Journey of the Isolated Variable, Part 4

Absolute Value Equations

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

Essential Question

How do I solve one-variable absolute value equations?

Summary

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

Snapshot

Engage

Students draw connections among different types of equations by participating in a Collective Brain Dump activity about the terms "equations" and "absolute value."

Explore

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

Explain

Students analyze their understanding of absolute value equations through a flowchart.

Extend

Students complete three "find the error" problems in which they identify the error another "student" made while solving an absolute value equation. Students then correct the error, explain how one might have made that error, and justify the correct answer.

Evaluate

Students compare and contrast the four types of equations on an Exit Ticket by solving an example of each, justifying their steps, and explaining what is unique about each type of equation.

Standards

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; printed front only)
- Explore Activity handout (attached; one per student; printed front only)
- Flowchart Absolute Value Equations (attached; one per student; printed front only)
- Flowchart Answer Key (attached; for teacher use)
- Extend handout (attached; one per student; printed front only)
- Extend Sample Responses (attached; for teacher use)
- Exit Ticket (attached; one per student; printed front only)
- Chromebooks or student devices with internet access
- Pencils
- Paper

10 minutes

Engage

Introduce the lesson using the attached **Lesson Slides**. Display **slide 3** to share the lesson's essential question: *How do I solve one-variable absolute value equations?* 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**. Introduce students to the Collective Brain Dump strategy. Pass out the attached **Engage** handout to each student. Instruct students to individually write down everything they know about the terms "equations" and "absolute value" in the designated columns on their handout. Give students about 2 minutes to write what they know.

Next, invite students to get in small groups of two or three students. You may assign groups or let students choose their groups. Within each group, have students compare their lists of information. Guide students to add new items to their lists as their group members share out.

Display **slide 6**. Once all students have had the chance to share in their groups, have a whole-class discussion. On the slide, create a collective list of knowledge the class has about "equations" and "absolute value."

30 minutes

Explore

Teacher's Note: Desmos Classroom Activity Preparation

To use this Desmos Classroom activity, select the following link: "Journey of the Isolated Variable, Part 4." 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/.

To set up the activity's pacing for students, select "View Dashboard" (next to the session code). In the upper-left corner of your screen, select the icon above the word "Pacing." Desmos Classroom should then prompt you to select the first and last screens that you want students to see. When prompted to set a range, select screens 1 and 2. Select "Restrict to Screens 1–2" to confirm your selection. This allows students to access only screens 1–2 at this time. For more information about teacher pacing, go to https://k20center.ou.edu/externalapps/pacing-activities/.

Display **slide 7**. Then, have students go to student.desmos.com and enter the session code.

Teacher's Note: Sign-in Options

If students sign in with their Google or Desmos accounts, then their progress is saved, and they can resume the activity or view their work later. If students continue without signing in, they can complete the activity, but they must do so in one sitting. It is strongly recommended that students sign in; otherwise, they risk losing their work.

Pass out the attached **Explore Activity** handout to each student. Introduce the activity by referring to the "absolute value" list created during the Engage section of the lesson, highlighting some of the key items that students shared. Let students know they will use the handout to write down their thought process for solving the problems on **screens 12–16** in the Desmos Classroom activity. Screen numbers are in the top-right corner of the Desmos activity.

As students are finishing **screens 1–2**, use student responses to see if students need a review before moving forward.

On the Dashboard, press the plus sign three times to allow students to progress to **screens 3–5**. As students finish screen 5, bring the class together to share and explain their thinking for how they found the distance between two values.

Press the plus sign three times on the Dashboard to allow students to progress to **screens 6–8**. As students finish screen 8, again bring the class together to share their expression for finding the distance between any two numbers.

On the Dashboard, press the plus sign three times to allow students to progress to **screens 9–11**. As students complete screen 11, ask for volunteers to share the *x*-value they found that was a solution to $|x - 6| = 5$. Ask students how many solutions they think there should be. Then ask for volunteers to share their sentence that represents that absolute value equation.

Teacher's Note: Guiding the Activity

Emphasize the idea of saying the sentence without specifically mentioning every symbol. In other words, challenge students to create a sentence that does not use the words "absolute value" or "minus."

Some examples of this are:

- The distance between *x* and 6 is 5.
- The distance between 6 and some number is 5.

On the Dashboard, click the orange "Stop" button; now students can complete the Desmos activity at their own pace. Remind students to use their handout for **screens 12–16**, where they will be illustrating absolute value equations on a number line. Desmos is designed to give students feedback on screens 12–14. Use the Teacher Dashboard to provide students feedback for screens 15–16.

As students complete the Desmos Classroom activity, ask for volunteers to share their description of the process of solving absolute value equations that they typed on **screen 17**.

30 minutes

Explain

Display **slide 8**. As a whole class, discuss how students determined their answers in the Desmos Classroom activity. Ask the following questions:

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

Sample Student Responses

Possible student responses include:

- "An important part is 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 Absolute Value Equations** handout to each student. Using the example equation provided on the slide and the flowchart steps, show students how to follow the steps to solve an absolute value equation. The first two examples will be easier problems for them because they can answer "Yes" to the first step.

Flowchart Example Answers

If you would like to see examples of how the flowchart works, please see the attached **Flowchart Answer Key**. Each example equation from the Lesson Slides has a flowchart filled out to show the path to solve the absolute value equation.

Go to **slide 10** for another simple absolute value equation. Have students work with a partner to complete example 2 using the flowchart. As students begin to comprehend the steps of solving absolute value equations while using the flowchart as a guide, introduce harder problems that require a "No" on one or both of the flowchart steps, such as the examples provided on **slides 11–13**. Challenge students to try the fourth example (on slide 12) on their own then compare their results and work with their partner. Feel free to add, delete, or modify the equations to best fit students' needs.

30 minutes

Extend

Teacher's Note: Activity Preparation

Students will be provided with incorrectly solved absolute value equations. Students are asked to complete the following four steps for each problem:

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 indicate that they have identified the error.

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 think about what the common mistakes are when solving absolute value equations and to avoid making the same mistakes in the future. Decide where you would like students to write this information.

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

Students need to be able to communicate their mathematical thinking. By justifying their answer and steps, students are using math vocabulary and process skills to communicate their understanding. Decide where and how you would like this communicated.

Students may have a tendency to just mark out the error and write over the original problem. However, it is recommended that students work to the side of the problem or on a separate sheet of paper so that you can see each step students take to correct the answer. Students should show the correct steps starting from the error to the end of the problem.

Display **slide 14**. Pass out a copy of the attached **Extend** handout to each pair of students. Each of the three problems contains an error that another "student" made in their steps while solving an absolute value equation. Direct pairs of students to complete all four of the following steps for each problem. Inform students how you would like them to communicate their thinking for 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

If you would like to see the answers and examples of possible student responses for this activity, please see the attached **Extend (Sample Responses)** document. The possible responses from students are not limited to the examples in the document.

After students have completed the handout, display **slide 15** . Have pairs find two other pairs of students (creating groups of 6). Within the new group of 6, have students organize the questions into stacks of Problem 1, Problem 2, and Problem 3. Then have two students pick one of the absolute value equations to verify the four steps as identified above, such that all of the questions are reviewed.

Teacher's Note: Verification

As students discuss in their new groups, walk around to hear justifications and processes from students. To clarify any remaining misconceptions, you may want to bring the whole class back together to discuss the correct answers after students have verified in their small groups.

As they are working, remind students of the value of seeing each others' work and how there is more than one correct way to communicate mathematics.

20 minutes

Evaluate

Teacher's Note: Other Types of Equations

Students need to know how to solve two-step equations, multi-step equations, and literal equations in order to complete the exit ticket. Solving these types of equations is the focus of Parts 1, 2, and 3 of this lesson series, respectively.

Display **slide 16**. Students will complete an Exit Ticket to close this lesson.

Pass out a copy of the attached Exit Ticket handout to each student. Direct students to work independently to solve each type of equation. Instruct students to also complete the table by justifying how they solved each equation and explaining what is unique about that equation type. Encourage students to go beyond the idea that numbers or operations are unique to each 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.). Absolute Value Equations Exploration [Interactive activity]. Desmos. https://teacher.desmos.com/activitybuilder/custom/5ec2d10f4748f47be91b6681