

Function Junction

Introduction to Functions

K20 Center, Kate Raymond
Published by *K20 Center*

This work is licensed under a Creative Commons CC BY-SA 4.0 License

Grade Level	8th – 9th Grade	**Time Frame**	2 class periods
Subject	Mathematics	**Duration**	70–80 minutes
Course	Algebra 1		

Essential Question

How can we represent relations?

Summary

In this lesson, students will explore real-world examples of functions and patterns within function notation to represent function machines algebraically. They will use given inputs and outputs to identify independent and dependent variables and the domain and range of different functions. This lesson focuses on the abstract concept of functions, which is an excellent challenge for advanced students.

Snapshot

Engage

Students consider three everyday objects that have inputs and outputs.

Explore

Students use pattern recognition to evaluate functions and investigate function notation.

Explain

Students formalize their understanding of function notation, then use function notation to represent the everyday objects from earlier in the lesson.

Extend

Students guess the rule of given relations, then determine if each relation is or is not a function.

Evaluate

Students watch a video about how search engines work, then apply their understanding to justify whether or not a search engine is a function.

Standards

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

F507: Interpret statements that use function notation in terms of their context

Oklahoma Academic Standards Mathematics (Algebra 1)

A1.F.1.1: Distinguish between relations and functions.
A1.F.1.2: Identify the dependent variable, independent variable, domain and range given a function, equation, or graph. Identify restrictions on the domain and range in mathematical models.

Attachments

- Finding Patterns—Function Junction - Spanish.docx
- Finding Patterns—Function Junction - Spanish.pdf
- Finding Patterns—Function Junction.docx
- Finding Patterns—Function Junction.pdf
- Guess My Rule—Function Junction - Spanish.docx
- Guess My Rule—Function Junction - Spanish.pdf
- Guess My Rule—Function Junction.docx
- Guess My Rule—Function Junction.pdf
- Guided Notes (Model Notes)—Function Junction.docx
- Guided Notes (Model Notes)—Function Junction.pdf
- Guided Notes—Function Junction - Spanish.docx
- Guided Notes—Function Junction - Spanish.pdf
- Guided Notes—Function Junction.docx
- Guided Notes—Function Junction.pdf
- Lesson Slides—Function Junction.pptx

Materials

- Lesson Slides (attached)
- Finding Patterns handout (attached; one per pair; print two-sided)
- Guided Notes handout (attached; one per student; print two-sided)
- Guided Notes (Model Notes) document (attached)
- Guess My Rule handout (attached; one per student; print two-sided)

5 minutes

Engage

Display **slide 3** of the attached **Lesson Slides**. As students walk into class, ask them to think about the question on the slide: “What do a toaster, a juicer, and a paper shredder have in common?”

Once class begins, introduce the Think-Pair-Share strategy. Give students a minute or two to think on their own, then have them share with a partner. Ask for volunteers to share their thoughts with the class.

Show **slide 4** and reveal the answer to the question: A toaster, juicer, and shredder all have inputs and outputs.

Share the lesson’s essential question on **slide 5** and learning objectives on **slide 6**. Review each of these with your class to the extent you feel necessary.

20 minutes

Explore

Display **slide 7** and give each pair of students a copy of the attached **Finding Patterns** handout. Direct students to work with their partner to answer each question in the order given. As students work, circulate the room and monitor students' discussions, but offer minimal guidance. At this time, students should try these problems on their own and later receive more guidance from you.

Teacher's Note: Purpose

The purpose of this activity is for students to see the pattern of evaluating functions before they are formally introduced to function notation or the formal vocabulary. Students are asked to plug numbers and variables into functions that are mostly written in function notation, but do not appear that way.

Allow students to have a healthy struggle with this activity, but use guiding questions to keep students encouraged. If a pair is stuck on a question, ask them to explain how they did the previous line of work or how they think the given previous line was done. Listen carefully to how they approached the previous line of work. If their explanation is missing some key details, ask prompting questions or draw attention to mistakes to help point students toward a successful path.

Use the hidden **slides 8–9** as sample student responses.

As pairs complete their handouts, move to **slide 10** and ask for volunteers to share how they approached the problems, how they knew what to do, and what patterns they noticed.

20 minutes

Explain

Display **slide 11** and give students a copy of the attached **Guided Notes** handout. Introduce the definitions of *input*, *output*, and *function*. Move to **slide 12** and have students write down on their handouts the definitions of the vocabulary words *domain* and *range*.

Show **slide 13** and explain to students how to read function notation. Remind students to take notes on their handouts. Use the attached **Guided Notes (Model Notes)** document as needed.

Move to **slide 14** and ask students if the toaster (from the prompt during the Engage phase) was a function, what the input and output would be.

After students have concluded that the input of a toaster would be something that fits in a toaster, like bread, and the output would be a toasted version of the input, like toast, transition to **slide 15**. Show students how to represent this idea using function notation. Emphasize to students that when reading function notation, what is inside the parentheses is what is put into the function (input), just like putting bread into a toaster.

Ask the class how they would describe the domain and range of the toaster function. Allow them time to discuss the question, then move to **slide 16**. Remind students to record the domain and range of the toaster function in their notes.

Display **slide 17** and give students approximately 1 minute to think about the answers to the questions on the slide. The slide provides variables to represent the juicer, the fruit, and the juice, and students are asked to describe the provided function notation, input, output, domain, and range.

Move to **slide 18** and engage the class in a discussion about the questions on the slide. Point out to students how the output can be represented in different ways: $J(f)$ or d. Emphasize to students the importance of them being able to interpret the meaning, regardless of the form, and that when they are asked to use function notation, they should use $J(f)$. Remind students to record their work on their handouts.

Show **slide 19** and ask students to represent the paper shredder using function notation. Give students a couple of minutes to try to answer the questions on the slide and record their thoughts on their handouts. Display **slide 20** and have students check their work. Remind students that it is okay if the letters in their work are different from the letters on the slide. Emphasize that the letter they selected for the input (the paper) must be the same letter inside the parentheses of their function notation, and the letter they selected for the function (the shredder) must be the same letter outside of the parentheses.

20 minutes

Extend

Have students get into groups of four or assign groups. Display **slide 21** and introduce the Numbered Heads Together instructional strategy. Give each student a copy of the attached **Guess My Rule** handout and assign each student within each group a number 1–4. Have each student write their assigned number somewhere at the top of their handout for quick reference.

Show **slide 22** and walk students through the first relation to ensure that they understand the task. Explain that the input of "triangle" has an output of "3" and the input of "square" has an output of "4," etc. Have students discuss within their groups what the relationship, or rule, is between the inputs and outputs and if the relation is or is not a function. Allow 1–2 minutes for discussion.

Ask students assigned number 3 to raise their hands. Take this time to make sure that each group of students has only one student assigned number three to ensure students understood the grouping process. Call on one of the students with their hand raised and ask them to share the rule. They should share that the rule is the number of sides of the polygon. Call on a different student whose hand is raised (another number three student) had have them share whether or not this relation is a function.

Have students assign variables for function notation to the input and output and label the domain and range of the function. Transition to **slide 23** and have students check their work. Remind them that their exact letter choice will likely be different from what they see on the slide.

Explain that for the next task, Relation 2, groups must determine the rule, if it represents a function, and if it does represent a function, they must label the input, output, domain, and range, as seen on the slide.

Move to **slide 24** and ask students who are assigned number 1 to raise their hands. Call on different students to each respond with a different detail about Relation 2. Transition to **slide 25** and have students check their work.

Repeat this process for the remaining relations using **slides 26–33**. Ensure that you call all student numbers (1–4) at least once.

Teacher's Note: Guiding the Activity

If a student shares an incorrect or coincidental rule, call on a different student whose hand is still raised. Facilitate discussion as needed to encourage the class to agree on the rule. If a group finds an alternative, accurate rule, celebrate their creative thinking.

If your students are able to find rules effortlessly, challenge them with Relation 6 on slide 32, which has an output reciprocal of the input. Ask them what they think the output will be if the input is zero. Consider furthering the discussion by asking if the undefined output would impact their decision on whether or not it is a function, which it should not.

5 minutes

Evaluate

Advance to **slide 34**. Preview the activity by explaining to students that they are going to watch a video about how search engines work. Explain that they are then expected to determine if a search engine is or is not a function. If they determine that it is a function, they should describe the domain and range. If they determine that it is not a function, they should explain why it is not. Tell students to keep these questions in mind as they watch the video.

Show **slide 35** and play the *How Search Works* video.

After the video is complete, display **slide 36** and give each student a piece of notebook paper. Have students write a Two-Minute Paper about whether or not they think a search engine is a function. Collect student papers to assess their understanding.

Teacher's Note: Evaluating Student Knowledge

For this assessment, focus on evaluating a student's reasoning. Some students may say that a search engine is a function, while others may say that it is not. Accept either response as correct, as long as the corresponding domain and range or justification demonstrates that the student understands what makes a relation a function. Sample student responses can be found below.

- **Example 1:** A student says that a search engine is a function where the domain is the set of keywords or phrases and the range is the set of page results. One keyword search (input) gives one results page (output), and is therefore a function.
- **Example 2:** A student concludes that a search engine is not a function because they see each web address as a list of individual search results. They say that one search (input) has multiple results (outputs), so a search engine is not a function.

In both examples, the student demonstrates their understanding of functions, which is the goal of the activity.

Resources

- Google. (2010, March 4). *How search works* [Video]. YouTube. https://www.youtube.com/watch?v=BNHR6IQJGZs
- K20 Center. (n.d.). Numbered heads together. Strategies. https://learn.k20center.ou.edu/strategy/2476
- K20 Center. (n.d.). Think-pair-share. Strategies. https://learn.k20center.ou.edu/strategy/139
- K20 Center. (n.d.). Two-minute paper. Strategies. https://learn.k20center.ou.edu/strategy/152
- K20 Center. (2021, September 21). *K20 Center 2 minute timer* [Video]. YouTube. https://youtu.be/HcEEAnwOt2c?si=IjQ0Z14eT1CEtWwS