ICE CREAM CONE REPORT

MY ORIGINAL POSITION

- ☐ Dr. Waller was right
- ☐ Mrs. Kalman was right

CENTRAL STATEMENT/TOPIC

Write two sentences to describe the central idea and lesson topic:

EXPLAIN YOUR POSITION & JUSTIFICATION WHY YOU ARE CORRECT.

Include specific steps you need to take to solve the problem mathematically. Please use complete sentences. Finish on back if necessary.

HOW MANY TIMES DID YOU CHANGE YOUR POSITION?

WHAT WAS YOUR ENDING POSITION?

HOW OPEN MINDED WAS I WHEN I LISTENED TO OTHER PEOPLE TALK?

- ☐ **MOSTLY OPEN-MINDED**
- ☐ **PARTIALLY OPEN-MINDED**
- ☐ **NOT VERY OPEN-MINDED**

Rules of Engagement

1. Be sure you understand the central statement or topic before the discussion begins. Decide which section you will sit in.
2. Listen carefully when others speak and seek to understand their arguments even if you don't agree.
3. Wait for the mediator to recognize you before you speak; only one person speaks at a time.
4. You must first summarize briefly the previous speaker's argument before you make your response.
5. If you have spoken for your side, you must wait until three other people on your side speak before you speak again.
6. Be sure that when you speak, you address the ideas, not the person stating them.
7. Keep an open mind and move to the other side or the undecided section if you feel that someone made a good argument or your opinion is swayed.

Will the Ice Cream Cone Melt Inside the Cone?

1. Who is Right? What is your choice? (Circle one)

   Mrs. Kalman or Dr. Waller

2. What do you think will happen and why? What logical assumptions will you use?

3. Make calculations to show your work: (Formula WS, Pencil, Paper, Calculator)

4. Mrs. Kalman's supporting evidence: (Note correct or flawed argument)

5. Dr. Waller's supporting evidence: (Note correct or flawed argument)

Communicate Reasoning in Mathematics

Your goal is to clearly and precisely construct viable arguments to support your reasoning and critique the reasoning of others.

Target	0	1	2
Test possible solutions to a problem using specific examples.	Student either provided one possible solution without citing examples or provided an example without demonstrating any work.	Tests were performed on only one possible solution with citation. Or there were tests on both possible solutions without citing examples.	Tests were performed on each possible solution citing specific examples.
Construct a chain of reasoning to justify or refute each possible solution. (STEPS for solving)	Student did not show a chain of reasoning or steps that took her/him to the solution	Student constructed a chain of reasoning on one possible solution.	Student constructed a chain of reasoning for each possible solution.
State logical assumptions that you are using.	There were no logical assumptions included in the writing.	Student included assumptions, but did not address them in his/her writing as such.	Student stated logical assumptions for the problem.
Use the technique of breaking each argument into cases.	Student did not break down the information when solving the problem.	Student broke the information down in one place during problem solving.	Student broke down the information for all arguments.
Distinguish CORRECT logic or reasoning from that which is FLAWED. And, if there is a flaw in the argument, explain what it is.	Student could not distinguish correct from flawed work and did not provide any explanation.	Student distinguished correct reasoning from flawed without providing an explanation. Or student found the flawed work to be correct but had sound arguments to why it was not flawed.	Student both distinguished the correct reasoning from the flawed, as well as gave an explanation why the information was flawed.
Base your arguments on concrete references such as objects, drawings, diagrams, and actions.	Student did not use concrete references (objects, drawing, actions, or examples) to provide arguments for their work.	Student based one argument on concrete references.	Student based all arguments on concrete references such as objects, drawings, diagrams, and actions.
Pose a possible condition under which the possible solution would be different. (For example, is there a size of the cone/sphere that would change the result of the experiment?)	Student did not pose a condition that would change the information.		Student posed possible condition that would change the results.

Mathematics Classroom Observation Protocol for Practices: Descriptors Manual

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How to Score

The $MCOP^2$ measures two distinct factors of Teacher Facilitation and Student Engagement through two subscales of 9 items each. (The $MCOP^2$ is not designed to get a single score of a classroom.)

The Teacher Facilitation subscale (Cronbach alpha of 0.850) measures the role of the teacher as the one who provides structure for the lesson and guides the problem solving process and classroom discourse. To calculate the score for the Teacher Facilitation subscale, one would add the scores for items 4, 6-11, 13, and 16.

The Student Engagement subscale (Cronbach alpha of 0.897) measures the role of the student in the classroom and their engagement in the learning process. To calculate the score for the Student Engagement subscale, one would add the scores for items 1-5 and 12-15.

Item	Student Engagement	Teacher Facilitation
1	X	
2	X	
3	X	
4	X	X
5	X	
6		X
7		X
8		X
9		X
10		X
11		X
12	X	
13	X	X
14	X	
15	X	
16		X

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2) Students used a variety of means (models, drawings, graphs, concrete materials, manipulatives, etc.) to represent concepts.

In mathematics instruction it is common for the teacher to use various representations (models, drawings, graphs, concrete materials, manipulatives, graphing calculators, compass & protractor, i.e. tools for the mathematics classroom) to focus students' thinking on and develop their conceptions of a mathematical concept. It is also important for students to interact with and develop representations of mathematical concepts and not merely observe the teacher presenting such representations. Thus, this item is concerned with whether the students use representations to represent mathematical concepts. The representations can be student generated (a drawing or a graph) or provided by the teacher (manipulatives or a table), but it is the students that must then use the representation. Just because there is a representation in a lesson, if it is only used by the teacher while students watch (such as a graph on a PowerPoint slide), it is not considered to be used by students unless the students manipulate and interact with the representation.

Students' notes can count as a type of representation if the students themselves offer some sort of input. For instance, if a student corrects a teacher's mistake in a problem he or she is copying down then the notes are actually being manipulated by a student and should therefore count as a type of representation.

Score	Description
3	The students manipulated or generated two or more representations to represent the same concept, and the connections across the various representations, relationships of the representations to the underlying concept, and applicability or the efficiency of the representations were explicitly discussed by the teacher or students, as appropriate.
2	The students manipulated or generated two or more representations to represent the same concept, but the connections across the various representations, relationships of the representations to the underlying concept, and applicability or the efficiency of the representations were **not** explicitly discussed by the teacher or students.
1	The students manipulated or generated one representation of a concept.
0	There were either no representations included in the lesson, or representations were included but were exclusively manipulated and used by the teacher. If the students only watched the teacher manipulate the representation and did not interact with a representation themselves, it should be scored a 0.

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4) Students critically assessed mathematical strategies.

In order for students to flexibly use mathematical strategies, they must develop ways to consider the appropriateness of a strategy for a given problem, task, or situation. This is because not all strategies will work on all problems, and furthermore the efficiency of the strategy for the given context needs to be considered. For students to make such distinctions it is important that they have opportunities to assess mathematical strategies so that they learn to reason not only about content but also about process. This item is concerned with *students* critically assessing strategies, which is more than listening to the teacher critically assessing strategies or asking peers how they solved a task. Examples of critical assessment include students offering a more efficient strategy, asking "why" a strategy was used, comparing/contrasting multiple strategies, discussing the generalizability of a strategy, or discussing the efficiency of different ways of solving a problem (e.g. the selection appropriate tools if needed).

To score high on this item it is the students who must be engaged in the critical assessment, not only the teacher.

Score	Description
3	More than half of the students critically assessed mathematical strategies. This could have happened in a variety of scenarios, including in the context of partner work, small group work, or a student making a comment during direct instruction or individually to the teacher.
2	At least two but less than half of the students critically assessed mathematical strategies. This could have happened in a variety of scenarios, including in the context of partner work, small group work, or a student making a comment during direct instruction or individually to the teacher.
1	An individual student critically assessed mathematical strategies. This could have happened in a variety of scenarios, including in the context of partner work, small group work, or a student making a comment during direct instruction or individually to the teacher. The critical assessment was limited to one student.
0	Students did not critically assess mathematical strategies. This could happen for one of three reasons: 1) No strategies were used during the lesson; 2) Strategies were used but were not discussed critically. For example, the strategy may have been discussed in terms of how it was used on the specific problem, but its use was not discussed more generally; 3) Strategies were discussed critically by the teacher but this amounted to the teacher telling the students about the strategy(ies), and students did not actively participate.

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6) The lesson involved fundamental concepts of the subject to promote relational/conceptual understanding.

Relational/conceptual understanding is "knowing both what to do and why" (Skemp, 1976). This is in contrast to a procedural understanding as being able to compute certain mathematical activities, but not understanding how the computation works or when one would need to use such a computation and what the answer would mean.

According to the NCTM (2006), certain topics are core to the mathematics learned at each grade level and can form the backbone of the K-8 curriculum. The NCTM extended this concept to the high school level with an emphasis on using these fundamental concepts to make sense of mathematics and deepen students' relational and conceptual understanding (Martin, et al., 2009). Similar to the NCTM's guidelines for middle school and high school mathematics lessons, at the undergraduate level the Mathematical Association of America has recommendations in the Committee on the Undergraduate Program in Mathematics Curriculum Guide (Barker, et al., 2004) for departments, programs, and all courses to promote relational/conceptual understanding for both mathematics majors and non-mathematics majors.

Score	Description
3	The lesson includes fundamental concepts or critical areas of the course, as described by the appropriate standards, and the teacher/lesson uses these concepts to build relational/conceptual understanding of the students with a focus on the "why" behind any procedures included.
2	The lesson includes fundamental concepts or critical areas of the course, as described by the appropriate standards, but the teacher/lesson misses several opportunities to use these concepts to build relational/conceptual understanding of the students with a focus on the "why" behind any procedures included.
1	The lesson mentions some fundamental concepts of mathematics, but does not use these concepts to develop the relational/conceptual understanding of the students. For example, in a lesson on the slope of the line, the teacher mentions that it is related to ratios, but does not help the students to understand how it is related and how that can help them to better understand the concept of slope.
0	The lesson consists of several mathematical problems with no guidance to make connections with any of the fundamental mathematical concepts. This usually occurs with a teacher focusing on procedure of solving certain types of problems without the students understanding the "why" behind the procedures.

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8) The lesson provided opportunities to examine mathematical structure. (Symbolic notation, patterns, generalizations, conjectures, etc.)

Following some of the "Standards for Mathematical Practice" (National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010) and the recommendations in the MAA's CUPM Curriculum Guide (Barker, et al., 2004), lessons should include opportunities for students to contextualize and/or decontextualize in the process of solving quantitative problems, explore and make use of mathematical structure, or to use repeated reasoning to generalize certain categories of problems and their solutions.

Score	Description
3	The students have a sufficient amount of time and opportunity to look for and make use of mathematical structure or patterns.
2	Students are given some time to examine mathematical structure, but are not allowed adequate time or are given too much scaffolding so that they cannot fully understand the generalization.
1	Students are shown generalizations involving mathematical structure, but have little opportunity to discover these generalizations themselves or adequate time to understand the generalization.
0	Students are given no opportunities to explore or understand the mathematical structure of a situation.

10) The lesson promoted precision of mathematical language.

This item follows the Standard of Mathematical Practice to "attend to precision". As such, "Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem" (National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010).

This item also follows the MAA's CUPM Curriculum Guide recommendation to "develop mathematical thinking and communication skills" which states: "Students should read mathematics with understanding and communicate mathematical ideas with clarity and coherence through writing and speaking" (Barker, et al., 2004).

Whether the communication is verbal or written and originating in the teacher or a student, using precise mathematical language is important. While the teacher cannot control the language used by students, there should be evidence of expectations of the teacher upon the students related to communicating with precise mathematical language. For example, if the lesson is primarily students solving problems, a culture of precision of language should come through in how the students are communicating with one another, both verbal and written.

Score	Description
3	The teacher "attends to precision" in regards to communication during the lesson. The students also "attend to precision" in communication, or the teacher guides students to modify or adapt non-precise communication to improve precision.
2	The teachers "attends to precision" in all communication during the lesson, but the students are not always required to also do so.
1	The teacher makes a few incorrect statements or is sloppy about mathematical language, but generally uses correct mathematical terms.
0	The teacher makes repeated incorrect statements or incorrect names for mathematical objects instead of their accepted mathematical names.

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12) There were a high proportion of students talking related to mathematics.

The focus of this descriptor is on the proportion of students talking (frequency). The Standards for Mathematical Practice (National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010) encourages students to be active in making conjectures, exploring the truth of those conjectures, and responding to the conjectures and reasoning of others. In a classroom dominated by only a few students, classroom discourse may appear to be high, but all students must be engaged.

Score	Description
3	More than three quarters of the students were talking related to the mathematics of the lesson at some point during the lesson.
2	More than half, but less than three quarters of the students were talking related to the mathematics of the lesson at some point during the lesson.
1	Less than half of the students were talking related to the mathematics of the lesson.
0	No students talked related to the mathematics of the lesson.

14) In general, the teacher provided wait-time.

The appropriate wait time must align with the question/task. In the elementary grades, a teacher may ask students to explain a situation that represents the expression 24*(1/2)*3. In middle school, the teacher may ask students to describe why the slope is positive. High school teachers may ask students to explain how linear and exponential functions are similar and different. In each instance, these questions/tasks are not simple yes/no answer and require wait time to provide an answer with meaning and understanding.

Simple Yes/No questions could be asked, but must be accompanied by an explanation. Simple skills or procedural problems should require explanations with the computation and/or procedures. If the class is dominated by rhetorical questions, a score of 0 or 1 is warranted. Even if rhetorical questions are asked, it is possible to score a 2 or 3 if there are questions asked sometimes or frequently that require students to reason, make sense, and articulate thoughtful responses.

Score	Description
3	The teacher **frequently** provided an ample amount of "think time" for the depth and complexity of a task or question posed by either the teacher or a student.
2	The teacher **sometimes** provided an ample amount of "think time" for the depth and complexity of a task or question posed by either the teacher or a student.
1	The teacher **rarely** provided an ample amount of "think time" for the depth and complexity of a task or question posed by either the teacher or a student.
0	The teacher **never** provided an ample amount of "think time" for the depth and complexity of a task or question posed by either the teacher or a student.

16) **The teacher uses student questions/comments to enhance conceptual mathematical understanding.**

Driscoll (1999; 2007) and Reys, et al. (2009) discuss how teacher questioning can build on student thinking to foster deeper mathematical thinking. In the elementary grades, students can make "over generalized" statements that have a correct nature about them. This is a teachable moment to use. A teacher can ask a question that has the student(s) reexamine their thoughts that would help simplify the over generalizing statement into precise understanding. Reys, et al. (2009) present a simple example, "Student: So every even number is composite. Teacher: Every even number? <Pause with wait time> What about 2?" The teacher's question stimulates further thought by the student. In secondary grades, Driscoll (1999) indicates that well-timed questions to students should help them shift or expand their thinking, or at least have students thinking about what is important to pay attention to during a lesson. When students are examining expressions, a teacher can ask questions to facilitate mathematical flexibility (Heinze, Star, & Verschaffel, 2009). For example, "What other ways can you write that expression to bring out the hidden meaning? How can you write the expression in terms of the important things you care about?"

Score	Description
3	The teacher **frequently** uses student questions/ comments to coach students, to facilitate conceptual understanding, and boost the conversation. The teacher sequences the student responses that will be displayed in an intentional order, and/or connects different students' responses to key mathematical ideas.
2	The teacher **sometimes** uses student questions/ comments to enhance conceptual understanding.
1	The teacher **rarely** uses student questions/ comments to enhance conceptual mathematical understanding. The focus is more on procedural knowledge of the task verses conceptual knowledge of the content.
0	The teacher **never** uses student questions/ comments to enhance conceptual mathematical understanding.

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Teacher: Grade/Course: Date:

Observer: Length of Observation: Lesson Plan included: ☐

MCOP[2] Rater Sheet for Student Engagement Items

1. Students engaged in exploration/investigation/problem solving.

Check one:	Rating	Description	Evidence and comments:
☐	3	Students **regularly** engaged in exploration, investigation, or in problem solving. Over the course of the lesson, the **majority** of the students engaged in exploration/ investigation/problem solving.	
☐	2	Students **sometimes** engaged in exploration, investigation, or problem solving. **Several** students engaged in problem solving, but not the majority of the class.	
☐	1	Students **seldom** engaged in exploration, investigation, or problem solving. This tended to be limited to **one or a few** students engaged in problem solving while other students watched but did not actively participate.	
☐	0	Students did not engage in exploration, investigation, or problem solving or the instances were carried out by the teacher without active participation by any students.	

2. Students used a variety of means (models, drawings, graphs, concrete materials, manipulatives, etc.) to represent concepts.

Check one:	Rating	Description	Evidence and comments:
☐	3	The students manipulated or generated **two or more** representations to represent the same concept, and the connections across the various representations, relationships of the representation to the underlying concept, and applicability or the efficiency of the representations **were** explicitly discussed by the teacher or students, as appropriate.	
☐	2	The students manipulated or generated **two or more** representations to represent the same concept, but the connections across the various representations, relationships to the underlying concept, and applicability or the efficiency of the representations **were not** explicitly discussed by the teacher or students.	
☐	1	The students manipulated or generated **one** representation of a concept.	
☐	0	There were either no representations included in the lesson, or representations were included but were exclusively manipulated and used by the teacher. If the students only watched the teacher manipulate the representation and did not interact with a representation themselves, it should be scored a 0.	

3. Students were engaged in mathematical activities.

Check one:	Rating	Description	Evidence and comments:
☐	3	**Most** of the students spend **two-thirds or more** of the lesson engaged in mathematical activity at the appropriate level for the class. It does not matter if it is one prolonged activity or several shorter activities. (Note that listening and taking notes does not qualify as a mathematical activity	

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		unless the students are filling in the notes and interacting with the lesson mathematically.	
☐	2	**Most** of the students spend more than **one-quarter but less than two-thirds** of the lesson engaged in appropriate level mathematical activity. It does not matter if it is one prolonged activity or several shorter activities.	
☐	1	**Most** of the students spend **less than one-quarter** of the lesson engaged in appropriate level mathematical activity. There is at least one instance of students' mathematical engagement.	
☐	0	**Most** of the students are **not engaged** in appropriate level mathematical activity. This could be because they are never asked to engage in any activity and spend the lesson listening to the teacher and/or copying notes, or it could be because the activity they are engaged in is not mathematical-such as a coloring activity.	

4. Students critically assessed mathematical strategies.

Check one:	Rating	Description	Evidence and comments:
☐	3	**More than half** of the students critically assessed mathematical strategies. This could have happened in a variety of scenarios, including in the context of partner work, small group work, or a student making a comment during direct instruction or individually to the teacher.	
☐	2	**At least two but less than half** of the students critically assessed mathematical strategies. This could have happened in a variety of scenarios, including in the context of partner work, small group work, or a student making a comment during direct instruction or individually to the teacher.	
☐	1	**An individual** student critically assessed mathematical strategies. This could have happened in a variety of scenarios, including in the context of partner work, small group work, or a student making a comment during direct instruction or individually to the teacher. The critical assessment was limited to one student.	
☐	0	Students **did not** critically assess mathematical strategies. This could happen for one of three reasons: 1) No strategies were used during the lesson; 2) Strategies were used but were not discussed critically by the teacher but this amounted to the teacher telling the students about the strategy(ies), and students did not actively participate.	

5. Students persevered in problem solving.

Check one:	Rating	Description	Evidence and comments:
☐	3	Students exhibited a **strong amount** of perseverance in problem solving. The **majority** of students looked for entry points and solution paths, monitored and evaluated progress, and changed course if necessary. When confronted with an obstacle (such as how to begin or what to do next), the **majority** of students continued to use resources (physical tools as well as mental reasoning) to continue to work on the problem.	
☐	2	Students exhibited **some** perseverance in problem solving. **Half** of students looked for entry points and solution paths, monitored and evaluated progress, and changed course if necessary. When confronted with an obstacle (such as how to begin or what to do next), **half** of students continued to use resources (physical tools as well as mental reasoning) to continue to work on the problem.	

☐	1	Students exhibited **minimal** perseverance in problem solving. **At least one** student **but less than half** of the students looked for entry points and solution paths, monitored and evaluated progress, and changed course if necessary. When confronted with an obstacle (such as how to begin or what to do next), **at least one student but less than half** of students continued to use resources to continue to work on the problem. There must be a road block to score above a 0.	
☐	0	Students **did not** persevere in problem solving. This could be because there was no student problem solving in the lesson, or because when presented with a problem solving situation no students persevered. That is to say, **all students** either could not figure out how to get started on a problem, or when they confronted an obstacle in their strategy they stopped working.	

12. There were a high proportion of students talking related to mathematics.

Check one:	Rating	Description	Evidence and comments:
☐	3	**More than three quarters** of the students were talking related to the mathematics of the lesson at some point during the lesson.	
☐	2	**More than half, but less than three quarters** of the students were talking related to the mathematics of the lesson at some point during the lesson.	
☐	1	**Less than half** of the students were talking related to the mathematics of the lesson.	
☐	0	**No** students talked to the mathematics of the lesson.	

13. There was a climate of respect for what others had to say.

Check one:	Rating	Description	Evidence and comments:
☐	3	**Many** students are sharing, questioning, and commenting during the lesson, including their struggles. Students are also listening (active), clarifying, and recognizing the ideas of others.	
☐	2	The environment is such that **some** students are sharing, questioning, and commented during the lesson, including their struggles. Most students listen.	
☐	1	Only a **few** share as called on by the teacher. The climate supports those who understand or who behave appropriately. Or some students are sharing, questioning, or commenting during the lesson, but most students are actively listening to the communication.	
☐	0	**No** students share ideas.	

14. In general, the teacher provided wait-time (think-time).

Check one:	Rating	Description	Evidence and comments:
☐	3	The teacher **frequently** provided an ample amount of "think time" for the depth and complexity of a task or question posed by either the teacher or a student.	
☐	2	The teacher **sometimes** provided an ample amount of "think time" for the depth and complexity of a task or question posed by either the teacher or a student.	

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☐	1	The teacher **rarely** provided an ample amount of "think time" for the depth and complexity of a task or question posed by either the teacher or a student.	
☐	0	The teacher **never** provided an ample amount of "think time" for the depth and complexity of a task or question posed by either the teacher or a student.	

15. Students were involved in the communication of their ideas to others (peer to peer).

Check one:	Rating	Description	Evidence and comments:
☐	3	Considerable time (**more than half**) was spent with peer to peer dialog (pairs, groups, whole class) related to the communication of ideas, strategies, and solution.	
☐	2	Some class time (**less than half**) was spent with peer to peer dialog (pairs, groups, whole class) conversations related to the mathematics.	
☐	1	The lesson was primarily teacher directed and little opportunities were available for peer to peer (pairs, groups, whole class) conversations. A **few** instances of developed where this occurred during the lesson but only lasted less than minutes.	
☐	0	**No** peer to peer (pairs, groups, whole class) conversations occurred during the lesson.	

Post-Lesson Reflection

Check that each part has been completed and fill in specific targets.

☐ 1.	**Teacher reflection about the lesson. (e.g., What went well? What might I do differently the next time?)**
☐ 2.	**(If available) Dialogue between observer and teacher about ratings.**
☐ 3.	**Targets identified for further investigation/growth/attention based on specific MCOP2 indicators and other feedback (list below).**

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