



# Function Operations, Part 1

## Basic Operations and Domain Restrictions



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<b>Grade Level</b>	10th – 11th Grade	<b>Time Frame</b>	75-85 minutes
<b>Subject</b>	Mathematics	<b>Duration</b>	1-2 class period(s)
<b>Course</b>	Algebra 2		

### Essential Question

How do we perform function operations and how do they cause domain restrictions?

### Summary

In this lesson, students will use their knowledge of functions and function notation to perform basic operations on functions. Students will learn how to find domain restrictions caused by function operations. This lesson should be taught after students learn about radical functions, as using notation with rational exponents and expanding polynomials is prerequisite knowledge for this lesson. This lesson does not include exponential or logarithmic functions. Students will not be expected to perform operations on rational functions; these functions will appear only as the result of division. This is the first lesson in the "Function Operations" lesson duo.

### Snapshot

#### Engage

Students recall function notation and how to evaluate functions.

#### Explore

Students work in pairs to try performing function operations.

#### Explain

Students are introduced to domain restrictions caused by function operations. Students complete guided notes with the class to formalize their understanding of performing function operations and finding domain restrictions.

#### Extend

Students work in pairs and apply what they have learned to evaluate functions, perform function operations, and find domain restrictions.

#### Evaluate

Students reflect on their learning using the Stoplight Stickies strategy.

## Standards

Oklahoma Academic Standards Mathematics (Algebra 2)

**A2.F.2.1:** Add, subtract, multiply, and divide functions using function notation and recognize domain restrictions.

## Attachments

- [Applying Operations—Function Operations, Part 1 - Spanish.docx](#)
- [Applying Operations—Function Operations, Part 1 - Spanish.pdf](#)
- [Applying Operations—Function Operations, Part 1.docx](#)
- [Applying Operations—Function Operations, Part 1.pdf](#)
- [Function Notation—Function Operations, Part 1 - Spanish.docx](#)
- [Function Notation—Function Operations, Part 1 - Spanish.pdf](#)
- [Function Notation—Function Operations, Part 1.docx](#)
- [Function Notation—Function Operations, Part 1.pdf](#)
- [Guided Notes—Function Operations, Part 1 - Spanish.docx](#)
- [Guided Notes—Function Operations, Part 1 - Spanish.pdf](#)
- [Guided Notes—Function Operations, Part 1.docx](#)
- [Guided Notes—Function Operations, Part 1.pdf](#)
- [Lesson Slides—Function Operations, Part 1.pptx](#)

## Materials

- Lesson Slides (attached)
- Function Notation handout (attached; one per student; printed front only)
- Guided Notes handout (attached; one per student; printed front only)
- Applying Operations handout (attached; one per student; printed front only)
- Pencils
- Sticky notes (preferably red, yellow, and green; two sticky notes per student in color(s) of their choice)

10 minutes

## Engage

Introduce the lesson using the attached **Lesson Slides**. Display **slide 3** to share the lesson's essential question with students. Go to **slide 4** to share the lesson's learning objectives. Review each of these with students to the extent you feel necessary.

Ask students to find partners or assign student pairs. Go to **slide 5** and pass out the attached **Function Notation** handout to each student.

Direct students' attention to the first part of the handout: Evaluating Functions. (Students will complete the second part of the handout during the Explore portion of this lesson.) Have students work in pairs to use the given functions—which are presented as an equation, table, or graph—to evaluate each function for a specified value of  $x$ .

Go to **slide 6** and give students time to discuss, check their work, ask questions, and correct their thinking. Use student responses to determine if students need a quick refresher on function notation and/or how to evaluate functions.

10 minutes

## Explore

Display **slide 7**. Direct students' attention to the second part of the Function Notation handout: Performing Operations. Ask students to work in pairs to perform the indicated operations on the given functions.

As students work, circulate the room and monitor students' discussions. This time is meant for students to try performing function operations on their own; you may give them more guidance later. Make note of any questions that students have and be sure to address these questions during the Explain portion of the lesson.

As students finish, have students identify which problem(s) they are most curious about or most interested in checking their work on. Ask the class: *Which problem are you most unsure of and why?*

After giving students a moment to think of their responses, ask for volunteers to share. Again, make note of these student responses and address them during the Explain portion of the lesson.

25 minutes

## Explain

Display **slide 8**. Give students time to discuss, check their work, ask questions, and correct their thinking as they review the solutions for questions 5–8. Ask for volunteers to explain how they understood what to do for each question. If students are struggling, this is an appropriate time to explain the process of performing function operations.

For question 8, the result that most students likely found has an asterisk next to it on the slide—this is where students need an introduction to domain restrictions caused by function operations, which are covered on the following slides.

Give each student a copy of the attached **Guided Notes** handout. Use **slides 9–11** to explain to students the importance of equivalence and how the result from just simplifying the ratio of  $g(x)$  and  $f(x)$  is not exactly the same as the original ratio, which is most easily shown graphically. By adding a domain restriction to the result, the final result becomes equivalent to the original ratio of the two functions. Have students take notes from these slides at the top of the Guided Notes handout.

Go to **slide 12**. Inform students there are two places where they should look for domain restrictions: variables in the denominator and even roots. Using the [Elbow Partner](#) strategy, have student pairs discuss the questions on the slide:

- Why should we look for variable(s) in the denominator?
- Why should we look for even root(s)?

After students have had a chance to discuss, ask for volunteers to share their thoughts. Use this time to help students understand that certain inputs cause undefined or imaginary outputs, thus causing the need for domain restrictions.

Display **slide 13** and explain the different notations for function operations.

Go to **slide 14** and complete the Guided Notes handout as a class. Once finished, have students add it to their math notebooks if that is a classroom norm.

20 minutes

## Extend

### Teacher's Note: Preparation

Decide whether you want the Applying Operations handout to be guided practice or independent practice. The sample responses to the handout are on hidden slides, so if you would like the class to check their work as they go, unhide slides 16–17 and 19–21.

Have each student find a new partner—someone they have not yet worked with during this lesson—or assign students new partners. Display **slide 15** and pass out the attached **Applying Operations** handout.

Direct students' attention to the first part of the handout: Focusing on Notation. Have students work in pairs to use the given functions—which are presented as an equation, table, or graph—to evaluate each function and perform the indicated operations for a specified value of  $x$ .

### Optional Slides

Unhide and display **slides 16–17** so students can check their work for questions 1–4. Ask for volunteers to explain their work.

Have each student find another new partner—again, someone they have not yet worked with during this lesson—or assign students new partners. Working with different peers fosters the development of academic vocabulary and encourages students to consider different approaches to a problem.

Go to **slide 18** and direct students' attention to the second portion of the handout: Finding Domain Restrictions. Have students work in pairs to find the product and quotient of each given pair of functions. Remind students that they also need to find the domain restriction for each new function. They are to write "none" if there is not a domain restriction.

### Optional Slides

Unhide and display **slides 19–21** so students can check their work for questions 5–7. Ask for volunteers to explain their work.

10 minutes

# Evaluate

## Teacher's Note: Activity Preparation

Students are going to use the Stoplight Stickies strategy in this activity. Students write a question or comment on a specific-colored sticky note regarding their level of confidence in performing function operations and in finding domain restrictions. Decide where you want students to put their sticky notes before starting this activity. Consider the following suggestions.

- Organize your dry-erase board, or another space in the room, into two columns: one titled "Function Operations" and the other titled "Domain Restrictions." Students would then put their sticky notes in the corresponding columns.
- Organize your dry-erase board, or another space in the room, into a table with three rows and four columns. In the first column, label the bottom two rows: "Function Operations" and "Domain Restrictions." In the first row, label the last three columns: "Confident," "Unsure," and "Not Confident." Students would place their green sticky notes in the confident column, yellow in the unsure column, and red in the not confident column.

Display **slide 22** and share the [Stoplight Stickies](#) strategy with the class. Make red, yellow, and green sticky notes available to students. Direct students to respond to each question on a different sticky note whose color corresponds with their level of confidence in performing function operations and in finding domain restrictions. Guide students to where you want them to put their sticky notes.

If time allows, answer some of the questions on the red sticky notes to help resolve any confusion. Use students' comments and questions to determine if students need remediation or are ready for the next lesson: "[Function Operations, Part 2](#)."

## Resources

- K20 Center. (n.d.). Elbow partner. Strategies. <https://learn.k20center.ou.edu/strategy/116>
- K20 Center. (n.d.). Function Operations: Part 2. Lessons. <https://learn.k20center.ou.edu/lesson/2196>
- K20 Center. (n.d.). Stoplight stickies. Strategies. <https://learn.k20center.ou.edu/strategy/92>
- K20 Center. (n.d.). Desmos Classroom. Tech tools. <https://learn.k20center.ou.edu/tech-tool/1081>