factor 20x + 5 as 5(4x) instead of 5(4x + 1). Really drive home the point here that factoring is division because it’s undoing the distributive property which is multiplication. Therefore, there should be the same number of terms inside the parentheses after taking out a common factor as the number of terms in the original expression. Project the sim and have students model 5(4x) and 5(4x+1) to make this clear.
* **#7 Pair-Share**: Prompt students to stop and compare their responses to #6. Facilitate a brief discussion about #6. Project the sim on the board and call on students to **share aloud** different factors for the same product and **demonstrate** their validity for the class.
 | Work on # 2 on the activity sheet while interacting with the sim. **Share aloud** #2. Work on #3-4.**Share aloud** #5.Work on #6-7.**Share aloud** #7.Play the third level of the *[Area Model Algebra](https://phet.colorado.edu/sims/html/area-model-algebra/latest/area-model-algebra_en.html?screens=4)* gameIf finished with other questions before class discussion, work on #9. |
|  | **DISCUSSION** *10 minutes* |
|  | *Teacher will…* | *Students will…* |
|  | * Facilitate a class discussion to bridge an understanding between the distributive property and factoring. Remind students to close their laptops or turn around so that the sim does not distract them from listening. Use an established teaching strategy such as popcorn discussion (one student answers, calls on the next student to talk), think-pair-share (pose question, allow time to think, turn and talk to partner), or group discussions (print out questions and have groups talk to each other and write down consensus to share aloud with class). Sample questions include:
1. How are the distributive property and factoring related?
2. What is the difference between a factor and the greatest common factor? For example, in #6c--2, 7, 14, x, 2x, and 7x are all factors, but 14x is the only greatest common factor.
* Direct attention to the original questions/observations from the intro. If possible, display the sim on the board during this whole-class discussion.
1. Did we answer all of these questions? Which still need answering? What are some answers that surprised you?
* (*While pointing out a particular question/observation)* What is this observation referring to? OR Can anyone help us to answer this question?

After the discussion, have students complete the third level of the [*Area Model Algebra* game](https://phet.colorado.edu/sims/html/area-model-algebra/latest/area-model-algebra_en.html?screens=4) as an informal assessment. This can be done for homework if necessary. | Participate in teacher-facilitated discussion. Complete the third level of the [*Area Model Algebra* game](https://phet.colorado.edu/sims/html/area-model-algebra/latest/area-model-algebra_en.html?screens=4) as an informal assessment. |

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Class: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Exploring Factoring as Undoing the Distributive Property**

**Learning Goals**

* Factor a greatest common factor from a binomial or trinomial
* Recognize factoring as undoing the distributive property

**Activity**

1. **Explore** the  [*Area Model Algebra*](https://phet.colorado.edu/sims/html/area-model-algebra/latest/area-model-algebra_en.html?screens=3) simulation for 5 minutes and think of 1–3 questions or observations.
2. **Verify** your expanded forms from the warm-up by modeling the expressions in the simulation.
3. **Build** your own expressions with the following dimensions.

|  |  |  |  |
| --- | --- | --- | --- |
| **Dimension** | **Factor 1** | **Factor 2** | **Product** |
| 1x1 |  |  |  |
| 1x2 |  |  |  |
| 1x3 |  |  |  |
| 2x1 |  |  |  |
| 3x1 |  |  |  |

1. **Partner Check:** Swap tables with a partner and check the factors and products.
2. **Pair-Share:** Which of these expressions are equal? Use the sim to defend your answer.

20x + 5 5(4x) 5(4x + 1)

1. **List** two factors that give the following products:

|  |  |  |
| --- | --- | --- |
| **Product** | **Factor 1** | **Factor 2** |
| 1. 42x
 |  |  |
| 1. 8x - 6
 |  |  |
| 1. -3x2 + 6x + -27
 |  |  |
| 1. 14x + 42x2
 |  |  |
| 1. 48 – 36x
 |  |  |

1. **Pair-Share:** Compare answers #6 with your partner. Is it possible to have more than one correct set of factors for each product? Why or why not?
2. **Play** the third level of the [*Area Model Algebra*](https://phet.colorado.edu/sims/html/area-model-algebra/latest/area-model-algebra_en.html?screens=4) game. Feel free to ask three then me if you need help. Screenshot your results and email it to me.
3. **Extension**: Multiply a matrix by a scalar

A matrix in math is a collection of numbers arranged into rows and columns. In other words, it’s an array.

For example, see matrix A below.

![A = [ row 1: -4 , 0  row 2: 3 , 6 ]]()

Using what you just learned, what numbers would belong inside matrix 2A? Hint: 2A means to multiply 2 by A.

Use this [matrix calculator](http://onlinemschool.com/math/assistance/matrix/multiply1/) for help.

![2A = 2 [ row 1: -4 , 0  row 2: 3 , 6 ]]()

![2A = 2 [ row 1: -4 , 0  row 2: 3 , 6 ]]()

Check your answer using [this site](http://www.coolmath.com/algebra/24-matrices/03-scalar-multiplication-01).

Now find 5B.

![= [ row 1: 7 , 0 , 15  row 2: -7 , 5 , 1 ]]()

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