Journey of the Isolated Variable, Part 4

Absolute Value Equations

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Published by *K20 Center*

Grade Level	9th Grade	**Time Frame**	2-3 class periods
Subject	Mathematics	**Duration**	120 minutes
Course	Algebra 1		

Essential Question

How do you solve one-variable absolute value equations?

Summary

In this lesson, students build on prior knowledge of solving equations to learn how to solve absolute value equations. Students then compare and contrast four types of equations including two-step, multi-step, literal, and absolute value equations. This is the fourth lesson in the four-part "Journey of the Isolated Variable" lesson series.

Snapshot

Engage

Students participate in a Collective Brain Dump activity on the terms “equations” and “absolute value” and draw connections between different types of equations.

Explore

Students solve absolute value equations using number lines in a Desmos Classroom activity.

Explain

Students solve absolute value equations and analyze their understanding of absolute value using a flowchart.

Extend

Students identify errors made in solving absolute value equations then correct the error, explain why the error was made, and justify the correct answer.

Evaluate

Students complete an Exit Ticket in which they solve examples of four types of equations and explain how each equation is unique.

Standards

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

N 404: Understand absolute value in terms of distance
A606: Solve absolute value equations

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

A1.A.1.2: Solve absolute value equations and interpret the solutions in the original context.

Attachments

- Engage—Journey of the Isolated Variable, Part 4 - Spanish.docx
- Engage—Journey of the Isolated Variable, Part 4 - Spanish.pdf
- Engage—Journey of the Isolated Variable, Part 4.docx
- Engage—Journey of the Isolated Variable, Part 4.pdf
- Exit Ticket—Journey of the Isolated Variable, Part 4 - Spanish.docx
- Exit Ticket—Journey of the Isolated Variable, Part 4 - Spanish.pdf
- Exit Ticket—Journey of the Isolated Variable, Part 4.docx
- Exit Ticket—Journey of the Isolated Variable, Part 4.pdf
- Explore Activity—Journey of the Isolated Variable, Part 4 - Spanish.docx
- Explore Activity—Journey of the Isolated Variable, Part 4 - Spanish.pdf
- Explore Activity—Journey of the Isolated Variable, Part 4.docx
- Explore Activity—Journey of the Isolated Variable, Part 4.pdf
- Extend (Sample Responses)—Journey of the Isolated Variable, Part 4.pdf
- Extend—Journey of the Isolated Variable, Part 4 - Spanish.docx
- Extend—Journey of the Isolated Variable, Part 4 - Spanish.pdf
- Extend—Journey of the Isolated Variable, Part 4.docx
- Extend—Journey of the Isolated Variable, Part 4.pdf
- Flowchart Answer Key—Journey of the Isolated Variable, Part 4.pdf
- Flowchart—Journey of the Isolated Variable, Part 4 - Spanish.pdf
- Flowchart—Journey of the Isolated Variable, Part 4.pdf
- Lesson Slides—Journey of the Isolated Variable, Part 4.pptx

Materials

- Lesson Slides (attached)
- Engage handout (attached; one per student)
- Explore Activity handout (attached; one per student)
- Flowchart handout (attached; one per student)
- Flowchart Answer Key document (attached; for teacher use)
- Extend handout (attached; one per student)
- Extend Sample Responses document (attached; for teacher use)
- Exit Ticket handout (attached; one per student)
- Chromebooks or student devices with internet access
- Pencils
- Paper

10 minutes

Engage

Teacher's Note: Desmos Classroom Activity Preparation

The Explore phase of this lesson features a Desmos Classroom activity that requires preparation beforehand.

To access the activity, select the link for the "Journey of the Isolated Variable, Part 4." Create an account or sign in under the "Activity Sessions" heading. After signing in, locate the "Assign," select the dropdown arrow next to the button, then select "Single Session Code." Choose the appropriate settings for your class then select "Create Invitation Code." Copy and paste the code into **slide 7** of the **Lesson Slides**.

For more information about how to preview and assign a Desmos Classroom activity, click here.

For more information about the features of Desmos Classroom or tips on how to use the site, click here.

To adjust pacing of the activity for students, select the "View Dashboard" button next to the session code. In the upper-left corner of the screen, select the icon above the word "Pace." Select the first and last screens that you want students to access. When prompted to set a range, select screens 1 and 2. Select "Restrict to Screens 1–2" to confirm your selection. Students will now only be able to access the two screens.

For more information about how to pace an activity, click here.

Introduce the lesson using the attached **Lesson Slides**. Display **slide 3** and read aloud the lesson's essential question, "How do you solve one-variable absolute value equations?" Display **slide 4** and introduce the lesson objective.

Transition to **slide 5** and introduce the Collective Brain Dump activity to students. Distribute one copy of the attached **Engage** handout to each student. Instruct students to write down everything they know about the terms "equations" and "absolute value" in the designated columns. Tell students to use words, pictures, symbols, and more to describe the terms. Allow students two minutes to complete the activity.

Organize students into small groups of two or three either by assigning groups or allowing students to choose groups. Tell students to compare their individual lists to those of their group members and add any new information to their lists as group members share.

Once all groups members have had the opportunity to share their responses, display **slide 6**. Lead a whole class discussion in which you invite students to share out what they know about equations and absolute value. As students share, add their responses to the slide under the appropriate columns.

30 minutes

Explore

Teacher's Note: Desmos Sign-In Options

Instruct or encourage students to sign in to the activity using their Google or Desmos accounts. If students sign in, their progress will be saved, which will allow them to resume the activity later or review their work. If students do not sign in, they can complete the activity, but must complete it during a single session as their progress will not be saved.

Display **slide 7**. Instruct students to navigate to student.desmos.com and enter the session code present on the slide.

Give each student one copy of the attached **Explore Activity** handout. Introduce the activity by reviewing students' responses about absolute value from the Engage phase of the lesson. Guide students' attention to the handout and tell them that they will complete a series of problems during the course of the Desmos Classroom activity. Notify students that once they arrive at **screens 12–16** they will record the reasoning for their answers on the handout.

Have students begin the activity and complete **screens 1–2**. As students complete the problems, review their responses to see if some students need a review of concepts before proceeding.

Return to the dashboard of the activity and select the plus sign three times to allow students to progress through **screens 3–5**. Once students have completed screen 5, initiate a whole class discussion and invite students to share out their answers and explain how they found the distance between two values.

On the dashboard, select the plus sign three times to allow students to progress through **screens 6–8**. Once students have completed screen 8, initiate another whole class discussion and have students share out their expression for finding the distance between any two numbers.

Return to the dashboard and select the plus sign three times to allow students to progress through **screens 9–11**. After students complete screen 11, ask volunteers to share out the x value they found for the equation $|x - 6| = 5$.

Ask students how many solutions they think there are for that equation. Then, ask volunteers to share the sentence they created to describe the absolute value equation.

Teacher's Note: Guiding the Activity

Challenge students to form sentences that describe the equation without mentioning each individual symbol. Encourage students to create sentences that do not use terms like "absolute value" or "minus."

For example, students may write "The distance between x and 6 is 5," or "The distance between 6 and some number is 5."

Click the orange "Stop" button on the dashboard, which will allow students to complete the activity at their own pace. Direct students to complete screens 12–16, which require students to illustrate absolute value equations on a number line. Remind students to record their reasoning for each problem on their Explore Activity handouts.

Teacher's Note: Student Feedback

Desmos is designed to give students feedback on their answers to screens 12–14. You may provide feedback on answers to screens 15–16 using the dashboard.

As students complete the activity, invite volunteers to share out their processes for solving absolute value equations that they described on **screen 17**.

30 minutes

Explain

Display **slide 8**. Invite students to share how they determined the answers to the questions in the Desmos Classroom activity. Use the following questions to guide the discussion:

- What key details helped you determine where the sliders should be moved?
- Why do you think those details are important?
- How might one solve the problems in a different way?

Sample Student Responses

Possible student responses include:

- “It is important to pay attention to what is happening to x.”
- "I just tried different numbers."
- "I plugged numbers into the equation to see which one would give me the answer."
- "The number on the other side of the equal sign is important because you’re trying to make the absolute value equation equal to that number."

Display **slide 9**. Pass out a copy of the attached **Flowchart** handout to each student. Using the example equation on the slide, guide students through the process to solve for *x*. Prompt students to respond with “yes” or “no” to each question as you follow the steps. This equation will be easier for students to solve, as they can answer “yes” to the first step.

Teacher's Note: Flowchart Use

For an example of how to use the flowchart, see the attached **Flowchart Answer Key**. The document includes a completed example of each problem found in the slides.

Explain to students that they should follow the flowchart for each question, but mark their responses on a separate sheet of paper. This will allow them to reuse the flowchart.

Transition to **slide 10** and introduce students to the next absolute value equation. Similar to the equation on slide 9, students can answer “yes” to the first step on the flowchart for this equation as well. Have students work with a partner to complete this example using the flowchart. As they work, walk around the room to ensure that students are properly using the flowchart, guiding those that need help if necessary.

Teacher's Note: Equations

Depending on the needs of your students, you may choose to add to, delete, or modify the equations on the slides.

Once the majority of students have complete the equation on slide 10, transition through **slides 11–13** to introduce increasingly difficult problems. These problems require students to answer “no” to the first step on the flowchart. Challenge students to try the example on **slide 12** individually then compare their results with their partner.

30 minutes

Extend

Teacher's Note: Activity Preparation

This portion of the lesson requires students to analyze incorrectly solved absolute value equations using the following four steps:

1. **Identify the error in solving the absolute value equation.**

Students may complete this step in a variety of ways. Students may circle, highlight, or star where the error occurred. Decide in advance how you would like students to notate the errors.

2. **Correct the error by showing the correct steps.**

Students may complete the correction on the handout or on a separate sheet of paper to be attached to the handout at the end. Decide where you would like students to show the correct steps.

3. **Explain how and why a student might have made that error.**

This step allows students to consider common mistakes in solving absolute value equations, which may help them avoid making those same mistakes in the future. Decide where you would like students to write this information.

4. **Justify the correct answer and steps taken.**

This step allows students to communicate their mathematical thinking. When students justify their answers and steps, they are using math vocabulary and processing skills to communicate their understanding. Decide where and how you would like them to communicate this information.

Encourage students to show their work on a separate sheet of paper or in the margins of the Extend handout instead of marking out the errors on the original problem. This will make it easier to review their responses. Ensure that students show the correct steps from the error to the correct solution.

Display **slide 14** and pass out one copy of the attached **Extend** handout to each pair of students. Tell students that each problem contains an error that another "student" made when solving the absolute value equation. Have to students complete the steps below for each problem and explain to them how you want them to document each step.

- **Step 1**: Identify the error in solving the absolute value equation.
- **Step 2**: Correct the error by showing the correct steps.
- **Step 3**: Explain how and why a student might have made that error.
- **Step 4**: Justify the correct answer and steps taken.

Extend Handout Sample Responses

For examples of possible student responses to the problems, see the attached **Extend (Sample Responses)** document. However, student responses are not limited to the examples in the document.

After students have completed the handout, display **slide 15**. Instruct pairs to join up with two other pairs of students to create groups of six. Have groups of six organize their papers into three stacks—one stack for each problem.

Tell groups to then organize back into three pairs and have each pair choose a problem. One pair will work on Problem 1, another on Problem 2, and another on Problem 3. Explain that pairs should review the papers for their chosen problem and verify the four steps identified earlier.

Teacher's Note: Verification

As students work in their groups, walk around the room and listen to students' justifications and processes. Make note of any common misconceptions you observe. Depending on how common these misunderstandings are, you may consider reviewing them as a whole class once students are done working in their small groups.

Remind students to see the value in each others' work and stress that there is more than one way to communicate mathematics.

20 minutes

Evaluate

Teacher's Note: Other Types of Equations

Students must know how to solve two-step equations, multi-step equations, and literal equations to complete the Exit Ticket. These equations are covered in parts 1, 2, and 3 of this lesson series, respectively.

Display **slide 16** and give each student one copy of the attached **Exit Ticket** handout. Instruct students to complete each type of equation independently. Tell students to additionally justify how they solved each equation and explain what is unique about that type of equation in boxes below each problem. Help students to understand that the numbers and operations used in each equation are not unique to only that equation type.

Resources

- K20 Center. (n.d.). Bell ringers and exit tickets. Strategies. https://learn.k20center.ou.edu/strategy/125
- K20 Center. (n.d.). Collective brain dump. Strategies. https://learn.k20center.ou.edu/strategy/111
- K20 Center. (n.d.). Desmos classroom. Tech tools. https://learn.k20center.ou.edu/tech-tool/1081
- Stokes, A. (n.d.). *Journey of the isolated variable, part 4* [Interactive activity]. Desmos. https://teacher.desmos.com/activitybuilder/custom/5ec2d10f4748f47be91b6681