

Prove Me Wrong

Two-Column and Paragraph Proofs

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Grade Level	9th – 10th Grade	**Time Frame**	120-145 minutes
Subject	Mathematics	**Duration**	3-4 class periods
Course	Geometry		

Essential Question

How can we use our knowledge of definitions, theorems, and postulates to justifying our reasoning?

Summary

In this lesson, students will use legal, game, and content based methods to understand how to create proofs. Students will practice identifying types of proofs and reasons that can be used when creating a proof. Students will then complete proofs as a whole class, in small groups, and individually. As they investigate proofs, students will also identify how proofs can be used in legal careers.

Snapshot

Engage

Students use Chat Stations to discuss how they argue and how arguments can be made stronger and weaker.

Explore

Students watch a movie clip of a court scene and reconstruct the line of questioning from the scene. Students then discuss the argument from the clip and its level of effectiveness.

Explain

Students complete guided notes over the types of proofs, list reasons for proofs, and practice answering proofs.

Extend

Students complete proofs in a Card Matching activity then watch a video interview to learn how legal professions use proofs.

Evaluate

Students complete proofs and use the GUS Method to indicate their feelings of confidence toward their proofs.

Standards

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

G401: Use properties of parallel lines to find the measure of an angle
G501: Use several angle properties to find an unknown angle measure
G704: Analyze and draw conclusions based on a set of conditions

Oklahoma Academic Standards Mathematics (Geometry)

G.RL.1.1: Use undefined terms, definitions, postulates, and theorems in logical arguments/proofs.

Attachments

- Closing Arguments Task Cards (Teacher Guide)—Prove Me Wrong.docx
- Closing Arguments Task Cards (Teacher Guide)—Prove Me Wrong.pdf
- Closing Arguments Task Cards—Prove Me Wrong - Spanish.docx
- Closing Arguments Task Cards—Prove Me Wrong - Spanish.pdf
- Closing Arguments Task Cards—Prove Me Wrong.docx
- Closing Arguments Task Cards—Prove Me Wrong.pdf
- Cross-Examination Card Sets—Prove Me Wrong - Spanish.docx
- Cross-Examination Card Sets—Prove Me Wrong - Spanish.pdf
- Cross-Examination Card Sets—Prove Me Wrong.docx
- Cross-Examination Card Sets—Prove Me Wrong.pdf
- Cross-Examination Records (Key)—Prove Me Wrong.docx
- Cross-Examination Records (Key)—Prove Me Wrong.pdf
- Cross-Examination Records—Prove Me Wrong - Spanish.docx
- Cross-Examination Records—Prove Me Wrong - Spanish.pdf
- Cross-Examination Records—Prove Me Wrong.docx
- Cross-Examination Records—Prove Me Wrong.pdf
- Evidence (Model Notes)—Prove Me Wrong.docx
- Evidence (Model Notes)—Prove Me Wrong.pdf
- Evidence Guided Notes—Prove Me Wrong - Spanish.docx
- Evidence Guided Notes—Prove Me Wrong - Spanish.pdf
- Evidence Guided Notes—Prove Me Wrong.docx
- Evidence Guided Notes—Prove Me Wrong.pdf
- Lesson Slides—Prove Me Wrong.pptx
- Opening Statements—Prove Me Wrong.docx
- Opening Statements—Prove Me Wrong.pdf
- Witness Testimony (Sample Responses)—Prove Me Wrong.docx
- Witness Testimony (Sample Responses)—Prove Me Wrong.pdf
- Witness Testimony—Prove Me Wrong - Spanish.docx
- Witness Testimony—Prove Me Wrong - Spanish.pdf
- Witness Testimony—Prove Me Wrong.docx
- Witness Testimony—Prove Me Wrong.pdf

Materials

- Lesson Slides (attached)
- Opening Statements posters (attached; one set per class)
- Closing Arguments Task Cards handout (attached; one card per student)
- Closing Arguments Task Cards (Teacher Guide) document (attached)
- Witness Testimony handout (attached; one per student)
- Witness Testimony (Sample Responses) document (attached)
- Evidence Guided Notes handout (attached; one per student)

- Evidence (Model Notes) document (attached)
- Cross-Examination Card Sets handout (attached; one per group)
- Cross-Examination Records handout (attached; one per group)
- Cross-Examination Records (Key) document (attached)
- Writing utensils
- Sticky notes
- UNO cards (optional)
- Glue sticks (optional)

Preparation

Print the attached **Opening Statements** posters and post each page in a location in the classroom. Print enough copies so that you have groups of three or four students per poster.

In this lesson, students will complete a Card Matching activity in which they match statement and reason cards to a two-column proof card. Prior to this portion of the lesson, identify which type of proof you would like students to complete. Print the listed pages of the **Cross Examination Card Sets** and the **Cross Examination Records** to align to the following topics:

- **Algebraic proofs:** Print Cross Examination Card Set pages 1–5 and Cross Examination Records page 1.
- **Angle proofs:** Print Cross Examination Card Set pages 6–10 and Cross Examination Records page 2.
- **Segment proofs:** Print Cross Examination Card Set pages 11–15 and Cross Examination Records page 3.
- **Similar triangle proofs:** Print Cross Examination Card Set pages 16–19 and Cross Examination Records page 4.
- **Congruent triangle proofs:** Print Cross Examination Card Set pages 20–25 and Cross Examination Records pages 5–6.
- **Parallel line proofs:** Print Cross Examination Card Set pages 26–30 and Cross Examination Records page 7.

Consider printing the card sets and records on cardstock so the cards can be reused. Cut out each individual statement and reason card. The two-column proof cards do not need to be cut out, as there is only one card per page. Use paperclips or storage bags to to keep the proof set and answers grouped together.

Print and cut out the attached **Closing Arguments Task Cards** handout. Print enough copies so each student will get one task card. Use the attached **Closing Arguments Task Cards (Teacher Guide)** document for example responses and to determine which proofs are appropriate for your students.

20 minutes

Engage

Teacher's Note: Lesson Customization

This lesson is designed to be flexible and fit your pacing needs. There are several different examples used throughout the lesson covering different types of proofs and mathematical concepts. Prior to the lesson, review the examples and options and select those most appropriate for your students.

Use the attached **Lesson Slides** to guide the lesson. Review the essential question and learning objective on **slides 3** and **4**.

Transition to **slide 5** and introduce the Chat Stations strategy. Place students into groups of three to four. Have each group stand by one of the attached **Opening Statements** and provide each student with three sticky notes.

Have each group discuss the question on their poster, write their answer on a sticky note, and place it near the poster.

Have students rotate to the next poster and repeat the process. After each group has answered all the questions, display **slide 6** and have them return to the poster at which they started. Have students read all of the sticky notes and organize them by similar ideas.

Ask each group to share what the sticky notes at their poster say and what they notice about the responses.

When all groups have shared, have students return to their seats.

20 minutes

Explore

Display **slide 7** and prepare to show the clip of *Legally Blonde* to students. Set the scene by explaining that the lead character in the movie, Elle, is a law student and is defending her client, who is accused of murder. Inform students that in this part of the scene, Elle is asking a witness questions to prove that her client is not guilty of murder. Ask students to evaluate Elle's argument by listening for strong points she makes and places she could have improved.

Embedded video
https://youtube.com/watch?v=GSu7BGbyJqc

After playing the video, move to **slide 8** and have students find an Elbow Partner.

Pass out a copy of the attached **Witness Testimony** handout to each pair. Explain to students that they should add the specific questions Elle asked to the "Line of Questioning" column, and explain the reasoning behind why those questions were asked in the "Reasoning" column. Allow students approximately 10 minutes to complete the handout. As they work, walk around the room and assist as needed.

Sample Student Responses

Use the attached **Witness Testimony (Sample Responses)** document to view possible reasons and lines of questioning.

Display **slide 9**. Ask students to share out some of the responses they recorded in the "Line of Questioning" and "Reason" columns. As they share, record their responses in the table on the slide.

After students have shared responses for each argument in the table, transition through **slides 10–13** and facilitate a whole-class discussion about the questions on the slides.

Teacher's Note: Guiding the Lesson

At this point in the lesson, ensure that students understand that effective arguments happen in a logical order. Guide students to understand the idea that people are less likely to understand your argument if you do not explain yourself, or if you jump to the conclusion without reasoning.

Optional *Uno* Proofs Activity

If time allows, unhide **slides 14–19** and guide students in completing the "*Uno* Proofs" activity.

Display **slide 14** and ask students if they are familiar with the card game *Uno*. Review the rules of the game for students who are not familiar with them.

Have students use the rules of *Uno* to predict the order in which cards were played to reach the yellow 7. Have students justify each card they believe was played by using the game rules as reasons. Allow students time to order the cards, then display **slide 15** to show students a sample response. Invite students to share how their orders are similar or different.

Assure students that there are multiple correct answers as long as they provide reasoning for their cards using the rules of the game.

Repeat the process with **slides 16–19**. Encourage students to organize their ideas in a table format as shown on the slide. Explain that this activity mimics mathematical proofs and remind students that there will be multiple correct answers for each proof, as long as they properly use and describe the rules of *Uno* in their proofs.

Consider investigating with the class how many possible answers there are for each proof.

30 minutes

Explain

Teacher's Note: Lesson Preparation

Prior to the lesson, review the reasons that are used in the proofs. Consider which reasons are appropriate for your students to understand and use. Depending on the needs of your students, you may need to review or omit some meanings and uses. Edit the slides to remove any omitted reasons prior to the lesson.

Display **slide 20** and give each student a copy of the attached **Evidence Guided Notes** handout. Using the attached **Evidence (Model Notes)** document for guidance, review the definitions of *proof* and *justify* with students and ask them to write these definitions on their handouts. These two terms are related because a student writes a proof by "laying out their mathematical thoughts and processes step-by-step" in order to prove that a statement is true.

Move to **slide 21** and explain that proof writers will categorize proofs based on the class that type of math is taught in. For example, algebraic proofs contain math and reasons commonly taught in algebra classes, while geometric proofs contain math and reasons commonly taught in geometry classes. These classifications serve no purpose other than to guide students toward possible reasons to use proofs.

Display **slide 22** and review the definitions that explain the difference between two-column and paragraph proofs. Have students write the types of proofs on their handout.

Display **slide 23** and show the examples of both types of proofs. Point out that a two column proof and paragraph proof contain the same information but differ in structure. Ask students the following questions to guide them in understanding these differences:

- Look at the first statement and reason in the two-column proof. Where does that information appear in the paragraph proof?
- Does the information appear in the same order in both the two-column proof and the paragraph proof?
- Look at the last two sentences of the paragraph proof. Would you make any changes?
- Which type of proof do you prefer? Why?

Optional Lesson Addition

There are three types of proofs: two-column, paragraph, and flowchart proofs. Two-column and paragraph proofs are most commonly used, and are consequently featured in this lesson. Consider adding flowchart proofs to this lesson if you would like students to use that format as well.

Display **slide 24** and have students find the table of definitions on the slide on their handouts. Ask them to write a checkmark next to the vocabulary words they remember and put a star next to the terms they do not know. As students work, walk around the room and observe, taking note of any terms that need to be reviewed.

Move to slide 25 and repeat the above process with the vocabulary terms *postulates* and *theorems*.

Teacher's Note: Guiding the Lesson

The reasons word bank on the handouts was created using all the proofs completed during the course of the lesson. If you do not complete all proofs included in the lesson, you will not use all of the reasons provided in the word bank.

Transition through **slides 26–27** and review the statements on the slides with students. Guide students to understand where reasons come from and why proofs can look different depending on the reasons used. Ensure that students understand this information before moving on to the examples.

Display **slide 28** and ask students to solve the algebra problem. Have them list each mathematical step in the "Statement" column on the left of the provided table.

After students complete the problem, transition through **slides 29–31** and help students make the connection between solving the problem and constructing the proof.

Transition through **slides 32–34** and explain the steps of creating a proof. After students have constructed the two-column proof, have them transfer the same information from the two-column proof into a paragraph proof. Students' paragraphs may differ, but should contain the same information found in their two-column proofs.

If time allows or if students need more practice, unhide **slides 35–40** and have students complete additional proofs.

Consider having students add their work to their math notebooks if notebooks are used in your classroom.

Teacher's Note: Guiding the Lesson

If students have difficulty choosing reasons for their proofs, have them refer to the reasons word bank in the Evidence Guided Notes handout.

25 minutes

Extend

Have students move into groups of three or four. Display **slide 41** and pass out one set of the **Cross-Examination Card Sets** and one copy of the **Cross-Examination Records** handout to each group.

Introduce the Card Matching instructional strategy. Have students match the missing statements and reasons with the provided cards. Have groups record their results on their Cross-Examination Records handouts.

As groups match the cards, use the attached **Cross-Examination Records (Key)** document to check students' work. Have them revisit any incorrect proofs.

Optional Card Matching Modification

You may choose to have students use glue sticks to glue the cards to their proofs, so these can be used for late reference. If you choose this option, prepare additional copies of the Cross-Examination Card Sets and Cross-Examination Records so each class has a set.

If time allows, move to **slide 42** and show students the video *K20 ICAP - Defense Attorney (Math) - Prove Me Wrong*. The video interview features a criminal defense attorney and introduces students to how proofs are used by the justice system.

Embedded video

https://youtube.com/watch?v=RW4SVMW5pgg

25 minutes

Evaluate

Display **slide 43** and give each student one task card from the attached **Closing Arguments Task Cards** handout. Instruct students to complete the proof on their task card.

After students have completed their proofs, move to **slide 44** and have them use the GUS Method to share their feelings about the answers they found. Have each student record a G, U, or S under their proof to denote their feelings toward their response.

Sample Student Responses

See the attached **Closing Arguments Task Cards (Teacher Guide)** document for possible proof responses.

Resources

- K20 Center. (n.d.). Card matching. Strategies. https://learn.k20center.ou.edu/strategy/1837
- K20 Center. (n.d.). Chat stations. Strategies. https://learn.k20center.ou.edu/strategy/944
- K20 Center. (n.d.). Elbow partners. Strategies. https://learn.k20center.ou.edu/strategy/116
- K20 Center. (n.d.). GUS method. Strategies. https://learn.k20center.ou.edu/strategy/76
- K20 Center. (2022, September 22). *K20 ICAP - Defense attorney (math) - Prove me wrong* [Video]. YouTube. https://www.youtube.com/watch?v=RW4SVMW5pgg
- Movieclips. (2015, November 30). *Legally blonde (2001) - Elle wins! scene (11/11) | Movieclips* [Video]. YouTube. https://www.youtube.com/watch?v=GSu7BGbyJqc