

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

- Lesson Slides (attached)
- Card Matching document (attached; one set per pair of students; printed front only)
- Card Matching Results handout (attached; one per pair of students; printed front only)
- Guided Notes handout (attached; one per student; printed front/back)
- Graphing With Asymptotes handout (attached; one per student; printed front/back)
- Pencils
- Scientific calculators

5 minutes

Engage

Teacher's Note: Card Matching Preparation

Before you begin, print the attached Card Matching documents (one copy per pair of students in your class). Consider printing the graph cards (page 1) in color on white paper and with the remaining cards (pages 2-6) in black & white, with each page on a different colored paper. For example, all graph cards printed on white paper; all domain/range cards printed on orange paper; all asymptote cards printed on yellow paper; etc. Additionally, consider printing on cardstock paper, especially if you plan to reuse these cards.

Once printed, cut out the cards. All of these cards are the same size for easy cutting.

Introduce the lesson using the attached **Lesson Slides**. Display **slide 3** to show the lesson's essential question: *What can cause asymptotes?* **Slide 4** identifies the lesson's learning objectives. Review each of these with your class to the extent you feel necessary.

Ask students to find a partner or assign partners yourself. Remind students to be kind and careful with the printed cards, then pass out a set of cards to each pair of students. Display **slide 5** and pass out the attached **Card Matching Results** handout to each pair of students. Have students find the graph and domain/range cards, these are the cards they will be working with first. Students should set aside the remaining cards. Share the instructional strategy Card Matching with the class, and have students use this strategy to match the graph and domain/range cards.

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.

Once students have finished, show **slide 6**. Give students time to discuss, check their work, ask questions, and correct their thinking. 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

Go to **slide 7.** Show students the video on the slide, "What are Vertical Asymptotes?," from the beginning 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

Show **slide 8** and instruct students to locate and add the asymptotes cards to their existing Card Matching activity. As students work with a partner to match the asymptotes cards with the graphs and domain/range cards from earlier, remind them to record their matches in the table on their Card Matching Results handout. As before, the letter label on each asymptote card is located on the top-left corner.

Show **slide 9**. Give students time to discuss, check their work, ask questions, and correct their thinking.

Instruct students to set aside their cards and Card Matching Results handout to resume later.

25 minutes

Explain

Go to **slide 10**. Give each student a copy of the attached **Guided Notes** handout. Distribute a scientific calculator to each student. Complete the handout as a class. Students should use the table feature of their scientific calculators to save time when calculating y-values.

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. Pass out a copy of the attached **Graphing With Asymptotes** handout to each student and display **slide 11**. Instruct students to work with their group to graph the first rational function.

As groups finish question 1, transition through **slides 12–13** so students can check their work. Instruct students to now work with only one person from their group of four to complete question 2.

As students work through and complete question 2, transition through **slides 14–15** so students can check their work. Direct students to work with a different person from their group to complete question 3.

As students work through and finish question 3, transition through **slides 16–17** so students can check their work. 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.

As students complete question 4, transition through **slides 18–19** so students can check their work. Give students an opportunity to ask questions and correct misunderstandings.

15 minutes

Evaluate

Teacher's Note: Preparation

Before starting the next activity, decide whether you want the remaining Card Matching activity to be guided practice or independent practice. To have students check their own work, unhide slide 21 from view before you begin. Otherwise, plan to have students submit their Card Matching Results handouts.

Direct students to find their original partner and get out their Card Matching cards and Card Matching Results handout. Tell students they now need all of the cards on their desks. Show **slide 20** and have students complete their matching activity. Remind students to record their matches on their Card Matching Results handout.

Optional: Slide 21

If desired, show **slide 21** to allow students to compare their work with the final results. Ask for volunteers to explain their process regarding how they matched their cards.

Guide a brief whole-group discussion by asking for volunteers to look over their cards one more time and explain their thinking. Use student responses to see which misconceptions persist before moving on to the next lesson: "Can't Touch This, Part 2."

Remember to collect students' cards and prepare each set for the next class if necessary.

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