The Great Domain

Domain and Range Notations

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Grade Level	10th – 12th Grade	**Time Frame**	80-95 minutes
Subject	Mathematics	**Duration**	2 class periods
Course	Algebra 2, Precalculus		

Essential Question

How can you represent and describe a function in relation to its domain and range?

Summary

This lesson focuses on the notation for writing domain and range of a function. Students will recall their knowledge of domain and range then formalize their understanding of algebraic, set, and interval notation. This lesson is designed to be taught at the beginning of an Algebra II course. There are extension opportunities in this lesson for use in a precalculus course.

Snapshot

Engage

Students reflect on their knowledge of domain and range through the Always, Sometimes, or Never True strategy.

Explore

Students recall their knowledge of domain and range.

Explain

Students formalize their understanding of algebraic, interval, and set notation for domain and range.

Extend

Students apply their understanding to create graphs given different notations of the domain and range.

Evaluate

Students reflect on their learning by using the Muddiest Point strategy.

Standards

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

F506: Understand the concept of domain and range in terms of valid input and output, and in terms of function graphs
F508: Find the domain of polynomial functions and rational functions

Oklahoma Academic Standards for Mathematics (Grades 9, 10, 11, 12)

A2.F.1.1: Use algebraic, interval, and set notations to specify the domain and range of functions of various types and evaluate a function at a given point in its domain.

Attachments

- Guided Notes (Model Notes)—The Great Domain.pdf
- Guided Notes—The Great Domain - Spanish.docx
- Guided Notes—The Great Domain - Spanish.pdf
- Guided Notes—The Great Domain.docx
- Guided Notes—The Great Domain.pdf
- Home on the Range—The Great Domain - Spanish.docx
- Home on the Range—The Great Domain - Spanish.pdf
- Home on the Range—The Great Domain.docx
- Home on the Range—The Great Domain.pdf
- Lesson Slides—The Great Domain.pptx
- Wrangle Up Domain and Range—The Great Domain - Spanish.pdf
- Wrangle Up Domain and Range—The Great Domain.pdf

Materials

- Lesson Slides (attached)
- Home on the Range handout (attached; one per student; printed front only)
- Guided Notes handout (attached; one per student; printed front only)
- Guided Notes (Model Notes) document (attached; for teacher use)
- Wrangle Up Domain and Range handout (attached; one per student; printed front only)
- Paper
- Pencil

10 minutes

Engage

Teacher's Note: Lesson Preparation

If using this lesson for a precalculus class, unhide **slide 9** to use with the Always, Sometimes, or Never True activity. Then use this slide in the same way as slides 7-8.

Introduce the lesson using the attached **Lesson Slides**. Display **slide 3** to show the lesson's essential question: "How can you represent and describe a function in relation to its domain and range?" **Slide 4** identifies the lesson's learning objective. Review each of these with students to the extent you feel necessary.

Display **slide 5** and introduce the steps for the Always, Sometimes, or Never True instructional strategy. Show **slide 6** to give students a pictorial definition for "bounded" and "unbounded." At this time, try not to give more than this as the definition, as students do not need more of a definition at this time. However, if students need additional clarification, a ray would be considered "bounded."

Teacher's Note: Guiding the Activity

The terms "bounded" and "unbounded" are often used in precalculus and beyond. The domain of a function would be bounded if it has restrictions, whereas the domain would be unbounded if it is all real numbers. This also applies to range.

Go to **slide 7** and have students discuss with an elbow partner the first Always, Sometimes, or Never True statement: "Domains are y-values and bounded by the graph." Give the pairs one minute to analyze the statement and choose their claim. After one minute, display the next statement on **slide 8** and repeat the process. Once each statement has been shown and the students had time to state their claim, have a whole group discussion about the statements by letting different pairs share their viewpoints on the topic.

This particular strategy can have various justifications, some justifications that students provide can support the incorrect answer. Focus on justifications for this activity. Use student responses to determine what misconceptions need to be addressed during the Explain portion of the lesson.

Sample Student Responses

Domains are y-values and bounded by the graph.

- This is never true. Domain refers to the x-values, not the y-values.

Ranges are y-values and bounded by the graph.

- This is always true. Range refers to the y-values. (Incorrect, but well justified)
- The range is not always bounded. For example, y=x has an unbounded range. However, $y = x^2$ has a bounded range. So the statement is sometimes true.

Domain or range can be represented as "All real numbers except 5." (hidden precalculus slide)

- This is sometimes true, but not always true. A discontinuous function with a hole at $x = 5$ that is continuous everywhere else has a domain of all real numbers except 5.

20 minutes

Explore

Go to **slide 10** and give each student a copy of the **Home on the Range** handout. Introduce students to the I Think / We Think strategy. Have students individually find the domain and range for each of the given graphs. Guide them to write their answers in the "I Think" column. This is the time for students to express what they know and don't know about domain and range.

After a few minutes, put students into groups of 3–5. Direct groups to discuss their reasonings to come to a group conclusion for the domain and range of each graph. Instruct students to all record what their group decided into the "We Think" column.

Facilitate a whole class discussion over the graphs. Ask for volunteers to share what their group found for domain and range on the first graph. Repeat this with different volunteers for each graph. Use student responses to determine if students need a quick review of finding domain and range before moving to the next portion of the lesson.

Teacher's Note: Guiding the Activity

Allow students during this portion of the lesson to use any notation they would like to represent domain and range. This is the time for them to share what they know, and for you to understand what prerequisite knowledge your students have.

If you have not yet taught asymptotes and students are struggling with the asymptote on the third graph, do not yet tell them that it is an asymptote. Instead have them recall linear inequalities and ask what made a linear inequality a solid or dashed line.

Optional Lesson Addition

If this lesson is taught at the end of an Algebra II course or during a precalculus course, consider having students also write the equations for the given graphs.

20 minutes

Explain

Teacher's Note: Note-Taking Preparation

Depending on your set up, how you complete Guided Notes is up to you and your classroom note-taking norms.

If you can draw on the slides, unhide **slides 12–14** to use the Lesson Slides for the Guided Notes.

Otherwise, this is the time to use a document camera, etc. to model completing the Guided Notes.

Go to **slide 11** and give each student a copy of the attached **Guided Notes** handout. Complete handout as a class.

Once finished, have students add this to their math notebook if that is a classroom norm.

Teacher's Note: Guiding the Activity

As you go through the notes, make sure that students understand how to read and what the symbols mean for the set-builder notation.

For more support for the Guided Notes, use the attached **Guided Notes (Model Notes)** document.

25 minutes

Extend

Show **slide 15**. Pass out the attached **Wrangle Up Domain and Range** handout to each student. Have students try questions 1-2 on their own.

After students finish question 2, display **slide 16** and have them find a partner or assign partners to share their created graphs. Transition through **slides 17–18** so that students can compare their graphs with the sample responses on the slides. Bring the class together for a whole-class discussion asking the class what is the same and different about their graphs with the sample responses on the slides. Consider using the following questions to facilitate a class discussion.

- What is important to consider about the domain?
- What is important to consider about the range?

Show **slide 19** and instruct students to work with their partner to create a graph for question 3. As students finish question 3, show **slide 20** for students to compare their graphs with the sample responses. Then show **slide 21** and bring the class together for discussion.

- What is important to consider about the domain?
- What is important to consider about the range?
- What did you find easy about creating this graph?
- What did you find difficult about creating this graph?

Optional Lesson Addition

If this lesson is taught at the end of an Algebra II course or during a precalculus course, consider having students also write the equations for the given graphs. Inform students at the beginning of the activity of this expectation.

5 minutes

Evaluate

Go to **slide 22**. Have students reflect on the lesson and their overall understanding of the content using the Muddiest Point strategy. Have students answer the following questions:

- Crystal Clear: What do you think is the easiest part of writing domains and ranges using different notations?
- Muddiest Point: What do you think is the most confusing part of writing domains and ranges using different notations?

You can collect responses in a variety of ways depending on your class. Sticky notes, pieces of paper, or digital posts are a few examples.

Resources

- K20 Center. (n.d.). Always, Sometimes, or Never True. Strategies. https://learn.k20center.ou.edu/strategy/145
- K20 Center. (n.d.). I Think / We Think. Strategies. https://learn.k20center.ou.edu/strategy/141
- K20 Center. (n.d.). Muddiest Point. Strategies. https://learn.k20center.ou.edu/strategy/109