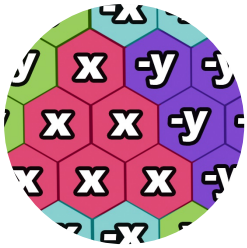

# Keep It Simple

## Simplifying Algebraic Expressions

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| **Grade Level** | 7th Grade | **Time Frame** | 2 class periods |
| **Subject** | Mathematics | **Duration** | 70–90 minutes |
| **Course** | Middle School Mathematics | | |

## Essential Question

How can we simplify algebraic expressions?

## Summary

Students will physically model the concept of simplifying algebraic expressions as a class then apply this knowledge to written expressions. This is a great lesson for both introducing, as well as remediating, the concept of combining like terms.

## Snapshot

**Engage**

Students recall how to model algebraic expressions.

**Explore**

Students use their models of algebraic expressions to add and subtract algebraic expressions.

**Explain**

Students formalize their understanding of subtracting algebraic expressions.

**Extend**

Students apply what they have learned to simplify algebraic expressions.

**Evaluate**

Students create their own adding and subtracting expressions problems given simplified expressions.

## Standards

*ACT College and Career Readiness Standards - Mathematics (6-12)*

**A303:** Combine like terms (e.g., 2x + 5x)
**A402:** Add and subtract simple algebraic expressions

*Oklahoma Academic Standards Mathematics (7th Grade)*

**7.A.4.1:** Use properties of operations (associative, commutative, and distributive) to generate equivalent numerical and algebraic expressions containing rational numbers, grouping symbols and whole number exponents.

## Attachments

- Create the Problem—Keep It Simple.docx
- Create the Problem—Keep It Simple.pdf
- Fruit Signs—Keep It Simple.docx
- Fruit Signs—Keep It Simple.pdf
- Lesson Slides—Keep It Simple.pptx
- Simplifying Algebraic Expressions—Keep It Simple.docx
- Simplifying Algebraic Expressions—Keep It Simple.pdf
- Student Variable Cards—Keep It Simple.docx
- Student Variable Cards—Keep It Simple.pdf
- Variable Signs—Keep It Simple.docx
- Variable Signs—Keep It Simple.pdf

## Materials

- Lesson Slides (attached)
- Variable Signs (attached; 8 sets; print one-sided)
- Simplifying Algebraic Expressions handout (attached; one per student; print one-sided)
- Create the Problem handout (attached; one per student; print one-sided)
- Fruit Signs (optional; attached)
- Student Variable Cards (optional; attached)
- Pencils
- Paper
- Algebra Tiles (optional)
- Student devices with internet access (optional)

# Preparation

During the Engage phase of the lesson, students will model algebraic expressions using the attached **Variable Signs**, which are essentially algebra tiles containing: $x$, $-x$, $y$, and $-y$. The document contains four pages. Print at least eight copies of each page, and consider printing each page on a different colored paper. Then, create four stacks of signs, one stack for each page. For example, you might have eight blue pages with $x$ in one stack, eight red pages with $-x$ in another stack, etc. See the Optional Differentiating note at the end of Engage to determine if you also need to prepare the attached **Fruit Signs** in the same way.

Additionally, if you plan to reuse these signs, consider printing them onto cardstock paper.

During the Extend phase of the lesson, students will practice simplifying algebraic expressions. A digital option for algebra tiles is provided, but if your students need the support of algebra tiles, print and cut the attached **Student Variables Cards**. See the Optional Resources note at the beginning of Extend for more details.

10 minutes

# Engage

Introduce the lesson using the attached **Lesson Slides**. **Slide 3** displays the lesson's essential question. **Slide 4** identifies the lesson's learning objectives. Review each of these with your class to the extent you feel necessary.

Place the printed pages of the attached **Variable Signs** in stacks ($x$, $-x$, $y$, and $-y$) that are visible and accessible to students. Show **slide 5** and ask volunteers to each take one sign to represent the expression on the slide ($3x + 2y$).

### Teacher's Note: What Model?

For the example $3x + 2y$, five students are needed. Three students would hold one '$x$' sign each, and two would hold one '$y$' sign each (making three $x$'s and two $y$'s).

Have those volunteers return their signs to their stacks and return to their seats. Transition to **slide 6**. Again, ask for volunteers to model the expression on the slide ($-2x + y$).

Have those volunteers keep their signs and potentially step to the side (but not return to their seats) because another group is going to join them.

Display **slide 7** and ask for another set of volunteers to model the expression on the slide ($x + 3y$). Direct students to stand such that the two groups holding signs are clearly both being modeled at the same time.

### Optional Differentiating

If students are not yet ready for the abstract concept of a variable, print the attached **Fruit Signs** instead. Start with the fruit, then transition to variables with later examples.

20 minutes

# Explore

### Teacher's Note: The Relationship Between Subtraction and Negatives

Students tend to struggle with understanding concepts we often take for granted such as subtracting an $x$ is the same thing as adding a $-x$. They might need help figuring out that $-3x$ is actually 3 negative $x$'s. Making this connection is a huge mental leap for them, so be prepared. Also, focus on the regrouping step. When students have a positive and a negative of the same term ($3x$ and $-3x$), both terms get removed from the equation because they form a zero pair.

As students have terms that cancel one another, have that pair of students move to the side. Emphasize what is left. For example, $3x - 2x$ does not leave 1, it leaves $1x$.

Show **slide 8**, which has a plus sign (+) between the two expressions. Facilitate a class discussion on how to combine the expressions together correctly. Use this time to ask guiding questions, but do not tell students how to combine like terms. Have students determine the final expression ($-x + 4y$) and write it on the board.

### Teacher's Note: Academic Language

Technically, the students are demonstrating the commutative property when they rearrange. You know your students best and whether they can handle full academic language "speak." This terminology should be mentioned a few times, even if not used exclusively.

Have those volunteers return to their seats then transition to **slide 9**. Ask for volunteers to model the two expressions: $(4x + 2y)$ and $(3x + y)$. Then, facilitate a class discussion on how to subtract the second expression from the first: $(4x + 2y) - (3x + y)$. Again, this is the time to ask more questions than you give answers.

Repeat this once more using **slide 10** for the expression: $(2x - 3y) - (x - 2y)$.

### Teacher's Note: Guiding the Lesson

Use student responses as a formative assessment to determine if students are ready to move to subtracting expressions where the result has negative terms or if they need additional practice. If they need additional practice, consider writing some of the examples below on the board for students to simplify:

- $(y + 2x) + (4x + 3y)$
- $(3y - 2x) + (-3y + 3x)$
- $(4x - 5y) - (2x - 2y)$

After students seem to understand the basics of adding and subtracting expressions, have students find a partner or assign partners. Display **slide 11** and before asking for volunteers to model the expression, have students discuss with their partner how they would simplify the expression on the slide: $(-3x + 3y) - (-2x + 4y)$. Give students approximately 3 minutes for discussion. It is okay and expected even that most students will not have a completely simplified expression during this time.

20 minutes

# Explain

After pairs have discussed, ask for volunteers to model the expression, as before. Then, facilitate a class discussion on how to simplify the expression from slide 11: $(-3x + 3y) - (-2x + 4y)$.

### Teacher's Note: Guiding the Discussion

This discussion will likely have students "taking away" two of the '$-x$' signs from the three available and "taking away" three of the '$y$' signs, but stumped with how to take away that fourth '$y$' sign from nothing. To model this, ask them if there is another way to represent "nothing." Ask guiding questions as needed, even if it leads to asking what a zero pair is, to get students to think about representing "nothing" with one '$-y$' sign and one '$y$' sign.

Once there are three volunteers: one pair holding a '$-y$' and '$y$' sign and another one holding a '$-y$' sign, students can now "take away" $y$, leaving one remaining '$-y$' sign. See the hidden **slides 12–14** for this approach modeled with algebra tiles.

Display **slide 15** to show students how to algebraically simplify the addition of '$-x$' and '$-y$' (the two signs) to $-x - y$.

This task of having students model this process should feel "like too much work." So when you hear students express this, challenge them to the idea that there *must* be a better way.

While still showing slide 15, ask students to think critically about that last step, changing the addition of a negative term to the subtraction of a positive term. Move to **slide 16** and ask students how they could use that same thinking to the expression they just simplified: $(-3x + 3y) - (-2x + 4y)$. If students struggle to see the connection, go ahead and directly tell them that instead of subtracting, they can add a negative expression. In other words, that minus symbol can be replaced with a plus sign and a -1 in front of the second expression: $(-3x + 3y) + (-1)(-2x + 4y)$. Display **slide 17** to show students this.

Now, have students use the distributive property to simplify the expression. Point out to students how much easier this is than the modeling (from earlier in the lesson).

### Teacher's Note: Guiding the Lesson

Be intentional about using academic vocabulary and ensuring that students understand the subtle differences between different phrases.

- An *expression* is one or more terms (one side of an equation, but not to be confused with the word "equation"). When we *combine expressions* (or add/subtract expressions), we are being asked to simplify the expression. To simplify, we use different properties like the commutative, associative, and distributive properties, to combine like terms. During this process, we are writing *equivalent expressions*—which may look different but are equal in value—until we have a *simplified expression*. The simplified expression is an equivalent expression to the original, but it is written in the most simplified form.

15 minutes

# Extend

### Optional Resources

During this phase of the lesson, students are going to practice simplifying expressions. Depending on when you teach this lesson and your students' needs, some students may need or want the support of modeling expressions. Have students use Polypad by Amplify and select the "Algebra" option to use digital algebra tiles. If you prefer a non-digital option, consider using traditional algebra tiles, bingo chips, or printing and cutting the attached **Student Variable Cards**. Consider printing each page on a different color, matching the formatting of the Variable Signs.

Show **slide 18** and give each student a copy of the attached **Simplifying Algebraic Expressions** handout. Encourage students to independently try each question. Tell them that once they finish (or get stuck) to check their work and discuss with their partner. If students are using modeling, consider having one student model, while the other practices using academic language to describe what the other is modeling; have students take turns.

### Sample Responses:

Use the hidden **slide 19** for sample student responses.

If students are using modeling to simplify their expressions, encourage them to challenge themselves to "try the next problem" without the algebra tiles. This will help them be better prepared for the last questions on their handout that do not use *x*'s or *y*'s.

After most students have simplified the third expression, transition to **slide 20** and bring the class together for a group discussion. Use this slide to show how to simplify an expression without writing the actual regrouping but by underlining the *x* terms and circling the *y* terms (assuming this is an acceptable form of regrouping in your classroom).

### Teacher's Note: Guiding the Activity

Move from group to group during the activity, listening to and verifying the accuracy of the explanations. Your movement ensures that the students are on task, but it also allows you to remediate students' incorrect perceptions in the moment.

15 minutes

# Evaluate

Show **slide 21** and give each student a half-page of the attached **Create the Problem** handout. Preview the activity with students by explaining that they are given five simplified expressions and need to fill in the blanks to create an equivalent unsimplified expression. Students are to select three of the five expressions, create those equivalent expressions, trade papers with a peer, and then check their peer's work. Let students know that one of their three expressions needs to be question #4 or #5 because they need to write at least one expression that involves the distributive property.

Give students approximately five minutes to independently work on their three expressions.

Once students are done, display **slide 22** and have students trade papers and check each other's work. Have students discuss any corrections that might be needed with their partners.

If time allows, consider having volunteers for those who selected question #3, for example, to write their equivalent expression on the board. Emphasize to students that the list of expressions are all equivalent and all simplify to the same expression. Use this time to emphasize the correct use of symbols and vocabulary.

### Teacher's Note: Spiral Curriculum

This type of problem would be great as a bellringer as you progress through the unit and the year. You could phrase the bellringer prompt as, "Write an expression that [guidelines] and simplifies to [result]." The guidelines could be "has two subtraction symbols," "uses the distributive property," etc.

## Resources


- K20 Center. (n.d.). Create the problem. Strategies. https://learn.k20center.ou.edu/strategy/149
- K20 Center. (n.d.). Polypad. Tech Tools. https://learn.k20center.ou.edu/tech-tool/4556