Shiver Me Functions!

Function Notation

Brittany VanCleave, Amber Stokes, Michell Eike, Mary Braggs
Published by *K20 Center*

Grade Level	8th – 9th Grade	**Time Frame**	90-105 minutes
Subject	Mathematics	**Duration**	2-3 class periods
Course	Algebra 1		

Essential Question

What can you represent with function notation?

Summary

This lesson will break down the components of a function and the relationship it has to real-world contexts. Students will recall their knowledge of inputs and outputs with a function machine. Students will simplify functions and then evaluate the functions. Students will practice simplifying polynomials through a digital breakout room.

Snapshot

Engage

Students activate prior knowledge and show what they know about function notation.

Explore

Students recall linear equations and use pattern recognition to find inputs, outputs, and the equation.

Explain

Students eliminate misconceptions about function notation.

Extend 1

Students complete a digital breakout focused on simplifying polynomials and compete to see who can unlock the treasure map first.

Extend 2

Students apply what they have learned to evaluate functions algebraically and graphically.

Evaluate

Students demonstrate their understanding of the meaning of function notation within the context of a real-world scenario.

Standards

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

A303: Combine like terms (e.g., 2x + 5x)
A505: Add, subtract, and multiply polynomials
F501: Evaluate polynomial functions, expressed in function notation, at integer values

Oklahoma Academic Standards Mathematics (Algebra 1)

A1.A.3.2: Simplify polynomial expressions by adding, subtracting, or multiplying.
A1.F.3.2: Use function notation; evaluate a function, including nonlinear, at a given point in its domain algebraically and graphically. Interpret the results in terms of the original context.

Attachments

- Card Matching—Shiver Me Functions - Spanish.docx
- Card Matching—Shiver Me Functions - Spanish.pdf
- Card Matching—Shiver Me Functions.docx
- Card Matching—Shiver Me Functions.pdf
- Lesson Slides—Shiver Me Functions.pptx
- Treasure Map Hunt Guide—Shiver Me Functions.docx
- Treasure Map Hunt Guide—Shiver Me Functions.pdf
- Treasure Map Hunt—Shiver Me Functions - Spanish.docx
- Treasure Map Hunt—Shiver Me Functions - Spanish.pdf
- Treasure Map Hunt—Shiver Me Functions.docx
- Treasure Map Hunt—Shiver Me Functions.pdf
- Using Function Notation—Shiver Me Functions - Spanish.docx
- Using Function Notation—Shiver Me Functions - Spanish.pdf
- Using Function Notation—Shiver Me Functions.docx
- Using Function Notation—Shiver Me Functions.pdf
- What's My Function—Shiver Me Functions - Spanish.docx
- What's My Function—Shiver Me Functions - Spanish.pdf
- What's My Function—Shiver Me Functions.docx
- What's My Function—Shiver Me Functions.pdf

Materials

- Lesson Slides (attached)
- What’s My Function? handout (attached; one per pair of students; printed front only)
- Card Matching cards (attached; one set per pairs of students; printed front only)
- Treasure Map Hunt handout (attached; one per pair of students; printed front only)
- Treasure Map Hunt Guide document (attached; for teacher use)
- Using Function Notation handout (attached; one per pair of students; printed front only)
- Student devices with internet access
- Envelopes or paper clips (optional)

15 minutes

Engage

Teacher's Note: Lesson Prep

Before the lesson, print the attached Card Matching cards (one set per pair of students in your class). Consider printing on cardstock paper, especially if you plan to reuse these cards. There is a digital Card Matching option available; see the Explore portion of the lesson for more details.

Once printed, cut out the cards. All of these cards are the same size for easy cutting. Use envelopes or paper clips to organize the cards. The cards will be used during the Explore portion of the lesson.

Additionally, take some time to try out and familiarize yourself with the digital breakout activity in the Extend section of this lesson.

Introduce the lesson using the attached **Lesson Slides**. **Slide 3** displays the lesson's essential question. **Slide 4** identifies the lesson's learning objectives. Review each of these with your class to the extent you feel necessary.

Go to **slide 5**. Assign each student a partner or have students find a partner and pass out a copy of the **What's My Function?** handout to each pair. Have students work together to determine the pattern or rule for the function machine. Have students use the table to determine which two operations have been applied to each input to get each output. Then, have them write the rule or pattern that would work for any input into the function machine, using the words "input" and "output."

Teacher's Note: Guiding the Activity

After students have had time to work on question 1, consider modeling how to write the pattern or rule on the function machine if students are struggling with this step. **Slide 7** has an example response for question 1.

Once students have completed their handouts, display **slide 6**. Have students compare their results from question 1 with what is on the screen. Give students time to discuss and ask questions. Then, ask students how to translate their words into an algebraic equation, still using the words input and output. Ask for some volunteers to share their ideas. Then, display the algebraic equation on **slide 7**.

Repeat this with question 2 using slides **8–9** and question 3 using slides **10–11**.

20 minutes

Explore

Technology Option: Digital Card Matching

If you prefer a digital card matching activity, use the following Desmos Classroom activity:

Navigate to "Function Card Match: Shiver Me Functions" Desmos page. Create an account or sign in under the "Activity Sessions" heading. After you sign in, the green "Assign" dropdown button will be active. Select 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, navigate to https://k20center.ou.edu/externalapps/using-activities/.

For more detailed information about Desmos features and how-to tips, navigate to https://k20center.ou.edu/externalapps/desmos-home-page/.

Go to **slide 12** and give each pair a set of **Card Matching** cards. Have students complete the Card Matching activity by matching cards from three categories: scenarios, equations, and function notation.

Teacher's Note: Guiding the Activity

Encourage students to not just look at the numbers as they are making their matches, but to closely read the wording of each scenario and think about why it is written the way it is. The scenarios give context to the big picture of functions.

This is likely the first time that students have seen a function notation. Encourage students to try even if they do not fully understand. This is a time for them to explore the content and formulate questions that they might have about the topic.

Show **slide 13** and reveal the correct matches to the students. Give them time to make any necessary revisions.

Display **slide 14** and ask the class: “What do you think f(x) means?” Have students write their answers on the back of their What’s My Function? handout.

Have students set aside their handouts. They will reflect on their answers to this question later in the lesson.

20 minutes

Explain

Teacher's Note: Pacing the Lesson

If you have a traditional 45-minute class period, it is recommended that you finish the first day with **slide 19**, finishing the definition of $f(x)$. Consider asking students to think about example 1 from **slide 20** as you dismiss the class. Then, you can begin the next class period by inviting students to share their ideas for example 1.

Show **slide 15** and have students think about the three functions machines from earlier in the lesson. Tell them that instead of using the words "output" and "input", they also could have used "*y*" and "*x*", as shown on the slide. Ask for a volunteer to share why that is true. Use student responses to determine if students need a reminder that, traditionally, *x* is the input, and *y* is the output.

Teacher's Note: Guiding the Activity

The next step is having students make the connection that labeling everything *y* is not very helpful when there is more than one equation. Let the students make that connection by playing devil's advocate. You will ask the question below, "What does *y* equal when *x* equals 3?"

Students will likely be confused and ask, "Which *y*?" or other clarifying questions. They may even make statements that they cannot answer your vague question. Engage with students in a playful manner for as long as it seems like a natural fit for your classroom.

Be careful to not let students get too frustrated but let them criticize the question without being disrespectful. This demonstrates that they are critical thinkers.

Now ask the class, "What does *y* equal when *x* equals 3?" As students start asking questions, try to stay casual and tell them that they just need to plug in $x = 3$.

Confess that you asked a ridiculous question and transition to **slide 16**. Explain that naming functions would have made your question clearer.

Teacher's Note: Guiding the Lesson

If students are not sure how using function notation would have made your question easier to answer, consider going back to slide 15 and giving each function a name, such as $f(x) = 2x + 1$, $g(x) = 3x - 5$, etc. Then ask the question, "What does $f(x)$ equal when x equals 3?" Point out to students that now they know which *y* you were referring to.

Show **slide 17** and ask students to recall the Card Matching activity from earlier in the lesson. Now that students have a formal definition of function notation, have students reread the function notation card (Card J on the screen) and interpret the meaning. Have students share with an Elbow Partner their interpretation of the meaning. If time allows, ask for a couple of volunteers to share.

Display **slide 18** to reveal the meaning of Card J. Give students time to reflect and ask questions.

Show **slide 19**. Use this slide to have students recall the function machine from earlier in the lesson and how they could write the equation algebraically but using function notation.

Now have students reflect on what they thought $f(x)$ meant, referring to the back of their What's My Function? handout (used at the end of the Explore portion of the lesson). Ask the class if their current understanding matches their prior understanding. Have students modify their definitions and express to them that now is the time to ask any questions about function notation. Use student responses to determine if students need more examples or if they are ready to evaluate functions using function notation.

Display **slide 20** and ask students how they think they can find $f(3)$. Encourage students to share their approaches. There are two common approaches that both have the same steps but not the same order: Simplifying then substituting, or substituting then simplifying. Show students both approaches for example 1. Ask students what they think the pros and cons of each approach are.

Continue by going through examples 2–3 on **slides 21–22**.

Teacher's Note: Guiding the Lesson

Which step should be done first: simplifying or substitution? Encourage students to practice simplifying before substituting because that is more efficient when wanting to evaluate a function for multiple x-values, such as when making a table—a skill they will often use.

20 minutes

Extend

Display **slide 23** and prepare students for a digital breakout treasure map hunt. Have students find a new partner or assign them new partners. Capture their interest by having them imagine that they are with a group of sailors who are on a voyage to find the missing treasure map. It is their job as their ships' captains to find the keys that unlock the three locks, retrieving the map that leads their crews to their destiny.

Teacher's Note: Digital Breakouts

Digital breakouts allow students to work collaboratively to solve a series of critical thinking puzzles and open a virtual "locked box." Linked clues are embedded within the digital breakout webpage, and students must hunt to find them. If you would like more information about creating digital breakouts and further resources related to their use, the Building Digital Breakouts page from the Norman, OK Public School District contains a wealth of information.

Teacher's Note: Guiding the Activity

To reach the treasure map, students need to locate the clues hidden on the digital breakout webpage by clicking on different images or words on the webpage. Do not tell students this information unless they are nearing frustration. Part of the digital breakout is to "find" the hidden clues, so let them figure out where to start or what to select.

Each "clue" is a Google Document, Google Sheet, or Google Drawing that students will be asked to make a copy of in their Google drive. To help with navigation during the activity, recommend to students to not close their tabs until they have successfully found the missing treasure map, which is a message that they will receive upon submitting the three correct keys.

If students answer the questions from their clue correctly, they will get a digital "key" (code) which they can enter into each of the three "locks." Each clue asks students to simplify polynomial expressions. Once a clue is solved, students receive a "key" that they will enter into the corresponding fields on the Google form (locks) on the main webpage. Once they have correctly identified all three keys, students should submit the form. Students will receive an error message if they have entered an incorrect key.

Show **slide 24** and preview the activity without giving away too many hints and share the vocabulary shown on the slide.

Display **slide 25** and instruct pairs to open the Treasure Map Hunt digital breakout by going to this link. In addition, pass out a copy of the **Treasure Map Hunt** handout to each pair. Students should use the handout to track their progress on the hunt. Have them document where they found each clue and the key that they identified, and have them describe how they found each key in mathematical terms(i.e., show their work). For your reference, a copy of the **Treasure Map Hunt Guide** is attached.

Teacher's Note: Digital Breakout Troubleshooting

- **Color Lock Clue**: If students are struggling, remind students to read the directions carefully and put spaces on both sides of their operation (between their two terms).
- **Word Lock Clue**: This is using Google Draw. Advise students to click the line tool each time they draw each line. It is easiest to use if they select a point, hold, and drag to the second point before they release to create the desired line segment.

10 minutes

Extend 2

Show **slide 26**. Have students find a new partner or assign new partners for them. Give each pair of students a copy of the **Using Function Notation** handout. Have pairs work together to apply their knowledge of function notation to the variety of questions.

5 minutes

Evaluate

Display **slide 27** and use the Exit Ticket strategy to individually assess what students have learned from the lesson. Give students a sticky note, an index card, etc. for them to write their response or have students write on the back of their Using Function Notation handout.

Collect student responses and use them to determine if your students need additional practice or are ready for the next topic. Use the hidden **slide 28** for a sample response.

Optional Addition

Consider using the Muddiest Point strategy as a bell work in the next class to have students communicate what they felt was the clearest and the most confusing parts of the lesson.

- Crystal Clear: What do you think is the easiest part of using function notation?
- Muddiest Point: What do you think is the most confusing part of using function notation?

Resources

- K20 Center. (n.d.). Bell Ringers and Exit Tickets. Strategies. https://learn.k20center.ou.edu/strategy/125
- K20 Center. (n.d.). Card Matching. Strategies. https://learn.k20center.ou.edu/strategy/1837
- K20 Center. (n.d.). Desmos Classroom. Tech tools. https://learn.k20center.ou.edu/tech-tool/1081
- K20 Center. (n.d.). Elbow Partners. Strategies. https://learn.k20center.ou.edu/strategy/116
- K20 Center. (n.d.). Google Drawings. Tech Tools. https://learn.k20center.ou.edu/tech-tool/629
- K20 Center. (n.d.). Muddiest Point. Strategies. https://learn.k20center.ou.edu/strategy/109
- K20 Center. (n.d.). Treasure Hunt. https://sites.google.com/ou.edu/treasurehunt/home
- OpenClipart-Vectors. (2013, October 16). Treasure Map [Illustration]. Pixabay. https://pixabay.com/vectors/treasure-map-treasure-hunt-153425/
- Stokes, A. (n.d.). Function Card Match: Shiver Me Functions. [Interactive activity]. Desmos. https://teacher.desmos.com/activitybuilder/custom/5d97a01d3212726a5434a25a