Function Operations, Part 1
Basic Operations and Domain Restrictions

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Grade Level	10th – 11th Grade	**Time Frame**	75-85 minutes
Subject	Mathematics	**Duration**	1-2 class period(s)
Course	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

- Desmos account
- Guided Notes handout (attached; one per student; printed front only)
- Pencils
- Student devices with internet access

10 minutes

Engage

Teacher's Note: Desmos Activity Preparation

To use this Desmos Classroom activity, select the following link: "Function Operations, 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/.

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 6. Select "Restrict to Screens 1–6" to confirm your selection. This allows students to access only screens 1–6 at this time. For more information about teacher pacing, go to https://k20center.ou.edu/externalapps/pacing-activities/.

Provide students with your session code. 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.

Introduce the lesson using **screens 1–2** of the Desmos activity. **Screen 1** displays the lesson's essential question. **Screen 2** identifies the lesson's learning objectives. Review each of these with students to the extent you feel necessary.

Ask students to find a partner or assign student pairs. Direct students' attention to **screens 3–6** and have them work with their partner to evaluate each function using the given functions. Students receive immediate feedback on each response. As time allows, ask for volunteers to explain their thinking for each question. Use student responses (both aloud and from the Desmos dashboard) to determine if students need a quick refresher on function notation or evaluating functions.

https://learn.k20center.ou.edu/lesson/2177?rev=25974

10 minutes

Explore

On the Desmos dashboard, click the orange plus sign four times to allow students to progress to **screens 7–10**. Ask students to work in pairs to perform the indicated operations on the given functions. Students receive immediate feedback on each response.

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

Teacher's Note: Desmos Feedback

It is very important to not discourage a student, especially in a virtual setting, by giving feedback that their answer is "wrong" when it is just written in a different order than you were expecting. When students are combining different types of functions, such as radical functions with polynomials, there is not always a standard way to write the expression. For these reasons, the activity is designed to give the feedback of "Well done!" if their result is equivalent to the final answer. This also means that an un-simplified response is accepted. Use student responses to determine if your students need a reminder of the expectation to always simplify your answer.

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25 minutes

Explain

As students finish screen 10, ask for volunteers to explain how they understood what to do for each question on screens 7–10. This is now an appropriate time to explain the process of performing operations if your class is struggling.

Question 4 on screen 10 is where students need an introduction to function operations causing domain restrictions, which they will see on the following screens.

Give each student a copy of the attached **Guided Notes** handout, then click the orange plus sign, on the Desmos dashboard three times to allow students to progress to **screens 11–13**. Use these screens to explain the importance of equivalence and how the result from 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, the final result is now equivalent to the original ratio of the two functions. Have students take notes from these screens at the top of their Guided Notes handout.

On the dashboard, click the orange plus sign to allow students to progress to **screen 14** and tell students where to look for domain restrictions: variables in the denominator and even roots. Using the Elbow Partner strategy, direct students to talk with their elbow partner about why those would be places to look using the following questions:

- 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, guide students to submit their thoughts on screen 14. Remind students that it is okay if they are unsure but that you would like to read their thinking. Now, ask for volunteers to share their thoughts. Use this time to help students see that certain inputs result in undefined or imaginary outputs, causing the need for domain restrictions.

Click the orange plus sign on the dashboard to allow students to progress to **screen 15**. Use this screen to explain the different notations for function operations.

On the dashboard, click the orange plus sign three times to allow students to progress to **screens 16–18**. Direct students to use the examples and explanations in Desmos to complete the Guided Notes handout.

Have students add their completed Guided Notes to their math notebook if that is a classroom norm.

20 minutes

Extend

Instruct students to find a new partner, someone they have not yet worked with during this lesson, or assign students new partners. On the dashboard, click the orange plus sign four times to allow students to progress to **screens 19–22**. 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*. Students receive immediate feedback on each response.

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

Click the orange plus sign to allow students to progress to **screen 23**. Here students are going to practice copying and pasting math symbols. Some of these symbols are on students' keyboards, and some are not. For those that are not available, copying the provided symbol and pasting it where it is needed, using keyboard shortcuts, is recommended for screens 24–26. If students see backticks (`) when they paste, advise students to just delete those symbols, as they have selected too much to copy. Students receive immediate feedback on each response.

On the dashboard, click the orange "Stop" button; now students can complete the Desmos activity at their own pace. On **screens 24–26**, 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. Students receive immediate feedback on each response.

> **Teacher's Note: Desmos Feedback**
>
> It is very important to not discourage a student, especially in a virtual setting, by giving feedback that their answer is "wrong," when their answer is just written in a different order than you were expecting. When students are combining different types of functions, such as radical functions with polynomials, there is not always a standard way to write the expression. For these reasons, the activity is designed to give the feedback of "Well done!" if their result is equivalent to the final answer. This also means that an un-simplified response is accepted. Use student responses to determine if your students need a reminder of the expectation to always simplify your answer.

10 minutes

Evaluate

As students finish screen 26, direct their attention to screens **27–28**. Here students use a modified Stoplight Stickies strategy to reflect on their learning. Students are to answer the following questions, one on each screen, using a robot's face and the colors red, yellow, and green to indicate their confidence level on what they learned during this lesson.

- How confident are you in your ability to perform function operations?
- How confident are you in your ability to find domain restrictions?

If time allows, answer some of the questions from students who had little (yellow) to no (red) confidence 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