HOW THE AMPLIFY SCIENCE CURRICULUM IMPACTS 4TH GRADE

STUDENTS AND THE TEACHER

by

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ABSTRACT

In this study, 4th graders at Benjamin Franklin Elementary in Kirkland, WA, were taught science using the newly adopted NGSS-aligned curriculum, Amplify. Throughout the Amplify Earth's Features unit, the author tracked student growth in the Science and Engineering Practice: engaging in arguments from evidence, measured student emotional and behavioral engagement, and measured student curiosity. Student pre-assessments and post-assessments, student surveys, short answer questions, teacher reflections, and video observed lessons were used to analyze the effects of the Amplify curriculum on students. While results suggest that insufficient opportunities for practice limited student growth, they also indicate that most students are both emotionally and behaviorally engaged. The study also found that while the Earth's Features unit fostered curiosity in the middle of the unit, students were less curious about the topics at the end of the unit.1

INTRODUCTION AND BACKGROUND

Purpose of Study

In the fall of 2019, The Lake Washington School District (LWSD) adopted the Next Generation Science Standards in all elementary schools. To meet this 2019 NGSS adoption goal, the LWSD adopted a new NGSS-aligned elementary science curriculum, Amplify. From 2004 to the spring of 2019, students were learning science with the FOSS science curriculum kits, which were not aligned to NGSS.

The Amplify curriculum was chosen by the LWSD Elementary Science Curriculum Adoption Team in June 2019. The Amplify curriculum is aligned to all three components of NGSS, and elementary teachers have been expected to teach this curriculum to the best of their ability since September 2019. Adopting the NGSS standards, along with the Amplify curriculum, was a massive change for LWSD elementary teachers and students.

My school district has been committed to fully implementing NGSS at the elementary level since September 2019. However, the LWSD also realizes that this change will take time, up to ten years, for the entire district to have full implementation. Teaching science with a NGSS-aligned curriculum involves different instructional methodologies and materials than those used before the adoption of the Amplify curriculum.

Beginning in September 2019, I began teaching fourth-grade students all components of NGSS using Amplify. Knowing that the LWSD would be using Amplify for at least the next ten years and that moving to an NGSS-aligned curriculum would be an adjustment, I wanted to learn the impact of the Amplify curriculum on both teachers

and students so that I could find ways to utilize it most effectively. I wanted to carefully observe and analyze what happened when I taught with Amplify so that I could find the best ways to teach with it and use its resources in the years to come. Therefore, my action research was a descriptive study focused on analyzing the impacts of the Amplify curriculum on both myself and my 4th-grade students.

In order to do this, my action research project measured what happened to student growth, engagement, and curiosity as I taught with the Amplify curriculum and materials. While observing and analyzing how the Amplify curriculum affected students in these three areas, I also evaluated how the curriculum impacted me as a teacher. I plan to use my findings to inform my teaching with Amplify in the years to come.

Significance of Issue

Understanding how the Amplify curriculum impacts student growth, engagement, curiosity and teachers is critical for effectively adopting Amplify in the years to come. Such information will allow me to reflect on possible modifications to the curriculum, which will help maximize student learning. This information will be pertinent to me and relevant to other elementary teachers in the LWSD who are teaching with Amplify. What I learn will inform both myself and teachers about how to utilize the curriculum best to promote student growth, what components of the curriculum are most engaging, and about how the curriculum is promoting curiosity about science. When teachers see how Amplify is impacting students in these areas, they can use this information to inform their teaching and maximize student learning.

Research Questions

In this action research project, my focus question was: How does the Amplify science curriculum impact students and the teacher?

Sub-questions included the following:

1. How does the Amplify curriculum impact student growth in the Science and Engineering Practice: engaging in arguments from evidence?

2. How does the Amplify curriculum impact student behavioral and emotional engagement?

3. How does the Amplify curriculum impact student curiosity?

4. How does the Amplify curriculum impact the teacher?

CONCEPTUAL FRAMEWORK

<u>Theoretical Framework</u>

This action research study is centered around how an NGSS-aligned curriculum impacts students, so it is crucial to understand the guiding principles behind NGSS. There are several guiding principles behind the theoretical framework of NGSS, and all are drawn from what is known about both the nature of learning science (A Framework for K-12 Science Education, 2012). These guiding principles culminate in the creation of the three domains of NGSS; the disciplinary core ideas (DCIs), cross cutting concepts (CCCs), and science and engineering practices (SEPs).

The National Research Council understood that the totality of science learning is not made up of a list of facts. So, the National Research Council created a framework for science education that brings coherence into science education using three key components, which are all behind the framework of NGSS. The first way the framework brings coherence to science education is,

> It is built on the notion of learning as a developmental progression. It is designed to help children continually build on and revise their knowledge and abilities, starting from their curiosity about what they see around them and their initial conceptions about how the world works (National Research Council, 2012, p. 11).

In Amplify, each unit begins with a phenomenon that is intended to spark their curiosity. At the beginning of each unit, students share their initial conceptions about how the phenomena works. Then, throughout the unit, as students gather more evidence, they build on and revise their knowledge of the phenomena. Clearly, the Amplify curriculum is designed around the notion of learning as a developmental progression.

Next, the Framework consciously limited the number of core ideas both within and across science and engineering disciplines. The purpose of this design was to avoid teaching concepts in a way that was "a mile wide, and an inch deep." Containing the core ideas allows more time for both teachers and students to explore the concepts in greater depth (National Research Council, 2012, p. 11). Again, this limits the long lists of facts that standards have had in the past, to help increase deep student understanding of the concepts. In line with this, each unit in the Amplify curriculum only contains one or two core ideas. This allows students to explore the concepts deeply, which increases student understanding of the concepts.

Finally, the Framework of NGSS,

Emphasizes that learning about science and engineering involves integration of the knowledge of scientific explanations (i.e., content knowledge) and the practices needed to engage in scientific inquiry and engineering design (National Research Council, 2012, p. 11).

The Framework is built upon the fact that students not only need to know engineering and science concepts but that to learn such concepts, they must integrate this knowledge with the practices. The Amplify curriculum adheres to this idea. In each unit, students engage in learning multiple SEPs and CCCs. Students are asked to engage in the SEPs and CCCs so that they can better understand the DCI. The SEPs and CCCs are woven in throughout the units and are taught as tools to help students access content knowledge.

In this project, I analyzed the effects of a curriculum founded upon these key ideas from the NGSS Framework. This led to see how the theoretical framework of the standards affects student growth, engagement, and curiosity in the Amplify curriculum.

Direction for the Work

This action research study is centered around three areas; each is central to the effects of NGSS science curriculum design on students. The first area of research concerns the measurement of student growth on the Science and Engineering Practice: engaging in arguments from evidence. The second area concerns student behavioral and emotional engagement, while the third concerns student curiosity.

The literature suggests a NGSS-aligned unit increases student achievement and engagement. Holthuis, Deutscher, Schultz, and Jamshidi (2018) created a project-based, NGSS aligned sixth-grade science curriculum. This curriculum is similar to Amplify in that both curriculums give students a variety of ways to access information and demonstrate understanding, including: designing and conducting investigations, engaging in whole-class discussions, developing explanations and models, reading text, and conducting research (Holthuis et al., 2018). Both curriculums also have students engage in structured group work. Like the 6th grade NGSS-aligned curriculum, Amplify also assigns student roles to promote active learning and equitable rates of participation in groups, has some activities that are open-ended and productively "uncertain," and shifts instruction so that teachers act more as facilitators (Holthuis et al., 2018). Finally, both curriculums have learning tasks that are directly related to the phenomena (Holthuis et al. 2018).

In their research, Holthuis et al. (2018) specifically studied student engagement and learning outcomes with this NGSS curriculum compared to a traditional curriculum. For the study, Holthuis et al. had sixth-grade science teachers at various schools and districts involved as either participating teachers that taught the NGSS-aligned course, or

non-participating teachers who implemented their regular curriculum (Holthuis et al., 2018, p. 26). This study found that over a three-year period of using an NGSS aligned curriculum, there were gains in both student engagement and learning outcomes compared to a traditional curriculum.

In their study, Holthuis et al. (2018) used surveys, observations, and interviews to measure engagement. These measures showed that students participating in the new curriculum were more engaged than those in the regular curriculum. Specifically, they saw high academic and behavioral engagement. For instance, the students using this curriculum showed evidence of, "manipulating materials, talking about their tasks with peers, doing projects, and making presentations" (Holthuis et al., 2018, p. 26), when engaging in group work. Also, in the student survey students learning from the NGSS aligned curriculum, "reported that their classroom assignments were more interesting, challenging and enjoyable" (Holthuis et al., 2018, p.26). This indicated the students learning with the new curriculum were more emotionally engaged than then those learning without.

In addition to tracking engagement, Holthuis et al. (2018) also measured learning outcomes. To do this, they compared student achievement in the participating and non-participating classrooms. They found that the participating students did better on the Smarter Balanced Assessment Consortium tests in math and English language arts than the non-participating students. Also, participating English Learners (ELs) performed better on the California English Language Development Test than non-participating ELs. Finally, participating students also scored better on the pre- and post- assessment

designed to measure content knowledge and levels of engagement with the science practices (Holthuis et al., 2018, pp. 26-27).

The work of Holthuis et al. (2018) indicates that NGSS-aligned curriculums can increase student achievement and engagement. While Amplify is not a problem-based learning curriculum, it does have many similar components to this NGSS-aligned curriculum. For instance, Holthuis et al. noticed that students were more interactive in group work with the new curriculum compared to the old. Both the sixth-grade NGSS-aligned unit and Amplify have very structured group work routines, to engage all students. So, Amplify has the potential to positively impact student behavioral engagement during group work.

Also, as stated above, Amplify has some other key components in common with the NGSS-Aligned unit in Holthuis et al. (2018). Amplify has a phenomena-based approach where students investigate real world science problems. Students learn about the phenomena in a variety of modalities and have many ways to demonstrate understanding. Holthuis et al. (2018) found that all the aspects together helped students engage more and learn more. While I can not expect similar results in that respect, my descriptive study will show me what about the curriculum engages students and what about the curriculum promotes growth. I may find that some of these parts influence growth and engagement more than others.

While this action research study is centered around student growth and engagement, it also measures how the Amplify curriculum fosters curiosity. In my action research project, I define curiosity as "the desire to learn more," which is different from interest. I define interest as, "something that gives you pleasure to learn about." Meaning,

one could be interested in something, but not be curious enough to want to learn more about it. Luce and Hui (2012) wanted "to seek to understand more about students' science-relevant curiosity, and how they express it, and how their 'expressions of curiosity' may relate to their interest in science learning" (Luce & Hui, 2012, p. 71). Luce and Hsi (2014) argue, "an under-explored and perhaps productive way to gauge and foster interest in science is to understand the ways in which students express curiosity about the nature of an object, phenomena, or a given topic" (Luce & Hsi, 2014, abstract). Luce and Hsi claim that it is more beneficial to measure student curiosity in science rather than student interest in a given science topic. They argue that measuring curiosity can provide another layer of insight into a child's interest in science.

> For example, knowing that a child has an interest in turtles is less informative for a teacher or parent in selecting supplemental science learning resources than is understanding the kinds of sense making that children engage in when wondering about turtles (e.g., How do their shells get bigger? I wonder why they have shells. I wonder if turtles get lonely. What would happen if the shell cracked?) (Luce and Hsi, 2014, p. 72).

When the learner tells us what they wonder about the turtle, we can see what precisely they are interested in and how they are engaged in the scientific practices (Luce and Hsi, 2014, p. 72). Luce and Hsi (2014) acknowledge that the literature does not present a clear distinction between curiosity and interest. Therefore, they define curiosity as "wonderment or intrigue about the kinds of investigation and explanation science seeks" (Luce & Hsi, 2014, p. 72). They "[choose] to refer to and frame both students' questions and statements of wonderment as 'expressions of curiosity'" (Luce and Hsi, 2014, p. 71). Examining student curiosity connects well with the scientific practices of NGSS. Luce and Hsi finally claim, "following up on one's curiosities through desiring to 'find out

more,'…[is] central in authentic science practice" (2014, p. 92), which means that students having curiosity and exploring their curiosity are both necessary to be successful in the scientific practices of NGSS. Before students can desire to follow up on their curiosities, they must have curiosities in the first place. Observing and analyzing how students are curious in this study is the first step to learning if Amplify is developing curiosity in a way that makes students more successful in the NGSS standards than other teaching methods.

This examination of the literature reveals that NGSS aligned curriculum can increase student achievement and engagement, while curiosity is necessary for success in the science practices.

Methodology Literature

Finally, I reviewed the literature to find the most valid and reliable ways of measuring student growth, engagement, and curiosity.

First, I found that pre-test and post-test were valid and reliable ways to measure student growth. For instance, to measure student growth Cobern et al. (2010) used a pre-test and a post-test as their primary measuring instrument. Their test contained 24 conceptual multiple-choice questions. These questions called upon students to apply the concepts in a new situation, rather than recalling factual knowledge (Cobern et al., 2010). Each question had four choices. Validity was determined by field-testing the assessment. Data was measured and analyzed using standard descriptive statistics, and then normalized gains were analyzed to show student growth. The results were compared to other data to find the statistical significance, using a t-test. However, this data only showed Cobern et al. that improvements were made, not why they were made.

Todd Lawrence Sammet (2008) also used this method for collecting data on student achievement. Sammet used this data to answer the following question: What is the impact of NGSS-aligned revisions on student learning, as measured by application of the science and engineering practices? Sammet found, "learning occurred in both the treatment and non-treatment units, with slightly more learning demonstrated in the treatment units" (Sammet, 2008, p. 23). However, when he analyzed the results using a t-test he had a p-value of 0.3163, so his results were not statistically significant. Like Cobern (2010) and Sammet, I found and measured student growth in a similar way. I used both a pre-test, a post-test, and used standard descriptive statistics to measure student growth.

An additional method of measuring student growth would be by looking at student scores on state assessments. Holthuis et al. (2018) measured student achievement by comparing the Smarter Balanced Assessment (SBA) tests in math and English Language Arts of those who learned via the NGSS aligned curriculum compared to those who learned using traditional methods. Their study found that the students who learned with the NGSS aligned unit had higher scores on both the math and ELA SBA. While I believe such data would have been valuable for the project, I did not use SBA data. This is because the data was not available until the fall of 2020, which was far after my project was completed.

Not only did my project measure student growth throughout the Amplify unit, but it also analyzed student engagement. Fredricks et al. (2011) summarized the characteristics of instruments that measure student engagement in upper elementary through high school. They identified and analyzed 21 different student engagement

instruments, and analyzed the dimensions of engagement. One engagement instrument that Fredricks et al. 2011 identified as effective was "engagement versus disaffection with learning scale (EvsD)" (Fredricks et al., 2011, p. 29). This instrument was developed by Dr. James P. Connell and his colleagues at the University of Rochester. Dr. Ellen Skinner at Portland State University has the most updated version of the engagement scale, found appendixes A and B of Skinner, Kindermann, and Furrer (2009). This engagement scale has been used on 1,018 students in grades 3-6 in both suburban and rural schools. Items have also been used with samples of white and low-income racial/ethnic minority elementary, middle, and high school students in urban and suburban districts (Fredricks et al., 2011, p. 28, Table A4).

To measure engagement, both the students and the teacher take a report survey. To administer the student self-report survey, students are given the paper and pencil questionnaire that is typically completed in 20-30 minutes. On the student questionnaire, 24 sub-scales of engagement are measured. There are five items to measure behavioral engagement, five items to measure behavioral disaffection, five items to measure emotional engagement and nine items to measure emotional disaffection (Skinner, Kindermann, & Furrer, 2009, Appendix A). Scores are calculated on average in terms of each sub-scale. The student self-report uses responses from 1 (not true) to 4 (very true). Sub-scales can be used separately or combined. The teacher report uses the four same sub-scales, with four items in each sub-scale.

Skinner, Kindermann, and Furrer (2009) found this scale to be reliable. They found internal consistency with a sample of students in grades 3-6 who were surveyed on all four sub-scales. They also found an internal consistency for the teacher report sub-

scales. This was a consistent finding with two administrations of the scale in both the fall and the spring.

When determining validity of the engagement scale, Skinner, Kindermann, and Furrer (2009) used several measures. First, they confirmed that behavioral engagement, behavioral disaffection, emotional engagement, and emotional disaffection, otherwise known as the four-factor engagement model, was the best fit for data reporting. When analyzing the correlation of the sub-scales, they found that they each correlated as expected. Behavioral and emotional sub-scales correlated positively while engagement and disaffection sub-scales correlated negatively. While teacher surveys and student surveys only showed modest agreement, teacher data reporting did correlate with external observer data reporting. Skinner, Kindermann, and Furrer (2008) also found evidence of expected grade engagement patterns. Elementary students were reported as more engaged than middle school and high school students. Together, this data indicated the validity of their data using this survey.

Other studies have used surveys to measure student engagement with much success. For example, Holthuis et al. (2018) also used surveys to measure student engagement. Both Skinner, Kindermann, and Furrer (2009) and Holthuis et al. (2018) show that scales and surveys are effective measures of student engagement. Therefore, I used Skinner's (2009) Engagement Versus Disaffection with Learning Scale as one measure of student engagement. Due to the consistent findings, I measured student engagement by only using the behavioral engagement and emotional engagement subscale survey questions. I did not use the behavioral disaffection and student disaffection questions, because Skinner, Kindermann, and Furrer (2009) found these

results to negatively correlate with the behavioral and emotional disaffection subscales.

Additionally, while the disaffection subscales would have provided me with some

additional insight to student engagement (because they did not negatively correlate

perfectly), many of my fourth graders struggled to understand the language of these

subscales when I trialed the subscale on them. So, I decided that the students confusion

was more likely to create less reliable data, than add insight to the behavioral and

emotional engagement subscale survey results. My EvsD Scale can be found in Appendix

A.

I did not use the teacher survey to measure data. This survey required the teacher

to complete this survey for every student, and this was not an efficient way to collect data

on student engagement from the teacher perspective. So, I choose to use an alternative

method to measure student engagement, an Off-Task Behavior Tally Chart.

When measuring student engagement, Crider also used a teacher survey. To

measure engagement, Crider first created an engagement tally chart to track off-task

behaviors that indicated the students were not engaged in the lesson. This chart was used

by the teacher or an outside observer to measure the amount of off-task behaviors, which

negatively correlated with engagement. To put this tally chart to use, Crider had his

principal observe four lessons and track off-task behaviors with this chart, and he also

used it to personally observe and tally the eight lessons he videotaped.

Along with assessing student engagement with the Engagement Versus

Disaffection with Learning Scale, I also created an Off-Task Behavior Tally Chart like

Crider's, to measure engagement in terms of the amount of off-task behavior (Appendix

B). I used this behavior tally sheet to measure engagement. Together, all engagement data sets gave me a full picture of how the Amplify curriculum effects student engagement.

The last area that this project observed and analyzed throughout the Amplify unit is student curiosity. While Crider measured student interest rather than curiosity in his project, I found his methods for measuring interest to be useful when measuring curiosity. To measure interest, Crider (2013), created an Attitude Scale and conducted student interviews to collect data on student interest. He gave students this Attitude Scale at the end of each unit and then compared the Attitude Scales to see which teaching style the students preferred. Students also completed a student survey at the end of the two units. The results were compared between both classes to find the preferred teaching style. He found that students showed higher interest when taught using the 5E model.

My study similarly measured student curiosity. I used a Curiosity Likert Scale (Appendix C), which was like Crider's (2013) attitude scale. I also used the Curiosity Short Answer Questions (Appendix D), which were similar to Crider's student survey. Having multiple data points help to support the reliability of the data.

While surveys are important, it was necessary to think critically about the types of questions to ask students to elicit valid curiosity data. In my action research study, like Luce and Hsi (2014), I defined curiosity as students' questions or statements of wonderment. From this definition, I created my Curiosity Likert Scale Questions (Appendix C) Curiosity Short Answer Questions (Appendix D), for measuring student curiosity. I asked students what questions they had and what they wondered during our Earth's Features unit.

In a different study, Ainley and Ainley (2011) found that a student's desire to learn more (or curiosity) was positively correlated with a student's interest in science. So, in my Curiosity Likert Scale Questions (Appendix C) and my Curiosity Short Answer Questions (Appendix D), I also asked students what they wanted to learn more about. I included questions such as, "What else do you want to learn about ___." If students said they wanted to learn more about a topic, I considered that to be an additional indicator of curiosity. A lack of desire to know more about the topic indicated less curiosity.

Reviewing the methodology literature on the project topic gave me both valid and reliable methods of collecting data on student growth, engagement, and curiosity.

METHODOLOGY

Demographics

For this project, I researched 4th-grade students at Benjamin Franklin Elementary in Kirkland, Washington. Benjamin Franklin Elementary consisted of approximately 486 students during the 2019-2020 school year, the period of research. During this time, Benjamin Franklin Elementary had 7.4% free and reduced lunch recipients and was 52.3% white, 29.4% Asian, 9.3% Hispanic, 0.8% African American and 8.2% two or more races.

During the research period, I taught two separate fourth grade classes science at Benjamin Franklin Elementary. I taught both my homeroom class of 22 students and my teammate's class of 24 students science. This gave me a sample size of 46 students. Specific student demographic information can be found in Appendix E.

My homeroom class of 22 students had twelve boys and 10 girls. The majority of the EL (English Learner) students were clustered into my class, so my class had a high proportion of EL students. I had four EL students that scored a level 2 on the WELPA (Washington English Language Proficiency Assessment) reading and writing assessment and one EL student that has scored a level 3. My class also contained six exited EL students. So 11 out of 22 of my students were EL students. My class had two emotional/social IEP students. I also had one student with a 504, for trouble focusing (with no diagnosis). Two other students in the class also had extreme difficulty focusing, but no diagnosis. I had two gifted students that were pulled out one day a week for services. One student in my class receives free and reduced lunch. A class list of these

students with demographic descriptions can be found in Appendix E, my students are the students numbered student 1-22.

My second science section, Lori O'Brien class, of 24 students had 15 boys and nine girls. Mrs. O'Brien's class had no IEP students. This class had two EL students that scored a level 2 in the WELPA reading and writing assessment, along with six exited EL students. So 8/23 students were EL students. Two students in Mrs. O'Brien's class had 504s. One 504 was for vision impairment, the other 504 was for attention. Mrs. O'Brien had two gifted students that were pulled out one day a week for services. Many students in her class struggled to pay attention, but had no diagnosis. Interestingly, unlike my class, nearly half of this class was experiencing at-home trauma. This trauma included, but not limited to: divorced or divorcing parents, hunger, living with non-parental family members, and lack of stable housing. Three of Mrs. O'Brien's students receive free or reduced lunch. A class list of these students with demographic descriptions can be found in Appendix E, Mrs. O'brien's students are the students numbered student 23-46.

Treatment

This classroom research was modeled after the action research design. Since the LWSD required all elementary teachers to teach only the newly adopted Amplify curriculum beginning in September 2019, I only taught Amplify for this project. I did not compare this curriculum to past, traditional teaching methods. So, this action research project was a descriptive study.

During the research period, November 4th, 2019- February 5th, 2020, I taught approximately two one hour Amplify lessons a week to each science class. I taught the lessons on Wednesdays and Thursdays. Some weeks students had an additional science

reading lesson by their homeroom teacher (Mrs. O'Brien, or me). These reading lessons happened throughout the Amplify units, and I usually taught the reading lessons during reading time rather than science time.

I followed the Amplify curriculum with fidelity. This means that I did not add any additional lessons or activities of my own. I taught every lesson in the curriculum and followed each lesson as the curriculum stated. I used all activities, assessments, and materials provided by the Amplify curriculum. The format of a typical Amplify lesson is explained in Appendix F.

I collected data on the Earth's Feature's unit from November 4th, 2019 to February 5th, 2020. This unit had 22 lessons. The focus of the Earth Features unit was on fossil, rock, and landform formation. The anchor phenomena for the unit was the following: How do rocks and fossils tell us about how the earth changes over time? Throughout the unit, students learned about fossil formation, rock formation, landform formation, and how these all tell how the earth changes over time. The LWSD expectation was that elementary teachers teach as much of each unit as they can without skipping lessons, so I followed this expectation. I taught all lessons in the unit.

<center>Data Collection Methods</center>

To answer the research question: How does the Amplify science curriculum impact students and teachers, data were collected on student growth in the science and engineering practices, student emotional and behavioral engagement, and student curiosity over the course of the unit. Data was also collected on the impact on the teacher. A summary of the data collection methods used to answer each sub question is shown in the matrix in Table 1.

Table 1. *Data Collection Methods Matrix*

DATA COLLECTION MATRIX	RESEARCH QUESTIONS				
	Main Topic How does the new NGSS aligned curriculum impact students and teachers?	Sub-question #1 How does the Amplify curriculum impact student growth on all three components of NGSS?	Sub-question #2 How does the Amplify curriculum impact student behavioral and emotional engagement?	Sub-question #3 How does the Amplify curriculum impact student curiosity?	Sub-Question #4 How does the Amplify curriculum impact the teacher?
DATA COLLECTION METHODOLOGIES					
Pre-Unit, Mid-Unit and Post-Unit Assessment	x	x			x
Amplify's "On the Fly" Assessments	x	x			
EvsD Scale	x		x		x
Off-Task Behavior Tally Chart	x		x		x
Emotional Engagement Short Answer Questions			x		
Curiosity Short Answer Questions	x			x	x
Curiosity Likert Scale	x			x	

Field Notes	x	x	x	x	x

Student Growth Data Overview

When deciding what area of student growth to measure, I knew that the LWSD agreed that during the first year of Amplify implementation teachers would only use assessments on the science and engineering practices for report card grades. I also knew that the Earth Feature's Unit only assessed students on the science and engineering practice: Engaging in Argument from Evidence. So, I exclusively collected student growth data on this science and engineering practice. Student growth was defined as how many standard based grade levels students improved from the pre-assessment to the post-assessment.

The unit pre-test, mid-unit test, and post-test told me how students grew in the science and engineering practices throughout the unit. However, the pre-and post-assessments only captured student understanding at two different moments in time, so I used formative assessments as additional data to monitor student growth.

Student Growth Data. During the unit, I administered the pre-test, mid-unit test, and post-test from the Amplify curriculum to measure student growth. The pre-test, mid-test, and post-test were not identical tests; this is because the Amplify curriculum does not give identical assessments. Each test asked the student to write an argument on evidence from a different topic. Still, all tests measured a student's ability to engage in arguments with evidence and used the same scaffolds to help them write their arguments.

Amplify's pre-assessment (to be given during the first lesson of the Amplify Unit) did not assess the practice: Engaging in Argument from Evidence. So, I used Amplify's

lesson 2.6 crucial juncture assessment as a pre-assessment for Engaging in Argument

from Evidence (Appendix G). I gave this during lesson 2.6, and not at the beginning of

the unit. So, Assessment 2.6 will be referred to as the pre-assessment.

The pre-assessment (Appendix G) asked students to write an argument about what

the environment in Desert Rocks National Park was like when the upper layer of rock

formed. Amplify broke the Earth's Features post-assessment into two parts. I gave part

one in Chapter 3 of the unit, and I gave part two in Chapter 4 of the unit. The Chapter 3

lesson 5 assessment asked students to write an argument about what the environment was

like when a given layer of rock was formed (Appendix H). I used this assessment as the

mid-unit assessment. The Chapter 4 lesson 5 assessment asked students to write an

argument about why more rock layers got exposed in one canyon over another (Appendix

J). I used this assessment as the post-assessment. All assessments measured the students'

ability to engage in argument from evidence, which allowed me to monitor growth in this

SEP.

I graded each assessment with the LWSD's required Engaging in Argument from

Evidence rubric (Appendix I). Students were given standards-based grades (1, 1.5, 2, 2.5,

3, 3.5, 4). The highest achievable grade was 3.5; this is because Amplify gave students

sentence frame scaffolds to help them write their arguments, so a 4 was not a possibility

according to the rubric.

The Amplify unit had one "On the Fly" assessment (a formative assessment) that

assessed engaging in arguments from evidence in Chapter 3, lesson 3. In this lesson, I

used the student discussions as an additional way to track growth. Additionally, I used

other student discussions throughout the unit as more formative assessments for growth.

To analyze student growth data, I compared pre-assessment test scores to the mid-unit assessment and post-assessment scores. I compared the data using histograms and box-whisker plots from each assessment. The means of the data sets were compared, along with the data ranges, standard deviations, and shape of the histograms. Then, I carefully analyzed student responses for patterns. I coded student responses in each data set, and I compared these patterns in student answers. This allowed me to see smaller areas of growth. It let me examine how students grew in writing claims, using data, explaining data, and organizing their arguments.

<u>Engagement Data Overview</u>

For this project, I defined engagement in two ways, the first was behavioral engagement, or the amount of time students spend on-task, and the second was emotional engagement, or student attitudes, in science.

I measured behavioral engagement using the EvsD Scale (Appendix A) and the Off-Task Behavior Tally Chart (Appendix B). Both of these instruments informed me of the amount of time students spent on task while learning with Amplify. While the EvsD scale had students self-report their perceived on-task behaviors, the Off-Task Behavior Tally chart helped me measure the accuracy of the student self-reports. This data told me if students appeared to be as engaged in the lessons as they thought they were.

Emotional engagement was measured using the EvsD Scale, and the Emotional Engagement Short Answer Questions. Student emotional engagement is challenging to determine from observation alone, so students self-reporting their emotional engagement using the EvsD Scale was the most reliable way to see how students felt about science.

However, the EvsD scale alone was not enough to give a full picture of student emotional engagement. So, I asked the students to explain their reasons behind three of their answers on the Emotional Engagement Short Answer Questions (Appendix K). These explanations, along with the EvsD scale, allowed me to understand how students felt about science with Amplify.

I also took field notes throughout the study (Appendix L), and I used these field notes to add to the narrative of student engagement. The format of these field notes allowed me to record impressions of a lesson quickly, and to add notes about each research question.

EvsD Scale. The EvsD scale (Appendix A) was used to measure both behavioral engagement and emotional engagement. The EvsD Scale was made up of ten questions. The questions on the EvsD scale fell into the following categories: Behavioral Engagement, and Emotional Engagement. All students took the EvsD Scale. Students were given the EvsD scale at the middle and end of the Earth's Features Unit, so that I could track student engagement over the course of the unit.

The EvsD Scale was given to the students with Microsoft Forms. Each time the survey was given, I explained the difference between the Likert scale answers. To ensure that students understood the questions and answers accurately as possible, I read aloud each individual question one at a time, and waited for all students to respond and get clarification before moving on to the next question. During the survey students were not be permitted to talk or share their answers. If students were absent during the survey, they took it as soon as possible upon their return.

I used Microsoft Forms for preliminary data organization and analysis. Then, I imported all EvsD data into the statistical program R. Then, with R, I performed Chi-Square Goodness of Fit Tests, and G-Test for Goodness of Fit tests to thoroughly analyze the data. The procedures used for analyzing this data with R is explained in Appendix O.

Off-Task Behavior Tally Chart. The Off-Task Behavior Tally Chart (Appendix B) was used to measure only behavioral engagement. The Off-Task Behavior Tally Chart was a list of seven off-task behaviors. Each behavior on the list is a behavior that signified a student was off-task, or not behaviorally engaged. So, the Off-Task Behavior Tally Chart measured behavioral dis-engagement, and the results of the Off-Task Behavior Tally Chart negatively correlated with student engagement.

To use the Off-Task Behavior Tally Chart, I first video recorded four science lessons from the science unit. For two lessons, I filmed the full class discussion portion of the lessons. For another lesson, I shot a computer simulation activity. The last lesson I recorded was a portion of a reading lesson. I videoed different lesson activities so that I could see how the various activities engaged students. I choose to video two discussion portions because every lesson has at least one discussion, so I wanted to capture more than one discussion in my data set. I only filmed a ten-minute part of each lesson; this is because ten minutes is the average amount of time a full class discussion or activity takes during an Amplify lesson. So, using the time limits allowed me to compare all lessons with the same parameters, regardless of how much longer some lasted than others.

After filming the lessons, I watched each of the videos and used the Off-Task Behavior Tally Chart to tally the off-task behaviors observed. I watched each video twice to ensure reliability. Each time I saw a student engaging in one of the off-task behaviors

on the list, I put a tally mark in the appropriate area of the off-task behavior chart. I

tallied students per instance of the behavior occurrence. So, if a student engaged in off-

task behavior, they were only counted for it once per event, no matter how long they

continued to engage in the behavior. However, if the student was re-directed, stopped the

behavior, and then later engaged in the behavior again, a second tally was added. I added

comments in the comments column of the chart as necessary. In this column, I made

notes about outside factors affecting behavioral engagement, notes about which students

are having the hardest time, and other general notes about how the class is engaged in the

lesson. I also took notes of students who participated in off-task behaviors, but still

appeared to be engaged in the lesson—for instance, students who were playing with

materials but still raising their hands and actively listening.

 I compared the data from the Off-Task Behavior Tally Chart with frequency

tables. This is because there was no "pre" and "post" data to compare each lesson. So, I

analyzed at the data together as a whole. I made frequency tables for each lesson. Then, I

looked for overall patterns of engagement within the lessons (comparing the discussions

to the activities), between the different lessons and throughout the unit.

Emotional Engagement Short Answer Questions. The Emotional Engagement

Short Answer Questions were designed to give additional detail about student answers to

the EvsD Scale. These short answer questions asked students to explain their answers to

three items on the EvsD Scale. This allowed me to understand student answers better and

added narrative to the collected data. Student answers were coded based upon the type of

answers given. This data was then compared to the other engagement data as a whole to

provide a complete picture of student engagement.

Curiosity Data Overview

For this project, I defined curiosity as students having questions or wanting to learn more about a subject in science. The Curiosity Likert scale questions told me how curious the Amplify unit made students. However, the answers to the Likert scale questions alone did not give enough information about student curiosity, so I also included short answer questions to some of these Likert scale questions. The short answer questions asked students to explain what made them curious and why giving me more in-depth information.

Curiosity Likert Scale. To collect data on student curiosity, I gave students the Curiosity Likert Scale (Appendix D) using Microsoft Forms. I gave this at the middle and end of the unit. The questions gauged how excited students were about what they are learning, if they had questions or wonders about their learning or if they wanted to learn more about topics from the unit. Like the EvsD scale, I collected the data in Microsoft Forms.

I used Microsoft Forms for preliminary data organization and analysis. Then, I imported all EvsD data into the statistical program R. Then, with R, I performed the Chi-Square Goodness of Fit Tests to analyze the data thoroughly. I explain the procedures used for analyzing this data with R in Appendix P.

Once each data set was analyzed individually in R, the middle of the unit Curiosity Likert Scale was compared to the end of the unit Curiosity Likert Scale. I analyzed the data in R with a Chi-Square Goodness of Fit Test. Again, the data was compared single question to single question. If I found the frequencies of the two

Curiosity Likert Scales to be statistically significantly different, then I could surmise that Amplify may have caused these frequencies to change throughout the unit.

Curiosity Short Answer Questions. To collect data on student curiosity, I gave students the Curiosity Short Answer Questions (Appendix D) at the middle and end of the unit. The Curiosity Short Answer Questions were given to all students in a written format. All the short answer questions gave me a picture of how curious the unit made the students about science.

Teacher Impact Overview

Data on how the Amplify curriculum impacted me, the teacher, was collected with field notes. Field notes were recorded after each lesson and analyzed as a whole after the completion of the unit. To analyze the data, I observed patterns in the field notes data that related to this question.

Field Notes

I took field notes (Appendix L) on student growth, student engagement, and student curiosity throughout the study. The field notes added additional data and background information to each area of research.

In the field notes, I ranked various aspects of the lesson with a 1-5 ranking scale (1= strongly agree, 5= strongly disagree with the statement about the lesson). I used my rankings of the lessons to quantify the field note observations on each sub-question. Questions 1-4 related to engagement, and questions 5-6 related to curiosity. There were no ranking questions for student growth. However, there were three free-response

questions where I took notes on the lesson in terms of each sub-question, including

student growth. The last question was a place for me to write about anything else of

interest in the research study.

Validity in instruments and data analysis was aided by using all the above

approaches. This research project was exempt from a full IRB review because it

presented the lowest amount of risk to subjects, and data were reported without identifiers

(Appendix M).

DATA ANALYSIS

Student Growth Data

Overall Student Growth

Throughout the Earth Feature's unit, I measured student growth in the science and engineering practice: Engaging in Arguments from Evidence. Analyzing student performance on the pre-assessment, mid-unit assessment, and end-of-unit assessment, along with formative data, showed that most students had limited growth in this practice during the unit.

Students completed the pre-assessment (Appendix D) on December 5th, 2019. Forty-three out of 46 students took the assessment (N=43). Students 43, 19, and 11 did not complete the assessment because they were absent for multiple of the necessary proceeding lessons. These lessons taught content knowledge that was necessary for success on the assessment. All students but one (N=45) took the mid-unit assessment on January 8th, 2020. The missing student was absent for key lessons necessary for the assessment, so she did not receive the assessment upon her return. All students except one (N=45) took the post-unit assessment on February 5th, 2020. Figures 1-4 below show the student growth assessment data.

Pre-Assessment Data

Student Growth Assessment Data
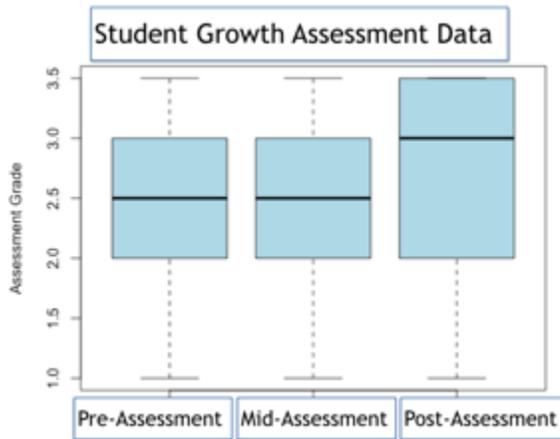
Figure 1. Pre, mid and post box whisker plot data.
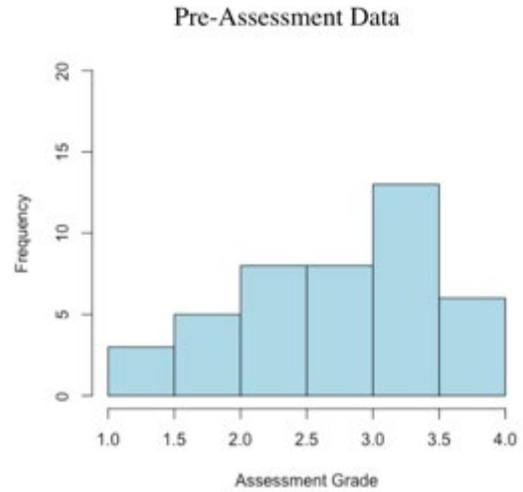
Figure 2. Pre-assessment histogram.

Post-Unit Assessment Data

Mid-Unit Assessment Data
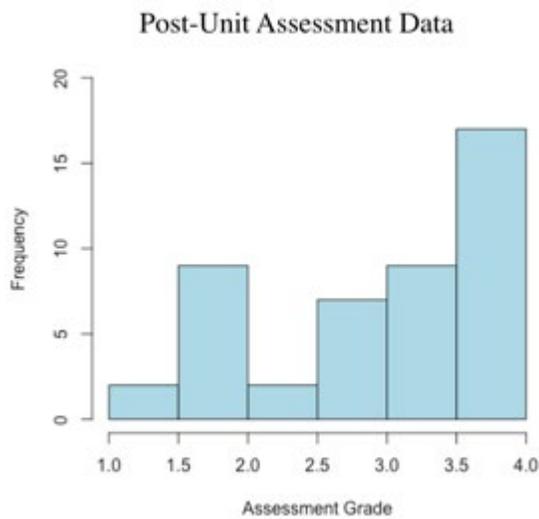
Figure 3. Mid-unit assessment histogram.
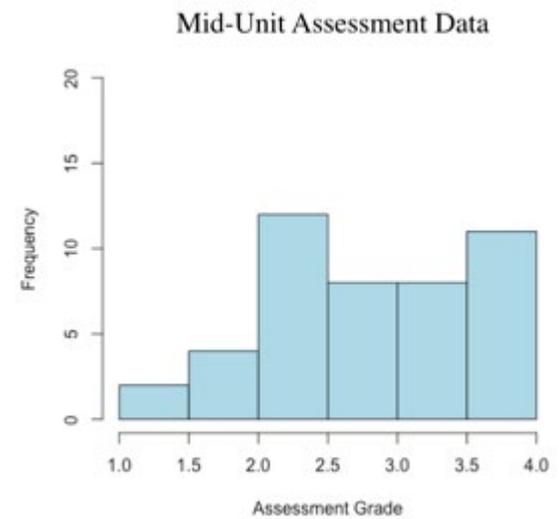
Figure 4. Post-assessment histogram.

The most notable finding about the student growth data was that the students did not grow much over the course of the unit. The means of the first two assessment were nearly the same. The mean of the pre-assessment was 2.47 while the mean of the mid-unit assessment was 2.54. The mean score of the final assessment was only slightly

higher at 2.68. A detailed explanation of the data statistics can be found in Appendix N. The lack of significant growth surprised me. However, upon looking back at the unit, I discovered the reason. Amplify did not provide students with enough opportunities to practice writing arguments. In the entire Earth's Features unit, there were two lessons about writing arguments, and neither of these two lessons had students practice the actual writing. Lesson 2.5, the lesson before the pre-assessment, introduced students to scientific arguments by having the class write an argument together. However, while students discussed ideas for the argument, only the teacher did the writing. After this lesson, it would have made sense for there to be an additional lesson where students practiced writing an argument with assistance from the teacher. But, this was not the case. The only other lesson Amplify had on scientific arguments was a reading lesson (lesson 3.3). This lesson had students read different scientific arguments and discuss which arguments they found to be stronger. However, it did not have students practice writing arguments of their own or analyzing the arguments' writing format. So, during the unit students did not get any practice in argument writing besides on the three argument assessments.

While Amplify only had argument lessons, it did scaffold each argument assessment. Before the pre, mid, and post-assessment, students were given evidence cards and discussed how these cards supported a claim in groups. After that, they took the assessment, where students needed to support the claim they discussed in their groups. While this was a great way to scaffold the assessments, it was not enough of a scaffold without the written practice.

While I did not add in any additional lessons to help students practice writing arguments, I did my best to help them learn about arguments by giving them feedback. Each time they got their assessments back, we discussed what the arguments needed to have and why. However, even with this feedback, not practicing writing arguments caused limited growth in the SEP, Engaging in Arguments from Evidence. The lessons provided by Amplify were not supportive enough, and feedback on their assessments could not fill in the learning gaps. Despite the curriculum, I found interjecting teacher skills and knowledge was necessary.

After looking at student scores and realizing the reason for the lack of growth, I carefully examined student growth in the different components of argument writing. I examined growth in the following areas: argument claim, data, explanation of data, and argument organization. Zooming in on these specific parts of argument writing allowed me to find particular areas of growth, particular areas with gaps, and the reasons behind the growth and gaps.

Student Growth in Claim Writing

On the pre-assessment (Appendix D), three out of 43 students wrote arguments about the wrong claim (students 26, 27, and 35). They tried to prove a different claim than the assignment asked them to. This was because these students all struggle with attention. Even though the directions were read aloud, explained thoroughly, and written on their paper, they could not attend to the task enough to follow them. This is something these students work on in all subject areas. Between the pre-assessment and the mid-unit assessment, these students improved. On the mid-unit assessment, all students but one wrote arguments about the correct claim. The three students who wrote and proved an

incorrect claim on the previous assessment did not repeat their mistakes. Meaning that these students were paying attention to the oral and written directions, and could use these directions to answer the right question.

Surprisingly, students were less successful at writing claims on the final assessment. However, upon closer inspection, I found this was because the claim for this argument was formatted differently than the arguments on the previous two assessments. On the first two assessments, students made a simple claim, "the environment was a ____." They did not need to include their reasons in their claim. However, on the final assessment, the students' claims had to include the two reasons why one canyon was deeper than another. A complete answer said, "More rock layers got exposed at Desert Rocks Canyon than Kellers Canyon because Desert Rocks Canyon is older and has a faster-moving river." The sentence was written for the students up until the "because", and it was their job to add what came after the because. If students did not tell both reasons why Desert Rocks Canyon was older, they could not get full points for the claim. While we discussed the different formatting as a class before the assessment, many students were still thrown by this new style. On the final assessment, three out of 45 students only included one reason, and 4/45 students repeated the bold statement in their own words rather than explaining two reasons. Meaning 7/45 students could not write a complete claim with the new formatting.

I believe that if students had time to practice claim (and argument) writing with claims that included reasons, the change in formatting would not have affected them on the final assessment. However, Amplify did not provide students with a claim or argument, writing practice. So, it was difficult for students to understand this difference.

Student Growth in Data Selection

After looking at how students grew in writing claims, I examined how students used data in their arguments. Students had two areas of confusion around data. First, many students wrote inferences in place of data. Second, students did not understand the difference between evidence and data.

On the pre-assessment, 40% (18/43) students wrote inferences instead of data. Students needed to support the claim that the environment of a rock layer in the rocky outcrop used to be an ocean. The Amplify assessment asked students to support this claim with data from the rock layer. The data students needed to use was as follows: "the layer of rock is made of mudstone," and "there was a mosasaurs fossil found in the layer of rock." But, instead of using this data, students wrote inferences. For example, many wrote, "the layer used to be a floodplain." Clearly, these students did not understand the difference between an inference and data.

This is an understandable misconception, considering Amplify did not explain the difference between data and inference. Amplify taught students what an inference was and how it differed from an observation. Amplify also taught students how to make inferences from their observations. Throughout the unit, Amplify clearly explained the difference between an inference and an observation. However, Amplify did not explicitly define data or explain what observational data was, or that it was difference from an inference. Students needed to provide observational data on the assessment, but without this clarification, the students did not realize the observations were the data. If students understood that observations were considered data, it is likely that they would have correctly identified and used the data on their assessment. As a teacher, I found it

frustrating that this difference was not clearly explained. In the future, I will make sure students understand observational data; however, I will have to add this to Amplify's lessons.

While the lack of clarity in the curriculum was the primary reason these students struggled to use data, I also found that those who struggled the most fit into specific demographic groups. For instance, those that had the hardest time were primarily low readers, level 2 EL students, students who rush through their work, and students who struggle to pay attention. While most of my attentive, high reading, high achieving students could infer that the given observations were data, these students could not do so as easily. The low readers and EL students struggled because they generally need more time to fully understand a concept, that concept being: what is data? So, the lessons that did not wholly explain data was not enough to help them understand. The rushers rarely check their work and, therefore, did not catch their error. The students with attention difficulties likely could not attend to the previous lessons enough to infer that data and observations are the same. These students need frequent repetition to understand concepts in all subject areas. The students in these subgroups struggled more than the rest because even when concepts are explained clearly, they require additional support. So, they need much more assistance when small but significant commonalities are not defined, such as how observations can be data.

On the mid-unit assessment and final assessment, students did not write inferences in place of data. When I gave students feedback on their assessments, we spent a lot of time talking about this difference, and about observations data. This feedback paid off. However, on these assessments, students still had misconceptions around data.

On both assessments, students struggled to understand the difference between evidence and data, so many used evidence in place of data. More specifically, on the mid-unit assessment 51% (23/46) of students used evidence instead of data in their arguments.

The confusion happened because of the "evidence cards" students were given on the mid-unit and final assessment (Appendix H and J). These cards were meant to help students see all of the evidence they could use to support their claim. Each card had a different piece of evidence that somehow backed up the claim students were to make on the assessment. Students had access to these cards during the assessment and used the cards to help them write their arguments. However, only one of these cards contained the data students needed to use in their argument (the data was the type of rock in the rock layer and the fossils in the rock layer). Not understanding that evidence was different than data, upon seeing each of these cards titled "Evidence 1," "Evidence 2," etc., students thought that each of these cards was a different piece of data. So, students picked evidence from any of these cards to use as data in their argument.

Looking back upon the unit, Amplify never explained the difference between evidence and data to students in the curriculum. While students learned data is what you measure or see, the curriculum never explained how this differed from evidence. As the teacher, I inferred the curriculum wanted students to know data is what you see, measure, or learn in an experiment or investigation while evidence is what other information you learn about the data. However, the students had a hard time making these inferences because they should have been taught this directly.

For instance, Amplify taught students that the mudstone layer of rock was data from the Rocky Outcrop. Then, Amplify helped students learn more about mudstone, and

that it is usually found in lakes, deep oceans, and floodplains. At this point, Amplify assumed students would understand that the new information about their mudstone data was considered evidence for their claim. However, Amplify did not explicitly explain this to the students. So, most students assumed the additional information about mudstone was data and did not understand the difference. As a teacher, I believe students should have been explicitly taught this difference. So, next time around, I will add to the lessons so that students learn this critical difference.

On the final assessment, students improved, and fewer students used evidence in place of data. In fact, on the final assessment, 42/45 used at least one piece of correct data in their arguments. However, this improvement was not caused by any of Amplify's lessons. Because Amplify did not have lessons about how to write an argument, I carefully explained the difference between evidence and data when students got back their mid-unit assessments for feedback. Evidently, explaining the difference between evidence and data helped students clear up their misconceptions on data. Again, I will need to add in such lessons in my future teaching to ensure students understand this difference.

Student Growth in Explanation of Data

When looking at students' explanations, I found that students mainly struggled to write complete explanations, and on topic explanations.

First, many students wrote explanations that left out important details. On the pre-assessment, 43% (19/43) forgot to include important, relevant information in their explanations. When explaining the "the layer is made of mudstone," data students needed to explain that because the rock layer was mudstone, the past environment could have

been a floodplain, lake, or an ocean (based on the data we had gathered in class).

However, these 19 students said that the mudstone layer was proof that the environment

was an ocean, and left out the other possibilities. Students did this because they thought if

they were trying to prove that the environment was an ocean, that there was no need to

include the rest of the possible environments. They did not understand that they first had

to state all of the possible environments, and then use their additional evidence to argue

that the only possible environment was an ocean. Most of the students that forgot the

other environments were low readers, level 2 EL students, students who always rush

through their work, and students who struggle to pay attention. The low readers and EL

students struggled because they are students who typically need extra time to understand

concepts fully, so they most likely did not know that this was a necessary part of the

argument from the single lesson beforehand. The rushers and attention-challenged

students struggled because they did not check their work or attend to the task completely.

This second time around, students improved at thoroughly explaining with all

relevant details. Similar to the pre-assessment, many students forgot to list all the

possible environments that the rock layer could have been on the mid-unit assessment.

However, this time only 31% of students forgot to include all possible environments,

compared to 43% on the pre-assessment. Again, it was mainly students who were low

readers, EL students, rushers, and inattentive. While many of these students were the

same who forgot on the pre-assessment, some were not. This demonstrates that those who

got it correct the first time either did not carefully read the evidence the second time, did

not check their work the second time, or were not paying attention the second time.

On the post-assessment, five students (students 40, 32, 33, 34, 4, 11) gave partial explanations. This was likely because of the lack of sufficient practice with writing scientific arguments, for most of these students struggled to fully explain on the previous assessments as well.

Another problem students encountered with explanations was writing off-topic explanations. On the pre-assessment, seven students had off-topic explanations. However, I found that each student with an off-topic explanation was a student who struggled with attention. Each of these students tried to prove an incorrect claim, or explained a claim incorrectly, meaning that their claims and explanations did not match up. Their attention difficulties were the primary cause of these errors. If they checked their work, they would have found these errors. All of these students with incorrect explanations are working on writing explanations in all subject areas. They have been working on this goal all year, so it is not a surprise that a single lesson could not suddenly make them great explainers.

On the mid-unit assessment, only three students were off topic in their explanations, four fewer students than the previous time (students 4, 21, and 44). As on the pre-assessment, inattention was the primary cause. On the final assessment, all students stayed on topic. This is a remarkable improvement from the first assessment. While the limited argument lessons did not stress this, we discussed staying on topic a lot when reviewing the previous assessments. It shows that the time taken to give students feedback on their previous assessments paid off.

<u>Student Growth in Argument Organization</u>

Overall, students improved at organizing their arguments as the unit went on. On the pre-assessment, 31% (14/43) of students did not use the graphic organizer provided correctly. This was most likely because previously, students only had one opportunity to see the graphic organizer. During this lesson, Amplify had the class fill in a single graphic organizer together orally. So, students did not have a chance to practice writing their own arguments. A single lesson without any argument writing practice was not enough for students to be successful at using the graphic organizer.

On the mid-unit assessment, students improved at organization. Only 3/44 students had unorganized arguments on the mid-unit assessments (students 2, 4, and 21). All three of these students have trouble focusing, and organized their arguments incorrectly the previous time. All other students used the graphic organizer correctly, showing that getting feedback on their prior arguments helped them learn how to use it successfully.

This improvement continued to the final assessment, where only one student (31) had an unorganized argument because they misused the sentence frames. This student had difficulty organizing his arguments on previous assessments because he chose to rush through his work, and not listen to the directions. This is something he is working on in all other subjects. All other students were able to organize their arguments correctly.

While students did not have any written argument practice between the assessments, I believe that students were able to improve at organization because of the feedback on their assessments combined with using a similar framework of argument organization on each assessment. Considering the lack of practice, I found the improvement in organization very impressive.

Formative Assessment

While student growth in writing written arguments was limited, my field notes from our class discussions (Appendix X), which served as formative assessments, indicate that most students could orally support a claim with data and explanation. In our many class discussions, students could usually pick out a correct piece of data to prove a claim, and then explain how that piece of data proved their claim. Students became very adapt to doing this both with their partners and in our full class discussions. While this oral practice did help students practice argumentation, students were not required to adhere to the strict format of the written arguments. For instance, in lesson 3.3's full class discussion "On the Fly" assessment, students could pick out evidence to support the author's claim, decide which evidence they thought to be the most convincing, and explain why. However, they did not have to put this in their argument sentence frames, clarify the difference between evidence and data, or explain in a paragraph format. So, while they could make an argument for the author's claim, they did not get a chance to practice moving from a more casual oral argument to a written formal argument. This lack of practice hindered their growth.

Engagement Data

Engagement data was collected using the EvsD Scale, Emotional and Behavioral Engagement Short Answer Questions, and with the Off-Task Behavior Tally Chart. Compiled together, this data indicated that as a whole, students were both emotionally and behaviorally engaged in their learning with Amplify.

All students (N=46) took the EvsD Scale and Emotional and Behavioral

Engagement Short Answer Questions at or near December 11th, 2019, for a mid-unit

check-in, and at or near January 29th for an end-of-unit check-in.
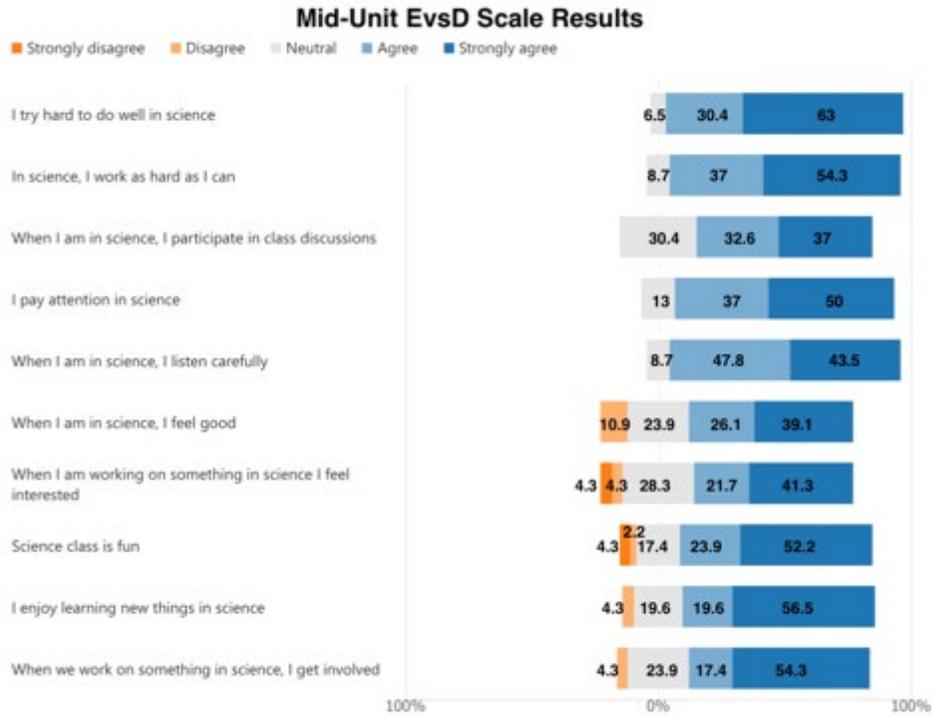
Figure 5. Mid-unit EvsD results.

Post-Unit EvsD Results
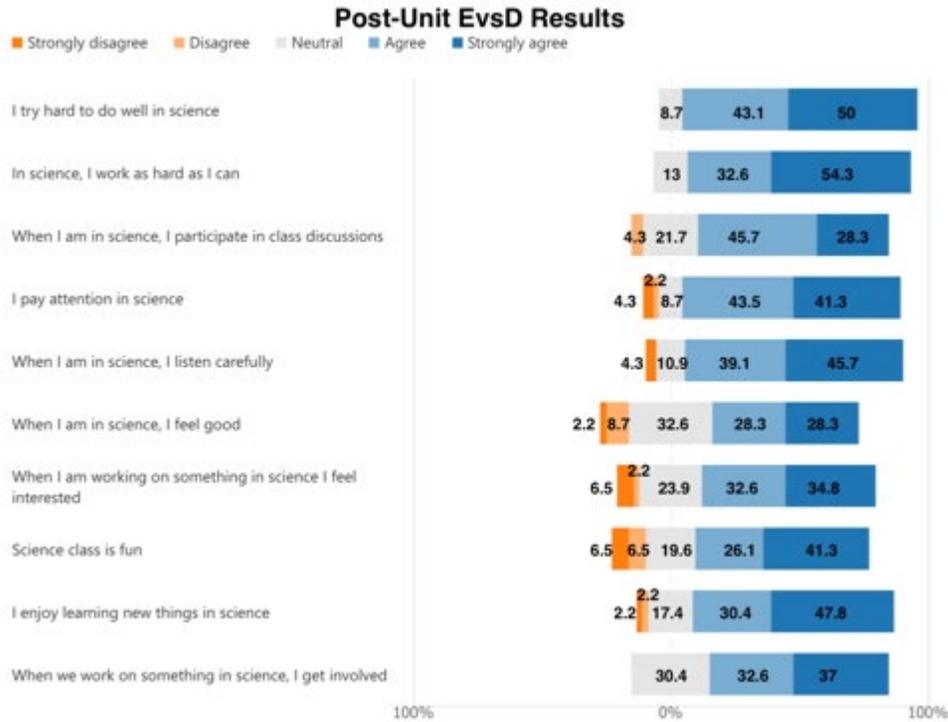
Figure 6. Post-unit EvsD results.

Figure 5. and figure 6 summarize *s*tudent responses to each question on the EvsD Scale at both mid-unit and end-of-unit. Appendix R gives specific student response data.

 The ideal responses, Agree or Strongly agree, meant that students believed they were emotionally or behaviorally engaged in the unit. The first five questions reflected behavioral engagement, and the last five reflected emotional engagement. Based on the results, overall, students believe they are both emotionally and behaviorally engaged. This is shown by the fact that at least 56% of students responded "agree" and "strongly agree" to each question on both the mid-unit and post-unit surveys.

At both the middle and end of the unit, over 92%, responded to, "I try to do well in science," and, "in science I work as hard as I can," with agree and strongly agree. When students were asked to explain why they work hard in science, most said that it is

because they want good grades (Appendix T). Other reasons included that science is fun, interesting, or because they want to learn more.

For the next question, "when in science I participate in class discussions," students mostly answered agree or strongly agree. On the mid-unit survey, more students responded strongly agree than at the end of the unit. A G-Test for Goodness of Fit determined that the response frequencies of the mid-unit and post-unit surveys are considered statistically different (Appendix S). I believe the reason for this difference is that students were more honest on the post-unit EvsD Scale Survey. Around the time students took the end-of-unit survey, students were reflecting on their goals for the year, and many students had goals to speak up during class discussions. Reflecting on this goal caused students to more carefully consider how they participated in class discussions, including science.

A large proportion of students responded neutral to this question. While less participation in class discussions does show less engagement, most students who picked neutral are quiet students who rarely speak up in any subject. So, this was more of an indicator of how quiet students were rather than an indicator of how engaged they were. On the other hand, three students gave inaccurate responses. Students 15, 17, and 19 all responded neutral or disagree to this question on both surveys. However, my observations tell me that their self-reflections were incorrect. These three students participate in science discussions frequently, raising their hands at least multiple times a lesson. In each lesson, they appear excited to share their ideas. The reason these three students selected neutral or disagree is that they have a strong dislike of science. On every EvsD and short answer question survey, they stated that they actively do not like science (Appendix T). I

believe that their dislike of science caused them to think they were not participating, even when they were.

The questions, "I pay attention in science," and, "when I am in science I listen carefully," received similar response frequencies. In the middle of the unit, 13% responded neutral to, "I pay attention in science," and 8.7% responded neutral to, "when I am in science I listen carefully." Zero students said they disagree or strongly disagree. All but two students who responded neutral were accurate in their self-reflections. These students generally have a hard time paying attention not only in science but in all subjects. So, their lack of attention was not necessarily due to their engagement in science, but more likely a factor of their general attention span. Students 15 and 17 responded neutral to both questions, but all observational data shows that they pay attention and consistently participate. Again, these students have a strong dislike for science, and I believe their dislike for science colored their responses.

At the end of the unit, 8.7% responded neutral to "I pay attention in science," and 10.9% responded neutral to "when I am in science I listen carefully." Upon examining the data, all students but number 17 were accurate in their self-reflections. Interestingly, two students, number 15 and number 4, selected strongly disagree for both questions. Number 4's response is valid. It is severely difficult for him to attend to any task in any subject, and his response indicates that he is aware of this. This response is not an indicator of his disengagement in science, but a sign of his overall inattention. Again, student 15's dislike of science colored his response. Throughout the unit continued to pay attention and participate often.

Interestingly, a G-Test of Goodness of Fit determined that by the end of the unit, more students disagreed or were neutral than the middle of the unit (Appendix S). I believe this difference is because by the end of the unit, some students got bored with the topic and became less engaged. The unit became less novel and more repetitive at the end. In the short answer questions, five students indicated they were board at the end of the unit while they reported they had enjoyed science during the middle of the unit. One student explained this by saying, "its repetitive after it has already been stuck in my mind" (Appendix T). I believe what she was trying to say was this: I learn the material quickly, but then we keep repeating the same concepts.

Overall, the responses to the first five questions show that students were behaviorally engaged when learning with Amplify. The students that were truly not engaged have a hard time paying attention in all subject areas, not just science.

The next five questions tracked emotional engagement in science. The first question, "when I am in science, I feel good," received the most negative responses from students out of all of the questions asked. Students 19, 15, 17, and 21 answered disagree or strongly disagree. These responses are again explained by their short answer questions, where they all claim they do not like science. If they do not like science, they must not feel good in science.

When students answered, "When I am in science, I feel interested," their answers shifted from the middle of the unit to the end of the unit, according to the G-Test for Goodness of Fit (Appendix S). At the middle of the unit, 6.5% more students strongly agreed than at the end of the unit. Student short answer responses gave some clarity to these answers. For instance, when asked if they liked learning new things in science, or if

they thought science was fun, many students responded yes to both of these questions,

explaining that they found science interesting. The students who shifted their answers to

agree (rather than strongly agree) or neutral likely did so because, as I said before, the

unit became repetitive. They did not find the unit as interesting when they were not

learning new information. The students who responded disagree and strongly disagree are

the group of four students who generally strongly dislike science (student 15, 17, 19, 7).

Interestingly, according to lesson observations, these students acted behaviorally engaged

in the lessons. However, this did not transfer over to their perceived levels of interest.

The next EvsD statement was, "science class is fun." Over 67% of students

agreed or strongly agreed with this statement at both the middle and end of the unit. The

short answer question helped identify what parts of science students thought were fun.

The most frequent response was that science is fun because you get to do experiments or

make models. Along these lines, one student responded that it is fun because "it's fun to

explore." Students also thought science was fun because they liked to learn new things.

Other students found science fun because of the "sims" or simulations we do on the

computers (Appendix T).

The students that did not find science fun were in the students that generally do

not like science. Most said they were bored, one said she does not like writing about what

we are learning all the time and sitting at the carpet, and another said it was not fun

because there were not many simulations.

The next EvsD statement was, "I enjoy learning new things in science." Over

76% either agreed or strongly agreed at both the mid-unit and end-of-unit EvsD Scale.

However, the G-Test for Goodness of Fit found the response frequencies of the two

surveys to be different (Appendix S). More students strongly agreed at the middle of the unit than at the end of the unit. The short answer question, "do you enjoy learning new things in science?" gave insight to the EvsD Scale responses. The most frequent short answer response was that students like learning new things in science because they like learning or learning new things. (Appendix T). While not the most detailed answer, it does showcase that this group of students enjoys learning. Other common responses were that they like learning in science because it's fun, it's interesting, because we make models or because they love science.

Again, there was a group of students that disagreed or remained neutral. Students 15 and 19 disagreed. Student 15 explained this by saying, "its boring." Student 15's intense dislike for science clearly influenced his response. Nine students remained neutral at the end of the unit EvsD. This included students 17 and 21 who frequently claim they dislike science. It also included some students that have a hard time enjoying learning in any subject. This group of students often has a hard time paying attention to all subjects, engaging in learning and caring about their education. So, it makes sense that they are only natural towards learning new things.

Finally, the last EvsD Statement was, "when we work on something in science I get involved." This question had a large proportion of neutral responses. I found it interesting that so many students responded neural, where my observations indicated that almost all students were always involved and participating in our science activities. A reason for this disconnect could be that while I did explain what being involved meant, the students may not have understood precisely what it means to be involved in an activity.

Table 2. Off-Task Behavior Tally Chart Data.

Off-Task Behavior Tally Chart								
Instances of Occurrence								
Lesson Date	11/21/19 Reading and Discussion		12/4/19 Computer Sim		1/9/20 Discussion		1/23/20 Discussion	
Class Section	Upp	Ob	Upp	Ob	Upp	Ob	Upp	Ob
Off Task Behavior								
Out of seat			3	2				
Playing with objects (e.g. pencil, toys etc.) and or other children	11	6	1	2	10	4	9	9
Calling out								
Talking to someone during listening time		4			1			8
Making Noise								
Eyes wandering around room	4	4	2	2	2	11	2	2
Laying Head on Desk or Laying Down on Carpet					3			1
Total	15	14	6	6	16	15	11	20

This data showed that students were, in general, emotionally engaged, except for those with a strong dislike of science. Since student self-reporting their engagement

levels can be inaccurate, I also collected data on behavioral engagement with the Off-Task Behavior Tally Chart. I recorded ten-minute portions of lessons on November 21st, 2019; December 12th, 2019; January 9th, 2020; and January 23rd, 2020, in both science class sections. Table 2. shows a summary of the data collected.

The video recorded lessons revealed two key insights about student behavioral engagement. First, it showed me that most students were engaged in the learning and that those that were not engaged are the students I already knew to have difficulty paying attention. Also, I found that while students were engaged most of the time, they all found the simulations the most engaging.

Upon looking at the data, I found most students to be engaged in the learning, and not many were off task. While there were a total of 103 off-task behavior tallies throughout the four lessons, the same group of 13 students (students 1, 2, 4, 7, 9, 13, 15, 21, 23, 25, 35, 37, and 44) performed most of these off-task behaviors. So, while 13/46 students were often disengaged, the remaining students were on task most of the time. These 13 students were all found to be off-task in at least two lessons and were usually off-task multiple times a lesson. All of these students are working on staying engaged in all subjects. It should be noted that while student 37 appeared off-task, she was still engaged in her learning. She played with her hair multiple times a lesson, but she continued raising her hand and participating in the learning each lesson.

Interestingly, of all the students who claimed not to like science on the EvsD Scale and short answer questions (7, 15, 17, 19, and 21), only student 21 performed an off-task behavior. So, while these students claim they are not engaged and do not like science, their behavior shows otherwise. Throughout the lessons, I noticed they enjoyed

talking to their partners, reading the book, and were excited to share their ideas. Even

student 21 was frequently raising his hand to participate in each lesson.

When comparing student behavioral engagement between the different lessons, it

was clear to see that students found the simulations the most engaging. The December

4th lesson was a lesson where students and their partners were completing a computer

simulation at their desks. Between the two classes, this lesson only had 12 instances of

off-task behavior, while the three other lessons all had about 30 cases. Also, of these 12

instances, only three students (9, 23, and 37) were found actually to be disengaged. When

the other presumably disengaged students were engaging in "off-task behaviors," they

were talking to other students about what they had learned and were walking around the

room to see what others were learning. While these behaviors were off-task according to

my chart, I considered these students to be engaged in the lesson. They were so engaged

that they wanted to discuss what they learned without direction from me.

Students were less engaged in the reading lesson on November 21st than the

computer simulation, but they were still behaviorally engaged. They all talked to their

partners during all of the turn and talks during this portion of the lesson. They were so

engaged in reading the fossil guidebook that they all were begging to share out their

ideas. Both classes found this book so engaging that 12 students were trying to read the

book instead of listening to their classmates share out their ideas. As a whole students

appeared to find both the reading and discussion in this lesson engaging. They clearly

enjoyed learning more about fossils.

While the discussions were also less engaging than the simulations, students still

participated and seemed to enjoy them. My field notes and videos show that while some

students were off task, most of the time, students were eager to share their ideas. More often than not I found students disappointed when I had to stop letting them share and move on with the lesson.

The Off-Task Behavior Tally Chart confirmed that students are most engaged when they get to do simulations, and still relatively engaged during reading lessons and full class discussions. However, while there were many off-task tallies, it became apparent that these tallies in all four lessons came from the same few students. This indicates that most students were behaviorally engaged. The students that were not behaviorally engaged routinely struggling to focus in all subject areas. So, their disengagement does not necessarily reflect on Amplify, but their inability to focus in general.

Engagement Field Notes

My field notes (Appendix L) show engagement patterns similar to the Off-Task Behavior Tally Chart. As a whole, students were very engaged during simulations, experiments, and reading lessons. They became less engaged when we did some of the simulations a second time, but still remained very on task for the simulations. According to my notes and engagement data, students also loved the experiments. For instance, they gave their best attention when we modeled how a canyon was forming with a stream table. Students were less engaged in the full class discussions than the simulations and experiments. However, my notes show there were many class discussions where they complained when we had to end. The most engaging discussions were when students were sharing their hypotheses about a phenomenon or when I asked them to give evidence to prove a claim. The times I saw the least engagement is when I asked them to

write arguments, mainly because they did not like the large amount of writing. My field

notes concluded that students were behaviorally engaged in the majority of the lessons; it

was exciting to see students so interested in science.

<div align="center">Curiosity Data</div>

Curiosity data was collected using the Curiosity Likert Scale (survey), and the

Curiosity Short Answer Questions. Compiled together, this data revealed that while

students were relatively curious during the Earth Feature's Unit, their curiosity waned at

the end of the unit.

All students (N=46) took the Curiosity Likert Scale and Curiosity Short Answer

Questions. The students completed the Curiosity Likert Scale and short answer questions

at or near December 11th, 2019 for a mid-unit check-in, and at or near January 29th for

an end-of-unit check-in. Student responses to each question on the Curiosity Likert Scale

at both mid-unit and end-of-unit are summarized in figure 7. and figure 8. Individual

student responses can be found in Appendix U.

Mid-Unit Curiosity Survey

■ Strongly Disagree   ■ Disagree   Neutral   ■ Agree   ■ Strongly Agree

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I want to learn more about rocks and sediments	4.3	10.9	28.3	19.6	37
I want to learn more about fossils	4.3	6.5	17.4	21.7	50
I want to learn more about how the earth has changed over time	4.3	10.9	17.4	17.4	50
I am excited to learn about rocks and sediment	2.2	4.3	30.4	26.1	37
I am excited to learn about fossils	2.2	4.3	10.9	30.4	52.2
I am excited to learn about how the earth has changed over time	2.2	8.7	13	23.9	52.2

100%   0%   100%

Figure 7. Mid-Unit Curiosity Survey Part 1
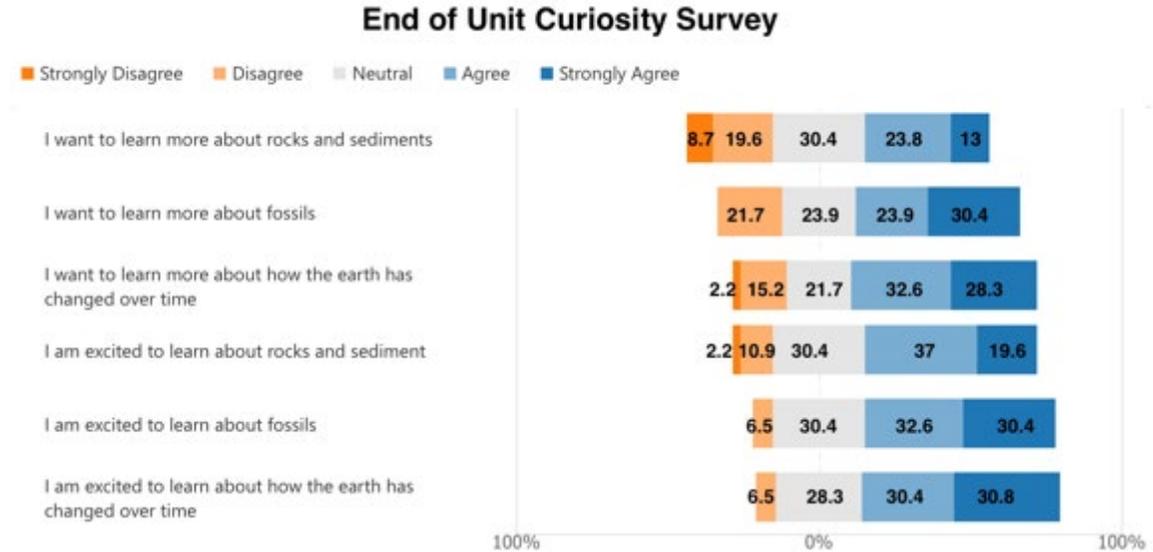
Figure 8. End-of-unit curiosity survey part 1.

When responding to, "I want to learn more about rocks and sediments," and "I am excited to learn about rocks and sediments," students were more in agreement during the middle of the unit than at the end of the unit. A G-Test for Goodness of Fit determined a statistical change in response frequencies for both questions from the middle to the end of the unit (Appendix V). This change in response frequencies was presumably because, by the end of the unit, students felt like they had learned it all or learned enough to be no longer curious. Throughout the unit, we did different investigations that fed their curiosity, and if they believed they learned enough about rocks and sediments, their curiosity ceased.

The students who claim not to like science (students 15, 19, and 21) either disagreed or strongly disagreed with both of these questions at both the middle and end of the unit. However, at the end of the unit, other students also responded with disagree or strongly disagree (students 5, 24, 28, and 44). Student 19 explained her answer to the

free-response question, "Do you want to learn more about how the earth has changed over time, rocks or fossils?" by saying, "No. I already know enough to be bored." I think student 19's statement sums up how the other disagreeing or strongly disagreeing students feel. They believe they learned everything rocks and sediments, and thus are no longer curious.

The next two questions were, "I want to learn more about fossils," and "I am excited to learn about fossils." Interestingly, more students responded agree and strongly agree to these questions than the questions about rocks and sediments. Students especially were interested in fossils at the middle of the unit. In the short answer questions, one student explained they wanted to learn more about the "mosoarous" fossil from the lesson in class (Appendix W). My field notes indicate that students found the lesson about the mosoarous particularly exciting. During the lesson, students were so curious about the mosoarous fossil that they did not want to stop asking questions and sharing their ideas. The short answer questions show that students had many other curiosities about fossils. One student said that she wanted to learn more about different "types of fossils," while another student said she wanted to know where "the fossil is from." Of course, the students that disliked science (students 15, 21, 19 and 7) were the exception.. However, apart from this group, fossils caused students to ask lots of questions, a sign of their curiosity.

While students were curious about fossils at the middle of the unit, the results indicate they were less curious at the end of the unit. The G-Test for Goodness of Fit showed, "I am excited to learn about fossils," had different response frequencies from the middle to the end of the unit (Appendix V). I believe this difference occurred for the

same reason it did with the rock and sediment questions; students had learned enough to be no longer curious. One student explained this sentiment by saying, "all of my wonders have been answered."

The next two questions were about student curiosity towards how the earth has changed over time. The G-Test determined that students were less curious about how the earth has changed at the end of the unit than the middle of the unit (Appendix V). However, while the students showed more disagreement at the end of the unit, their short answer questions showed they still had many wonders about how the earth has changed. On the short answer questions, students were most curious about how canyons were formed (Appendix W). One student said they wanted to learn more about "canyons and erosion because I thought it was super interesting and super fun." Another student said, "how does speed affect depth?" meaning, how does the speed of the water affect the depth of a canyon. A third student said, "I want to know how a river delta can get deeper." A total of 20 students asked questions about canyons, erosion while only ten students were wondering about the earth had changed at the middle of the unit. Notably, the students got more specific in their questions at the end of the unit, showing they had learned enough to get curious about more specific ideas.

When comparing student curiosity around the three topics: fossils, rocks and sediments, and how the earth has changed over time, it is clear that students were the most curious about fossils and the least curious about rocks and sediments. Students responded with the most agreement to fossils, and the least agreement to rocks and sediments. While student survey responses to fossils and the earth changing over time

were similar, the short answer questions show that they had many more questions about fossils than how the earth has changed over time.

The last question I asked students was if they had any wonders from the unit. I asked this question because having wonders or questions is a sign of curiosity. When the Curiosity Likert Scale asked, "There is at least one thing that I wonder about in our Earth Feature's Unit," 31 students responded yes, and 15 students responded no at both the beginning and end of the unit (*figure 9.* and *figure 10.*). So, 67% (31/46) of students had at least one wonder, which I took to mean were at least a little bit curious about something in the unit.

Figure 9. Middle of the Unit Curiosity Survey Part 2. Responses to: There is at least one thing that I wonder about in our earth's feature's unit.

Middle of Unit Curiosity Survey

There is at least one thing that I wonder about in our Earth's Feature's Unit?

● Yes	31
● No	15
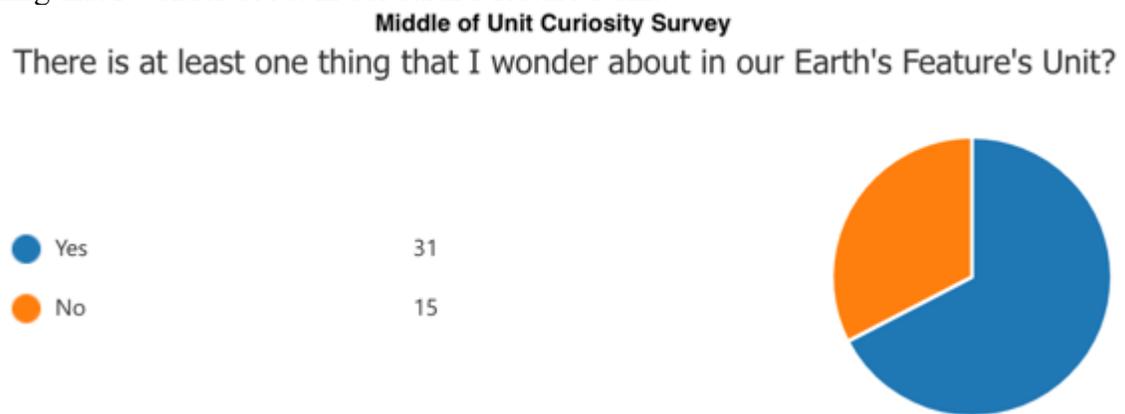
Figure 10. End of the Unit Curiosity Survey Part 2. Responses to: There is at least one thing that I wonder about in our earth's feature's unit.

End of Unit Curiosity Survey

There is at least one thing that I wonder about in our Earth's Feature's Unit?

● Yes	31
● No	15
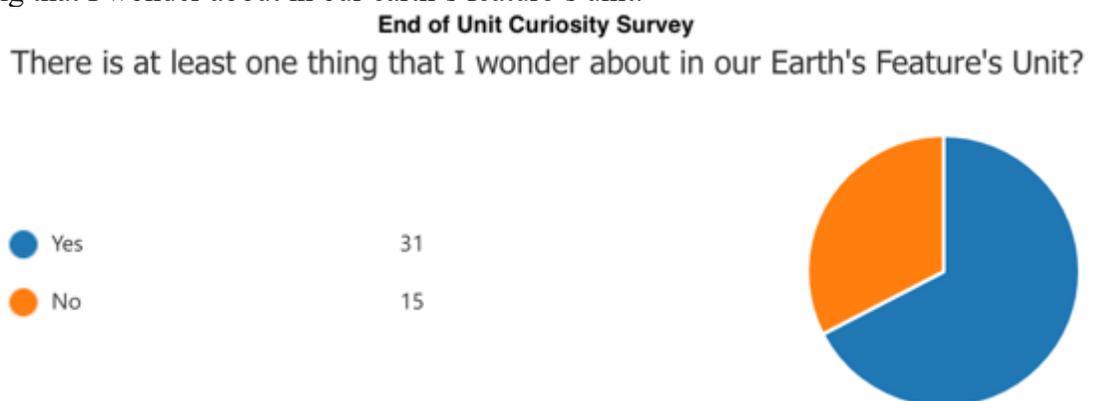
Students 7, 13, 21, 44, 34, 24, and 28 all responded no both times. However, this means the remaining students had at least one wonder sometime during the unit, making them more curious than the eight who responded no both times. Of the seven who responded no both times, students 7 and 21 most likely said so because they do not like science. Student 15, and 17, who also dislike science only responded no to once, making them slightly curious, even with their dislike of science. When looking at their short answer questions for clarification, all of these students said "no" or "nothing," without any explanation.

That being said, many students had wonders. The short answer questions helped shed light on these wonders (Appendix W). As discussed above, 20 students had wonders about canyons, erosion, and our stream table model. One student was wondering, "why did the fast stream [in the stream table model] only have one stream?" While another asked, "would a river with hard rock erode faster or slower?" The students had many wonders about these topics, showcasing the depth of their curiosity. Other students had wonders related to one of our Amplify reading lessons about how the dinosaurs died. One student asked, "is the dust from the carter that killed the dinosaurs still there, or did it dissolve?" Another asked, "how did the dinosaurs get extinct?" Others wondered about rocks. One student asked, "how long does it take for lava to harden?" While most of their wonders came from topics we learned about, others were from other areas in science. For instance, one student wanted to know "how trees clean the air." The students had a wide variety of wonders, showing that they are curious about many different topics.

As a whole, Amplify fostered curiosity throughout the unit. However, it encouraged more curiosity during the unit than after the unit. While I would have liked it to promote longer lasting curiosity after the unit, I believe that the curiosity it fostered during the unit motivated students to want to learn more and caused students to deeply engage in the learning.

CLAIMS, EVIDENCE, REASONING

<u>Claims From the Study</u>

This study helped me discover the effects of the Amplify curriculum on both students and myself. It allowed me to see how the Amplify curriculum effected student growth, engagement, and curiosity.

In response to my question, how does Amplify impact student growth, I found Amplify's Earth's Features unit did not provide students with enough practice to sufficiently grow in the SEP, Engaging in Arguments from Evidence. The Earth's Features only provided two lessons in the SEP, Engaging in Arguments from Evidence. The first lesson, lesson 2.5, introduced students to writing arguments by having students engage in a shared writing of an argument. While this was an essential introduction to writing scientific arguments, it was not followed up with any written practice. So, this left students unprepared for the pre-assessment in the following lesson (Figure 2). The other argument lesson, lesson 3.3, did not have students practice writing arguments; it only had students reading arguments. Again, this lesson did not include any argument writing practice. While the unit included two more argument assessments after lesson 3.3, it did not include any argument practice. So, the students could not make much progress in the standard (Figure 1).

As a teacher, I found the lack of argument writing practice frustrating. While giving students feedback on their argument assessments did help them grow some, what students needed was more guided practice. I did not think it was fair to grade students on a standard that they did not have the opportunity to learn and master. In the following years, I will be adding in lessons that allow students to practice writing arguments.

However, Amplify should have done this task, and therefore it is frustrating that it will take my additional time and effort.

While I found Amplify's support of student growth disappointing, I did find that in response to my question on how Amplify impacts student engagement, that the unit engaged my students in learning. In general, I found that most students were engaged in most lessons (Figure 5, Figure 6, Table 2.) Those that had a difficult time remaining engaged were the students that struggle to focus in all subject areas. Even the students who said they did not like science were at the very least behaviorally engaged most of the time. The simulations engaged students the most, but students also found the reading lessons, making and using models, and class discussions engaging.

As a teacher, I loved seeing students so engaged in science. If students are engaged in what they are doing, then they are learning. Student growth data did not track student learning outside the Engaging in Arguments from Evidence SEP. However, I did notice that all students became quite knowledgeable in the subject matter by the end of the unit, and I attribute much this learning to their high engagement.

In response to my question on how Amplify impacts student curiosity, I found Amplify inspired students' curiosity. Throughout the unit, as shown on the mid-unit surveys, students were found to be quite curious (Figure 7, Figure 8). They had many questions about fossils, how the earth has changed, dinosaurs, and more. However, students were more curious during the middle of the unit than at the end of the unit. By the end of the unit, many students had learned enough to be no longer curious. So, while Amplify fostered curiosity throughout the unit, it did not promote a long-lasting curiosity of the Earth's Features.

As a teacher, I was glad to see students so curious. Throughout the unit, they were always asking questions. Being curious helped them engage in the learning, and gave them a reason to want to learn the material. While I do wish the unit fostered a longer lasting curiosity, I am hopeful that the other units in Amplify have the potential to do just that.

Value of the Study and Considerations for Future Research

Performing this research study allowed me to examine the effects of the new Amplify curriculum carefully. First and foremost, this research was valuable to me personally. I will use what I learned in this study to adjust my future teaching of the Earth's Features unit.

The primary change that I will make to my future teaching is that I will create lessons on how to write an argument from evidence to use with the unit. This will help my future students effectively learn this SEP.

I also learned that this unit was not necessarily more engaging for students who already have difficulties focusing. While my data showed many students who struggle to focus were emotionally engaged, this did not always change their day to day behavioral engagement. While this was true, I did learn that the computer simulations engaged even the most inattentive students. So in the future, I will try to use this to my advantage. I will be sure never to cut out a computer simulation lesson to save time and to have students do these on their own computers rather than on my smartboard as a class. Doing these two things will help boost the engagement of all students. The most important item this data taught me is that while all students were generally focused, I will still need to use other tools and interventions to help my inattentive students focus.

The curiosity data taught me that students are by and large curious about science. Fourth graders want to learn and get their questions answered. However, since many fourth graders were less curious at the end of the unit, I will have to work to develop strategies to help students find curiosity for a subject in science even after the unit has ended.

Not only was my research valuable for my teaching, but it was relevant to other teachers at my school. Every year Benjamin Franklin Elementary sets school-wide growth goals, or SIP (School Improvement Plan) Goals. One of our goals from the 2019-2020 school year was to implement Amplify while monitoring student engagement, curiosity, and growth. More specifically, we wanted to have all teachers at our school, implementing and utilizing Amplify learning resources and lessons. For this first year of data collection, we used my data to look at how Amplify has affected student engagement and curiosity. State testing was canceled this school year due to COVID-19, but state testing data for the 2020-2021 school year will help us begin to track growth. We will use the findings from my data to determine any essential next steps for using Amplify at our school. At the moment, potential next steps include: collecting school-wide data; using one or two of my data collecting instruments school-wide to improve our teaching; and collecting the same data on my current 4th graders in 5th grade, to see the long term impacts of Amplify on engagement, curiosity, and growth. At the moment, our purpose for collecting this data is to simply observe how the Amplify implementation is going. As a brand new curriculum, we are curious to see how the change in learning effects our students. As more data is collected, it will lead us to more specific science growth goals.

Finally, what I learned from this study will be valuable to teachers in the Lake Washington School District. I will be sharing my findings with our science curriculum adoption committee, and they will be sharing anything they deem important with the teachers at their schools. What I think will be vital for them to realize is that while Amplify does a great job at engaging students and fostering curiosity, there are some gaps in the curriculum concerning student growth. I assume that if there were insufficient lessons to teach students to write scientific arguments, that there are other Amplify units with learning gaps that will need to be fixed. As the implementation of Amplify continues, it is this committee's job to help teachers use Amplify. Our next job may be to find gaps in the curriculum and to create lessons to fill these gaps. At the very least, the 4th-grade teachers on this team can begin writing lessons to help students learn how to write arguments in the Earth's Features unit, and then these lessons can be given to the other 4th grade teachers in the district.

<u>Impact of Action Research on the Author</u>

During my day to day teaching, it is always hard to find time to reflect on my practice. There are always too many things to do that seem like they have to come first. So, I found this action research project was the perfect way to help me find time to reflect on my teaching. If I started teaching Amplify without this research study, I would have noticed some things that I would like to change, and would have likely taken a few notes on those thoughts for next year. However, I would have never thought as deeply about this new curriculum as I have over the course of this project. It is easy to know if a lesson went well or terribly while you are teaching, but it can be hard to find the time to reflect deeply on the why and to find ways to make it better the next time. Thinking deeply

about what I was doing and how it affected my students gave me the time I needed to carefully consider why some things went well, and others did not. These reflections will most certainly improve my future teaching of this unit and with this curriculum.

Aside from the time to reflect, what I enjoyed most about this project was reading my students' answers to the short answer questions. We all know asking students what they think is helpful, but again it is always hard to find the time to ask students for their feedback. There are always more important things to teach, tests to give, and reading the feedback takes time. However, I was so glad I took the time to do this for this project. It made me realize why the practice is so important, and that I want to continue to do this in the future. Their answers made me laugh, made me wonder, and taught me more about them as learners and as people. The best response I got when I asked them if science was fun was: "Yes. Science is an adventure." Another great response I got was, "Science is like a mystery book. There is always something to discover." Answers like these reminded me why I love teaching and why I love teaching science.

The action research process was long, laborious, and overall fantastic experience. Everything I learned from this project was well worth the extra effort.

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APPENDICES

APPENDIX A

EVSD SCALE

Name_____ #_____ Date_____ HR_____

Please answer all of the following questions as honestly as you can. These questions will NOT affect your grade.

I try hard to do well in science.
Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

In science, I work as hard as I can.
Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

When I am in science, I participate in class discussions.
Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

I pay attention in science.
Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

When I'm in science, I listen very carefully.
Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

When I'm in science, I feel good.
Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

When I am working on something in science, I feel interested.
Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

Science in class is fun.
Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

I enjoy learning new things in science.
Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

When we work on something in science, I get involved.

Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

APPENDIX B

OFF-TASK BEHAVIOR TALLY CHART

Off-Task Behavior	Tally	Comments
Out of seat		
Playing with objects (e.g. pencil, toys etc.) and or other children		
Calling out		
Talking to someone during listening time		
Making Noise		
Eyes wandering around room		
Laying Head on Desk or Laying Down on Carpet		

APPENDIX C

CURIOSITY LIKERT SCALE

Name_____ #_____ Date_____ HR _____

Participation in this research is voluntary and participation or non- participation will not affect a student's grade or class standing in any way.

1. **I am excited to learn about the Rocks.**
   Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

2. **I am excited to learn about Fossils.**
   Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

3. **I am excited to learn about how the earth has changed over time**
   Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

4. **There is at least one thing that I wonder about in our Earth's Features Unit.**
   Yes   No

5. **I want to learn more or research about how the earth has changed over time.**
   Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

6. **I want to learn more about or research about rocks.**
   Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

7. **I want to learn more about or research about fossils.**
   Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

<u>APPENDIX D</u>

CURIOSITY SHORT ANSWER QUESTIONS

Name_____ #_____ Date_____ HR_____

Participation in this research is voluntary and participation or non- participation will not affect a student's grade or class standing in any way.

1. Do you want to learn more about how the earth has changed over time, rocks or fossils? If yes, what do you want to learn more about?

   _____

   _____

   _____

   _____

2. What is something our earth's features unit makes you wonder?

   _____

   _____

   _____

3. Do you want to find out answers to any of these wonders in class or outside of class? Why or why not?

   _____

   _____

   _____

   _____

APPENDIX E

STUDENT DEMOGRAPHIC DATA

EL= English Language Learner

Number	Demographics
1	Exited EL, Gifted
2	EL level 2 in reading and writing
3	Gifted
4	EL level 2 in reading and writing
5	Social IEP
6	
7	Exited EL
8	EL level 2 in reading and writing
9	
10	EL level 2 in reading and writing
11	Exited EL
12	
13	EL level 2 in reading and writing, receives free and reduced lunch
14	
15	Strongly dislikes science
16	Exited EL
17	Social IEP
18	Exited EL
19	Strongly dislikes science
20	Exited EL

21	Safety net reading
22	
23	EL level 2 in reading and writing
24	
25	Exited EL
26	Gifted
27	504 for focus
28	
29	receives free and reduced lunch
30	
31	
32	Vision 504
33	Exited EL
34	Reading Safety Net, receives free and reduced lunch
35	Trouble focusing
36	504, EL level 2 reading and writing
37	
38	
39	
40	Exited EL
41	Exited EL, receives free and reduced lunch
42	
43	Gifted

44	
45	
46	

<u>APPENDIX F</u>

TYPICAL AMPLIFY LESSON FORMAT

According to Amplify's website, "Each unit of Amplify Science engages students in a relevant, real-world problem where they investigate scientific phenomena, engage in collaboration and discussion, and develop models or explanations in order to arrive at solutions." Amplify also explains, "Amplify Science is rooted in the Lawrence Hall of Science's Do, Talk, Read, Write, Visualize model of learning. This research-based approach presents students with multiple modalities through which to explore the curriculum." Amplify's lesson are thus centered around this "Do, Talk, Read, Write" format. Each lesson include most to all of these components.

APPENDIX G

PRE-ASSESSMENT

Name: _____ Date: _____

Scientific Argument About the Environment
When the Upper Layer Formed

1. Write a scientific argument that answers Question 1 below.
2. Begin your argument with the claim you made on page 42 in your Investigation Notebook. Then, record the evidence that supports the claim. Your argument should include:
   - a claim that answers the question.
   - data and ideas that support the claim.
   - scientific language to connect data and ideas together to support the claim.
3. Using what you learned from your investigations of the rocky outcrop, answer Question 2.

Question 1: What was the environment like in Desert Rocks National Park when the upper rock layer formed?

The environment of Desert Rocks National Park was _____

_____ .

The data show that _____

_____

_____ .

I know that _____

_____

_____ .

This means that _____

_____

_____ .

Name: _____ Date: _____

Scientific Argument About the Environment
When the Upper Layer Formed (continued)

The data shows that _____

_____

_____ .

I know also know that _____

_____

_____ .

This means that _____

_____

_____ .

Question 2: How do you know that the environment must have changed
from the time when the upper layer and lower layer formed?

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

APPENDIX H

MID-UNIT ASSESSMENT AND EVIDENCE CARDS

Name: _____ Date: _____

End-of-Unit Writing Part 1: Arguing About the Environment When the Unknown Rock Layer Formed

1. Write a scientific argument that answers Question 1 below.
2. Your argument should include:
   - a claim that answers the question.
   - data and ideas that support the claim.
   - scientific language to connect data and ideas together to support the claim.
3. Your audience is the park director at Desert Rocks National Park.

Dessert Rocks Canyon rocky outcrop

① *Inoceramus*

UNKNOWN LAYER
Shale: ?

UPPER LAYER
Mudstone: Deep Ocean

LOWER LAYER
Siltstone: Floodplain

(Image credits: left, Shutterstock; right, Ghedoghedo via CC BY-SA 3.0)

Question 1: What was the environment like when the unknown layer formed?

Claim: When the unknown layer formed the environment at Desert Rocks National Park was _____ .

Name: _____ Date: _____

End-of-Unit Writing Part 1: Arguing About the Environment
When the Unknown Rock Layer Formed (continued)

The data shows that _____

_____

_____ .

I know that _____

_____

_____ .

I also know that _____

_____

_____ .

This means that _____

_____

_____ .

The data shows that _____

_____

_____ .

I know that _____

_____

_____ .

Name: _____ Date: _____

End-of-Unit Writing Part 1: Arguing About the Environment
When the Unknown Rock Layer Formed (continued)

I also know that _____

_____

_____ .

This means that _____

_____

_____ .

Evidence Card 1
Data from Geologists' Observations

Inoceramus Fossil

UNKNOWN LAYER
Shale
UPPER LAYER
Mudstone, Deep Ocean
LOWER LAYER
Saltstone, Floodplain

rocky outcrop

Lesson 3.5: Students' Arguments

Evidence Card 2
Idea from *Fossil Hunter's Handbook*

Clay piles up in floodplains, lakes, a shallow part of the ocean, or a deep part of the ocean.

Evidence Card 3
Idea from *Fossil Hunter's Handbook*

Shale is a sedimentary rock made mostly of clay, a tiny sediment.

Evidence Card 4
Idea from a Reference Book

An *Inoceramus* is a shelled animal similar to an oyster that was found in beach environments or shallow parts of the ocean.

<u>APPENDIX I</u>

LWSD ENGAGING IN ARUGMENT FROM EVIDENCE RUBRIC

Science and Engineering Practice Rubric: Engaging in Argument from Evidence

Criterion	Level 1 – Not at Standard (1 point)	Level 2 – Approaching Standard (2 points)	Level 3 – Meets Standard (3 points)	Level 4 – Exceeds Standard (4 points)
Responsive	Arguments do not include a claim that addresses the problem or question at hand. The argument does not attempt to describe an observed phenomenon by proposing a claim that accounts for how or why the observed phenomenon occurred.	Arguments include a claim that partially address the problem or question at hand. The argument attempts to go beyond describing an observed phenomenon by proposing a claim that accounts for how or why the observed phenomenon occurred.	Arguments include a claim that fully addresses the problem or question at hand. The argument should go beyond describing an observed phenomenon by proposing a claim that accounts for how or why the observed phenomenon occurred.	Arguments include a claim that addresses the problem or question at hand. The argument extends beyond describing an observed phenomenon by proposing a claim that accounts for how and why the observed phenomenon occurred.
Provides supporting evidence	Argument employs no information as evidence to support the claim.	Argument employs low-quality information as evidence to support the claim.	Argument employs high-quality information as evidence to support the claim.	Argument employs multiple pieces of high-quality information as evidence to support the claim.
Justified by the reasoned use of evidence	Argument does not connect available evidence to the claim in and is unable to convince the audience that the proposed explanation is the best one available.	Argument attempts to connect available evidence to the claim in a way that will show the audience that the proposed explanation is a feasible solution.	Argument connects available evidence to the claim in a way that will convince the audience that the proposed explanation is the best one available.	Argument connects both available and student provided evidence to the claim in a way that will convince the audience that the proposed explanation is the best one available.
Clear and well-organized	Argument is not written in a structure that makes it easy for the intended audience to understand and lacks the use of appropriate scientific language.	Argument is written with a structure that makes it easy for the intended audience to understand and uses scientific language appropriately.	Argument is written with a structure that is clear and makes it easy for the intended audience to understand and uses scientific language effectively.	Argument is written with a structure that is clear, concise, and makes it easy for the intended audience to understand and employs the use of various scientific language effectively.
Engages with alternative claim (4th and 5th only)	The argument does not consider or critique alternative claims.	The argument eludes to alternative claims.	The argument considers alternative claims and critiques them.	The argument uses alternative claims and critiques them.

2nd and 3rd grade:

Criterion	1	1.5	2	2.5	3	3.5	4
Range	0-4	5-6	7-8	9-10	11-12	13-14	15-16

4th and 5th grade:

Criterion	1	1.5	2	2.5	3	3.5	4
Range	0-5	6-8	9-10	11-13	14-15	16-18	19-20

APPENDIX J

END OF UNIT ASSESSMENT

Name: _____ Date: _____

End-of-Unit Writing Part 2: Arguing About Why More Rock Layers Were Exposed in Desert Rocks Canyon

1. Write a scientific argument that answers the question below.
2. Your argument should include:
   - a claim that answers the question.
   - data and ideas that support the claim.
   - scientific language to connect data and ideas together to support the claim.
3. Your audience is the park director at Desert Rocks National Park.

Question: Why did more rock layers get exposed in Desert Rocks Canyon than in Keller's Canyon?

More rock layers got exposed in Desert Rocks Canyon than in Keller's

Canyon because _____

_____ .

The data show that _____

_____

_____ .

I know that _____

_____

_____ .

I also know _____

_____

Earth's Features—Lesson 4.5 (Version B)

Name: _____ Date: _____

End-of-Unit Writing Part 2: Arguing About Why More Rock Layers Were Exposed in Desert Rocks Canyon (continued)

_____ .

This means that _____

_____

_____

_____ .

The data shows that_____

I know that _____

I also know that

_____

This means that_____

APPENDIX K

EMOTIONAL ENGAGEMENT SHORT ANSWER QUESTIONS

Name_____ #_____ HR_____ Date_____

Participation in this research is voluntary and participation or non- participation will not

affect a student's grade or class standing in any way.

1. Do you enjoy learning new things in science? Explain why or why not.

   _____

   _____

   _____

   _____

2. Do you think science is fun? Explain why or why

   not. _____

   _____

   _____

   ___

3. Do you work as hard as you can in science? Explain why or why

   not. _____

   _____

   _____

APPENDIX L

FIELD NOTE FORMAT

Lesson Grey= Uppendahl White= O'Brien		
Statement Students are_____	Rating 1-5 1= Strongly Agree 5=Strongly Disagree	Comments
Listening with attention		
On-Task		
Excited about the lesson		
Sharing their ideas		
Asking questions about their wonders		
Predict answers to questions		

Overall thoughts on engagement:

Overall thoughts on curiosity:

Overall thoughts on how lesson facilitates growth:

Overall thoughts:

<u>APPENDIX M</u>

INSTITUTIONAL REVIEW BOARD (IRB) EXEMPTION LETTER

INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
FWA 00000165

MONTANA STATE UNIVERSITY

2155 Analysis Drive
c/o Microbiology & Immunology
Montana State University
Bozeman, MT 59718
Telephone: 406-994-4706
FAX: 406-994-4303
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Chair: Mark Quinn
406-994-4707
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Administrator:
Cheryl Johnson
406-994-4706
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MEMORANDUM

TO: Kathryn Ann Uppendahl and Walter Woolbaugh

FROM: Mark Quinn

DATE: October 4, 2019

RE: *"The Impact of the Amplify Curriculum on Students and Teachers"* [KU100419-EX]

The above research, described in your submission of October 3, 2019, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

__X__   (b) (1)   Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

__X__   (b) (2)   Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation; and (iii) the information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by section 16.111(a)(7).

_____ (b) (3)   Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

_____ (b) (4)   Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.

_____ (b) (5)   Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

_____ (b) (6)   Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.

APPENDIX N

EXPLANATION OF GROWTH DATA

On the pre-assessment, the mean score was 2.47, meaning that the majority of students were approaching standard. The histogram (figure 2) has a slight right skew, with 13 students scoring level 3, but most students scored below standard (below a level 3). Only six students scored level 3.5, the highest grade attainable. The box whisker plot (figure 1) indicates that students scores spanned the range of possible scores. The lower quartile of students scored a level 2, while the upper quartile of students scored a level 3. Specific student pre-assessment data can be found in Appendix Q.

On the mid-unit assessment, the mean grade was 2.54, only slightly higher than the mean of the pre-assessment. Certainly not high enough to be considered statically different. The histogram (figure 3) shows that fewer students got 3.5's on the mid-unit assessment than the pre-assessment, while more students got 2's on the mid-unit assessment than the pre-assessment. The box whisker plot (figure 1) shows that both the median, the quartile ranges, and the data range are essentially the same. Specific student mid-unit assessment data can be found in Appendix Q.

The mean score of the final assessment was slightly higher at 2.68, closer to standard than the previous two assessments. In *figure 1.*, the box whisker plot shows that the final data set has a median of 3, higher than the earlier assessments. It also shows that while the lower quartile still scored a level 2, the upper quartile scored a level 3.5. Examining the histogram in *figure 4.* shows that 17 students scored a 3.5, and nine students scored a 3. Meaning 57% (26/45) students were at or above standard on the final assessment, a 14% improvement from the first assessment. Specific student post-assessment data can be found in Appendix Q.

APPENDIX O

PROCEDURE FOR ANALYZING EVSD DATA

The EvsD Scale was a Likert scale, so it was first analyzed using the Chi-Square Goodness of Fit Test. The data met the Chi-Square Goodness of Fit Test assumptions of being a SRS and being independent of each other. First, each EvsD scale given had its data analyzed using the Chi-Square Goodness of Fit Test. To do this I used the statistical program R, and ran the Chi-Square Goodness of Fit Test. The test was run on each question in each data set separately. Data from the test told me the likelihood of the Likert scale answers for each question were due to chance. The test's null hypothesis was that the students answered each question in equal frequencies (meaning each Likert scale answer should have a response frequency of 20%). So, frequencies that were statistically significantly more extreme than 20% told me that the student responses were not due to chance alone.

Once each data set was analyzed individually in R, the middle of the unit EvsD scale was compared to the end the unit EvsD Scale. This was analyzed in R with a G-Test For Goodness of Fit. A G-Test was used instead of a Chi-Square test because many of the expected frequencies were less than five. Again, these were compared single question to single question. If the frequencies beginning and end of the unit EvsD scale were found to be statistically significantly different, then I could say that Amplify may have caused these frequencies to change over the course of the unit.

After that, I carefully examined which frequencies of responses to which questions changed and how they have changed. This allowed me to extrapolate how Amplify had changed (or not changed) behavioral and emotional engagement over the course of the unit.

APPENDIX P

PROCEDURE FOR ANALYZING CURIOSITY LIKERT SCALE DATA

The Curiosity Likert Scale was analyzed using the Chi-Square Goodness of Fit Test. The data met the Chi-Square Goodness of Fit Test assumptions of being a SRS and being independent of each other. First, each Curiosity Likert scale given had its data analyzed alone using the Chi-Square Goodness of Fit Test. To do this I ran the Chi-Square Goodness of Fit Test on each data set in R. The test was run on each question in each data set separately. The Chi-Square Goodness of Fit test told me the likelihood of the Likert scale answer to a single question being due to chance. The test's null hypothesis was that the students answered each question in equal frequencies (meaning each Likert scale answer should have a response frequency of 20%). So, if the frequencies were statistically significantly more extreme than 20%, I knew that the proportions of the answers of the students are not equal. This told me if the student responses were not due to chance alone.

APPENDIX Q

INDIVIDUAL STUDENT GROWTH DATA

Number	Demographics	Pre-Assessment Grade	Mid-Unit Assessment Grade	Post-Assessment Grade
1	Exited EL, Gifted	3.5	2.5	3.5
2	EL level 2 in reading and writing	2.5	1.5	abs
3	Gifted	3	3.5	3.5
4	EL level 2 in reading and writing	1.5	1	2
5	Social IEP	3	3.5	3
6		2.5	2.5	3.5
7	Exited EL	2.5	2	2 abs
8	EL level 2 in reading and writing	2	2	1.5
9		3	3	3.5
10	EL level 2 in reading and writing	3	2.5	3.5
11	Exited EL	Absent for lessons needed for test, did not take	1.5	3
12		3.5	3.5	3.5
13	EL level 2 in reading and writing	2.5	2	1.5 abs
14		3	3.5	3
15	Strongly dislikes science	3	2.5	3
16	Exited EL	3	1.5	3.5

17	Social IEP	2	1.5	2.5 -had it, just did not give complete answers
18	Exited EL	2.5	3.5	2.5
19	Strongly dislikes science	Absent for lessons needed for test, did not take	2.5	3
20	Exited EL	3	3	3
21	Safety net reading	2	1	1.5
22		3	3.5	3.5
23	EL level 2 in reading and writing	3	2	2.5
24		3.5	3.5	3.5
25	Exited EL	3	3	3.5
26	Gifted	1	3	1.5
27	504 for focus	1	2.5	3.5
28		2	2	3
29		1	3.5	3.5
30		2.5	2.5	3.5
31		1.5	2	1
32	Vision 504	3.5	3	3.5
33	Exited EL	3.5	2	3
34	Reading Safety Net	2	2	2.5
35	Trouble focusing	1.5	3.5	1.5

36	504, EL level 2 reading and writing	1.5	2	1
37		3	3	2.5
38		2.5	3	2.5 abs
39		2.5	2.5	1.5 abs
40	Exited EL	1.5	2	1.5
41	Exited EL	2	2	1.5
42		3.5	3	3.5
43	Gifted	Absent for lessons needed for test, did not take	3.5	3.5
44		2	2	2.5
45		2	abs	3.5
46		3	3.5	3.5

APPENDIX R

INDIVIDUAL MID-UNIT AND END-OF-UNIT EVSD RESPONSES

		Individual Mid-Unit EvsD Responses									
#	Demo-graphics	EvsD Questions									
		I try hard to do well in science	In science I work as hard as I can	When I am in science I participate in class discussions	I pay attention in science	When I am in science, I listen carefully	When I am in science, I feel good	When I am working on something in science, I feel interested	Science class is fun	I enjoy learning new things in science	When we work on something in science class, I get involved
1	Exited EL, Gifted	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
2	EL level 2 in reading and writing	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
3	Gifted	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
4	EL level 2 in reading and writing	Neutral	Neutral	Agree	Neutral	Neutral	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
5	Social IEP	Agree	Agree	Neutral	Agree	Agree	Neutral	Neutral	Neutral	Neutral	Neutral

#	Description										
6		Agree	Agree	Agree	Agree	Agree	Agree	Agree	Agree	Agree	Agree
7	Exited EL	Agree	Agree	Agree	Agree	Agree	Neutral	Neutral	Agree	Agree	Agree
8	EL level 2 in reading and writing	Strongly agree	Strongly agree	Agree	Strongly agree	Agree	Neutral	Strongly agree	Strongly agree	Strongly agree	Strongly agree
9		Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Agree	Strongly agree	Agree	Strongly agree	Strongly agree
10	EL level 2 in reading and writing	Agree	Agree	Neutral	Strongly agree	Strongly agree	Agree	Neutral	Strongly agree	Strongly agree	Disagree
11	Exited EL	Agree	Agree	Agree	Agree	Agree	Neutral	Agree	Neutral	Strongly agree	Strongly agree
12		Strongly agree	Agree	Neutral	Strongly agree	Strongly agree	Disagree	Neutral	Neutral	Agree	Neutral
13	EL level 2 in reading and writing	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Agree	Agree	Strongly agree	Agree	Agree	Strongly agree
14		Strongly agree	Strongly agree	Neutral	Strongly agree	Strongly agree	Agree	Agree	Strongly agree	Agree	Disagree
15	Strongly dislikes science	Neutral	Agree	Neutral	Neutral	Neutral	Disagree	Strongly disagree	Strongly disagree	Disagree	Neutral

16	Exited EL	Strongly agree	Strongly agree	Agree	Strongly agree	Agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
17	Social IEP	Agree	Agree	Neutral	Neutral	Neutral	Neutral	Neutral	Agree	Neutral	Neutral
18	Exited EL	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
19	Strongly dislikes science	Neutral	Neutral	Neutral	Agree	Agree	Disagree	Strongly disagree	Strongly disagree	Disagree	Neutral
20	Exited EL	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
21	Safety net reading	Agree	Agree	Neutral	Agree	Agree	Disagree	Disagree	Disagree	Neutral	Agree
22	Strongly agree	Strongly agree	Neutral	Strongly agree	Strongly agree	Strongly agree	Agree	Strongly agree	Strongly agree	Neutral	
23	EL level 2 in reading and writing	Agree	Strongly agree	Strongly agree	Neutral	Agree	Neutral	Disagree	Agree	Neutral	Neutral
24		Strongly agree	Strongly agree	Agree	Agree	Agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
25	Exited EL	Agree	Agree	Neutral	Agree	Agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Neutral

26	Gifted	Strongly agree	Strongly agree	Neutral	Agree	Agree	Agree	Neutral	Agree	Agree	Agree
27	504 for focus	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Agree	Strongly agree	Strongly agree	Strongly agree
28		Agree	Neutral	Neutral	Agree	Agree	Neutral	Neutral	Neutral	Agree	Neutral
29		Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
30		Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
31		Agree	Agree	Agree	Agree	Strongly agree	Disagree	Neutral	Neutral	Neutral	Strongly agree
32	Vision 504	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
33	Exited EL	Agree	Agree	Neutral	Neutral	Agree	Neutral	Neutral	Neutral	Neutral	Agree
34	Reading Safety Net	Strongly agree	Strongly agree	Agree	Strongly agree	Strongly agree	Strongly agree	Agree	Strongly agree	Strongly agree	Strongly agree
35	Trouble focusing	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
36	504, EL level 2 reading	Strongly agree	Strongly agree	Strongly agree	Agree	Agree	Agree	Agree	Strongly agree	Agree	Strongly agree

#											
	and writing										
37		Strongly agree	Agree	Agree	Agree	Agree	Agree	Agree	Agree	Neutral	Agree
38		Strongly agree	Agree	Strongly agree	Strongly agree	Strongly agree	Agree	Agree	Agree	Strongly agree	Strongly agree
39		Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
40	Exited EL	Strongly agree	Strongly agree	Agree	Agree	Agree	Agree	Neutral	Strongly agree	Neutral	Strongly agree
41	Exited EL	Strongly agree	Strongly agree	Agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Agree
42		Strongly agree	Strongly agree	Strongly agree	Agree	Agree	Agree	Agree	Agree	Strongly agree	Strongly agree
43	Gifted	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
44		Agree	Agree	Agree	Agree	Agree	Neutral	Neutral	Neutral	Neutral	Neutral
45		Agree	Agree	Neutral	Neutral	Neutral	Strongly agree	Neutral	Strongly agree	Agree	Neutral

#	Demographics										
46		Strongly agree	Agree	Agree	Agree	Agree	Neutral	Strongly agree	Agree	Strongly agree	Agree

Individual Post-Unit EvsD Responses											
#	Demo-graphics	EvsD Questions									
		I try hard to do well in science	In science I work as hard as I can	When I am in science I participate in class discussions	I pay attention in science	When I am in science, I listen carefully	When I am in science, I feel good	When I am working on something in science, I feel interested	Science class is fun	I enjoy learning new things in science	When we work on something in science class, I get involved
2	EL level 2 in reading and writing	Strongly agree	Strongly agree	Agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
3	Gifted	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree

#											
4	EL level 2 in reading and writing	Neutral	Agree	Strongly agree	Strongly disagree	Strongly disagree	Neutral	Strongly agree	Strongly agree	Strongly agree	Strongly agree
5	Social IEP	Agree	Agree	Neutral	Neutral	Agree	Agree	Agree	Neutral	Agree	Agree
6		Agree	Agree	Agree	Agree	Neutral	Neutral	Neutral	Strongly agree	Strongly agree	Agree
7	Exited EL	Agree	Agree	Agree	Agree	Agree	Disagree	Disagree	Strongly disagree	Neutral	Agree
8	EL level 2 in reading and writing	Strongly agree	Strongly agree	Agree	Strongly agree	Strongly agree	Neutral	Strongly agree	Agree	Strongly agree	Agree
9		Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Agree	Agree	Agree	Agree	Strongly agree
10	EL level 2 in reading and writing	Agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Agree	Neutral	Agree	Strongly agree	Neutral
11	Exited EL	Strongly agree	Strongly agree	Agree	Agree	Agree	Neutral	Strongly agree	Agree	Strongly agree	Strongly agree
12		Strongly	Strongly	Disagree	Agree	Agree	Neutral	Neutral	Disagree	Neutral	Neutral

		agree	agree								
13	EL level 2 in reading and writing	Strongly agree	Strongly agree	Agree	Agree	Strongly agree	Agree	Agree	Agree	Strongly agree	Strongly agree
14		Agree	Agree	Neutral	Agree	Agree	Neutral	Neutral	Agree	Agree	Neutral
15	Strongly dislikes science	Neutral	Neutral	Neutral	Strongly disagree	Strongly disagree	Neutral	Strongly disagree	Strongly disagree	Disagree	Neutral
16	Exited EL	Agree	Strongly agree	Agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
17	Social IEP	Neutral	Neutral	Disagree	Disagree	Neutral	Disagree	Strongly disagree	Disagree	Strongly disagree	Neutral
18	Exited EL	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
19	Strongly dislikes science	Agree	Neutral	Agree	Agree	Agree	Strongly disagree	Strongly disagree	Strongly disagree	Neutral	Agree
20	Exited EL	Agree	Agree	Agree	Strongly agree	Strongly agree	Neutral	Agree	Agree	Agree	Agree

21	Safety net reading	Agree	Agree	Agree	Agree	Agree	Neutral	Neutral	Neutral	Neutral	Neutral
22	Strongly agree	Strongly agree	Strongly agree	Neutral	Strongly agree	Strongly agree	Agree	Agree	Strongly agree	strongly agree	Agree
23	EL level 2 in reading and writing	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Agree
24		Agree	Agree	Strongly agree	Agree	Agree	Strongly agree	Strongly agree	Strongly agree	Agree	Neutral
25	Exited EL	Strongly agree	Agree	Neutral	Agree	Neutral	Strongly agree	Strongly agree	Agree	Strongly agree	Neutral
26	Gifted	Strongly agree	Strongly agree	Neutral	Agree	Agree	Agree	Agree	Strongly agree	Agree	Agree
27	504 for focus	Strongly agree	Strongly agree	Strongly agree	Agree	Agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
28		Agree	Neutral	Neutral	Agree	Agree	Neutral	Neutral	Neutral	Neutral	Neutral
29		Strongly agree	Strongly agree	Agree	Agree	Strongly agree	Disagree	Strongly agree	Strongly agree	Strongly agree	Agree
30		Strongly	Strongly	Agree	Strongly agree	Agree	Strongly agree	Agree	Neutral	Strongly agree	Strongly

#											
		agree	agree								agree
31		Agree	Agree	Agree	Agree	Agree	Disagree	Neutral	Neutral	Neutral	Agree
32	Vision 504	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
33	Exited EL	Agree	Agree	Neutral	Agree	Agree	Neutral	Neutral	Neutral	Neutral	Neutral
34	Reading Safety Net	Strongly agree	Strongly agree	Agree	Agree	Agree	Agree	Agree	Agree	Agree	Agree
35	Trouble focusing	Agree	Agree	Agree	Agree	Agree	Agree	Agree	Strongly agree	Agree	Agree
36	504, EL level 2 reading and writing	Strongly agree	Strongly agree	Agree	Neutral	Agree	Agree	Agree	Agree	Agree	Agree
37		Strongly agree	Strongly agree	Agree	Strongly agree	Strongly agree	Agree	Agree	Agree	Agree	Strongly agree
38		Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Agree	strongly agree	Strongly agree	Strongly agree
39		Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Neutral	Agree	Neutral	Agree	Strongly agree
40	Exited EL	Agree	Agree	Agree	Agree	Neutral	Agree	Neutral	Agree	Agree	Neutral

41	Exited EL	Agree	Strongly agree	Agree	Strongly agree	Strongly agree	Agree	Strongly agree	Strongly agree	Strongly agree	Agree
42		Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree
43	Gifted	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Agree	Agree	Strongly agree	Strongly agree	Strongly agree
44		Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
45		Agree	Agree	Neutral	Neutral	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Neutral
46		Agree	Agree	Neutral	Agree	Agree	Neutral	Agree	Neutral	Agree	Neutral

APPENDIX S

EVSD CHI-SQUARE AND G-TEST RESULTS

	I try hard to do well in science	In science I work as hard as I can	When I am in science I participate in class discussions	I pay attention in science	When I am in science, I listen carefully	When I am in science, I feel good	When I am working on something in science, I feel interested	Science class is fun	I enjoy learning new things in science	When we work on something in science class, I get involved
EvsD Earth Features 1, Answer Frequencies	Strongly Disagree: 0 Disagree: 0 Neutral: 3 Agree: 14 Strongly Agree: 29	Strongly Disagree: 0 Disagree: 0 Neutral: 3 Agree: 17 Strongly Agree: 26	Strongly Disagree: 0 Disagree: 0 Neutral: 14 Agree: 14 Strongly Agree: 18	Strongly Disagree: 0 Disagree: 0 Neutral: 6 Agree: 16 Strongly Agree: 23	Strongly Disagree: 0 Disagree: 0 Neutral: 4 Agree: 21 Strongly Agree: 13	Strongly Disagree: 0 Disagree: 5 Neutral: 10 Agree: 11 Strongly Agree: 19	Strongly Disagree: 2 Disagree: 2 Neutral: 12 Agree: 9 Strongly Agree: 20	Strongly Disagree: 2 Disagree: 1 Neutral: 7 Agree: 11 Strongly Agree: 24	Strongly Disagree: 0 Disagree: 2 Neutral: 9 Agree: 8 Strongly Agree: 26	Strongly Disagree: 0 Disagree: 2 Neutral: 11 Agree: 8 Strongly Agree: 24
EvsD Earth Features 1, Chi-Square P-Values	P-value= 6.594e-14	P-value= 3.09e-12	P-value= 2.076e-06	P-value= 2.214e-09	P-value= 5.37e-09	P-value= 0.0001635	P-value= 4.311e-05	P-value= 9.072e-08	P-value= 1.78e-09	P-value= 4.328e-08
EvsD Earth Features 2, Answer Frequencies	Strongly Disagree: 0 Disagree: 0 Neutral: 4 Agree: 19 Strongly Agree: 23	Strongly Disagree: 0 Disagree: 0 Neutral: 6 Agree: 15 Strongly Agree: 25	Strongly Disagree: 0 Disagree: 2 Neutral: 11 Agree: 20 Strongly Agree: 13	Strongly Disagree: 2 Disagree: 1 Neutral: 4 Agree: 20 Strongly Agree: 19	Strongly Disagree: 2 Disagree:0 Neutral: 5 Agree: 18 Strongly Agree: 21	Strongly Disagree: 1 Disagree: 4 Neutral: 15 Agree: 13 Strongly Agree: 13	Strongly Disagree: 3 Disagree: 1 Neutral: 11 Agree: 15 Strongly Agree: 16	Strongly Disagree: 3 Disagree: 3 Neutral: 9 Agree: 12 Strongly Agree: 18	Strongly Disagree: 1 Disagree: 1 Neutral: 8 Agree: 14 Strongly Agree: 22	Strongly Disagree: 0 Disagree: 0 Neutral: 14 Agree: 15 Strongly Agree: 17
EvsD Earth Features 2, Chi-Square P-Values	P-value= 1.096e-10	P-value=3.119e-10	P-value= 6.378e-06	P-value= 6.966e-08	P-value=3.744e-08	P-value= 0.001895	P-value=0.0003939	p-value=0.001234	P-value=4.58e-7	P-value= 2.821e-06
Comparing EvsD 1 vs. EvsD 2 frequencies with a G-Test of Goodness of Fit	P-value= 0.518	P-value= 0.6265	P-value= 2.2e-16	P-value= 2.2e-16	P-value= 2.2e-16	P-value= 2.2e-16	P-value= 0.1201	P-value= 0.41	P-value=0.15	P-value= 0.007

<u>APPENDIX T</u>

EMOTIONAL ENGAGEMENT SHORT ANSWER RESPONSE SUMMARIES

#	Demographics	Mid-Unit Emotional Engagement Sort Answer Responses				Post-Unit Emotional Engagement Sort Answer Responses		
		Do you enjoy learning new things in science?	Do you think science is fun?	Do you work as hard as you can in science?		Do you enjoy learning new things in science?	Do you think science is fun?	Do you work as hard as you can in science?
1	Exited EL, Gifted	Sometimes, it depends on the topic	Sometimes, it depends on the topic	Sometimes, it depends on the topic		Agree. I don't like to stay on a topic forever	Disagree. I really don't like to go in depth with boring topics	Neutral- it depends on the topic
2	EL level 2 in reading and writing	Yes: I like science	Yes: Science is fun	Yes: I work hard, but cant get any right answers		Yes.	Yes.	Yes
3	Gifted	Yes: its interesting, I want to learn it	Yes: Its interesting	Yes: Its fun		Yes because our units are fun and its exciting to learn new things.	Yes because it keeps me interesting and I don't think it is boring. Some things are really fund because we build our own modeland get to see what it does.	I work hard in science because I am happy and have fun figuring things out in sims, worksheets and models.
4	EL level 2 in reading and	Yes: I love science	Yes: Its fun	Sometimes it is hard because I		Yes. We get to learn how things are	Yes. Experiments	Yes

				dont listen			
5	Social IEP	Yes	Sciecne is alright	Yes			
6		Yes: I like to explore the world	Yes: its fun to explore	Yes: I want good grades	Yes I like to learn more about our planet and sands	Yes Science is amazing its fun to learn about different things on our planet	Yes I work as hard as I can all the time
7	Exite d EL	Yes: I did not know	Yes: I did not know these things	Yes: Good grades	Not that much because I don't like science that much	No it's a little boring	Yes I want better grades
8	EL level 2 in readin g and writin g	Yes: its fun	Yes: You can learn more things	Yes: I want good grades	Yes because its interestin g	Yes because you do not have to do boring stuff	Yes so I don't get in trouble
9		Yes: its interestin g	Yes: Full of surprises	Yes: I enjoy science	Yes I like learning new things	Kind of because I am not a big fan of science	Yes because I want good grades
10	EL level 2 in readin g and writin g	Yes: I like learning new things	Yes: Its fun to work with your friends, and to get good grades	Yes: For tests. I also work hard without my	Yes because I like learning new things so I will be better at	Yes because we do stream and work. It is very fun.	I do when somethin g is really important to me and you Ms. Uppenda hl

					friends there		new things.		
11	Exited EL	Yes: its interesting	Somewhat	Yes: We need to know a lot of things	Yes because I get to know how it works.	Yes when we do experiments	Yes it is interesting.
12		Yes: I can learn more and be smarter	No: I don't like learning about things in the past or the body of animals	Yes: Good grades	Sometimes because I might know the thing we are learning or not	Sometimes like when we do fun experiments I think it is fun but when we have to write all the time and be at the carpet I think it is boring	Yes because I can get a good grade
13	EL level 2 in reading and writing	Yes: I learn new things	Yes: its fun	Yes: It can be hard for some people.... did he think this asked if science was hard?	Yes because its interesting	kind of	Yes because its cool
14		Yes: I like to learn new information	Yes: experiments	Yes: the harder I work, the more fun I have	Yes. Learning about the earth and life is really fun	We learn cool things about the world	Yes. So I can understand everything

15	Strongly dislikes science					No its boring	Not its boring only engineering is fun	Yes becaue even though I hate it I still try hard
16	Exited EL	Yes: it is fun, I am interested	Yes: you learn interesting things	Yes: Good grades	Yes because learning new things in science helps me learn and also is interests me.	Yes because in science I get included and I love sharing with my partner.	Yes because I listen hard as I can to a lesson to get 4s or 3s on my assignment.
17	Social IEP	Yes: the sims are fun	Yes: the sims are fun	Yes: I want good grades	No because I don't like science	No because there are very little simulations	No because it isnt fun
18	Exited EL	Yes: It makes me understand what the earth was like before	Yes: you learn new things	Yes: I want to learn how the earth was made	No! Because enjoyment is meant to be in fun places, but not in science. I feel scared every single time when I do something because if something goes wrong I	Yes! It is but I take science serious because it is investigating something really important.	I work much more hard than in any subject. My goal is to find answers to all the wonders I have.

					am scared that I will get the wrong information.		
19	Strongly dislikes science				For a bit, then its repatitive after it has already stuck in my mind		I like to do the best I can in all education
20	Exited EL	Yes: its interesting	Yes: Experiments	Yes: I like science	Some yes some no	Kind of because you get to do experiments	Really yes because I like to do well so I can improve.
21	Safety net reading	No: It is not useful in life	No: We do not do fun stuff	Yes: I want to because I want to be done with the lesson	No because it wont be useful in life	No because its boring	Sometimes because I don't have fun

22		Yes: I like learning new things, it makes me wonder and I like wondering	Yes: Making rocks is fun	Yes: working hard lets you do fun things, so it pays off		Yes. I like telling my sibblings things they didn't know.	Yes. I like telling my sibblings things they didn't know	Yes science is exciting and the quicker you get done the more stuff you get to learn.
23	EL level 2 in reading and writing	Yes: Its interesting	Yes: experiments	Yes: I love science		I am just interested	My favorite is part is when we do experiment	I do my best behavior so I can learn more science
24		Yes: amplify is very detailed	Yes: Ms U. has a fun way of teaching	Yes: Good grades		Yes because they are unique	Yes because I enjoy the earth's change over tiem	Yes because I want to get an A+
25	Exited EL	Yes: there is so much possibilities in science	Yes: there is always something to do	Yes: I want to be one (a scientist)		Yes because I like to knonw more		Yes because I want to be a biologist
26	Gifted	Yes: Its educational	Yes: We get to learn about how the earth has changed over time	Yes: Good grades		Yes because I like learning	Yes because science is fun and we get to do experimetns sometimes	Yes because I want to learn as much as I can to get a good education
27	504 for focus	Yes: I like learning about the earth	Yes: I have the best science teacher	Yes: Good grades		Yes because I like learning	Yes because I have the best science teacher to teach it	Yes so I wont let my family down

					about the earth		with my grades
28		Yes: its interesting	Yes: experiments	Yes: its interesting	No because I don't really like science kind of stuff	Only when we do experiments and models	Yes because I want good grades
29					Yes because they may be helpful another time	Yes because I learn new things and fun models	Yes because its very fun and interesting
30		Yes: I like learning	Yes: Its a mess	Yes: Good grades	Yes I like to learn	Ok I do get bored	Yes so I get a good grade
31		Somewhat: I never get called on	A little	I try	Yes I am curious	Oh yes its pretty fun because I get to do experiments	I do because I want good grades
32	Vision 504	Yes: It makes me have wonders	Yes: You explore in science	Yes: I love science	Yes because it's fun and we explore	Yes because it bring mystery	Yes because I love science
33	Exited EL				Sometimes its fun	Sometimes because its interesting	Yes because I am good at it.

34	Reading Safety Net	Yes: its interesting	Yes: Its fun	Yes: Good grades	Yes becasuse science is fun	Yes becaues I am curious about things	Yes because I want a good grade and then I know what to do
35	Trouble focusing	Yes: I like to learn new things	Yes: You get to investiagate and write an argument to prove your thinking	Yes: This is my favorite subject so I listen	Yes because its fun and interesting	Yes becase you learn new things	Yes becaes I like science
36	504, EL level 2 reading and writing	Yes: I know what to do, you could ask lots of questions	Yes: you could ask a lot of questions	Yes; I can learn then when I post my college degree it will be the master of science	Yes	Because I like fosles and how sediment form	Yes because science is all about learning stuff
37		Yes: I like learning	Yes: the sims	Yes: Good grades	Yes because I love doing models	Yes because cool experiments	Yes I try to get good grades
38		Yes: I like learning, I like science	Yes: I like science	Yes: Good grades	Yes because I like to learn	Yes because we learn about things I have wondered my whole life. Also we do experiments	Yes good grades

39		Yes: its fun and exciting	Yes: Science is fun and exciting	Yes: When I work hard we get things done and have fun	Yes because its interesting	Yes and no, it matters what we are learning	Yes because I work hard at everything
40	Exited EL	Sometimes: Sometimes I know half the unit	Sometimes fossils are fun	Yes: Good grades	sometimes because I get ot learn about them all at home	Yes	Yes its interesting
41	Exited EL	Yes: I like rocks	Yes: I like projects	Yes: I listen at the carpet and my desk	Yes because science is my favorite	Yes becase we get to do experiments	yes
42		Yes: I can get to know the earth better	Yes: I like learning about animals and other stuff	Yes:	Yes because I use this knowledge in real life	Yes because it shows me things I cant learn in another opportunity	Yes I would like to figure out what we are learning
43	Gifted				Yes its fun	Yes its interesting and I learn things	Yes good grades
44		Yes: Its fun to talk with your partner	Yes: Its fun to talk and explore	Yes: sometimes science is hard-confused?	Yes because we do cool things when we do them	Yes because we do experiment with stuff	sometimes its too easy

45		Yes: its fun	Yes: its fun	Yes: Sometimes I get off track, but I try my best because its fun and a good experience	Yes because science is so fun I love science! When it comes to learning in science… IM DOWN	Yes yes yes its YOU you make it fun	Well not as hard all the time but that's because I'm pooped (tired) so when I'm not pooped (tired) I work as
46		Yes: I like learning new things, it makes me smarter	Yes: but its hard for me to remember some stuff	Yes	Sort of sometimes it gets boring but I mostly like it	I think its fun because we get to swap teachers and I like learning new things	Yes because I don't want to get a bard grade on my report card

APPENDIX U

INDIVIDUAL MID-UNIT AND END-OR-UNIT CURIOSITY LIKERT SCALE
RESPONSES

		Mid-Unit Individual Curiosity Likert Scale Responses						
#	Demographics							
		I am excited to learn about rocks and sediment	I am excited to learn about fossils	I am excited to learn about how the earth has changed over time	There is at least one thing that I wonder in our earth's features unit	I want to learn more about rocks and sediments	I want to learn more about fossils	I want to learn more about how the earth has changed over time
1	Exited EL, Gifted	Neutral	Neutral	Disagree	No	Neutral	Neutral	Disagree
2	EL level 2 in reading and writing	Strongly agree	Strongly agree	Strongly agree	No	Strongly Agree	Strongly Agree	Strongly Agree
3	Gifted	Strongly agree	Strongly agree	Strongly agree	Yes	Neutral	Agree	Agree
4	EL level 2 in reading and writing	Agree	Agree	Agree	Yes	Strongly Agree	Strongly Agree	Strongly Agree
5	Social IEP	Neutral	Agree	Agree	Yes	Disagree	Neutral	Agree
6		Agree	Agree	Agree	Yes	Agree	Agree	Agree

7	Exited EL	Agree	Agree	Agree	No	Neutral	Disagree	Neutral
8	EL level 2 in reading and writing	Agree	Strongly agree	Strongly agree	Yes	Strongly Agree	Agree	Strongly Agree
9		Strongly agree	Strongly agree	Strongly agree	Yes	Strongly Agree	Strongly Agree	Strongly Agree
10	EL level 2 in reading and writing	Strongly agree	Strongly agree	Strongly agree	Yes	Strongly Agree	Strongly Agree	Strongly Agree
11	Exited EL	Neutral	Strongly agree	Strongly agree	Yes	Neutral	Strongly Agree	Strongly Agree
12		Neutral	Neutral	Neutral	Yes	Agree	Neutral	Neutral
13	EL level 2 in reading and writing	Agree	Strongly agree	Agree	No	Agree	Strongly Agree	Agree
14		Agree	Agree	Strongly agree	Yes	Agree	Strongly Agree	Strongly Agree
15	Strongly dislikes science	Disagree	Disagree	Disagree	No	Disagree	Disagree	Disagree
16	Exited EL	Strongly agree	Strongly agree	Strongly agree	Yes	Strongly Agree	Strongly Agree	Strongly Agree
17	Social IEP	Neutral	Agree	Neutral	Yes	Neutral	Agree	Neutral
18	Exited EL	Strongly agree	Strongly agree	Strongly agree	Yes	Strongly Agree	Strongly Agree	Strongly Agree

19	Strongly dislikes science	Strongly Disagree	Strongly Disagree	Strongly Disagree	Yes	Strongly Disagree	Strongly Disagree	Strongly Disagree
20	Exited EL	Strongly agree	Strongly agree	Strongly agree	No	Strongly Agree	Strongly Agree	Strongly Agree
21	Safety net reading	Disagree	Disagree	Disagree	No	Disagree	Disagree	Disagree
22		Agree	Agree	Agree	Yes	Neutral	Agree	Neutral
23	EL level 2 in reading and writing	Neutral	Neutral	Disagree	Yes	Neutral	Agree	Disagree
24		Strongly agree	Strongly agree	Strongly agree	No	Strongly Disagree	Strongly Disagree	Strongly Disagree
25	Exited EL	Agree	Strongly agree	Strongly agree	Yes	Agree	Strongly Agree	Strongly Agree
26	Gifted	Agree	Agree	Strongly agree	No	Agree	Agree	Strongly Agree
27	504 for focus	Strongly agree	Strongly agree	Strongly agree	Yes	Strongly Agree	Strongly Agree	Strongly Agree
28		Neutral	Agree	Agree	No	Disagree	Neutral	Agree
29		Strongly agree	Strongly agree	Strongly agree	Yes	Strongly Agree	Strongly Agree	Strongly Agree
30		Strongly agree	Strongly agree	Strongly agree	No	Strongly Agree	Strongly Agree	Strongly Agree

31		Neutral	Strongly agree	Strongly agree	Yes	Neutral	Strongly Agree	Agree
32	Vision 504	Strongly agree	Strongly agree	Strongly agree	Yes	Strongly Agree	Strongly Agree	Strongly Agree
33	Exited EL	Neutral	Neutral	Neutral	Yes	Neutral	Neutral	Neutral
34	Reading Safety Net	Agree	Strongly agree	Agree	No	Agree	Agree	Agree
35	Trouble focusing	Strongly agree	Strongly agree	Strongly agree	Yes	Strongly Agree	Strongly Agree	Strongly Agree
36	504, EL level 2 reading and writing	Strongly agree	Agree	Agree	Yes	Strongly Agree	Strongly Agree	Strongly Agree
37		Agree	Agree	Agree	Yes	Neutral	Neutral	Neutral
38	need to add to responses	Strongly Agree	Strongly agree	Agree	No	Strongly Agree	Strongly Agree	Agree
39		Strongly agree	Strongly agree	Strongly agree	No	Strongly Agree	Strongly Agree	Strongly Agree
40	Exited EL	Neutral	Agree	Neutral	Yes	Neutral	Neutral	Neutral
41	Exited EL	Strongly agree	Strongly agree	Strongly agree	Yes	Strongly Agree	Strongly Agree	Strongly Agree
42		Neutral	Strongly agree	Strongly agree	Yes	Neutral	Agree	Strongly Agree

#	Demographics							
43	Gifted	Agree	Strongly agree	Strongly agree	Yes	Agree	Strongly Agree	Strongly Agree
44		Neutral	Neutral	Neutral	No	Disagree	Neutral	Disagree
45		Neutral	Agree	Strongly agree	Yes	Agree	Strongly Agree	Strongly Agree
46		Neutral	Agree	Neutral	Yes	Neutral	Agree	Neutral

Post-Unit Individual Curiosity Likert Scale Responses							
#	Demographics							
		I am excited to learn about rocks and sediment	I am excited to learn about fossils	I am excited to learn about how the earth has changed over time	There is at least one thing that I wonder in our earth's features unit	I want to learn more about rocks and sediments	I want to learn more about fossils	I want to learn more about how the earth has changed over time
1	Exited EL, Gifted	Strongly Disagree	Neutral	Neutral	Yes	Strongly Disagree	Disagree	Neutral

2	EL level 2 in reading and writing	Agree	Strongly agree	Strongly agree	Yes	Agree	Strongly Agree	Strongly Agree
3	Gifted	Strongly agree	Agree	Strongly agree	Yes	Neutral	Neutral	Strongly Agree
4	EL level 2 in reading and writing	Strongly agree	Strongly agree	Strongly agree	Yes	Strongly Agree	Strongly Agree	Strongly Agree
5	Social IEP	Agree	Disagree	Agree	Yes	Agree	Disagree	Agree
6		Agree	Agree	Strongly agree	Yes	Agree	Neutral	Agree
7	Exited EL	Neutral	Neutral	Neutral	No	Disagree	Disagree	Disagree
8	EL level 2 in reading and writing	Agree	Strongly agree	Strongly agree	Yes	Agree	Strongly Agree	Agree
9		Agree	Agree	Agree	No	Neutral	Neutral	Neutral
10	EL level 2 in reading and	Strongly agree	Strongly agree	Strongly agree	Yes	Agree	Strongly Agree	Strongly Agree

	writing						
11	Exited EL	Neutral	Strongly agree	Agree	Yes	Neutral	Strongly Agree	Agree
12		Agree	Neutral	Neutral	Yes	Disagree	Agree	Strongly Agree
13	EL level 2 in reading and writing	Agree	Agree	Agree	No	Agree	Agree	Agree
14		Neutral	Neutral	Neutral	Yes	Neutral	Neutral	Neutral
15	Strongly dislikes science	Disagree	Disagree	Disagree	Yes	Disagree	Disagree	Disagree
16	Exited EL	Strongly agree	Strongly agree	Strongly agree	Yes	Strongly Agree	Strongly Agree	Strongly Agree
17	Social IEP	Disagree	Disagree	Disagree	No	Strongly Disagree	Disagree	Disagree
18	Exited EL	Strongly agree	Strongly agree	Strongly agree	Yes	Strongly Agree	Strongly Agree	Strongly Agree
19	Strongly dislikes science	Disagree	Neutral	Neutral	No	Strongly Disagree	Disagree	Neutral

20	Exited EL	Agree	Neutral	Agree	Yes	Neutral	Neutral	Neutral
21	Safety net reading	Neutral	Agree	Neutral	No	Neutral	Agree	Neutral
22		Neutral	Neutral	Agree	No	Neutral	Neutral	Agree
23	EL level 2 in reading and writing	Disagree	Agree	Neutral	Yes	Agree	Strongly Agree	Neutral
24		Disagree	Neutral	Strongly agree	No	Strongly Disagree	Neutral	Strongly Agree
25	Exited EL	Agree	Strongly agree	Agree	Yes	Agree	Strongly Agree	Agree
26	Gifted	Neutral	Neutral	Strongly agree	Yes	Neutral	Neutral	Strongly Agree
27	504 for focus	Agree	Agree	Strongly agree	No	Strongly Agree	Strongly Agree	Strongly Agree
28		Neutral	Neutral	Neutral	No	Disagree	Disagree	Disagree
29		Strongly agree	Strongly agree	Strongly agree	Yes	Agree	Agree	Agree
30		Strongly agree	Agree	Disagree	Yes	Disagree	Disagree	Strongly Disagree
31		Neutral	Agree	Agree	Yes	Neutral	Agree	Agree
32	Vision 504	Strongly agree	Strongly agree	Strongly agree	Yes	Strongly Agree	Strongly Agree	Strongly Agree
33	Exited EL	Neutral	Neutral	Neutral	No	Neutral	Neutral	Neutral

34	Reading Safety Net	Agree	Agree	Agree	No	Agree	Agree	Agree
35	Trouble focusing	Agree	Neutral	Neutral	Yes	Disagree	Disagree	Disagree
36	504, EL level 2 reading and writing	Agree	Agree	Agree	Yes	Agree	Agree	Agree
37		Agree	Agree	Agree	Yes	Neutral	Neutral	Neutral
38	need to add to responses	Neutral	Agree	Neutral		Disagree	Agree	Disagree
39		Agree	Strongly agree	Agree	Yes	Agree	Strongly Agree	Agree
40	Exited EL	Neutral	Neutral	Neutral	No	Disagree	Disagree	Disagree
41	Exited EL	Agree	Agree	Strongly agree	Yes	Agree	Agree	Strongly Agree
42		Strongly agree	Strongly agree	Strongly agree	Yes	Disagree	Agree	Strongly Agree
43	Gifted	Agree	Strongly agree	Strongly agree	Yes	Strongly Agree	Strongly Agree	Agree
44		Neutral	Neutral	Neutral	No	Neutral	Neutral	Neutral
45		Neutral	Strongly agree	Agree	Yes	Neutral	Strongly Agree	Agree

| 4 6 | | Neutral | Agree | Agree | Yes | Neutral | Agree | Agree |

<u>APPENDIX V</u>

CURIOSITY SURVEY CHI-SQUARE AND G-TEST RESULTS

	I am excited to learn about rocks and sediment	I am excited to learn about fossils	I am excited to learn about how the earth has changed over time	There is at least one thing that I wonder in our earth's features unit	I want to learn more about rocks and sediments	I want to learn more about fossils	I want to learn more about how the earth has changed over time
Curiosity Earth Features 1, Answer Frequencies	Strongly Disagree: 1 Disagree: 2 Neutral: 14 Agree: 11 Strongly Agree: 17	Strongly Disagree: 1 Disagree: 2 Neutral: 5 Agree: 13 Strongly Agree: 24	Strongly Disagree: 1 Disagree: 4 Neutral: 6 Agree: 11 Strongly Agree: 23	Yes: 29 No: 15	Strongly Disagree: 2 Disagree: 5 Neutral: 8 Agree: 8 Strongly Agree: 17	Strongly Disagree: 2 Disagree: 3 Neutral: 8 Agree: 10 Strongly Agree: 22	Strongly Disagree: 2 Disagree: 5 Neutral: 8 Agree: 9 Strongly Agree: 22
Curiosity Earth Features 1, Chi-Square P-Values	P-value= 0.0001333	P-value= 2.549e-08	P-value= 1.34e-06		P-value= 0.002735	P-value= 1.014e-05	P-value= 3.951e-05
Curiosity Earth Features 2, Answer Frequencies	Strongly Disagree: 1 Disagree: 5 Neutral: 14 Agree: 17 Strongly Agree: 9	Strongly Disagree: 0 Disagree: 3 Neutral: 14 Agree: 15 Strongly Agree: 14	Strongly Disagree: 0 Disagree: 3 Neutral: 13 Agree: 14 Strongly Agree: 16	Yes: 31 No: 14	Strongly Disagree: 4 Disagree: 9 Neutral: 14 Agree: 13 Strongly Agree: 6	Strongly Disagree: 2 Disagree: 3 Neutral: 8 Agree: 10 Strongly Agree: 23	Strongly Disagree: 1 Disagree: 7 Neutral: 10 Agree: 15 Strongly Agree: 13
Curiosity Earth Features 2, Chi-Square P-Values	P-value= 0.001055	P-value= 0.0001965	P-value= 0.0001609		P-value= 0.08692	P-value= 3.46e-06	P-value=0.01066
Comparing Curiosity 1 vs. Curiosity 2 frequencies with a G-Test of Goodness of Fit	P-value= 0.0139	P-value= 5.091e-09	P-value= 0.00901		P-value=0.00166	P-value=0.7275	P-value=0.05113

APPENDIX W

INDIVIDUAL STUDENT CURIOSITY SHORT ANSWER RESULT SUMMARIES

#	Demogr aphics	Curiosity Short Answer Responses			Curiosity Short Answer Responses		
		Do you want to learn more about how the earth has changed over time, rocks or fossils?	Wonders	Do you want to Find out the answers to your wonders?	Do you want to learn more about how the earth has changed over time, rocks or fossils?	Wonders	Do you want to Find out the answers to your wonders?
1	Exited EL, Gifted	No: Its boring		No	Kind of. I want to learn more about how changed in the lasat 4 billion years	Is the crator that killed the dinosaurs or the dust still on earth or did it dissolve?	Maybe because I am not that into science
2	EL level 2 in reading and writing	Yes: I wante to learn how the earth has changed over time	Yes: was a forest the lower layer and an ocaen the upper layer? We have already learned these answers, this is incorrect	Yes	I do want how earth has changed over time and how fossils formed in the dust and rockes too.	Why the asteroid hit the earth long time ago and why the fossils formed?	Maybe the asteroid hit the earth where the dinoasurs are.

3	Gifted	Yes: About the earth	Yes: What happens in global warming? How does it work?	Yes: in class	Canyons and erosion because I thought it was super intersting and a SUPER FUN unit. It was fun and exciting for me.	How long did it take for water to erode and eventually carve out the grand canyon?	Yes because science was interesting and I might be able to figure it out.
4	EL level 2 in reading and writing	Yes	I love fossils	Yes: in class because i like observing	Yes. I and everyone loves fossils	I wonder if I will remember the earth's features	Yes, I love learning about fossils
5	Social IEP	Yes: What causes the environment to change?	Yes: What causes the environment to change?	Yes: In class		Would a river with hard rock erode faster or slower?	Yes, in class.
6		Yes: How does the water go away?	Yes: How do fossils stay so long?	No	I want to kow more about crosinon and how it works	I wonder why it wakes thousands of years just ot make a couple feet deeper	At home I wont be able to do it on my own and ask as mene questions as I want
7	Exited EL	No: I don't like science	No	No, too busy	No because I don't like seicnce	nothing	no

8	EL level 2 in reading and writing	Yes: How the earth has changed over time	Yes: How the obsidah is made	Yes: in class. There is no obisdan outside of school	Yes cause its fun	how dinosaurs got exitecnd	Class because there is more people helping me
9		Yes: how sea level changes	Yes: How sea level changes	No, too busy	No	No	no
10	EL level 2 in reading and writing	Yes: I want to learn more about fossils	Yes: what did they eat?	Yes: In class	Yes. Fossils becaue I love learning about animals that lived before us and to find they fossils to learn.	How do they know about our earth better?	Yes. Class and at home. I want to know better to help my sister and family to tell.
11	Exited EL	Yes: How has the earth changed? Fossils	Yes: What would it be like with real dinosaurs?	Yes: in class	Yes. Fossils because they are really interesting.	If rain takes part in erosion?	Yes. Class so we can learn more things.
12		No	How come it takes so long to become a fossil?	Yes: So I can be smarter	I want to learn about why erosion takes so long	If when I go hiking I'll step over burried fossils	Yes because I can become a smarter person
13	EL level 2 in reading	Yes: Science is really cool	Yes: How can it change	Yes: its interesting	No becaue I get bored	Nothing	At home because its easy

	and writing		over time?					
14		Yes: How the earth has changed over time	Yes: How new species come on earth	Yes: What good is having wonders if you are never going to answer them		Yes. I want to see the earth change. I want to learn all about it.	What happens to the rocks that water erodes?	I want to find answers everywhere and I want to see it for myself.
15	Strongly dislikes science					No	How long can the earth erode?	No I don't like science I only like engineering
16	Exited EL	Yes: How deep and high was the ocean?	Yes: How do different rock layers form? - We have already learned this.	Yes: in class		I want to learn more about fossils and how they are formed	I wonder how the canyons got that tall	Yes because I am very curious and this is interesting.
17	Social IEP	No: It is not very fun	Yes: How has the environment changed?	Yes: but I am too busy		no	no	no because I don't like science

18	Exited EL	Yes: Where is the fossil from? Where was the animal? I want to know where it was born	Yes: What was earth like before this generation	Yes: Outside of class to find a natural resource		Yes!	Was the earth like this before humans were created? How was the solar system created?	Yes! I want answers to all my wonders in class. Because I feel interested in class and I feel concentrated in class.
19	Strongly dislikes science					No. I already know enough to be bored with it	no	no
20	Exited EL	Y: How earth has changed its features over time	Why is there so much water in the earth's features?	Yes		Not so much	What does well how does canyon form by sediment and water and also why does it have to take a long time to compact	Class because teaching makes more sense
21	Safety net reading	No: Its boring	No	No: I dont like learning about fossils		No because I wont be a scientist	Nothing much	No because I wont be a scientist

2 2		No	Yes: How does a floodplain or ocean turn into a desert?	Yes: In class, not comfortable doing it outside of class	I want to learn what they whole class learned when I was sick	No	I
2 3	EL level 2 in reading and writing	No	Yes: How does a floodplain become an ocean?		I want to learn about the rocks because I got to do so many experiments and models	How do trees clean the air	My parents don't let me do models at home so school
2 4		Yes: What is the difference between the ologists	No	No: I listened well	No	Why did the fast stream have only one stream?	No
2 5	Exited EL	Yes: How does the environment change?	Yes: How do canyons exist?	Yes: In class	Do different sediments compact faster?	How long does it take for lava to harden?	In class because I focus better
2 6	Gifted	Yes: How does the earth change over time? I find that the earth changing is amazing	No	Yes: I need the education- confused about the question	I want to learn more about canyons. I want to learn more about them because they are unperdictible in how they form	What happens when sandstone gets burries under a lot of mudstone, does the sand get compacted and a billion	

							years later turn to mudstone?	
27		504 for focus	Yes: I am curious about how the earth has changed	No	Yes I am curious - confused	f	Nothing	No because Ms U already answered all of my questions
28			No	No	No. Ms U explained it well	No	no	no
29						I want to learn about gems, plants and animals	I wonder more about plant fossils	Yes because Im interested
30			Yes: The mosarurous		Yes: I want to learn about digging	Nothing	Nothing	Nothing, you taught me everything I want to know

31		Yes: I want to learn how they survive	No	Yes: Outside of class I want to learn how they hunt	How does the dinoasurs eat hunt survive	The depth of the earth	
32	Vision 504	Yes: I want to learn more about every topic because I love science	Yes: are there more sedimentary rocks?	Yes: i love exploring with science	Can erosion happen under a rock layer becaue I really want to know	Would there be more or less or the same amount if slow and longer time flowed and if a fast and shorter time river flowed	I want to find out in class because it would be fun
33	Exited EL				Sometimes because its sometimes interesting	Nothing	no
34	Reading Safety Net	No: You taught me all of my questions	No	No	No because I don't have one	I don't have a wonder	no
35	Trouble focusing	Yes: more about different sediments like calicum carbonate	Yes: How water rises and falls	Yes: I like to find things out	How speed effects depth	What happens when you leave water on for a longer amount of time and make it go faster	Yes because I have had this wonder for a long time

3 6	504, EL level 2 reading and writing	Yes: When I grow up it will be more easier, I want to learn about fossils	Yes: I am curious	Yes: I am interested in science	Yes about how the bucket formed to a river delta	First is that when sediment forms why does it do that	No
3 7		Yes: What is the difference between the ologists	Yes: how do plants survive in the desert?	Yes: in class	Why are there no side streatms on the faster model?	Why are there no side streams on the faster model?	Yes in class
3 8		Yes: What is the difference between the ologists	Yes: What other dinosaurs used to live on earth?	Yes: In class	Yes, fossils		In class because I dont have cool experi ments to do
3 9		Yes: How has the earth changed? Its interesting	Yes: How do they find fossils	Yes:	Do canyons every stop getting deeper?	Do canyons ever stop getting deeper?	Yes in class
4 0	Exited EL	No: I am not really interested	Yes: How do fossils form into crystals?	Yes: I want to find fossils and crystals	no	about crystals	yes I already learn aboty wonder s at home
4 1	Exited EL	Yes: rocks	Yes: fossils, I am curious	Yes: outside of class there are lots of rocks	Yes I want to see the river delta go deeper	Why the side stereams are short not long	Yes in class

4 2		Yes: About types of fossils	Yes: What did the earth look like when the first person was alive?	Yes: I want to see a fossil myself	I would like to learn about mamals and how different features of tehir body parts have changed over time. I want to know how we might be in the future	What will we look like in the future?	Yes in class because teacher helps me underst and
4 3	Gifted				Why were there no side streams?		Yes I want to know the answer
4 4		No: I know too much about rocks	Yes: Why do people mine fossils?	Yes: in class is easier	no	no	no
4 5		Yes: how the rocks in the grand canyon became	Yes: what is the difference between the ologists?	Yes: in class	I want to learn why there are like no water is not in the	Where does the water come from	Yes because questio ns are worth being answer ed
4 6		Yes: more about animals	Yes: how have the different biomes changed?	Yes: its interest ing	I would like to learn about other places canyons formed	I wonder about how steep you can a river be	I want to find out in class becaes I like learnin g at school

APPENDIX X

FIELD NOTE DATA