Journey of the Isolated Variable, Part 1

Solving Two-Step Equations

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Grade Level	8th – 9th Grade	**Time Frame**	1-2 class period(s)
Subject	Mathematics	**Duration**	80 minutes
Course	Algebra 1, Pre-Algebra		

Essential Question

How do I isolate a variable in a two-step equation?

Summary

This lesson focuses on the properties of real numbers, properties of equality, and inverse operations to help students solve linear equations. The goal is for students to understand the fundamentals of isolating a variable. Students will then be able to solve two-step equations by applying properties of rational numbers. The next lesson in this series focuses on isolating variables in multi-step equations. This is the first lesson of four in the "Journey of the Isolated Variable" lesson series.

Snapshot

Engage

Students reflect on their knowledge of algebraic properties through a card matching activity.

Explore

Students investigate how to isolate the variable *x* using the weighted scale method.

Explain

Students analyze their understanding through a foldable.

Extend

Students use dice as a randomizer to create and comprehend harder equations.

Evaluate

Students' new knowledge is evaluated through an exit ticket.

Standards

Oklahoma Academic Standards for Mathematics (Grades 9, 10, 11, 12)

A1.A.3.1: Solve equations involving several variables for one variable in terms of the others.

Attachments

- Algebraic Properties Card Matching—Journey of the Isolated Variable, Part 1 - Spanish.docx
- Algebraic Properties Card Matching—Journey of the Isolated Variable, Part 1 - Spanish.pdf
- Algebraic Properties Card Matching—Journey of the Isolated Variable, Part 1.docx
- Algebraic Properties Card Matching—Journey of the Isolated Variable, Part 1.pdf
- Exit Ticket—Journey of the Isolated Variable, Part 1 - Spanish.docx
- Exit Ticket—Journey of the Isolated Variable, Part 1 - Spanish.pdf
- Exit Ticket—Journey of the Isolated Variable, Part 1.docx
- Exit Ticket—Journey of the Isolated Variable, Part 1.pdf
- Extend Activity—Journey of the Isolated Variable, Part 1 - Spanish.docx
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- Extend Activity—Journey of the Isolated Variable, Part 1.docx
- Extend Activity—Journey of the Isolated Variable, Part 1.pdf
- Extend Cards—Journey of the Isolated Variable, Part 1 - Spanish.docx
- Extend Cards—Journey of the Isolated Variable, Part 1 - Spanish.pdf
- Extend Cards—Journey of the Isolated Variable, Part 1.docx
- Extend Cards—Journey of the Isolated Variable, Part 1.pdf
- Foldable—Journey of the Isolated Variable, Part 1 - Spanish.docx
- Foldable—Journey of the Isolated Variable, Part 1 - Spanish.pdf
- Foldable—Journey of the Isolated Variable, Part 1.docx
- Foldable—Journey of the Isolated Variable, Part 1.pdf
- Lesson Slides—Journey of the Isolated Variable, Part 1.pptx
- Practice—Journey of the Isolated Variable, Part 1 - Spanish.docx
- Practice—Journey of the Isolated Variable, Part 1 - Spanish.pdf
- Practice—Journey of the Isolated Variable, Part 1.docx
- Practice—Journey of the Isolated Variable, Part 1.pdf
- Weighted Scale Activity—Journey of the Isolated Variable, Part 1 - Spanish.docx
- Weighted Scale Activity—Journey of the Isolated Variable, Part 1 - Spanish.pdf
- Weighted Scale Activity—Journey of the Isolated Variable, Part 1.docx
- Weighted Scale Activity—Journey of the Isolated Variable, Part 1.pdf

Materials

- Lesson Slides (attached)
- Algebraic Properties Card Matching handout (attached; one per group; printed front only)
- Weighted Scale and Variable Cards (attached; one per group; printed front only)
- Weighted Scale Activity handout (attached; one per group; printed front only)
- Foldable handout (attached; one per student; printed front only)
- Extend Activity handout (attached; one per group; printed front only)
- Practice handout (attached; one per student; printed front only)
- Exit Ticket handout (attached; one half-sheet per student; printed front only)
- Extend Cards (attached; optional; printed front only)
- Paper
- Pencils (one per student)
- Polyhedral dice (three per group, including one die of a different color; digital option available)
- Student devices with internet access (optional)

- Scissors
- Glue Stick

15 minutes

Engage

Teacher's Note: Preparation

Before beginning the lesson, print out the attached **Algebraic Properties Card Matching Activity** handout and cut out and shuffle the cards for each group. The groups may be based on your seating arrangements and norms, but placing students in pairs will provide the most depth and conversation to the activity.

Introduce the lesson using the attached **Lesson Slides**. Display **slide 3** to share the lesson's essential question: *How do I isolate a variable in a two-step equation?* Display **slide 4** to go over the lesson's learning objective. Review these slides with students to the extent you feel necessary.

Go to **slide 5**. Students will analyze their understanding of algebraic properties using the Card Matching strategy. Place students in groups of two or three, and provide each group with the cut-out cards from the attached **Algebraic Properties Card Matching Activity**. The card matching activity has three different categories: the word or expression, the definition, and an example. In their groups, invite students to match the word/expression, definition, and example provided. As they are matching, have students discuss why they believe the cards fit together based on their previous knowledge.

After the groups have had time to discuss, invite them to share their answers with another group. As a class, define each property and eliminate any misunderstandings students may have about the card matching activity or definitions by revealing the answers. The more students can process why the definitions matter, the easier solving equations will be.

Technology Option

If you would prefer a digital card matching activity, use the following Desmos Classroom activity.

Select the following link: "Journey of the Isolated Variable, Part 1." Create an account or sign in under the "Activity Sessions" heading. After you log in, the green "Assign" dropdown button will be active. Click the arrow next to the word "Assign," then select "Single Session Code." After making some setting selections, select "Create Invitation Code" and give the session code to students. For more information about previewing and assigning a Desmos Classroom activity, go to https://k20center.ou.edu/externalapps/using-activities/.

For more detailed information about Desmos features and how-to tips, go to https://k20center.ou.edu/externalapps/desmos-home-page/.

Provide students with your session code. Then, have students go to student.desmos.com and enter the session code.

Students do not have to sign in unless they intend to pause and resume the activity at a later time.

Card Matches

The correct matches for the card matching activity can be found in the original Algebraic Properties Card Matching handout.

20 minutes

Explore

Teacher's Note: Preparation

For this activity, students will be in pairs. Print out the attached **Weighted Scale and Variable Cards**, cut out the variable cards on the second page, and put them in baggies for each pair. Be mindful of how many variable cards students will need for each activity. If the equation is $x+5 = -7$, they will need one positive variable card, five positive number "coins," and seven negative number "coins."

Display **slide 6**. As a class, discuss what the different variables mean, but don't use this slide to show students how to solve the equation just yet. Simply show students there is a weighted scale with variable pieces on the scale, as well as an equation at the base of the scale. To the right of the scale, there are the four different symbols students can use to create an equation. The squares represent positive and negative variables, which don't always have to be *x*, and the circles represent positive and negative numbers.

Teacher's Note: Exploration

As a class, talk about what the different variables mean, but don't show students how to solve the equation using the weighted scale activity just yet. Give students the opportunity to explore that on their own. You just want them to feel comfortable with what the symbols mean and make sure everyone is on the same page with the instructions before starting. Before passing out the materials, make sure students are in pairs. They may work in their original pairs, or you may assign them to a different partner for this activity.

Pass out the attached **Weighted Scale Activity** handout, the first page of the attached **Weighted Scale and Variable Cards**, and the cut-out **Variable Cards**. One student will use the weighted scale and variable cards to solve, and the other will draw out the process on the Weighted Scale Activity handout.

Once each partner completes the first problem, they will check to see if they got the same answer. They will analyze how they solved the problem using their manipulative (either moving the cards physically on the scale or drawing their pieces on the handout), and then they will discuss the process with their partner.

After each partner has talked about how they solved the problem, they will switch materials. By the end of this activity, each person will have had an opportunity to use both the cards and the handout to solve the problems.

25 minutes

Explain

Display **slide 7**. Pose the question: *How do you isolate a variable?*

Have students use the strategy Think-Pair-Share to communicate to the class how they solved the problems using the weighted scale. At this point in the lesson, it is time to eliminate any misconceptions students may have and bring back the properties discussed in the Engage section of the lesson to begin using academic vocabulary to discuss the concepts.

Teacher's Note: Preparation

Once the discussions come to a close, introduce students to the attached **Foldable** handout. Depending on time, you may walk them through how to create their foldables, or you may do the prep work beforehand. Students will need scissors and glue to assemble this foldable.

Once students have assembled their foldable, display **slide 8**. Use the example provided on the slide and the foldable steps to teach students how to follow the steps (how to use the foldable) to solve an equation. The first example will be easier for them because they can answer "no" to the first step.

Go to **slide 9**. As students are comprehending how to follow the steps of solving equations using the foldable as a guide, begin to introduce harder problems that require a "yes" on each foldable step, such as the example provided on this slide. Feel free to add, delete, or modify the equations given to best fit students' needs.

10 minutes

Extend

Teacher's Note: Preparation

Before beginning this part of the lesson, print out a copy of the attached Extend Activity handout for each pair. If you want students to solve these problems in order, use the handout as is. You may instead choose to randomize the expressions by cutting each handout in half to separate the equations, then having students solve them in random order.

Alternative Digital Dice

Students are to use the dice to generate coefficients and constants for their equation. If you prefer that students use a digital version, you can use the CPM Probability Generators and select the dice or the random number generator. If you recommend the random number generator, be sure to let the students know what maximum value to use.

For this activity, invite students to work together in pairs, but make sure each partner has their own copy of the attached **Practice** handout to work on. Also pass out a copy of the attached **Extend Activity** handout to each student pair. If you do not want to print out the Practice handout, students can always use a piece of paper to show their work.

Give each pair of students three polyhedral dice—two dice should be the same color and the third a different color. The different colored die represents a negative number. Ask the pairs to identify one partner to go first, "Student A." This student should begin with the first equation on the Extend Activity handout (or the first strip if the cards are halved and being solved in random order).

Go to **slide 10**. Invite the partner who is going first to follow the steps on the slide:

1. Roll a polyhedral die. Place the resulting number in the first slot of the equation.
2. Roll a different polyhedral die. Place the resulting number in the second slot.
3. Roll the last polyhedral die. Place the resulting number in the third slot.

Ask both students in each pair to write this randomized equation down on their Practice handout, under the "Student A" column in the first row. Next, ask each pair to work together to solve for x. Allow enough time for every pair to finish 10 rounds of solving their randomized equations, alternating between Student A and Student B rolling the dice.

Optional Activity: Extended Equation Manipulation

Some students may quickly grasp how solving equations works. You may choose to make this activity more challenging for those students by cutting out the equation symbols in the attached **Extend Cards**. Have students randomly draw numbers for their equations and then add plus or minus symbols and variables, placing the plus or minus symbols in the equations to create a much longer equation to simplify. For example, they could create a problem that looks like 5x-2+7x=10 or an even harder problem with variables on both sides, such as 4x+3=7-6x. How to solve for these harder problems will be taught in Journey of the Isolated Variable, Part 2 of this lesson series, but some students will be up for this enriching challenge already—don't limit them if they are ready!

Evaluate

Display **slide 11**. Have students complete an Exit Ticket to close this lesson. Provide each student with a half-sheet from the attached **Exit Ticket** handout and have them respond to the following prompt: *Create two different equations that will give you a solution of x = -7*.

Encourage students to be creative when writing their equations instead of picking easy equations just to get the assignment finished. Once they pick their equations, have them justify their answers by solving the problems and describing their steps. This quick assessment will give you a good indication that students are understanding the concept if they can create their own problem, solve it, and give an explanation of the process.

Resources

- K20 Center. (n.d.). Bell Ringers and Exit Tickets. Strategies. https://learn.k20center.ou.edu/strategy/125
- K20 Center. (n.d.). Card Matching. Strategies. https://learn.k20center.ou.edu/strategy/1837
- K20 Center. (n.d.). CPM Probability Generators. Tech Tools. https://learn.k20center.ou.edu/tech-tool/2317
- K20 Center. (n.d.). Desmos Classroom. Tech tools. https://learn.k20center.ou.edu/tech-tool/1081
- K20 Center. (n.d.). Think-Pair-Share. Strategies. https://learn.k20center.ou.edu/strategy/139
- Stokes, A. (n.d.). Journey of the Isolated Variable, Part 1 [Interactive activity]. Desmos Classroom. *https://teacher.desmos.com/activitybuilder/custom/5ec289300ddf040f35680d93*