For the lesson on November 7, 2017
A Science and Study Lesson Conference
It's Go Time: Science for All
1st Grade Bolivar Road Elementary

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Our Ideals

When our students graduate from Chittenango Schools, we would like them to possess the intellectual skills that enable them to function as successful citizens and community members. Some of these characteristics include being inquisitive, self-motivated, driven by goals, and being able to communicate their ideas logically. When required, we would like our students to support their ideas with evidence. Communicating ideas intelligently also depends on specific character traits. We endeavor to teach our students to be well-rounded, and to be respectful as they hold conversations with their peers. We aspire to prepare our students to be kind, compassionate, and happy just being themselves. Intellectual and interpersonal skills are equally important in a well-rounded individual. We believe the following research lesson addresses both our long and short-term ideals for our first-grade students.

1. Title of the Lesson: Good Vibrations- What is needed to make sound?

2. Brief description of the lesson: Students will complete their sound investigation. They will use patterns of movement in objects that make sound to argue from evidence that vibration causes sound. They discuss their observations as a group. They learn that argument in science is a good thing because it helps scientists answer questions. Students build a final claim, then support that claim with evidence from their investigations. In the end, the students should understand vibrating objects cause sound.

3. Research Theme

The Smithsonian unit for 1st grade called, *How can we Send a Message Using Sound?* offered us high-quality curriculum linked to the newly adopted Next Generation Science Standards. It also provided us with ideas for science notebooks. We used their ideas about notebooks, and adapted them based on our knowledge of the developmental levels of first-grade students in the first few months of a new school year. Our research theme endeavors to address the effectiveness of our adaptations to our students' notebook entries, and how it affects our students' capacity to engage in productive talk with science content.

Hypotheses

Our first hypothesis or testable questions focus on how the science notebook pages enable our students to record their thinking efficiently. Our primary hypothesis is: **If we alter the notebook pages to include pictures as a means to communicate our expectations and if we provide the students more space to draw and write their ideas, then our students will be better able to express their scientific thinking more efficiently and effectively in their notebooks.**

Our second hypothesis relates to our whole class discussion. **If we visually organize the students' ideas about evidence they collected during the lesson on the whiteboard in sequential order, then our students will be better able construct claim(s) linked to that evidence.**

4. Goals of the Unit

Students will be able to:

A. Identify arguments that are supported by evidence;
B. Distinguish between explanations that account for all gathered evidence and those that do not;
C. Analyze why some evidence is relevant to a scientific question and some is not;
D. Distinguish between opinions and evidence in one's own explanations;
E. Listen actively to arguments to indicate agreement or disagreement based upon evidence, and/or retell the main points of the argument;
F. Construct an argument with evidence to support a claim; and
G. Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence.

5. Goals of the Lesson:

A. Students will understand that sound can make matter vibrate, and vibrating matter can make sound;
B. Students will be able to construct explanations;
C. Students will engage in argument from evidence, using multiple pieces of evidence from all or most of their stations to support their claim;
D. Students will listen actively to other students' claims and respond using evidence; and
E. Students will observe a pattern in objects that make sound, e.g., they say that all objects that make sound vibrate.

6. Relationship of the Unit to the Standards:

The unit "How Can We Send a Message Using Sound" was developed specifically for the Next Generation Science Standards. The unit is aligned to meet the following disciplinary core ideas:

-PSA4.A: Wave Properties
-PS4.C: Information Technologies and Instrumentation
-ETS1.A: Defining and Delimiting Engineering Problems
-ETS1.B: Developing Possible Solutions
-ETS1.C: Optimizing the Design Solution

Research Lesson Standards

1-PS4-1 Performance Expectation: Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. [Clarification Statement: Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.]

Disciplinary Core Idea:

PS4.-1 A. Wave Properties: Sound can make matter vibrate, and vibrating matter can make sound.

WAVE PROPERTIES *What are the characteristic properties and behaviors of waves?*

Science and Engineering Practices: Planning and Carrying out Investigations

Cross-Cutting Concepts: Cause and Effect

ELA Connections:

Speaking and listening
Comprehension and collaboration (SL.1.1 and SL.1.3)
Presentation of knowledge and idea (SL.1.4.)

Reading
Foundational skills: Phonological awareness (RF.1.2.)

Writing
Notebooks: Research to build and present knowledge (W.1.8.)

7. Background and Rationale

a) Notebooks

Notebooks serve a variety of educational purposes. A science notebook is a flexible, integral tool that provides space for our students to record their scientific thinking in the written, art and mathematical forms. The science notebook is the glue that connects the investigation to the whole-class discussions. It is critical to the entire learning experience. Students learn how to engage in a scientific analysis by collecting, organizing, and processing data. A science notebook is a necessary tool for our students to hold the data they collect during investigations or engineering design challenges. Students use this evidence to support their claims about the phenomenon in question.

During the initial whole group phase of the preliminary lesson--the entire class discussion--we observed our students were unable to collectively construct a claim about the relationship between the vibration of the larynx and the humming sound. We became concerned about our students' capacities to make claims in general. As the students moved into the second phase of the lesson--the stations--we observed them making claims, and conceptual connections as they informally discussed their experiences with their peers. However, the students did not record those claims in their notebooks consistently, or they did not record their thinking at all.

Another issue that surfaced during the station phase of the lesson related to students understanding the procedures at the stations especially the station with the tuning fork. Students were not handling the tuning fork correctly, or they did not fully understand how to proceed. Incorrect use of the tuning fork was problematic because it limited their learning experiences.

To address these issues, we changed the notebook pages for each of the stations to include spaces to draw their ideas adjacent to spaces for them to write their ideas. The pictures were designed to

clarify, and scaffold the procedures of the investigation, and to help those students who find it difficult to write their thoughts. Given the reality that our students are in their first three months of a new school year as first graders, we attempted to find the correct balance between providing enough direction without directly telling them the most accurate way to manipulate the materials or write in the notebooks. We did not want our notebook pages to look like glorified worksheets. We wanted to create notebook pages aligned with the science and engineering practices articulated in the Next Generation Science Standards, and with the intentions of the scientists at Smithsonian who designed the investigation.

b) Productive Talk

We expect our students to use science notebook entries as a point of reference during whole class discussions. We believe the class discussions are just as critical as the hands-on investigations.The classroom discussions provide our students with opportunities to express their misconceptions, practice their skills in argumentation using claims based on evidence, and eventually learn the targeted science content.

During our preliminary lesson, the whole class discussion after the stations did not go as expected. We wanted our students to make conceptual connections between the stations, and their experience creating the humming sound from the beginning of the lesson. We think we can facilitate the discussion for our students more efficiently by publicly highlighting their data from the three stations. We have attempted to structure our whiteboard to record students ideas strategically. We will display the progression of the lesson sequentially, and post student ideas about the evidence they recorded in their notebooks from each station. We believe if the students see the evidence they collected from each station organized on the whiteboard and situated within the context of the entire lesson, they will be able to communicate appropriate claims with greater ease as they engage in the whole class discussion.

8. Research and Kyozaikenkyu

In researching the topic of teaching about sound, the team began by looking at the Next Generation Science Standards, on which the unit is designed. We specifically looked at standard PS4.A:Wave Properties-Sound can make matter vibrate, and vibrating matter can make sound. To learn more about the topic, we read chapter 5 of Disciplinary Core Ideas: Reshaping Teaching and Learning, entitled "Core Idea PS4:Waves and their applications in Technologies for Information Transfer," by David Fortus and Joseph Krajcik. This selection highlights the importance of students' awareness and understanding of waves, because waves are virtually all around us at all times. They state, "Understanding wave properties and the interactions of electromagnetic radiation with matter is critical to the investigation of nature at all scales, including the invisible world of atoms and molecules and the faraway world of stars and galaxies. Wave properties and interactions of electromagnetic radiation with matter explain how

information can be transferred over long distances and stored as digital information." For the first grade unit "How Can We Send a Message Using Sound?," we require that students acquire the knowledge at its very infancy, simply that sound is created by vibration, and can be used to send messages, or communicate, with others.

When analyzing the unit, we quickly realized that the challenges of the third and fourth lessons are most crucial in developing the solid foundational knowledge of not only the aforementioned standard, but also in serving as a foundation for the NGSS Science Engineering Practices of developing and using models, carrying out investigations, constructing explanations, and engaging in argument from evidence. After delving further into these lessons (which are paired due to the nature of the activities and how they are structured) we decided that it would be impossible to teach one without the other, and decided to combine them for our lesson study process. We quickly realized that the challenges in this lesson would be threefold for our students. First, they would be introduced to a scientific claim, and required for the first time, to make one. Second, they would be asked to engage in exploratory activities, and record their scientific thinking and observations/evidence. Finally, they would be asked to analyze the evidence that they had collected, and use it to participate in discussion, and further support their initial claim. The latter of these two, seemed to us to be the most challenging for our students, based on their developmental level and the hindrances presented by their lack of prior knowledge, language development and motor skills, inexperience in science related dialogue, and conversational practices.

Based on our many years of collective experience teaching first grade students, we decided that we definitely needed to make some adaptations to the organization of the lesson and adjust some of the content, and further, we all agreed that the "science notebook" provided in the Smithsonian unit would need to be adapted to best encourage our students' success in these areas. The original plan of the lesson has the teacher introducing the the scientific practices of claims and evidence, as well as introducing the idea of cause and effect, all of which are unfamiliar concepts to many of our students. We decided that focusing on simply the idea of making a scientific claim and collecting the evidence to support, or refute a claim, should be the priority. Cause and effect could be addressed in a follow up discussion, or as a component of a later activity.

Upon examining the unit, we immediately realized that the science notebook pages provided as backline masters would be problematic for first grade students. They were designed as a half page booklet, which doesn't take into account the motor skills of a typical first grade student, and

the space required to adequately record an idea. Secondly, all of the recording places were designed with lines, with very few opportunities to draw or create simple diagrams to record observations and ideas. Prior to our test lesson, one informal lesson was taught to another class, with a modified notebook format for students, using a whole page design, and spaces for recording both pictures and words. Our test lesson used only enlarged versions of those provided in the Smithsonian manual. After comparing the two, it seemed that the modified version encouraged more diagram use and description, and that students could more readily recall their observations afterward. As learners of this age are also early in their language development, it provided a means for all students to record ideas, even if they weren't capable of doing so through written words that could be read later.

The final modification we made to the lesson, was to change the method of sharing and recording students' ideas during the concluding discussion. While we observed that many students had made great discoveries and observations, directly supporting the idea that movement creates sound, or that sound is created by vibrations, these discoveries and observations did not translate back to our whole group discussion. As these conversations are so key in further developing scientific concepts, comparing and contrasting observations, and supporting the initial claim, we chose to modify the 'board plan' for recording the final conversation, so that students could view their observations recorded by the teacher as they were sharing them, in a format that reflected observations made at each of the sound stations. This will ideally provide students with a visual tool to compare observations made at the different stations, and to see the common observation that movement is related to sound.

9. Unit Plan

Lesson	Learning goal and tasks
1	Students will define the problem of how to send a message long distance by playing the telephone game. Students will identify and sort objects people use to send messages short and long distances using a T-chart.
2	Students will develop a pattern of beats that solves the problem of sending a message a short distance. Students will test a pattern of beats to see how well it solves the problem by

	playing a board game.
Combination of 3 & 4	***Research Lesson:*** Students will ask questions about what causes sound. Students will do three station activities by carrying out an investigation to answer the question: What is needed to make sound? Students will complete their investigation to answer the question: What is needed to make sound? Students will argue from evidence that sound is caused by something vibrating.
5	Students will read a text on a musical instrument and use evidence to answer the question: How is music made? Students will make a claim that music is caused by parts of an instrument vibrating.
6	Students will plan and carry out an investigation to test different kazoo parts. Students will identify the parts of a kazoo. Students will argue from evidence for which kazoo parts make the best kazoo sound.
7	Students will plan and carry out an investigation to answer the question: Does sound cause vibration?
8	Students will read a text on human ears and use evidence to answer the question: How do our ears hear sounds? Students will construct an explanation for what causes us to hear sounds?
9	Students will ask questions about what parts of a banjo are needed to make the banjo's sound. Students will identify the components they need to make a banjo by reviewing pictures of different banjos. Students will argue from evidence for which banjo parts make the best banjo sound.
10	Students will design a pattern of sounds that solves the problem of sending a

	message a short distance that will help Hopper the frog cross the river without being seen by Brian the beaver. Students will test a pattern of sounds to see how well it solves a problem.

10. Design of the Unit and Lesson

a. The Science

The unit was designed to provide our students with the opportunity to work both as scientists and as engineers. The emphasis of the unit is on students solving problems using engineering design. Scientists and engineers have a variety of similarities and at the same time critical differences. Science begins with a question about the natural world. Scientists seek to explain natural phenomenon using evidence. Engineering starts with a problem people need to solve. Engineers work to design solutions to the issues targeted. The unit was designed to provide our students with the opportunity to work both as scientists and as engineers with an emphasis on engineering design.

In this unit, students learn about ways people send messages short and long distances. They experience patterns of sound that can be used to send messages. Students learn that vibration causes music and that we hear due to the way sound causes our eardrums to vibrate. The unit concludes with students designing instruments, and then use their instruments to solve an engineering problem. They experience the idea that different solutions need to be tested to see which solution is best to solve the problem.

With Smithsonian ideas and materials as our foundation, we designed our research lesson to offer our students the opportunity to think and act like scientists. The information they learn in this lesson builds content knowledge about sound. This information will help them solve the engineering challenges offered to them later in the unit. This lesson provides the students with three objects (ruler, loom, and tuning fork) for them to manipulate. Students will experience the interplay between vibrating objects and sound.

b. Cognitive Demand

The Smithsonian constructed this unit for students to build knowledge about sound gradually. The progressive design of the unit allows students to use what they have already learned to make sense of new information. Eventually, they should understand how the new information informs their work solving novel engineering design problems or investigating science phenomenon. As

students are introduced to novel problems and required to solve the problems collectively in small groups, they have the opportunity to experience productive struggle. Productive struggle using a developmentally appropriate task designed within this lesson is cognitively demanding.

c. Equitable Access to Content

The structure of this lesson has been designed to maximize the active engagement of all students. The class is presented with the same objects to investigate to provide a shared experience. We offered all students small group work time to think deeply about the problem with a peer and to write down their ideas in their science notebooks. Partner and table discussions allow for all students to listen to their friend's scientific ideas, and express their thoughts to justify their scientific reasoning. The lesson progresses to a whole group discussion, which allows our first-graders the chance to learn how their ideas relate to their classmate's ideas. In this way, students have the opportunity to engage in argumentation using evidence to support their claims. Additionally, we hope to observe if our students are becoming cognizant of how their ideas fit into the targeted concepts associated with the goals in this lesson.

d. Agency, Authority and Identity

In designing this lesson, the team was careful to consider the agency of our students. That is, we wanted to offer our students the opportunity to think independently, to be free to manipulate the objects in the lesson as they see fit. The teacher will provide strategic advice through facial expressions, body language, and if needed, verbal directions if their productive struggle leads to abject frustration. Still, we welcome some struggle, some failing forward as an intellectual and character building exercise. The notebooks provide limited direction through the pictures. There will be some verbal directions as well; yet, we are confident the lesson design is developmentally appropriate for our first graders. The teacher's role shifts from showing students how to solve problems and giving them scientific answers up front, to asking questions and facilitating student investigations. We want to empower our students with authority to make decisions as they manipulate the materials, and express their knowledge or misconceptions in discussions to deepen their conceptual knowledge about sound.

e. Uses of Assessment

The use of student notebooks as the central artifact in the lesson provides an opportunity for ongoing formative assessment. Students are recording their thoughts, feelings, and science reasoning in their notebook using sketches and words. In this lesson format, teachers are continually checking student work, because student ideas and reactions to the activities implicate

how we move forward, how we construct our next lessons. We agree with our colleagues in Japan who believe, " Student misconceptions are treasures." We intend on analyzing student responses in this lesson both written and verbal to guide our decisions for next steps in the unit. We will not include any form of summative assessment in this research lesson.

11. Research lesson plan

Steps, Learning Activities Teacher's Questions and Expected Student Reactions	**Teacher Support**	**Assessment**
1. Introduction Conduct discussion about sound from previous lessons. -What caused the sound in the drum (Zoo Game)? -Think of an everyday sound. -How do we make sound/What makes the sound? Demonstrate touching throat and humming. Ask kids to do the same, and think about what they notice. -What did you feel when you hummed? -What do you think caused the humming sound? 3) Introduce activity. "Today you're going to be scientists. You will collect evidence—The things scientists observe when they're conducting an experiment.—"Today you will be collecting evidence to answer the question, "WHAT IS NEEDED TO MAKE SOUND?"	Students hum and make observations. Students speculate about what makes sound. They connect this to observations about what makes noise when we hum. Students speculate what causes humming	Are students able to make a claim?

4) Pose question: What evidence do we have so far about what is needed to make sound? -What causes sound when we hum? RECORD: I feel something moving/tingling/vibrating when I hum." 5) Tell students that you're going to introduce another word scientists use: claim. A claim is something scientists say to answer a question. -What causes sound when we hum? RECORD: Humming is caused by something moving. -Whether they agree with this claim and explain why, or why not.	Students agree or disagree with claim.	
2. Posing the Task Introduce "Sound Journey". Explain that students are going on a 'sound journey' to collect more evidence to answer the question, "What is needed to make sound?"—You will use your evidence to improve your claim. Explain that there will be 3 sound stations, and students will be divided among them. Read the instructions for each sound stop and model. Ask students if they have any questions. Briefly outline the notebook pages for each activity.	In explaining the sound stop stations, it is important that the teacher makes clear the proper technique for using the materials for the explorations, and also briefly highlight and review the methods they may use for recording their observations.	Are students recording their observations in ways that they will be able to read and use

Ask students the following guiding questions: -What will you write in the different boxes on the notebook sheet? -What senses will you use to make observations? -How will you show sound? -How will you show something moving? Give students 5-7 minutes to carry out the activity and record at each station, then ask them to rotate to the next. Rotate among the groups and ask: -Do you have any more evidence to answer the lesson question yet?	Students conduct activities at each Sound Stop, as modeled and described for them.	later for the discussion? Are they using diagrams, words or both?
3. Anticipated Recording Results Students may draw pictures, write observations with words, or both. Ideally, they will draw diagrams in a way that they can later understand their observations and share them with others.		
4. Comparing and Discussing Bring the class back together in the common seating area.. Use the following guiding questions to facilitate a discussion about observations/evidence: -What happened at the first sound stop when you pushed the ruler? What did	In facilitation the discussion, it is important that the teacher record student observations as well, reflecting both written notes and diagrams.	In facilitation the discussion, it is important that the teacher record student observations as well, reflecting both written notes and diagrams.

you observe? -What happened at the second sound stop when you plucked the elastic bands? What did you observe? -What happened at the third sound stop when you tapped the tuning fork? -What happened when you touched the tuning fork to your hand? -What happened when you put the tuning fork into the water?	If the term has not yet been suggested by students, introduce the term vibration, and briefly describe what it is. Have students demonstrate it with their finger or hand.	
4. Summing up Tell students that we are going to review their original claim and see if they can make a better one that answers the question: What is needed to make sound?	Tell students that scientists always do the following when they make/evaluate/discuss a claim: ● Listen quietly to other people ● Ask questions politely and respectfully ● Speak loudly and clearly ● Always use evidence Explain that it is OKAY for scientists to disagree about a claim, so long as they are respectful to one another's ideas, and can use evidence to support their position.	
5. Reflection		

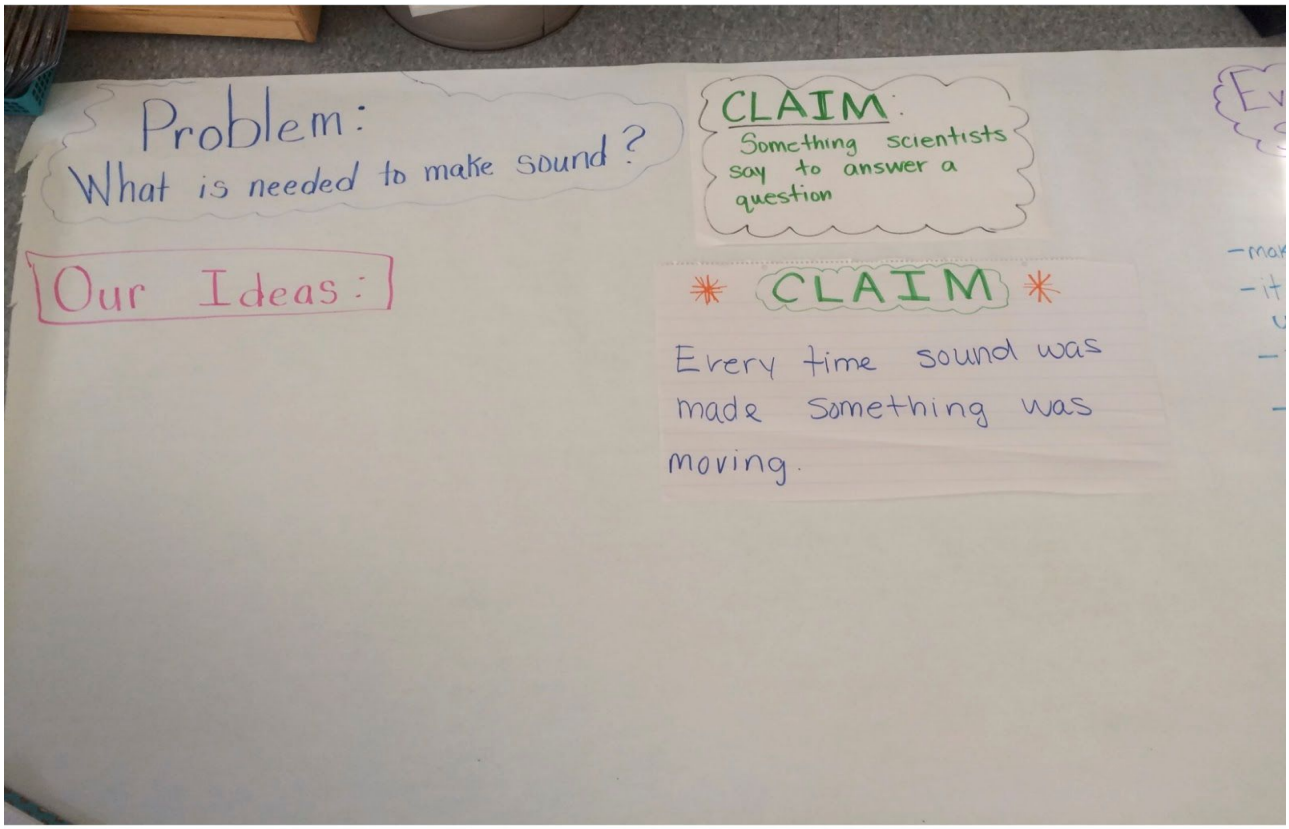
Ask for a volunteer to share a claim about what they think is needed to make sound. Use these sentence frames for dialogue: -I think sound is caused by _____ because _____. -I agree/disagree with the claim _____ because _____. Once the many students have had the opportunity to share, write the final claim on chart paper. - i.e. “Sound is caused by something vibrating.”		

12. Evaluation

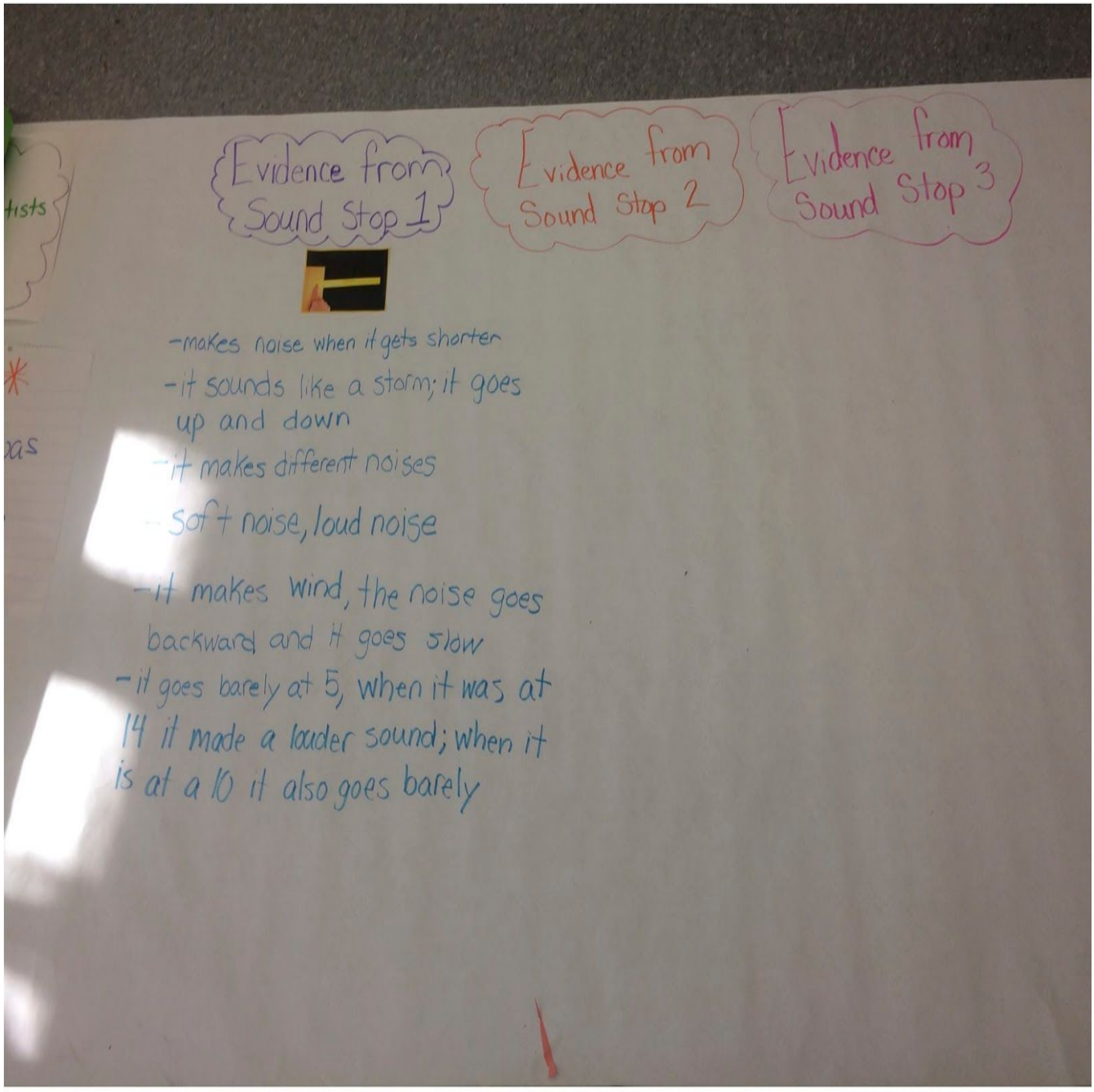
- Do the students utilize their scientific notebooks to record their thought process during their science experiments?
- Does the research lesson design encourage students to justify their ideas using scientific evidence to support their claims?

13. Board Plan (With anticipated responses)

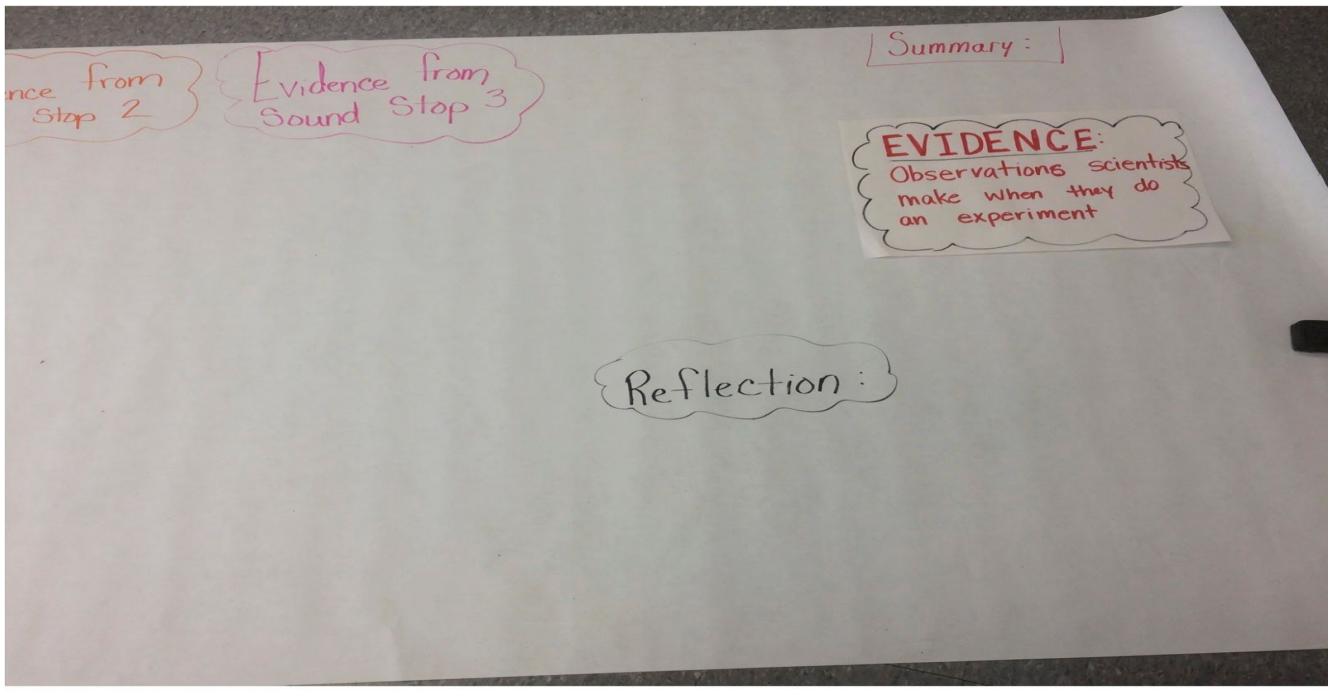
Section # 1


Problem:
What is needed to make sound?
CLAIM
Something scientists say to answer a question
Our Ideas:
CLAIM
Erery time sound was made Something was moving.

Section # 2



Section # 3


nce from
Stop 2
Evidence from
Sound Stop 3
Summary:
EVIDENCE:
Observations scientists make when they do an experiment
Reflection: