

# Session 1: What is Argumentation?

## Session Goals:

- Develop a deeper understanding of argumentation and its potential in the math classroom.
- Analyze mathematical arguments within a basic structure.

*Thinking is the hardest work there is, which is probably the reason why so few engage in it. — — Henry Ford*

# FIND SOMEONE WHO....

Consider the many descriptors in the chart below

Determine four descriptors from the grid that all members at your table have in common.

<b>Plays a musical instrument</b>	<b>Has owned more than 3 vehicles (not at the same time)</b>	<b>Has never traveled outside the US</b>	<b>Has less than three siblings</b>
<b>Has traveled abroad within the past year</b>	<b>Has one or more pets</b>	<b>Has been to the movie theater in the past 6 months</b>	<b>Can recite more than 6 digits of pi</b>
<b>Has had a broken bone</b>	<b>Speaks another language fluently or nearly fluently</b>	<b>Secretly watches reality television</b>	<b>Struggled in math class as a student</b>
<b>Has an intern or student teacher in the coming school year</b>	<b>Has a birthday in an EVEN numbered month</b>	<b>Is a Red Sox fan</b>	<b>Owns more than 20 pairs of shoes</b>
<b>Has worked as a waitress/waiter</b>	<b>Has one or more tattoos</b>	<b>Has purchased something on-line</b>	<b>Has eaten a bug</b>

# 1.1 Community Agreements

Purpose: To set the ground rules that will help us stay focused on the important work in which we engage throughout these sessions.

Guiding Question: What are some of the things that are important for a group to agree to in order for that group to work well together?

## 1.2 What is a Mathematical Argument?

### Sum of Two Consecutive Numbers Task

Consider the following mathematical statement:

*When you add any two consecutive numbers, the answer is always odd.*

Think

- 1) Is this statement (claim) true?
- 2) What's your argument to show that it is or is not true?



## Angel's Response

Consecutive numbers go even, odd, even, odd, and so on. So if you take any two consecutive numbers, you will always get one even and one odd number.

And we know that when you add any even number with any odd number the answer is always odd.

That's how I know that no matter what two consecutive numbers you add, the answer will always be an odd number.

Does the argument show the claim is true?

## Kira's Response

Consecutive numbers are  $n$  and  $n+1$ .

Add the two numbers:

$$n + (n+1) = 2n + 1$$

You get  $2n + 1$  which is always an odd number, because an odd number leaves a remainder of 1 when divided by 2. (2 goes into  $2n + 1$   $n$  times, with a remainder of 1)

Does the argument show the claim is true?

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<sup>1</sup>Original problem from Bieda, K., Holden, C., & Knuth, E. (2006). Does proof prove?: Students' emerging beliefs about generality and proof in middle school. *Proceedings of the 28th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*. Mérida, Mexico: Universidad Pedagógica Nacional (pp 395 – 402).



## Student Argumentation Work Sample Sorting Task

### PART 1: Individual

**A: Setting the context: Mathematics Task. (5 mins)**

Work through the math task on your own. Ideas to think about: What was the “big idea” of the task/assessment? What result or claim needed justification? What would a high quality argument on this task look like?

**B: Initial Sort (10-15 mins)**

On your own, do a “quick sort” of students’ work by the degree of proficiency demonstrated with providing an argument of relevant claims. For each sample, record the corresponding work sample letter in the appropriate column of the chart below.

HIGH Quality (strong example of a mathematical argument)	ADEQUATE Quality (adequate example of a mathematical argument)	LOW Quality (not a strong example of a mathematical argument)

### PART 2: Collaborative

**Assign Roles**

Role 1: Handler – responsible for moving around the student work samples into piles (High, Adequate, Low Quality) based on discussion and direction from group

Role 2: Reporter – responsible for sharing small group ideas and reasoning with the larger group during discussion

**C: Working Towards Group Consensus (10-15 mins)**

As a group, discuss each student work sample. Decide as a group where each sample belongs (High, Adequate, or Low). The Handler will sort the samples into the appropriate piles as determined by the group. Record work sample letters in the appropriate column of the chart below.

*The Reporter will record the official group sort on the white board.*

HIGH Quality (strong example of a mathematical argument)	ADEQUATE Quality (adequate example of a mathematical argument)	LOW Quality (not a strong example of a mathematical argument)

**D: Collaborative Discussion for Final Sort (15 mins)**

As a larger group, examine the collective sorting of the work samples. Discuss and defend any differences in sorting among the groups based on your understanding of a mathematical argument (Claim, Evidence, Warrant). Consensus on a Final Sort is the goal of these discussions.

## THE TASK

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### DJ for the Prom

In preparation for the Prom, students are researching the costs of two local DJ companies. Music Makers charges a fee of \$200 and an additional \$ 175per hour. Dance Partners does not charge an initial fee, but charges \$225 per hour. Which company would be more cost effective for the prom committee? Write a mathematical argument to support your decision.

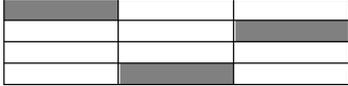
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## THE TASK

**Laura says  $\frac{1}{4}$  is shaded. Is she right?**

Think

What fraction of the rectangle below is shaded?



Laura says that  $\frac{1}{4}$  of the rectangle is shaded. Do you think she is correct?

Defend your answer.

Source of the task: Adapted from Illustrative Mathematics <https://www.illustrativemathematics.org/content-standards/tasks/881>