

Can't Touch This, Part 1

Graphing Rational Functions

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Grade Level	10th – 11th Grade	**Time Frame**	80-90 minutes
Subject	Mathematics	**Duration**	2 periods
Course	Algebra 2		

Essential Question

What can cause asymptotes?

Summary

In this lesson, students will use their knowledge of domain and range to match pictures of graphs of rational functions with their corresponding domains and ranges. Students will learn about asymptotes, including what they are and how to find vertical and horizontal asymptotes of rational functions. Students will finish the lesson with a Card Matching activity to compare graphs, domains, ranges, asymptotes, equations, tables, and intercepts. This is the first lesson of two in the "Can't Touch This" lesson series.

Snapshot

Engage

Students recall domain and range to match graphs of rational functions with their corresponding domains and ranges in a Card Matching activity.

Explore

Students get a brief introduction to asymptotes and add cards with asymptotes to the Card Matching activity.

Explain

Students complete guided notes with the class and formalize their understanding of graphing rational functions.

Extend

Students apply what they have learned to graph rational functions.

Evaluate

Students add cards with equations, tables, and intercepts to complete the Card Matching activity.

Standards

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

F508: Find the domain of polynomial functions and rational functions
F510: Find where a rational function's graph has a vertical asymptote

Oklahoma Academic Standards Mathematics (Algebra 2)

A2.F.1.6: Graph a rational function and identify the domain (including holes), range, x- and y-intercepts, vertical and horizontal asymptotes, using various methods and tools that may include a graphing calculator or other appropriate technology (excluding slant or oblique asymptotes).

Attachments

- Card Matching Results—Can't Touch This Part 1 - Spanish.docx
- Card Matching Results—Can't Touch This Part 1 - Spanish.pdf
- Card Matching Results—Can't Touch This Part 1.docx
- Card Matching Results—Can't Touch This Part 1.pdf
- Card Matching—Can't Touch This Part 1.pdf
- Graphing With Asymptotes—Can't Touch This Part 1 - Spanish.docx
- Graphing With Asymptotes—Can't Touch This Part 1 - Spanish.pdf
- Graphing With Asymptotes—Can't Touch This Part 1.docx
- Graphing With Asymptotes—Can't Touch This Part 1.pdf
- Guided Notes—Can't Touch This Part 1 - Spanish.docx
- Guided Notes—Can't Touch This Part 1 - Spanish.pdf
- Guided Notes—Can't Touch This Part 1.docx
- Guided Notes—Can't Touch This Part 1.pdf
- Lesson Slides—Can't Touch This Part 1.pptx

Materials

- Desmos account
- Card Matching Results handout (attached; one per pair of students; printed front only)
- Guided Notes handout (attached; one per student; printed front/back)
- Pencils
- Student devices with internet access

5 minutes

Engage

Teacher's Note: Desmos Activity Preparation

To use this Desmos Classroom activity, select the following link: "Can't Touch This, 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 4. Select "Restrict to Screens 1–4" to confirm your selection. This allows students to access only screens 1–4 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. Display **screen 1** to show the lesson's essential question: *What can cause asymptotes?* **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 partners yourself. Pass out the attached **Card Matching Results** handout to each pair and direct students' attention to **screen 3**. Have pairs work together, using the Card Matching strategy to match each graph card with a domain/range card. Students have six cards of each type.

Teacher's Note: Desmos Card Sort

This card matching activity may be overwhelming on small screens. Share with students the following tips to avoid frustration:

- Enter full screen: To increase the size of your workspace, select the expanding arrows in the center of the top pane of the window.
- Organize your workspace: In the same way you would arrange cards on a physical surface, organize the cards on your screen.
- Condense a stack of cards: Once you have matched a set of cards together, click the arrow at the top of the column of cards.
- Enlarge the card: Click on the card to magnify the image.

As students complete their Card Matching activity, direct them to write the label of each domain/range card in the second column of the Card Matching Results table, corresponding to the label of the matching graph cards. The label of the domain/range cards is a number found in the top-left corner of each card.

Inform students that they can check their work on **screen 4**, where Desmos shows how many cards out of 12 are correctly matched. If the screen appears empty, then there are no correct matches (whether from a lack of attempts, guessing, or misunderstanding). Use student responses to determine if students need a quick refresh on domain and/or range.

Before moving on, let students know that they or their partners should hold on to their Card Matching Results handouts. They will add to it throughout the lesson and use it as a way to check their results.

10 minutes

Explore

On the Dashboard, press the orange plus sign to allow students to progress to **screen 5**. Have students the video on the screen, "What are Vertical Asymptotes?," up to the 1:25 timestamp. The video gives a very brief overview of an asymptote, particularly that it is a line that the curve approaches but does not touch or cross. Students may need a more detailed explanation of asymptotes during the Explain phase of the lesson.

Embedded video

https://youtube.com/watch?v=xz7fNEaQh3U

On the Dashboard, press the orange plus sign twice to allow students to progress to **screens 6–7**. Direct students to work with their partners to match the asymptotes cards with the graphs and domain/range cards from earlier. Have students use their Card Matching Results table to start the Card Matching activity, as the graph cards and domain/range cards are the same as before. Remind students to record their matches in the table on their Card Matching Results handout.

Inform students that they can check their work on **screen 7**, where Desmos shows how many cards out of 18 are correctly matched. If the screen appears empty, then there are no correct matches (whether from a lack of attempts, guessing, or misunderstanding).

Explain

Give each student a copy of the attached **Guided Notes** handout, then press the orange plus sign on the Dashboard three times to allow students to progress to screens 8–10. Direct students to use Desmos to complete the handout.

Students should complete **screens 8–9** by reading definitions and working through Example 1. Have the class come back together for questions and discussion. Ask for volunteers to explain how to find the vertical and horizontal asymptotes in their own words. Ask students about the "DNE" in the y-column. Use student responses to help clarify any misunderstandings.

Have students complete **screen 10** by working through Example 2. Have the class come back together for questions and discussion once more. Ask for volunteers—preferably different volunteers from the previous round of discussion—to share with the class. Use student responses to help clarify any misunderstandings.

Sample Questions & Responses

As students work through the Guided Notes handout together, they are likely to ask why we use the ratio of the coefficients to find the horizontal asymptote. In lieu of explaining limits to a group of Algebra II students, consider using the following example:

"Let's say we have the equation y = (x)/(x+5). Horizontal asymptotes help us see what y-value the graph is approaching as x approaches infinity and as x approaches negative infinity. Since infinity is not a real number, we can't just plug that in for x.

"Instead, let's talk about money—a million dollars. If the money I [as the teacher] have is represented by the top of the fraction, and the money you [the student] have is represented by the bottom of the fraction, let's compare what we have if we let x = one million dollars.

"We would see that I have one million dollars and you have one million and 5 dollars. Don't we basically have the same amount of money? We *almost* have a ratio of 1, but since we don't and never will, the function will never equal 1. But it will get really close to 1."

This illustration can be used with any of the examples provided in this lesson.

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

25 minutes

Extend

Have each pair of students find another pair and partner up to create groups of four students. On your Dashboard, press the orange plus sign to allow students to progress to **screen 11**. Instruct students to work with their group to graph the first rational function.

Teacher's Note: Feedback From Desmos

Note that the Desmos activity is designed to withhold feedback until the student has entered values for the vertical and horizontal asymptotes and the x-column. Once the student has attempted both, Desmos provides specific feedback to direct the student toward what, if anything, needs to be corrected. If they have entered the correct values, then the graph shows the "connecting dots" animation.

When groups finish question 1, press the orange plus sign on the Dashboard to allow students to progress to **screen 12**. Instruct students to work with just one person from their original group of four to complete question 2.

When students complete question 2, press the orange plus sign on the Dashboard to allow students to progress to **screen 13**. Direct students to now work with a different person from their original group of four to complete question 3.

When students finish question 3, press the orange plus sign on the Dashboard to allow students to progress to **screen 14**. Challenge students to now work independently to complete question 4. Remind students that this is a great opportunity to reflect on what they know and what questions they may have.

25 minutes

Evaluate

On the Dashboard, click the orange "Stop" button; this allows students to complete the rest of the Desmos activity at their own pace.

Direct each student to find their original partner, get out their Card Matching Results handout, and go to **screen 15**. Remind students to use their Card Matching Results table to start the Card Matching activity, as they have already matched 18 of these cards before. Inform students that they can check their work on **screen 16**, where Desmos shows how many cards out of 36 are correctly matched.

While students are working, circulate the room. Listen to students talk about the matching activity and what questions they ask. Use student responses to see which misconceptions persist before moving on to the next lesson: "Can't Touch This, Part 2."

Resources

- 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
- King, K. [KristaKingMath]. (2017, February 20). *What are vertical asymptotes?* [Video]. YouTube. https://www.youtube.com/watch?v=xz7fNEaQh3U