THE EFFECT OF SCIENCE NOTEBOOKS ON ELEMENTARY STUDENT ACHIEVEMENT

by

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Ashley N. Milbrandt

July 2013

DEDICATION

I would like to dedicate the work I have done to my wonderful first graders and their parents who have all helped me on my way through this final project. My students and parents have been so supportive and open to being a part of it.I would also like to dedicate this to my family. They have always made education a major priority in my life and have shown great support and encouragement throughout the entire process.Finally, I would like to dedicate this work to my two classmates, colleagues, but most importantly friends – Tami and Tina. Four long years ago, these two convinced me to join them in a science cohort program, which then spun into a Master's degree. We have all had ups and downs, but have always had one another to work through it. I love the memories we've created in the process and I know I could not have done it without either of them!

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I also would like to extend my appreciation to Tina Brothers and Tami Jendro. We have worked through the program together and I don't think that I could have done it without either of you. You both are the best support team a colleague and friend could ask for!

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ABSTRACT

This research project investigates using science notebooks with first grade students. Students used science notebooks to record (written or with drawings) what they observed, predicted or experienced. Student pre and post-tests, summative test, rubric scores, interviews and teacher field notes contributed to the final conclusion of this study. Science notebooks proved to be helpful to first grade students, but provided the most support for growth for below average students.

INTRODUCTION AND BACKGROUND

Study Background

I have taught first grade at Jim Darcy Elementary in Helena, Montana for six years. Jim Darcy is located approximately 12 miles north of Helena. The school is quite small and has been having its struggles keeping up with the growing population around Jim Darcy School. Helena is a growing middle class town of about 30,000 people with a surrounding area totaling close to 64,000 ("Helena overview population," 2010). Jim Darcy educates 305 students ranging from kindergarten through fifth grade; 20.3% of the school's population qualify for free and reduced lunch.

There are three kindergarten classrooms, followed by two classrooms of each grade level through fifth grade. I have 22 first graders in my classroom daily, 15% that are free and reduced. There are 13 boys and nine girls in my classroom. I have one female student and one male student that attend speech twice a week for 20 minutes per day, and there are no other identified students with special needs.

I teach reading, spelling, writing, math, art, science and social studies throughout the day. Some of these areas are only taught two or three times a week, which saddens me as an educator. Science and social studies are the main areas that get pushed to the side if reading and math lessons don't get finished during the day. I was especially frustrated with this fact in regards to science. When science is done in classrooms, students are rarely assessed or have any measurement taken of the knowledge they may

or may not have gained during the lessons. Science is an equally important area to develop a strong base in at a young age.Science is all around us, making it a valuable subject.This is what sparked my research topic.

Research Purpose

Elementary science students are given minimal time experiencing science activities. I wanted to think of a way to make the science instruction stronger and more driven by what the students knew. I was thinking about students that came to school with misconceptions. How was I meeting their needs? How could I face those misconceptions and increase students gaining the correct knowledge?This has been an intense topic of discussion in my school with my grade level partner and several other teachers in my building, as well as other teachers within the district. Science needed to be included or integrated into the school day more often in order to meet the needs of those students, but it also needed to have some checks and balances. Therefore, I wanted to make students' elementary science time more valuable, meaningful and hopefully increase science mastery.

I read and thought about the use of science notebooks. Science notebooksweretheapplication tools for students to recreate or rewrite their interpretation of lessons. I also went on to realize the value this could hold with shyer students. I would be able to see how my less verbal students understood the science concepts delivered during our lessons. After much discussion with my partner teacher, two other

colleagues, and my principal I decided to study the effects that science notebooks had on elementary students.

Research Questions

The main focus for this study is found in my primary question: How does the use of science notebooks impact elementary student learning?

I then created four sub-questions to help reach an answer to my overall question listed above. Next you will see the four listed questions.

1. What is the correlation between student notebook entry scores and formal assessments?

2.How do science notebooks affect the different achievement levels of students?

3. How are student's attitudes towards science affected by using science notebooks?

4. How does the use of science notebooks affect my teaching?

These questions helped me conduct my research for this project and come to a final conclusion regarding the effects of science notebooks.

Support Team

Throughout this process I have had support from two friends and colleagues. Tami Jendro, a third grade teacher at Jim Darcy, and Tina Brothers, a kindergarten teacher at Jim Darcy have been working through the Master of Science in Science

Education (MSSE) program with me the entire time. We consistently bounce ideas off of one another and have continued support and help whenever needed. My partner teacher, Theresa Meek has also been a huge support and has helped with formulating good lessons and providing good feedback on what I have found in my research so far. She is knowledgeable of our curriculum and is an effective science teacher. Finally, my mom has been a lot of help in the proofreading area. She has always been good at catching mistakes and it also helps to have an "outsider" read my material to ensure that anyone could in-fact take this and use it efficiently.

CONCEPTUAL FRAMEWORK

Literature Review

Beginning science, in general, at the elementary level is extremely beneficial to students. Student science notebooks can provide valuable opportunities for learners to develop a solid understanding of science concepts while possibly maximizing the lessons when given minimal time. Notebooks provide an evaluation or measurement tool for elementary teachers to use to help identify students' conceptual understanding (Brenneman&Louro, 2008). Science notebooks also provide a support system for children's natural curiosity about the world around them. Elementary teachers need to support this curiosity and work to include or integrate science notebooks into areas of the curriculum (Derick-Frye &LeSage, 2010).

Schumacher and Nash developed theories based off of cognitive research involving writing and learning. They felt there were several areas that science notebooks would improve science education. Students with poor background knowledge could easily address their misconceptions through writing. They might be asked to rewrite a lesson or draw their version of an activity done in class. Any teacher could use the notebooks to assess the gained or missing knowledge within that student. That teacher could then gauge their lessons appropriately to meet the student's needs for learning.

The different theories help recognize all of the important skills that go into the task of writing. Students' ability to record materials in different formats or themes require them to be able to reflect, process concepts over and over, interpret information, elaborate at times, develop hypothesis'- all of which develop a higher level thinking (Yore, Hand &Prain, 1999). Then, the social aspect of sharing their entries makes the utilization of science notebooks an even more powerful learning tool. Brain research has shown the use of a nonverbal tool such as science notebooks can significantly increase verbal growth in young children. The act of writing/representing the information nonverbally will develop more "schemata" which will eventually lead into richer verbal recollections of those science experiences (Sinatra, 1983). This will allow the lower achieving or the more shy students to gather their thoughts, organize them and record them all before actually having to verbally share about the science lesson. A science notebook and its structure utilizes the brain and its ability to work through different processing skills to create a representation of what was learned and then provides the student with something

to share (Nesbit, Hargrove, Harrelson & Maxey, 2004; Ruiz-Primo, Araceli, Li &Shavelson, 2002).

There has been conflict in the past based on what concepts children were old enough for. According to Jean Piaget's developmental stages, some science content was considered not to be age-appropriate for children. Research has begun to show that the knowledge that children currently hold is a base for what they can learn next (Metz, 2011). Students that hold the proper background knowledge can be introduced to new concepts and then use writing to interpret what they learned. There have been significant increases in writing across the curriculum in all content areas since the 70's (Tynjala, Mason &Lonka, 2001). Most of these studies involving science notebooks include students in the upper elementary and not at the primary level. The two studies that are reviewed next use notebooks with fifth grade students.

A study was conducted with ten teachers and 60 fifth graders. Each teacher planned to use science notebooks regularly while implementing two extensive science units with their classes. The teachers collected pre and posttests provided in a science-kit for each unit. These teachers also looked over the science notebook entries. The test scores were calculated together by class and unit, and the entries were divided into categories or themes that commonly occurred. Teachers coded the entries by the type of entry made and its characteristics. Were the explanations thorough? Did the picture go along with the explanation? How much detail did the student include? The notebook entries were then evaluated with a 4-point scale, something similar to a rubric. Evaluators found that 85 percent of the student entries were easy to identify the lesson's

concepts or skills. The evaluators also found that among all of the science notebooks from ten different classrooms the majority of the entries were the same type and contained very similar characteristics. This is where the teacher participation affects student performance. An observer may have identified the teacher providing too much structure and falling into the *overly prescribed guidance* group (Ruiz-Primo,Arceli, Li &Shavelson, 2002).

There are several areas of concern regarding the teacher's role and their development of student notebooks. How are teachers organizing science writing? What kinds of opportunities are students getting to record in their notebooks? Are teachers paying attention and providing feedback to student entries (Baxter, Bass & Glaser, 2000)? If students are not asked the right questions or provided the right guidance on what to record in their journals then entries will not be worthy of any form of data collection (Ruiz-Primo, Araceli, Li &Shavelson, 2002; Baxter, Bass & Glaser, 2000; Aschbacher& Alonzo, 2006). The amount of guidance was referred to as the "Three Little Pigs." There is *minimal/low guidance, overly prescriptive guidance* and *moderate* or *"just right" guidance.* It is important for teachers to find the balance between the first two levels (Aschbacher& Alonzo, 2006).

The analysis of these results brought teachers to the realization that students are rarely given the opportunity to make appropriate connections between what is taught and their world. Students are not given enough opportunity to interpret concepts on their own. The notebooks contained a lot of definitions, most of which were copied from a textbook, and few showed the application of the concept that was presented. The pre and

posttest scores did show some correlation with the entries. Students that provided more meaningful entries performed better on the posttest. Could the use of science notebooks improve this fact if used more? Could using science notebooks more increase the number of different interpretations or representations among students? This study ended with more questions than answers. Science notebooks did provide an opportunity for teachers to assess student's science understanding, but there wasn't enough evidence to draw a solid conclusion regarding the value of the science notebooks in these fifth grade classrooms (Ruiz-Primo, Arceli, Li &Shavelson, 2002).

A second study performed consisted of data collected from 83 students in three separate fifth grade classrooms. Students were taught four curricular units and were asked to document their thoughts and outcomes in a science notebook. Teachers used classroom observations and videotaping, as well as the notebook entries for their data collection resources. Someone other than the classroom teacher was asked to make observations during the class time; therefore allowing the teacher to focus on the science lessons. The three classroom teachers were responsible for evaluating the notebook entries (Baxter, Bass &Galser, 2000).

The analysis of the observations and video recordings involved highlighting specific features/themes within the classroom. Did the teacher state the purpose of the unit? Was there structure to the unit lessons? Did the teacher provide feedback to student questions? Did the teacher explain the notebook entry? The notebooks were broken down into themes as well: introduction present, purpose presented within entry, and summary statement regarding the daily lesson. The observer had noted that the

teachers set up the science notebook thoroughly throughout the different units. The teachers directly identified what students should include in their notebook entries. When it was time to look for correlations between the observations and the entries, it was found that the student notebook entries had little variation between the different students and classrooms. Student entries all contained very similar writings and drawings. The entries included mostly what students have observed or what the teacher concluded during each of the lessons. This was determined to be due to the fact that again the teachers provided too much structure that it took away from the students' use of their own critical thinking and understanding. Having an outsider observe really helped this study in the realization that the teachers did prescribe too much to be written, resulting in very similar entries. It was concluded that science writing is very important when recording things such as observations. Students might gain better independence if not given as much structure from their teacher. This study found it hard to identify student's own reflections, their own thought process in generating a hypothesis, as well as their ability to think through different scientific experiences (Baxter, Bass &Galser, 2000).

Although, thoughts and feelings are positive about use of science notebooks there were no strong correlations in either study regarding science notebooks as a tool to show growth in students. There is an importance for integrating writing with science and with more data sources and comparisons made; different conclusions could surface.

METHODOLOGY

Treatment

My treatment for this research project was the use of science notebooks in my first grade classroom of 22 students. The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintainedduring Fall 2012 (Appendix A). I began my alternating non-treatment/treatment cycles in mid-Septemberafter receiving all of the signed parent consent forms for their child's participation in my study (Appendix B). Before I even began using the science notebooks we went through examples and discussed what a "notebook" was. I asked the class to imagine themselves as a scientist and what they thought scientists might record or write about. We gathered a list of ideas such as tables and pictures that scientists might have studied or seen. We then discussed how we would be recording those items in our science notebooks and did a brief classroom notebook after a couple of science lessons.

I began my study with a non-treatment phase while teaching lessons on sink and float. I taught as I would regularly teach. We first developed a KWL chart of what we (K) knew about sink and float and what we (W) wanted to know, we saved the final (L) column for the end of the unit to list what we had learned. Lessons following the KWL chart involved experimenting and investigating different items and shapesto see what would sink or float. Students made written predictions and then wrote what actually

happened. Then we shared what we discovered as a whole class. This non-treatment phase lasted two weeks, I taught three lessons per week that lasted about 40 minutes each. Non-treatment phases did not include science notebooks.

The following two weeks were a treatment phase. The treatment phases did utilize science notebooks after each science lesson or every other one depending on the amount of content we got in that day. I created special science notebooks that had covers that displayed the unit we were on and included pages that had a drawing and writing area to accommodate all first graders at the beginning of the year (Appendix C). Firstgraders are typically not the most efficient writers in the beginning months of the school year; therefore I wanted to provide them with an area to draw as well as write.

I made sure to plan to teach science the same amount of time as the non-treatment cycles to keep the variables the same during the treatment phases. The treatment phase also included three lessons per week for two weeks, each lesson lasting about 40 minutes. In order to try to ensure equal difficulty of lessons across treatment and non-treatment phases, I collaborated with Tina and Tami; part of my support team, quite often. Together we predicted areas that might be difficult or a bit easier. All of these factors helped to make adjustments to those lessons.

The five senses unit was the first treatment phase. The first five lessons involved one sense per lesson and the final lesson was a culmination of all of the senses. I taught the daily lesson; then we would share about the lesson as a class. We shared about our observations, what we learned, and what more we were curious about. I then directed students to write/draw about something from the science lesson that day. I tried not to

make the entry topic too specific: write one thing you learned from that lesson, or draw me something that would involve this sense. Previous studies showed that the teachers providing too much structure resulted in entries that were pretty much the same. I tried keeping the prompts short and simple for my first graders. As we progressed through the different phases, these guidelines changed according to different expectations and ability levels. I had several students that struggled with writing the entire time; it was quite a big deal when one of these students actually did write a complete sentence in the final treatment/non treatment cycle. I had to raise the bar for other students that were more efficient writers by providing different expectations; for example writing two to three sentences versus only one. These students also were expected to elaborate more and explain or give reasoning.

After students wrote or drew in their notebooks I would then have them turn their notebooks into me. I wanted to make sure I could read what they wrote or understood their drawing. This was possibly the most time-consuming, but most valuable time. More often than not, students would share even more of what they learned when they showed me their notebooks. I wrote their additional comments in their notebooks.

I continued an alternating pattern of two weeks of non-treatment, two weeks of treatment over the course of six total weeks. This provided me with three non-treatment phases, and three treatment phases. Table 1 on the following page displays the timeline for these phases as they occurred along with the data collection tools scheduled for each phase.

Table 1
Research Designand Treatment Schedule

Unit	**Dates**	**Treatment/ Non-treatment**
Sink/Float	Sept. 17 – Sept. 28	Non-Treatment
9/17 Week One: - Initial Student Interview - Administer Pre-Test - Begin Field Notes	9/24 Week Two: - Field Notes - Post Test	
Senses	Oct. 1 – Oct. 12	Treatment
10/1 Week One: - Continue Field Notes - Administer Pre-Test - Students record 3 entries - Rubric Score Entries	10/8 Week Two: - Field Notes - Students record 3entries - Rubric Score Entries - Administer Post Test	
Living/Nonliving	Oct. 22 – Nov. 2	Non-Treatment
10/22 Week One: - Continue Field Notes - Administer Pre-Test	10/29 Week Two: - Field Notes - Post Test - Mid-Student Interview	
Insect versus Spider	Nov. 5 – Nov. 16	Treatment
11/5 Week One: - Continue Field Notes - Administer Pre-Test - Students record 3 entries - Rubric Score Entries	11/12 Week Two: - Field Notes - Students record 3 entries - Rubric Score Entries - Administer Post Test	
Seasons	Nov. 26 – Dec. 7	Non-Treatment
11/26 Week One: - Continue Field Notes - Administer Pre-Test	12/7 Week Two: - Field Notes - Post Test	
Friction	Jan. 7 – 18	Treatment
1/7 Week One: - Continue Field Notes - Administer Pre-Test - Students record 3 entries - Rubric Score Entries	1/14 Week Two: - Field Notes - Students 3 entries - Rubric Score Entries - Administer Post Test - Final Student Interview - Summative Assessment	

Data collection instruments

There are several different methods that I used for data collection. Table 2 displays the breakdown of data collection instruments and their correlation with my research questions.

Table 2
Questions and Data Collection Methods

Research Questions	**Data Collection Methodologies**				
	Student Interviews	Notebook En try Rubrics	Pre/ Post Tests	Summative Assessment	Teacher Journal
1. How does the use of science notebooks impact elementary student learning?	√	√	√	√	√
2. How do science notebooks affect the different achievement levels of students?	√	√	√	√	√
3. What is the correlation between student notebooks and formal assessments?		√	√	√	
4. How are student's attitudes towards science affected by using science notebooks?	√				√
5. How does the use of science notebooks affect my teaching?	√	√	√	√	√

The student interviews (Appendix D)were administered at the beginning of the project, mid-project and at the end. I interviewed all 22 students pre-project, but decided to only use 12 of those for data analysis. These 12 were chosen with a stratified random sampling by choosing two females and two males from each of the listed achievement levels: high achieving, average achieving and lower achieving. The mid-interviews and final interviews weredone with these 12 students as well.

I conducted the initial interviews during our reading centers. While students were at centers I called students back individually and interviewed them. I took notes as they responded to questions and eventried to type as they responded. This was extremely time consuming and distracting to some of the students, so I adjusted my methods for the mid- and final interviews by usingEvernote on my IPad to record the interviews. I still performed the interviews during our reading time and this proved to be a much more efficient way.

The student interviews and my teacher journal provided me with ample qualitative data. I looked at the research questions and developed appropriate interview questions that would lead me to a final conclusion. I wrote in my journal after most of the lessons taught. I took notes during at least four days during both treatment and non-treatment phases. My notes included student reactions to science lessons and whether there were any differences between non-treatment and treatment phases. I also included student comments regarding the topics being taught. After looking over student notebook entries, I also wrote about what students thought was important to write/draw about and if they grasped the concepts taught during the lessons. During my one-on-one time looking over the entries with each student I was also able to write down notes about students being able to expand further through verbal communication. I added this to their journal entries for scoring.

I attempted to use a protocol or format for my notes, but found it much easier to type what stood out, how I felt, and how the students responded to the lessons that day. Most of my writing was done on sticky notes or notepads, whatever was most readily

available to me at a point in time when something was significant enough to record. I used my teacher field notes in association with the interviews to see if I found any student responses that didn't match their behavior during science.

I chose several different methods for collecting quantitative data. As you can see in Tables 1 and 2 I used pre and posttests for both non-treatment and treatment phases (Appendix E). I created each of these tests based off of the learning objectives of the unit.All 22 students were given these tests. I walked through each question with them using a document camera to ensure each student understood the questions. Students wrote down their responses as we moved from question to question.

I compared the amount of growth of all students from pre to post tests during non-treatment phases to the amount of growth students made during treatment phases. I had three sets of pre and posttests for my non-treatment and treatment phases tohelp ensure reliability.

The rubric scores were the only "specified" treatment data collection method. I used a rubric that I created myself to evaluate student's notebook entries (Appendix F).Every student made entries into their notebooks; therefore rubrics were used to evaluate each of my 22 students' entries. The rubric evaluated the student's ability to process the information and then transfer it into their notebook. Student's content knowledgewas also assessed as well as their individual thinking. I created the rubric using a three-point scale, three being the best response, one being a poor response. Rubric scores were looked at in comparison to student's success on the unit posttests.

How did rubric scores correlate with the test scores; higher the score, the higher the posttest score? Were test scores higher just by students using the notebooks?

Also, I looked at the different levels of learners to see how well my lower achievers use the notebooks in comparison to my mid to high achieving students. My partner teacher, Theresa Meek, as well as Tina and Tami,helped me evaluate these entries in order to get a non-biased opinion, increasing the validity of this data source.

My final data collection tool was a summative test that was given at the end of the project. With the help of Tina and Tami I created a test including five questions from each of the six units. Tina and Tami helped me brainstorm question formats and question difficulty. I included questions regarding the concepts that were taught and information I felt students should have remembered. After creating and giving the test I looked to see which questions had consistent misses identifying any correlation with it being taught during a treatment or non-treatment phase. The layout of the test,which included both non-treatment questions and treatment questions, allowed me to compare what information students retained over time. I also used the summative test to look at the different achievement level groupings. I compared the success of each group, non-treatment to treatment questions. Which group found most success and were students more successful in answering treatment questions or non-treatment questions? If students showed success in the treatment phases this would support science notebooks having a positive effect on student learning over time.

DATA AND ANALYSIS

Many weeks went into analyzing assessments, notebook entries, student interviews, and teacher reflections. I took time looking at the data collected from my group of 13 boys and nine girls and decided to identify similar patterns within the whole group of students as well as patterns within a stratified sampling of students. In order to get a good sampling to work with I first grouped students into ability groups based on their overall performance in the classroom. I had a very strong sense of each child's ability after the first month of school. This allowed me to start comparing and analyzing data between the ability groupings early on. Eight students fell into what I considered the high performance group. These students averaged between 90%-100% on work ranging from Math, Writing, Science, Spelling and Reading.

Nine students were placed in the average performance group, averaging between 70%-89% in the same subject matter. The final five students left were in the below average performance group that averaged below 70%. Then, I selected four students from each ability grouping, two boys and two girls. I had to choose four boys from the low performance grouping since there were no girls in that group.

I have designated themes according to the research questions presented at the very beginning of this capstone. First we will take a look at the affects science notebooks had on student performance. Within this section, we will be looking at student achievement on pre and posttests during both treatment and non-treatment phases along with science

notebook rubric scores. In addition to this, student responses to interviews and my own teacher reflections will help make sense of all the information gathered.

Figure 1 displays the class averages of pretest and posttest scores from each non-treatment and treatment phase. Each phase consists of two science units: one non-treatment unit and one treatment unit. Science notebooks were used only during the treatment phases.

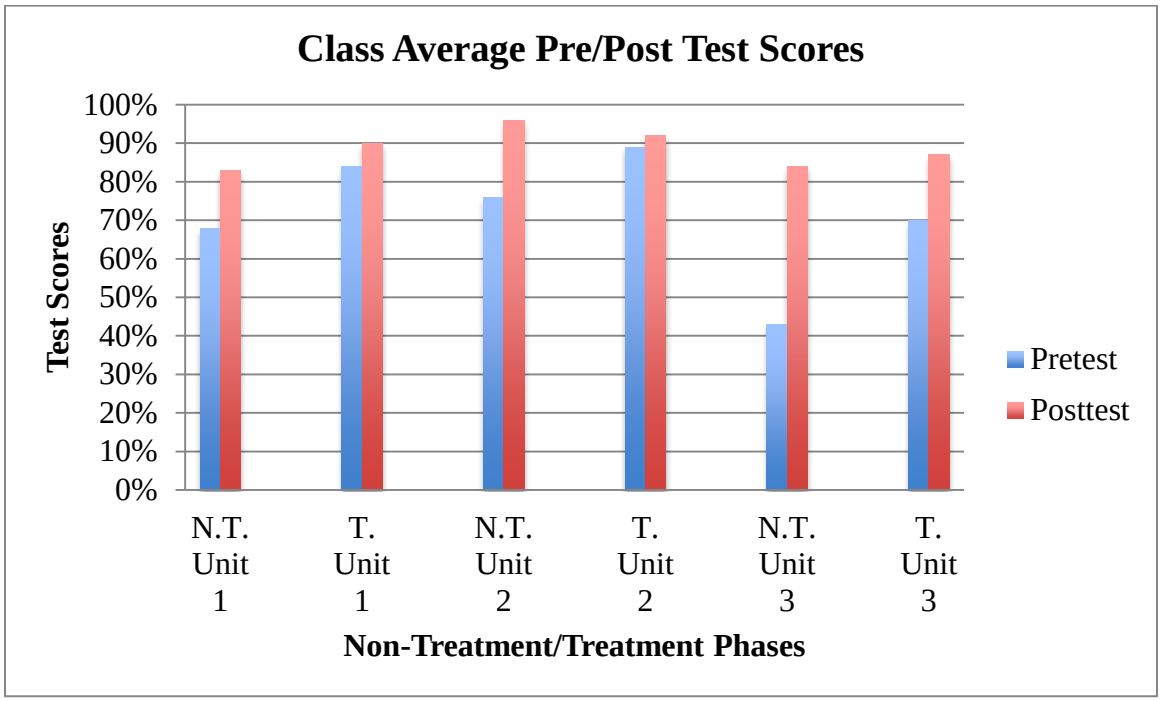

Figure 1. Test averages, (*N*=22).

Initially the figure displays positive student growth during each unit. Students, on average, increased their scores from the beginning pretest to the final posttest for each unit taught. However, the most significant growth is seen, surprisingly, during the non-treatment phases. The average non-treatment pretest scores range from 43% to 76%. This is much lower compared to the treatment pretest scores ranging from 70% to 89%.

The result of students scoring so much higher on their treatment pretests is that they have limited growth to show over time.

Originally I had worked with my teaching partner to create these tests to ensure both treatment and non-treatment tests were in the same difficulty range. We also referred to our science series and pulled some questions from the book tests. After looking at the data, I am realizing that treatment pretests regarding the five senses and spiders/insects were a bit easier compared to the pretests for the non-treatment units, sink/float and living/nonliving. I had my peer group look over the tests after the fact and they felt that students probably had more background knowledge regarding the treatment phase topics. Due to students having this background knowledge and scoring higher on their pretests, they had less room for growth.

Figure 2 shows the average growth all students made between pretest and posttest for each unit.

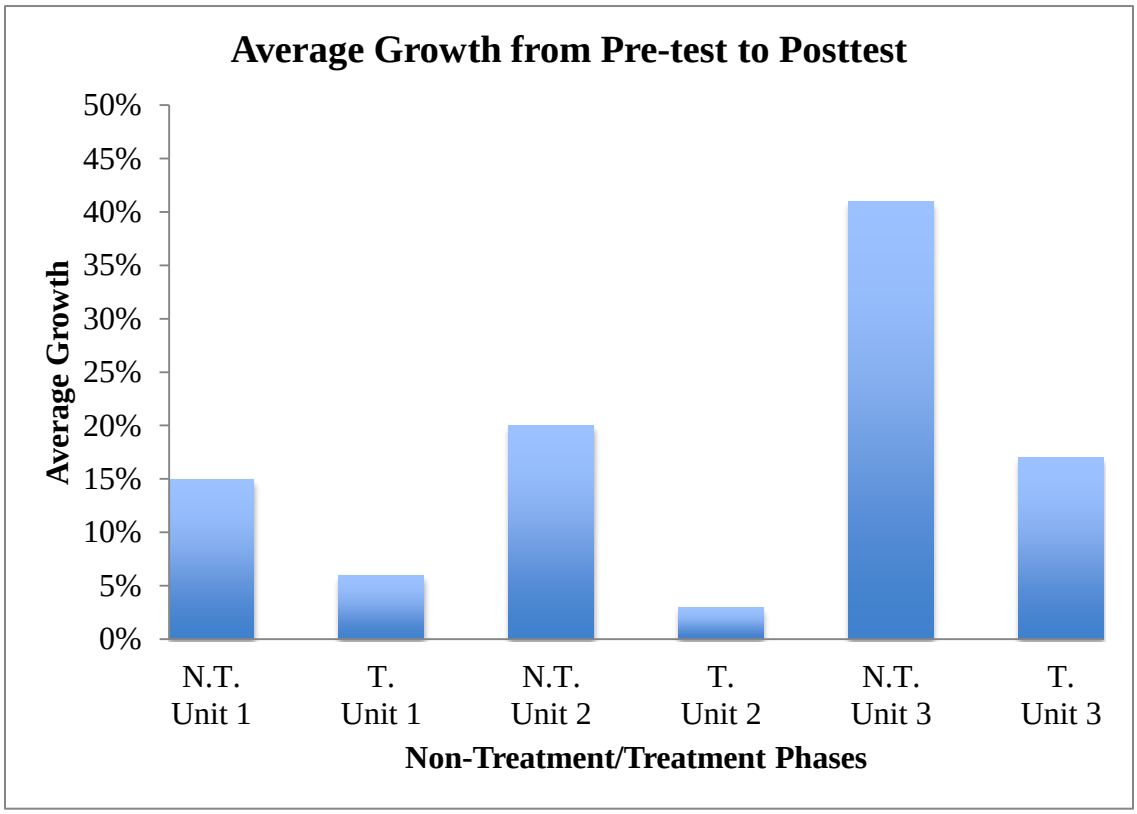

Figure 2. Average growth, (*N*=22).

This really amplifies the larger growth students made during the non-treatment units. Student's scores increased 15% to 41% during the non-treatment phases. All students did increase their scores during the treatment phases as well, but only by 3% to 17%. Based on teacher journal reflections, there might be some explanation for these higher scores: "Once pretests were corrected, I was very impressed considering the amount of frustration during the test; students had more background knowledge than they thought. I am assuming this is from experiences at home and parents identifying their child's use of their "senses""(journal entry, 10/22/12). I didn't expect students to have as much background knowledge of these topics since I had been collaborating with Tina Brothers who is a kindergarten teacher at the same school. I chose topics that

hadn't been gone over at all or as thoroughly the year prior. One would have to assume that students gained background knowledge of the five senses, spiders/insects, and friction (the three treatment units) in some other area of their life. Only 5/22 (23%) students mentioned performing some science experimentation at home during the preliminary interviews. When students were asked: "What do you do during science?" theirresponses included:

"My dad and I look at plants a lot when we go hiking. We look for things in the river too!" (This student's father is a Biologist.) Another girl discussed sinking and floating materials in the bathtub while her and her sister took baths at night. The other three students mentioned doing experiments at home with their older siblings. None of the preliminary interview responses supported students having much background knowledge regarding the topics to be taught. The five discussed real science topics, but nothing specific to our treatment units. The majority of students responded: "I don't know" or "we do fun stuff". Nobody identified what "stuff" was.

On the following page, Figure 3 presents the average class scores on the science notebook rubrics(Appendix E). The rubrics had a 3-point scale, 1 being the lowest and 3 being the highest score. There were three components used to rate the student's science notebook entries: their understanding of the process skill by either making good observations, predictions, conclusions etc., their understanding of science information and their individual thinking. Students had three to four entries scored per unit. All of the rubric scores from all students were added together and then averaged by unit. Figure 3 shows a comparison between the rubric averages and the averages of the posttests from

each of the treatment units. I looked at these two scores to see if their achievement level in their science notebooks had any correlation with the final posttest. For example: if students did well writing/drawing in their science notebooks and were receiving higher scores on their rubric, did they show higher success on their posttests?

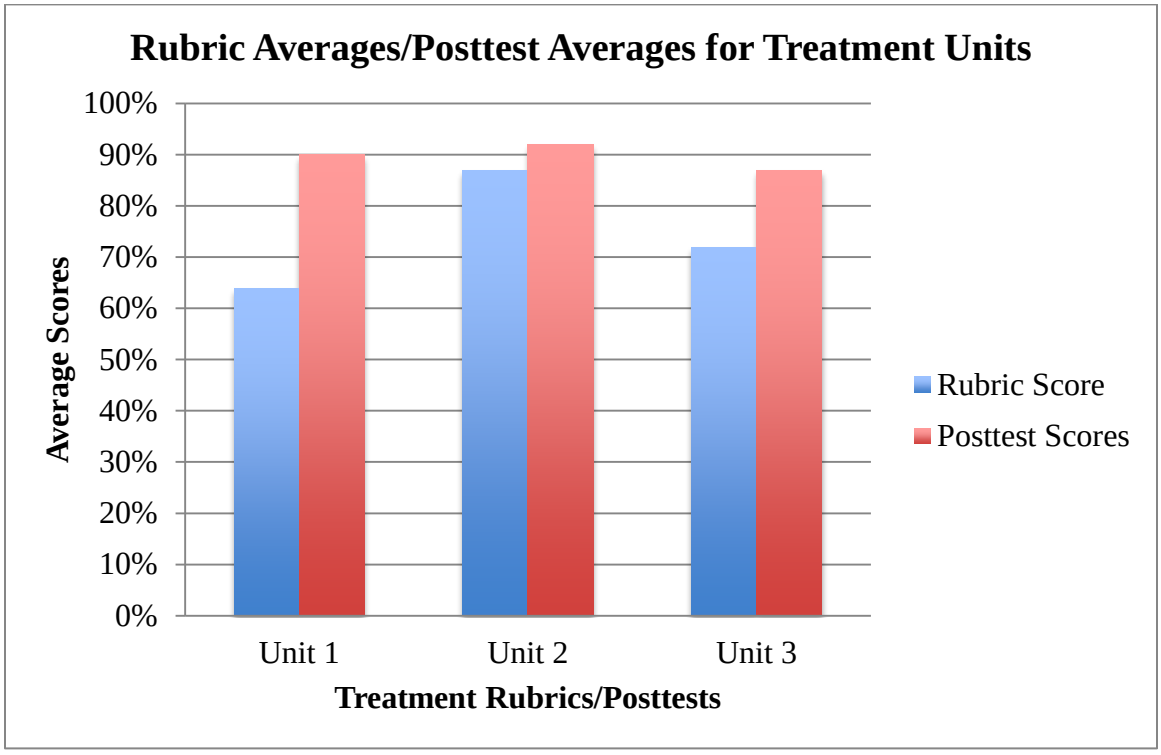

Figure 3. Average rubric/posttest scores, (*N*=22).

There is a correlation shown between rubric scores to posttest scores in the first two units. Treatment Unit 1 shows that students averaged 64% in their science notebooks and scored around 90% on their posttests. You can then see that during Treatment Unit 2 student's science notebook averages increased to 87%, showing better entries being made and in turn scored higher on the posttest, around 92%. Unit 3 displays rubric score averages in between Unit 1's 64% and Unit 2's 87%, but the posttest is the lowest of the three. I believe this is due to the fact that the Unit 3 topic; friction, was a bit more

difficult for students to grasp. Discussions with my peer group helped me realize that friction is much more difficult than spiders and insects and the five senses because it is a more abstract concept.

The first treatment unit displays the lowest rubric average of the three phases. It makes sense that they would be the lowest due to the "newness" of it, regardless of practicing the writing template before the project began. This unit was taught at the beginning of the school year and first graders have a difficult time writing early on in the year and transferring their knowledge to paper. I could see a natural progression throughout the project and students did show improvements in both the amount written as well as content included.

The class as a whole did improve during both non-treatment and treatment phases; which is what all educators hope to see. Science notebooks may not have had a noticeable effect on the entire class, but now we can approach our second theme. This theme will help answer the second research sub-question by taking a look at how notebooks might have helped the different performance groups within the class. I have broken the data down into three separate performance groups that were previously mentioned; high achieving, average achieving and below average. The following figure displays the average scores from four of my higher achieving students. Averages were calculated for each student's non-treatment pretests and posttests (three tests each), and then averages were taken of the three treatment pretests and posttests.

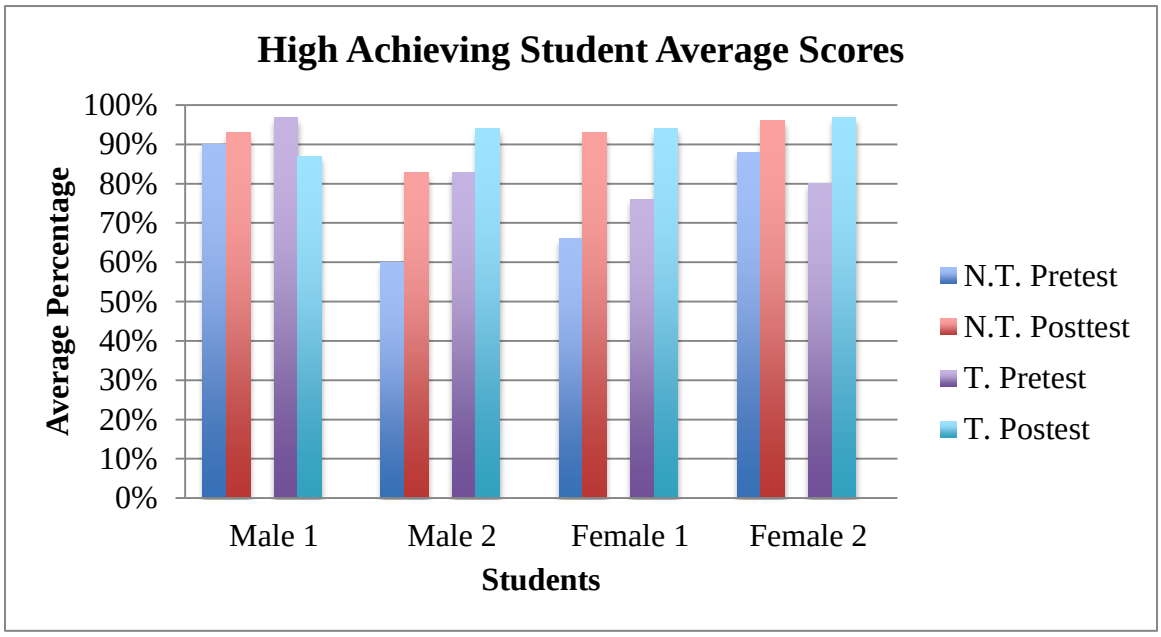

Figure 4. High achieving student averages of pre and posttests for both non-treatment and treatment phases, (*N*=4).

This group follows the trend of the entire class by scoring higher on the treatment pretests than the non-treatment pretest. (I mentioned above that this has to do with the unequal difficulty level of the tests.)This results in less room for improvement between the pretest and posttest. All but one student showed improvement from beginning to end of their tests. Male 1 is the only one that did have a lower average on his treatment posttests than his pretests. He was gone for a week during the first treatment unit; therefore, missing three lessons towards the end of our 5 senses unit. He had scored 100% on the pretest, and I knew how bright he was in all areas of school so I assumed he would be successful on the posttest without making up all three of the lessons during his recess time. We did discuss what he missed and we had a very intelligible conversation regarding our senses so I allowed him to take the posttest. He then ended up receiving an 86%. I felt terrible that I didn't go over it with him, but then I noticed a similar

occurrence when we got to the second treatment unit. The same student scored 100% on the spiders and insects pretest. He then was out sick for two days of lessons right before the posttest. I did go over what he had missed since I hadn't the first treatment phase. I had him write in his science notebook as well and then had him take the posttest. He scored an 87%. I couldn't believe it! I then had to sit down with him and discuss what was happening. He expressed that he knew all of this stuff the first time around and didn't know why he had to take the test over again, when he "already knew everything about spiders and insects." I then realized that he is the type of student that once he learns something he wants to move on to the next thing. He has it in his brain and can use the information when necessary, but having him writing in his science notebook about it, talking and learning about it for two weeks and then making him take another test after he had already gotten 100% correct on the pretest was too much for him. He was "over it". I explained that even though he knew everything he still needed to try hard on the tests and not rush through them. He understood and ended up earning 100% on both pretest and posttest for the final treatment unit. This experience with him helped me identify that science notebooks are more of an irritation to students like him. If similar students have learned something and understand it, they want to build on that knowledge or begin a new adventure of learning about something new rather than writing about the unit topic for two weeks.

Figure 5 shows us a breakdown of the growth between pre to posttest of the same four students compared to their science notebook rubric scores during each treatment unit.

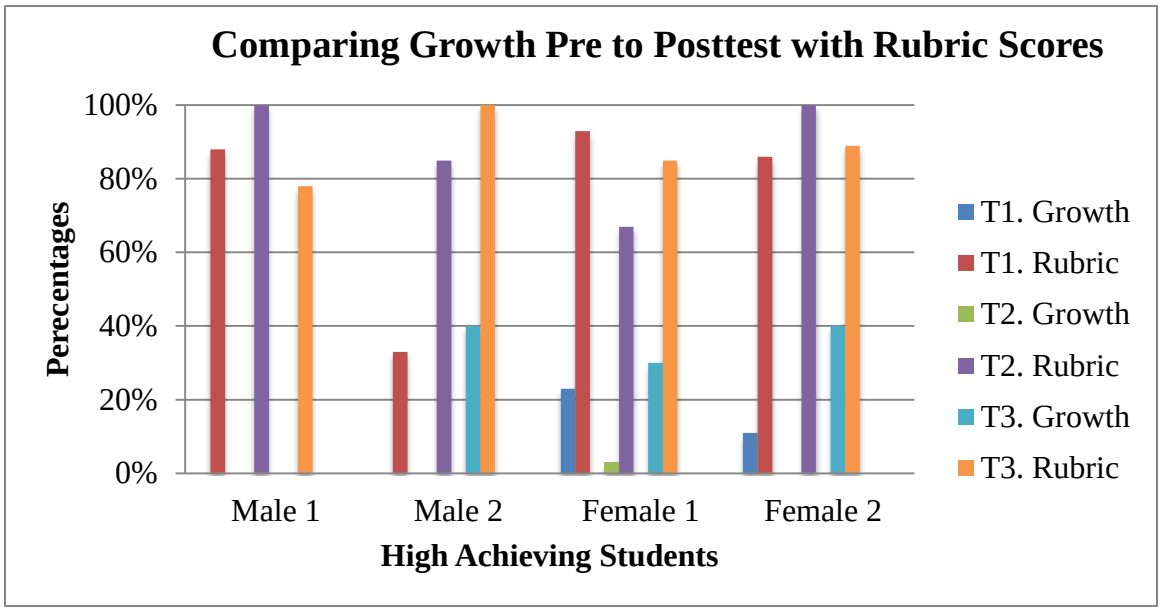

Figure 5. Student growth from pretest to posttest for treatment units compared to rubric scores from science notebooks, (*N*=4).

Male 1 didn't have positive change from his pretest to posttest scores resulting in no data in those areas. He did quite well writing in his science notebooks, even with him being tired of doing it over and over. He had great content knowledge and gave good examples.

The rest of this group did quite well with their science notebooks. Male 2 and Female 2 each have areas showing no growth. In their cases, they each scored the exact same on their pretests and posttests.

I am drawn to the Treatment 3 section. Aside from Male 1, you can see that there might begin to be some correlation between science notebooks and the effects on student achievement. Male 2 and Female 2 both have very high rubric scores from their science notebook writings, and both show a 40% increase from their pretest to posttest scores. Female 1's rubric score is slightly lower, as is her nearly 30% growth. Male 2 and

Female 2 are both students that love writing. I think their love of writing increased the amount of what they wrote and their thought process was much higher. In return, they found more success on the test. Female 1 liked to write, but it was not her first choice when she had free time. Regardless, it is intriguing to see her lower scores on her rubric, as well as her posttest since she is a higher achieving student. The students that took more time to write (Female 2 and Male 2) and process the information received higher scores. Maybe the task now is to get students "hooked" on writing. This is a limited piece of positive data that could support the idea that notebooks do in fact help improve student achievement.

As I look at these four students' interviews and look at questions regarding science notebooks they all found the notebooks valuable. Female 2 stated: "They helped, I can write down what I learned and then go back and look at it again to remind me about the science topics." She agreed that science notebooks should be used more often. Female 1 was in agreement with using notebooks during science more often as well and felt it was helpful to think about what we learned and then write it down in our notebooks. The interviews really show the difference between boys and girls; the girls really had a lot to say about the notebooks and were very positive. Girls tend to enjoy the writing process a lot more at a younger age level. The boys didn't want to elaborate much at all, even with numbers of prompts. Both Male 1 and 2 responded "yes" when asked if notebooks should be used more, but they did not say much else. I asked both students how they were helpful and Male 1 complained about having to write "so" much, but he liked drawing the pictures (very developmental for first grade boys) and Male 2

said he “didn’t know”. I prompted Male 2 with several different questions, but it ended up with him agreeing with me when I asked if writing things down helped him remember things more or did drawing pictures with labels help him remember? This data helps support that science notebooks did help my higher achievers; at least the students felt that way.

Let’s take a look at our next group of students.

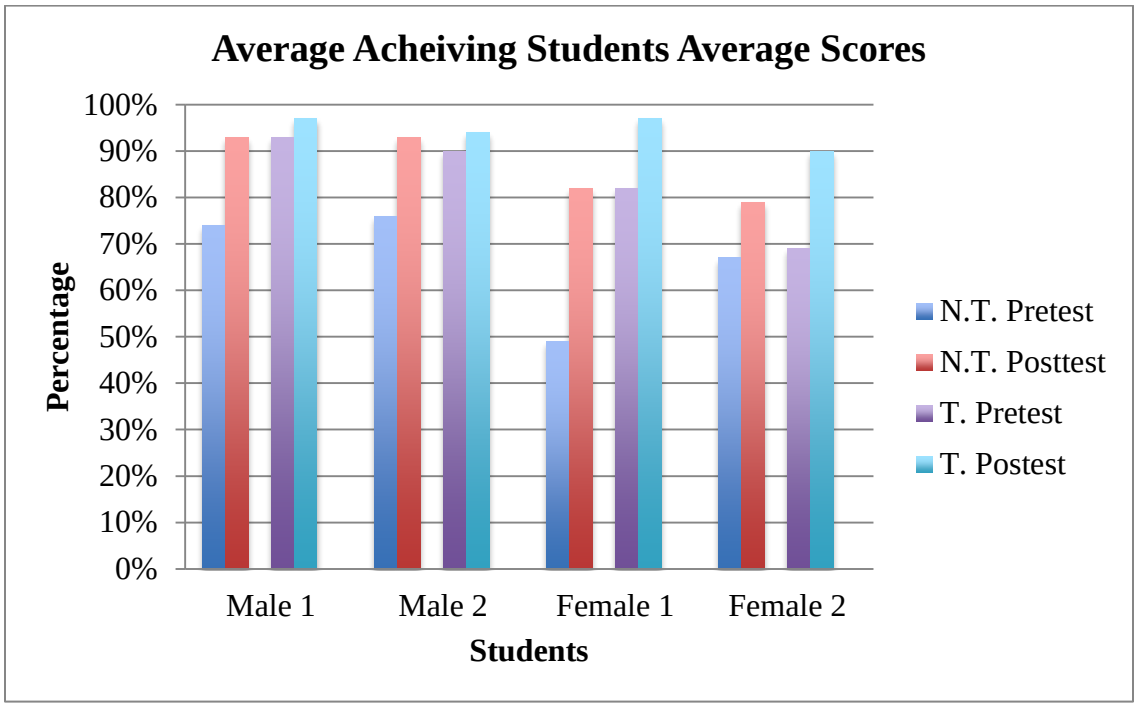

*Figure 6.*Average achieving student’s averages of pre and posttests for both non-treatment and treatment phases, (*N*=4).

These four students are consistent with data from the whole class; they showed higher scores on the treatment pretests than the non-treatment pretests leaving that same limited space for improvement. All students do show positive growth between the pretest and posttest scores in both non-treatment and treatment phases. On average, their pretest to posttest scores increased 20% during non-treatment units, while they only increased

the treatment test scores by 8.5%. These students did have less room for growth due to their higher pretest. Their overall posttest scores are higher than the non-treatment posttest. All four students' posttest scores after using science notebooks are 90% and above, only two of the posttest scores from the non-treatment phase are over 90%. Would you rather see more growth with a lower final test score, or less growth but better accuracy earning the higher scores? The non-treatment test scores display more knowledge gained; which is excellent, but they are still scoring lower than the treatment units. Next we can look at their growth during treatment in comparison to their science notebook rubric scores.

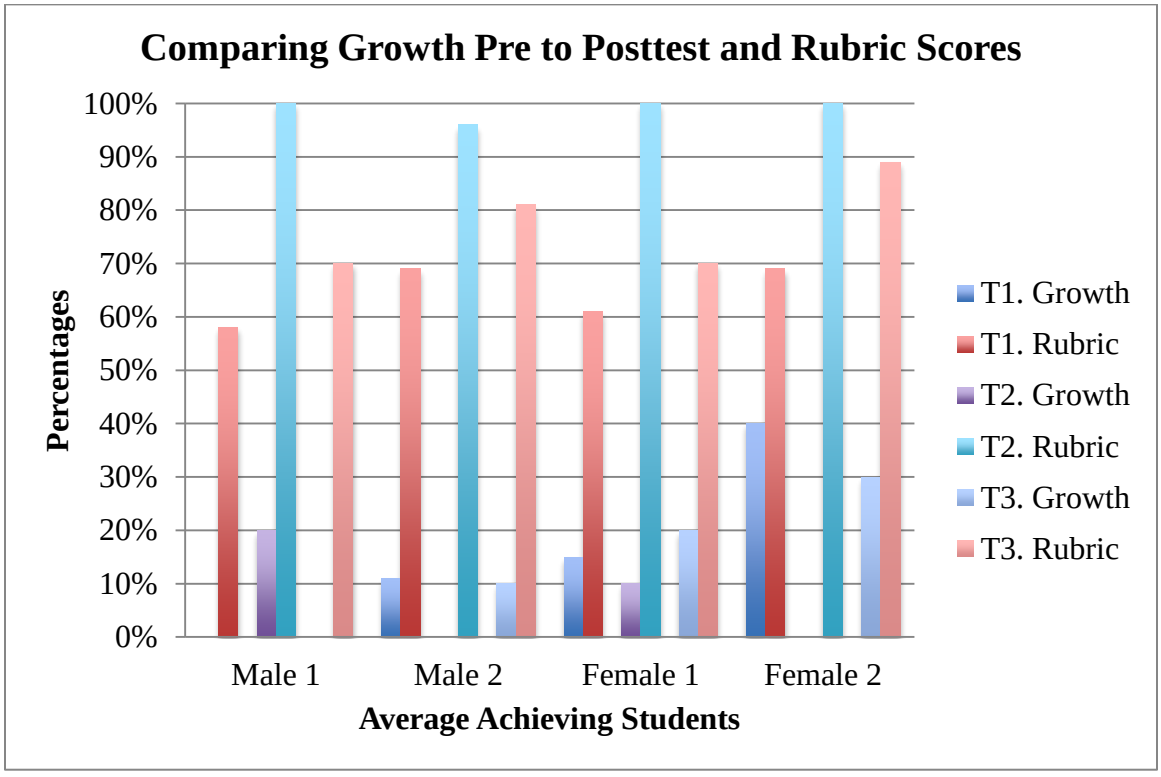

*Figure 7.*Student growth from pretest to posttest for treatment units compared to rubric scores from science notebooks, (*N*=4).

From this group Male 1, Male 2 and Female 2 have some missing data due to either having the same score from pre to posttest or they only missed one on the final test.

When I looked at the errors they were very simple mistakes and the students identified their mistake and could correct it; therefore they would have scored the same test to test.

The rubric scores from the first treatment unit were pretty low which was expected due to it being the beginning of first grade and the ability to transfer what is learned into notebook writing can be difficult. This group drew a lot more pictures than the higher achieving group, but they weren't always accurate in the beginning. Their notebooks improved immensely during the second treatment unit, which was all about spiders and insects. These were a lot easier to draw pictures of, but they did start writing good facts down regarding what was learned. Students had much higher scores for their notebooks, but it was not reflected in the amount of growth between pre to posttest scores. This is the unit where Male 2 and Female 2 missed one and their score decreased. As stated before, they identified their mistake without my help when I asked them to look over their test. These two students are students that get easily distracted and have a harder time staying focused during tests. I have seen both make very silly mistakes on spelling tests, math tests and reading tests, which is exactly why I did allow them to look their test over to see if they would catch their mistakes and they did.

Overall there is very little correlation to say science notebooks benefited my average-achieving students. The rubric scores and the growth were all over the board with little ability to say the higher the rubric score the more growth shown. My average students earned mostly middle-ranged scores on the science notebook rubric scores. It does show that students stuck to their abilities with the higher achieving students

receiving the highest scores, and the below average group receiving most of the low scores.

Figure 8 will introduce us to the below average group. I did not have any females in this group when I started my random sampling therefore you will see results from four male students.

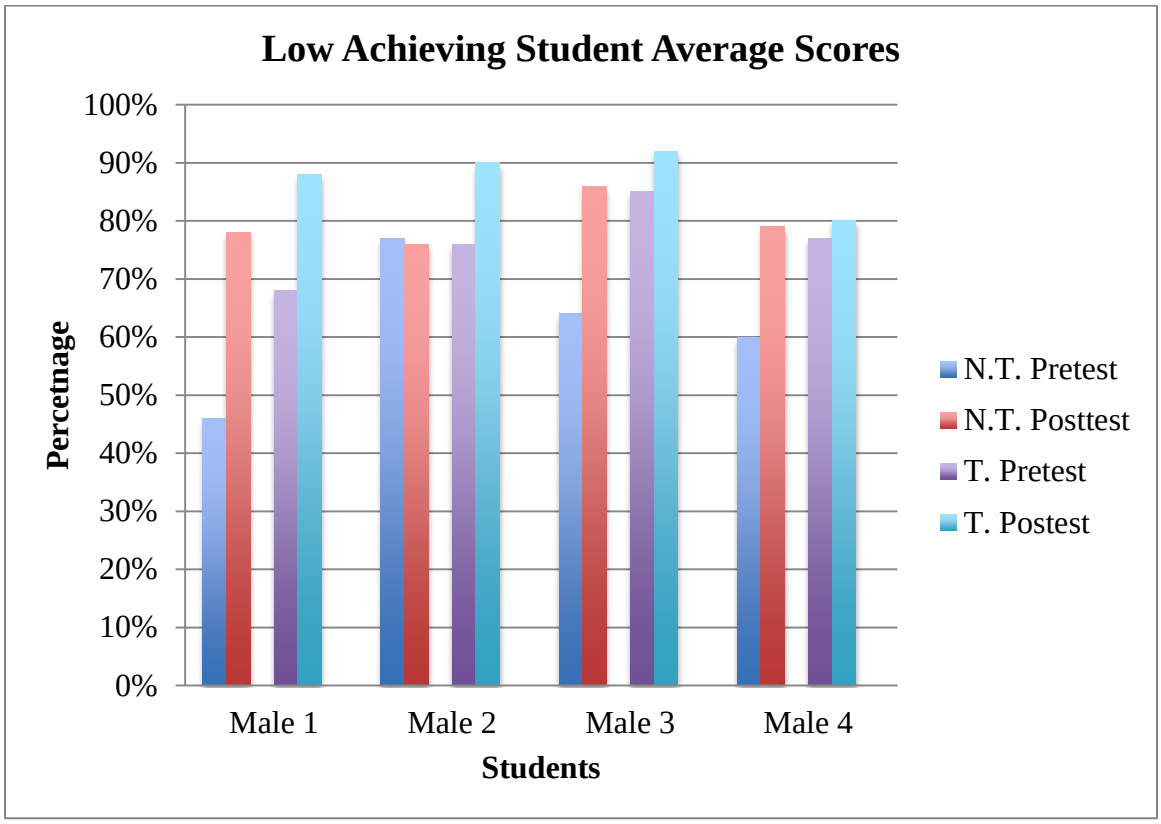

*Figure 8.*Below average student's averages of pre and posttests for both non-treatment and treatment phases, (*N*=4).

Regardless of these four struggling more than the rest of the group, they stayed consistent with the rest of the class by having higher pretest scores during the treatment phases. I have to believe that these topics were discussed a bit more in kindergarten than I understood. I would love to believe that my kids learned about these things at home. I

have a great group of parents, but I do know that science is not the main concern for first graders; reading and math are. These subjects take up the majority of what parents work on at home, but it is still possible that students could be picking up extra science information either through, dinnertime conversations, weekend family traveling, or adventures and other outside school experiences.

Overall they all showed improvement from their pretest to posttest scores for all different units. On average, the boys improved around 18% from pretest to posttest during the non-treatment units. Their treatment unit test scores increased on average by about 14%. They improved close to the same amount regardless of having less area to improve their treatment scores. As mentioned and questioned in the average-achieving students area, this group also had higher scores on their treatment posttests than those of their non-treatment posttests. Yes, they had more growth, but they had more success at correctly answering close to all of the questions rather than part of them.

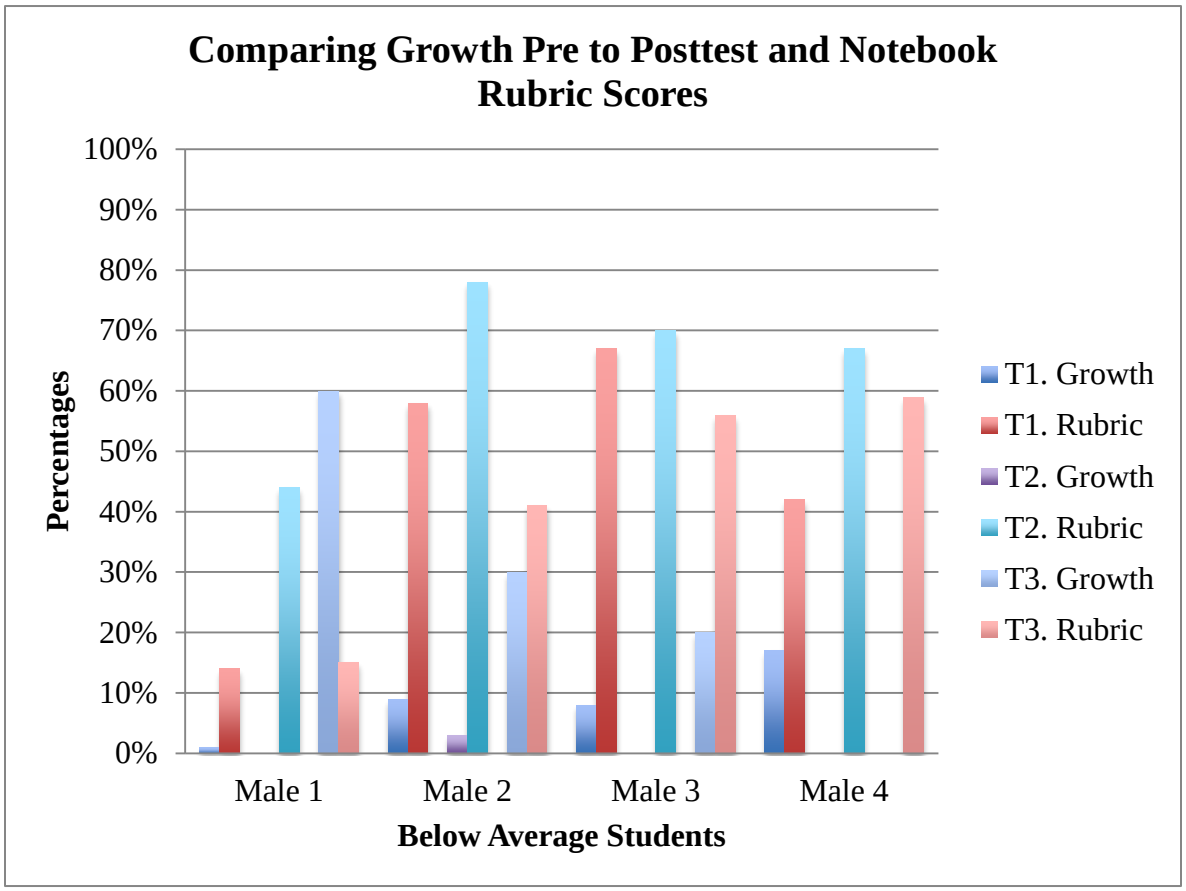

*Figure 9.*Student growth from pretest to posttest for treatment units compared to rubric scores from science notebooks, (*N*=4).

Again we can see that some of these students have missing data. Male 1, Male 3 and Male 4 all have areas that do not display a percentage. The most significant area I found this in was the second treatment phase displayed in purple. All three of the boys decreased their scores from the pretest to posttest. They each only missed one on the posttest, but that still shows a negative when you hope for them to be doing better. I looked at each of their posttests and found that all three of them missed questions regarding numbers; for example the number of legs/body parts for the spider or insect. Each boy had an accurate number, but not in correct association with spiders or insects.

These three do struggle a bit in math and I assumed that after learning all of the facts and talking about this for two weeks, that they got their numbers mixed up, because that is what I witnessed from them during math. One day they had specific facts and the next they got them backwards.

Male 4 also shows no data for the posttest during the third treatment unit; he received the same score as he did on the pretest.

Their rubric scores from unit to unit are very interesting to me, and I can really identify reasoning for their scores. Initially, all of them had low rubric scores ranging from 15% - 67% during the first treatment. This was not shocking at all; lower students always have more difficulty with writing and do not have the confidence or organizational skills. Science notebooks were not exciting or fun for any of them. Male 1 and Male 4 stated that they did not want to use science notebooks again and thought they were a bad idea during the final interviews. "I don't know what they have done for me", "Writing is not fun and I don't like these" were some other responses I received from these two. These two boys were the only ones to respond in that manner when they were asked what they thought about science notebooks and if we should continue using them. I also have notes from my field notes regarding Male 1 not wanting to write anything at all; which is apparent in his scores. My reflections recall having to keep him in extra time to work with him one on one; even trying to get him to draw a picture was difficult. He is a student that struggles a lot with reading. I believe having to sound out all the words to write them caused extreme frustration. Regardless of how poorly they

did in their science notebooks, these four boys still improved and had posttest scores ranging from 79%-93%.

After looking at their second treatment unit rubric scores we can see improvement compared to the first unit. The scores range from 44% - 78%, which is much better than the first go-around. My field notes express them all being more comfortable with the notebooks and more open to trying to write in them. Also, they loved learning about spiders and insects, which I believe also contributed to their increase in success. Their posttest scores; however; went down for three out of the four boys. I explained this previously, but it doesn't give much support for science notebooks helping in any way. Hopefully it planted a seed for the years to come.

I was excited about the notebook improving, but you can then see that their rubric scores go down during the final treatment phase; ranging from 15% - 59%, which is worse than the first treatment. My teacher field notes said that the four boys actually showed more enjoyment learning about friction during our lessons, but due to it being such an abstract concept, they all had a really difficult time putting it into words. Their frustration led them to not even trying. They could model what friction was any day, but writing or even drawing a picture was not going to happen. Most of what they did have in their notebooks were drawings, but not always accurate ones. The ability to transfer an abstract topic to paper isn't there for these four boys yet. Even though their science notebooks were difficult they still gained that extra knowledge and all received a 90% on the final posttest. For these four boys, 90% is a pretty good job!

Lastly, I gave a summative assessment (Appendix G) a couple of weeks after having finished the units. I developed a 30-question test that included about five questions per unit. Below is a table displaying all student scores and the numbers they missed per treatment/non-treatment phase. For example: if you look at Student "1", you can see that this student received 18/30 (60%), and missed 6 questions regarding non-treatment units and six questions regarding the treatment units. This breakdown allowed me to see the amount of questions missed comparing non-treatment versus treatment sections of the test.

You will also see that I have highlighted my groups of students that I used for my analysis from the previous ability groupings. The students highlighted in green are the higher-achieving students, yellow are the average students, leaving red to be the below average group.

Table 3
Summative Assessment Breakdown

Student I.D. Number	**Summative Test Scores**	Number of Non-Treatment Questions Missed	Number of Treatment Questions Missed
1	**18/30**	6	6
2	**27/30**	5	0
3	**28/30**	1	1
4	**28/30**	2	0
5	**25/30**	4	1
6	**28/30**	1	1
7	**27/30**	1	2
8	**29/30**	1	0
9	**29/30**	1	0
10	**24/30**	2	4
11	**27/30**	2	1
12	**27/30**	0	3
13	**28/30**	1	1
14	**23/30**	3	4
15	**23/30**	5	2
16	**24/30**	5	1
17	**15/30**	8	7
18	**18/30**	7	5
19	**20/30**	7	3
20	**19/30**	7	4
21	**26/30**	3	1
22	**24/30**	4	2
TOTAL MISSED		**24 missed**	**21 missed**

We can see that the class as a whole missed more questions that dealt with non-treatment topics (24 missed) compared to the treatment topics (21 missed). All of the information displays the possibility to me that, over time, students actually retained more knowledge of the treatment units, which is when science notebooks were used!

The overall average of scores on this test was 81.4%. 12 of the 22 students earned grades above 80%, while 5 of the 22 scored only up to 5% lower. The remaining five scored 67% and lower. Only one of these five is in my lower group, which was good and bad. It meant that the other four students that are considered my lowest did very well, while also prompting me to look at the rest of the group scoring below 67%. Students 1 and 20 were sick the week before I gave this test, they were part of the reason I waited an extra week to give the test, because I didn't want them to have to make it up. I didn't review the material with any of the kids, so I assumed they would be okay to take it. I believe that the fact that these two were out of school affected their performance. They weren't really in "school" mode once they returned from being gone. Absence is an issue for most students. They get out of the routine and have to assimilate back in to their learning environments for a few days.

Student 18 was getting ready to move to Billings at the time that the test was given. His dad had been gone for a month or two and his mom, brother and him had plans to move within a week of this assessment. He didn't show a lot of emotion at school, but I have a feeling his mind was somewhere else during this test. He was looking forward to moving and this distraction was reflected in other areas of the curriculum for him. Students 17 and 19 were my last two with low scores.

Student 17 is my lowest student in class and he was part of the previous analysis. He struggled with the notebooks immensely, but actually showed the most success during the treatment units on this test! Student 19 surprised me a lot and is a definite outlier for me. She did so well during all of the units and she must have just had a bad day of

testing the day this was given. All five students still had higher success during the treatment unit questions.

Continuing to be intrigued by all of this information prompted me to look at the percentages for just the non-treatment questions versus the treatment questions. The average score of the non-treatment questions (14 questions total) was 77.5%. The average scores of the treatment (16 questions total) was 85.5%. The higher treatment score average shows that students retained more information involving the treatment units over a three month time period.

The following figure displays the breakdown of average scores of my ability groupings. I used the same four students for each of my ability groups that I used in previous analysis. I identified their scores on the non-treatment questions and the treatment questions. I then averaged their four scores together for the non-treatment average; doing the same for the treatment scores.

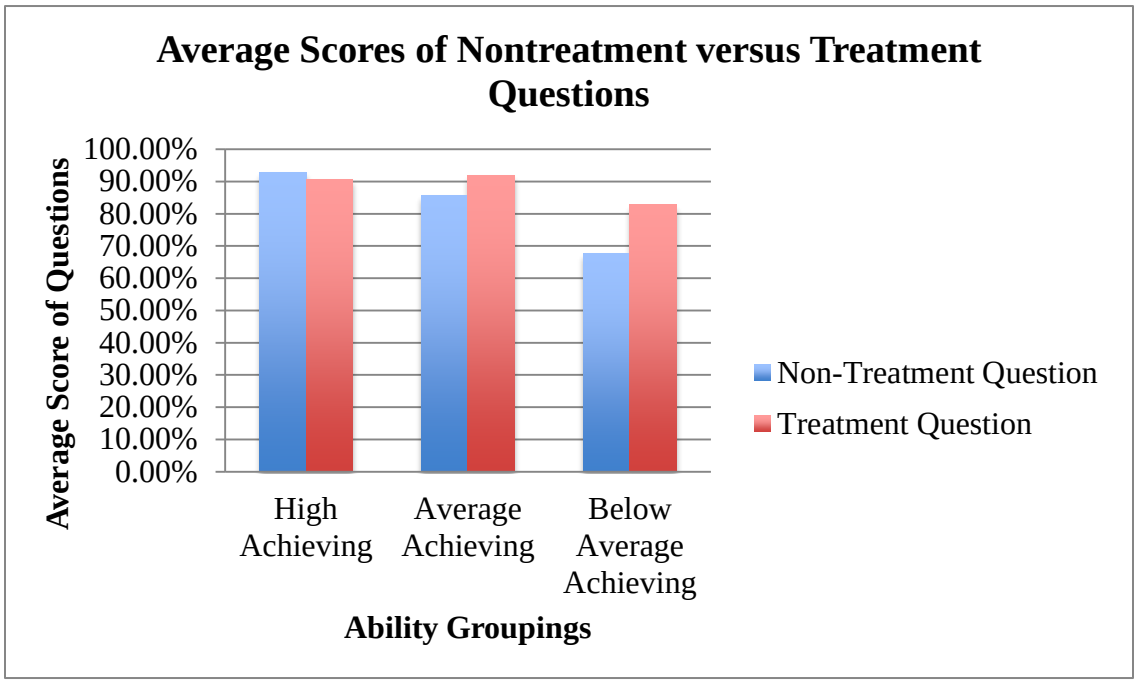

*Figure 10.*Ability grouping averages scored on non-treatment versus treatment questions from final summative assessment, (*N*=12).

I was so glad to look at this breakdown from the summative test. I was excited to see that the treatment units produced higher averages than the non-treatment units. The high achieving students scored similarly from non-treatment to treatment questions. All four of these students found success in both areas, receiving 90% or above in both sections.

The average achieving group averaged 85.7% on the non-treatment questions, while scoring 92% on the treatment questions. This shows a positive correlation between student science notebooks and their ability to remember that information over time. All four students had more correct responses to the treatment questions than non-treatment questions. Science notebooks were a positive for this group of kids.

Finally, looking at the below average group was very exciting. These four male students averaged only 67.8% on the non-treatment questions, but averaged 82.8% on the

treatment questions. Science notebooks had an extremely positive effect on these students; increasing their scores by close to 15%. Regardless of their difficulties using the science notebooks, the notebooks still helped these boys recall the concepts more correctly versus the units we did not use them in. That extra thought process about what to write or draw helped store this information more securely in their brain.

After seeing the final scores and affects science notebooks it was interesting to see the student attitudes towards notebooks and how they felt about them in class and in association with science. I performed student interviews at the beginning of the project, the middle and then finally at the end. All students loved science in the beginning and during the project. Students responded to questions regarding science with: "It is fun! It is surprising. I love science!" "It is neat, because it is cool." "Pretty good, because it is fun and you get to learn." "I like it, because you get to do experiments!" These were the more expressive comments, but all students had positive feelings towards science. This trend continued on through the mid-year interviews too.

The mid-year interviews also involved questions about science notebooks. Students were asked if the notebooks had helped them learn and whether or not they should be used more often. All but two students seemed to enjoy the notebooks. Some examples of positive comments given were: "Yes, we use them for doing science and write things down so we remember." "They help us learn a lot more." "I got to write what I observed and then got to reread it." The majority preferred using science notebooks rather than not using them. I also documented in my field notes students asking me when we would be using them again on several different occasions during the

non-treatment phases. The two boys that did not like the science notebooks had contradictory mid-year interviews and post interviews. Both boys stated that they liked science notebooks and they were “pretty good” or “okay”, but both expressed not liking to write in them and drawing was hard sometimes too. They also both said that they would not like using science notebooks in the future.

I had similar answers at the final interviews. The same two students did not find them helpful; these two boys do not surprise me, due to their lack of success with the notebooks. They both struggled using them, one having to have me help him to even draw a picture. How were these students other grades? The rest of the students continued their support and love of science notebooks to the end of the project. My higher students expressed the most desire to use them. These students were also my students that found the most success on their rubric scores and assessments. Their responses definitely correlated with their scores.

After receiving positive feedback from 90% of my students regarding science notebooksI thought about what I had learned from them. This covers the final theme; how did science notebooks affect my teaching? My field notes and recollection of the entire project helped me realize that I was a lot more aware of what my students were learning and understanding during our science lessons due to the use of science notebooks. The non-treatment units were taught as I normally taught. I saw their growth on their pretest to posttest, but I didn’t see their development throughout the unit. The experiences were not nearly engaging. A section in my notes during the second non-treatment phase read: “We reviewed living/nonliving characteristics again, then played a

game that involved identifying.Students were positive, but not as excited this entire unit. I wasn't "that into it" either. There's a feeling of "getting through" the lessons in order to be done with unit. Not a good feeling." (Journal entry, 12/5/12). I wondered what notebooks would have done for this unit. Students could record all the neat items we worked to identify being either living or nonliving. I would have loved to read those entries!

Notebooks gave me the opportunity to gauge where students were and how far I could move forward with a certain topic or what I might need to reteach as the unit went on. For example, could students identify the car or ball slowing down at different paces when rolled on the carpet versus the tile floor? If students couldn't write accurate observations of this, I couldn't move forward with discussions and lessons on the cause being friction. Most of my students did identify this in their observations and wrote about it in their science notebooks; therefore I could define it as friction. We could then move forward and create tests for different materials to see what created more or less friction. Without science notebooks providing me the opportunity to check each student's understanding, I would have normally gone through the next lesson right away.This is how the non-treatment phases went until I saw the posttest score. By that time the unit was over I would have to integrate corrective lessons in the future science units.

The value of science notebooks was pretty high for me as an educator. I got to see what they thought was important to mention in their notebooks and also see if their information was accurate. I also spent time looking at the notebooks one-on-one with my

students, which I rarely do any other time since it is mostly whole group instruction or breaking the students into small groups. The one-on-one opportunities and progress monitoring reasons made me find them quite valuable!

INTERPRETATION AND CONCLUSION

The research performed during this project was intended to determine the impact science notebooks hadon elementary student learning. The data provided plenty of information in order to come to the following conclusions regarding the research questions.

The first research area questioned whether there was any correlation betweenstudent science notebooks and formal assessments. The use of pretests, posttests, a summative assessment and science notebook rubrics allowed me to look at the treatment phase (using science notebooks) compared to the non-treatment phase (not using science notebooks). Students' average non-treatment posttest scores ranged from 83% to 96% during the three different phases. Student's average treatment posttest scores ranged from 89% - 92%. Although the treatment phase posttest scores are high and show high student achievement, they do not include large areas of growth from pretest to posttest. The non-treatment phases actually display students having the most growth averaging 15% - 41% improvement pre to posttest during these three phases, which did not include science notebooks. The treatment phases only had 3% - 17% growth from pretest to posttest. This doesn't support that science notebooks had a

significant impact on student assessment (See Figures 1 & 2). The good news is that students showed growth and improved their science knowledge during both phases!

Student science notebook rubric scores were never very high percentages during the three treatment phases (64% - 87%). I started to see some correlation in association with student achievement on their science notebook entries compared to their achievement on the posttests. The class averaged 64% on their notebook rubrics and their average posttest score was 90%. The following treatment phase they averaged 87%; much higher than the first, and their posttest score was 92%. With further research this trend may have continued with a longer trial of non-treatment/treatment phases. The better students did writing in their science notebooks; the better they did on their posttest (See Figure 3).This created more questions that I could investigate at a later time: would the trend have continued given more treatment phases? Would this project have shown different results if it had started in the spring when first graders had better writing skills? These are all things to look for if science notebooks are used in the future.

The summative test shows a definite correlation between science notebooks and assessments as well. The test had 14 non-treatment test questions and 16 treatment questions. The class got an average of 85.5% of the treatment questions correct; alternatively they received only 77.5% for the non-treatment questions (See Table 3). Students obviously retained more treatment unit information over the four-month project.There is close to a 10% difference in accuracy from non-treatment to treatment. This showsa significant positive correlation between using science notebooks and a student’s ability to retain information for formal assessments.

After looking at the class as a whole I met my next question: what effects do science notebooks have on the different achievement levels of my students? I had a high-achieving group, average achieving and below average group that was included in my analysis. All three of the groups improved their notebook writing from treatment 1 (61.5%) to treatment 2 (83.75%), but then dipped down during treatment 3 (69.42%). (Averages were taken of rubric scores from Figures 5, 7, & 9). Friction was the topic of the third treatment phase and was a very abstract concept for all of the students, causing most to have a difficult time transferring the information into their notebooks. Regardless of their hard times writing in their science notebooks about friction, each group showed the most growth pretest to posttest (See Figure 3, growth of 17%).

The high-achieving group did not show much of a positive or negative correlation between science notebooks and their achievement. Student's scores stayed the same from pretest to posttest regardless of it being a treatment or non-treatment unit. They also had close to the same accuracy when it came to the summative assessment, scoring 92.9% on the non-treatment questions and 90.6% on the treatment questions (See Figure 10). One outlier was in this group; Male 1 had scores that decreased between his pretest and posttest during the treatment phases. On average his three pre-test scores were 97%, but he only received an 87% average between the three posttests (See Figure 5). I did have conversations with him and he expressed his frustrations of having to go "over and over the same things". He was a student that was ready to move forth and not take extra time to make sure the information was mastered. In regards to this one student, science notebooks weren't necessarily detrimental to him, but more of an irritation thatcaused

him to make silly mistakes on his tests since he worked through them so quickly. For future uses I could differentiate the entries for students needing more challenging material.

My average achieving group was quite similar to the high achieving group.The average achieving group didn't show much correlation between the science notebooks and testing until I saw the summative assessment breakdown. These four students averaged 85.7% correct on the non-treatment questions, but showed 92% success at answering questions about the treatment units (See Figure 10). The units using science notebooks showed the most retained knowledge from start to finish of the project, which is a positive correlation for the use of science notebooks and average-achieving students.

My below average grouped showed the strongest positive correlation on the summative assessment.The four students averaged 67.8% on the non-treatment questions, but averaged 82.8% on the treatment questions. Science notebooks had an extremely positive effect on these students; with a difference in scores being 15% (See Figure 10). Their science notebook rubric scores were not strong throughout the entire project (T.1. average of 45.25%, T.2. average of 64.25% and T.3. average of 42.75%). Regardless of their difficulties using the science notebooks, the notebooks still helped these students recall the concepts more correctly versus the units that notebooks were not used. Writing is a tough part of the curriculum for lower achieving students, but there is a process that occurs before the pencil even hits the paper. Those brain processing skills are what benefited my below average learners. These students had to organize what they had learned and figure out a way to display that on paper; whether it was a drawing or written

words. The treatment unit information was storedmore securely in their brain and easier for them to recall at the end of the six total units. Science notebooks will be a valuable tool for the below average learner.

When looking at how each ability grouping was affected and finding that the below average students had the most growth due to science notebooks it made me think about another area being looked at during this project; student attitudes. The only two students that had negative comments about science notebooks throughout the project were two boys that science notebooks most directly improved their science knowledge! These two boys, part of the below average group, make up the 10% of student comments including: "I don't know what they have done for me", "Writing is not fun and I don't like these". These two students didn't understand the positive effect that the notebooks had on their learning. They visualized the science notebooks as "hard", but not as a tool that was getting their brain working and thinking about what they were learning.

The other 90% of students had very supportive attitudes towards science notebooks from the very beginning. There were some frustrating points at the beginning of the year, but the group really looked forward to using their science notebooks. They understood if they couldn't write something, that drawing was a great alternative for them. If I did this again I would sit down and explain this to my students to help them understand that even though it seems hard, the notebooks are helping them as learners. Close to 50% of the class did recognize this on their own. Some of the supporting comments included: "We could write things down and then look at what we wrote to

help us remember." Another girl stated "Writing stuff in my notebooks helps me think about science more and then I remember it a lot better!"

In response to my last sub-question, I completely agree with these two responses. My teacher field notes, observations and recollections of this project found science notebooks to be a very powerful tool. It helped direct me towards what could be taught next. For example, if a student wrote about spiders having six legs instead of eight, I couldn't move on to lessons about insects because students would then identify spiders as insects. I also got to understand how the student was processing the learned information, could they put it into words or just draw a picture? Were they making predictions or connections to their lives? I really enjoyed this aspect of the science notebooks. They gave me a one-on-one opportunity with my students involving science topics, not just reading and math.

Science notebooks do impact elementary learning, although it might not be revealed on unit posttests or in their notebooks. Over time science notebooks help students process the information needed more thoroughly; which increases their ability to recall the information. Science notebooks are great for the below average learner, even if they do seem "too hard". Notebooks can still be used with all achieving levels of students; showing no detrimental effects to student learning. They are great tools to keep a teacher in touch with student progress in the area of science.

VALUES

I enjoyed working through this project. Some areas were difficult, but overall it was a huge endeavor that I am glad to have completed. The most difficult part of the project was the more questions it created: What would this project have looked like during the second half of first grade when students were more comfortable with writing? Would the outcomes be any different if the project was done throughout the year? Next time, could I make sure the units were all within one area of science, for example: Biology, Physical Science etc.? These are all questions that I can be thinking of and try to answer when I use science notebooks again.

My experiences with science notebooks have expanded my thoughts and approaches to teaching science. I have come to realize the true value these simple tools hold for the science education of elementary students. They provide opportunities for teachers to meet the student at their level. Notebooks allow a check and balance system that most elementary education science curriculums do not require.I was able to view the raw thoughts of my students by what they wrote or drew in each entry. I could identify what students found significant enough to write down, but also areas students may still have misconceptions about. The processing skills that it also takes for students to record an entry is quite valuable. My students seemed to work through the science material differently when using science notebooks and appeared more engaged in conversation about science topics with their peers. This provided a strong support for my more "science-savvy" students that might struggle in other areas.

I appreciate how great it ended up being for students, but I also recognize how useful science notebooks and this research were for me as an educator. I took away a much better understanding of assessing and analyzing data appropriately and then using it. The notebooks drove the daily lessons based on student success. I took more time with the science topics, when I usually would rush through the units. I had to check on what knowledge students gained and made time for one-on-one conversations regarding science.

This project helped me teach in order to create a solid foundation of a few science concepts, rather than touching on several concepts for just a brief period of time with nothing too in depth. I will continue to use science notebooks in the years to come. They might not be as structured or specific as they were for this project, but simply a science journal (possibly using a composition notebook). These will provide students with an area to draw or record written recollections or curiosities regarding our science topics. All students showed positive growth while using science notebooks regardless of how "well" their rubric scores were. Students consistently improved their pre to posttest scores. Science notebooks proved to be valuable to increase student thinking and improve student's ability to retain information over time after looking at the summative test. Student's ability to remember information throughout their years in school will allow the next year's teacher to build on what they already know.

I also will create more challenging questions in order to meet the needs of the higher achieving students. Science notebooks are simple tools that can be manipulated to

meet the needs of every different achievement level of student. All students found some form of success throughout this project.

Incorporating science notebooks into science instruction is a current task I am working to continue. Science notebooks can help students improve content knowledge while giving them more exposure to writing and continue to help the effectiveness of my teaching.

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APPENDICES

APPENDIX A

IRB EXEMPTION FORM

MONTANA STATE UNIVERSITY

INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
FWA 00000165

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Montana State University
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Chair: Mark Quinn
406-994-5721
mquinn@montana.edu
Administrator:
Cheryl Johnson
406-994-6783
cherylj@montana.edu

MEMORANDUM

TO: Ashley Milbrandt and Walter Woolbaugh

FROM: Mark Quinn, Chair Mark Quinn CJ

DATE: October 3, 2012

RE: *"The Effects of Incorporating Science Notebooks into 1st Grade Science Instruction"* [AM100312-EX]

The above research, described in your submission of October 3, 2012, 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.

____ (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 B

INFORMED CONSENT

Informed Consent Form for Students in the Research Study

I will be performing action research this year in my classroom for my final project towards my Master's Degree in Science Education. The purpose of my research is to see the effects of student science notebooks on their science learning. I will be analyzing student recordings in their notebooks as well as completing student surveys, interviews, and pre/post assessments. None of these are anything out of a regularly used assessment technique in the classroom.

All students involved will be kept completely confidential. Names and any other identifying characteristics will not be included in any of the research.

Your child's participation in the use of science notebooks does not include any foreseeable risks. All of the treatment and data collection will be administered as normal classroom instruction techniques. There will not be grades given and will not affect any grade throughout the year.

Student participation in this project will provide me with valuable information and help me to greatly improve my teaching styles and techniques in science and most likely, other subjects.

Please feel free to contact myself with any questions of concerns via email, phone or in person.

Parent Signature: _____

Date: _____

APPENDIX C

NOTEBOOK COVERS AND WRITING PAGE

_____ Senses

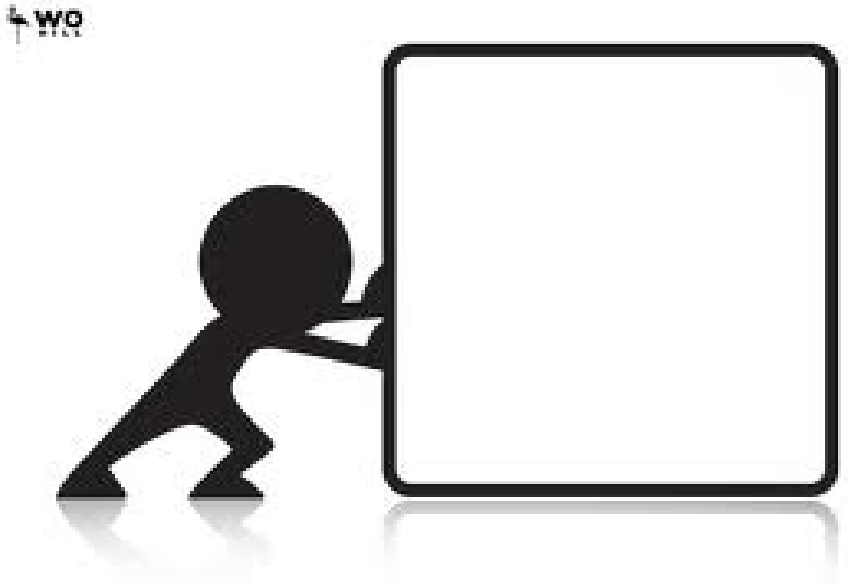
Science Journal

Living or Nonliving?

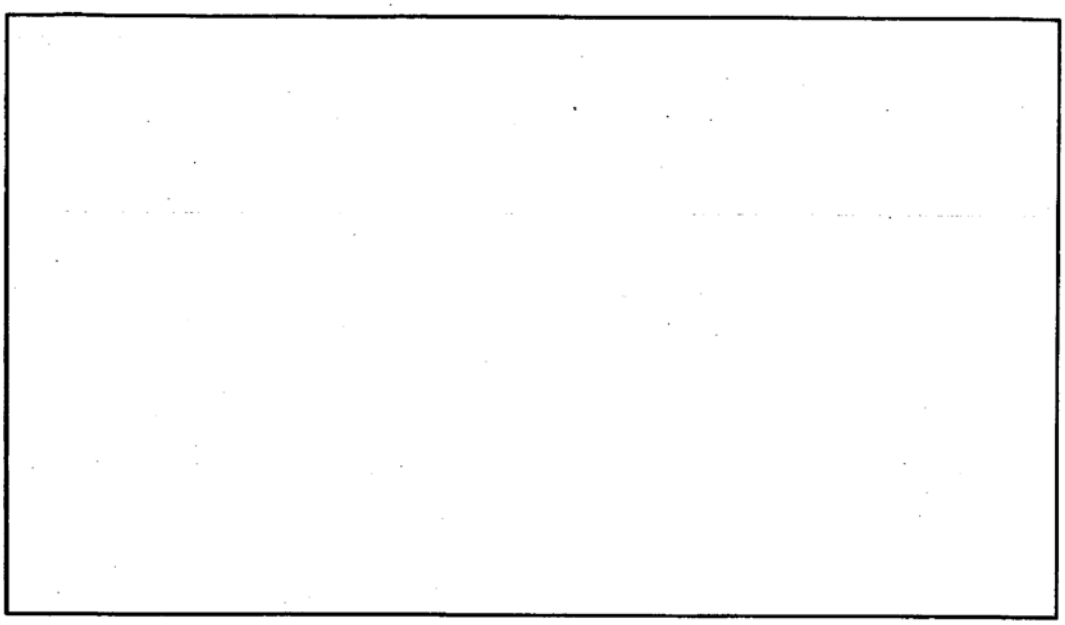
_____ Science Journal

Finding out about FRICTION!

By:



Date: _____



APPENDIX D

PRELIMINARY, MID AND POST INTERVIEW QUESTIONS

Preliminary Interview Questions

1. What is Science?
    - Probe: Can you think of a time you have done science?
2. What do you do during Science?
    - Probe: Do you have a favorite thing you do during science?
    - Probe: Do you think Science is important?
3. How do you feel about Science?
    - Probe: Do you like science a lot?
    - Probe: What do you like/dislike about science?
4. Is Science ever hard for you?
    - Probe: What makes it hard?
    - Probe: What could make it easier for you?
5. Do you ever get bored during Science?
    - Probe: What causes you to get bored?
    - Probe: What could be changed to make science more exciting for you?

Mid-Study and Post Interview Questions

1. What is Science?
    - Probe: Have you been doing science in class this year?
2. What do you do during Science?
    - Probe: What is one of your favorite things to do during science?
3. Do you like science right now?
    - Probe: What kinds of things in science do you like?
4. What are some things that you have learned so far?
    - Probe: Why do you think we have learned about that?
5. Do you feel like you do a good job in science?
    - Probe: Has anything been hard for you?
    - Probe: Do you want to do a good job?
6. Did I help you understand the lessons presented so far?
    - Probe: Have you had any questions that I didn't answer?
    - Probe: Is there anything more that I can do?
7. How do you feel about you science notebooks?
    - Probe: Have they helped you?
    - Probe: What would make them better?

APPENDIX E

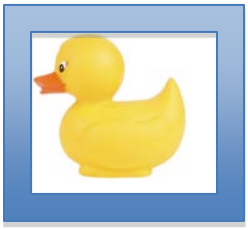
PRE AND POSTTESTS

Sink/Float Pretest

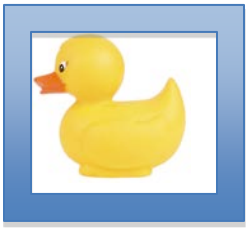
Name: _____

Sink or Float?

1. Cut out duck and place it where it would be if it were sinking.



2. Cut out the duck and place it where it would be if it were floating.



Circle the items that will float. Cross out the items that will sink.

cork

rock

sponge

marbles

eraser

watermelon

Sink/Float Posttest
Name: _____

What Objects Sink or Float?

Circle **float** or **sink** for each picture.

1. 

float **sink**

2. 

float **sink**

3. 

float **sink**

4. 

float **sink**

Circle **True** or **False**:

5. All heavy things sink. True False

6. All light things float. True False

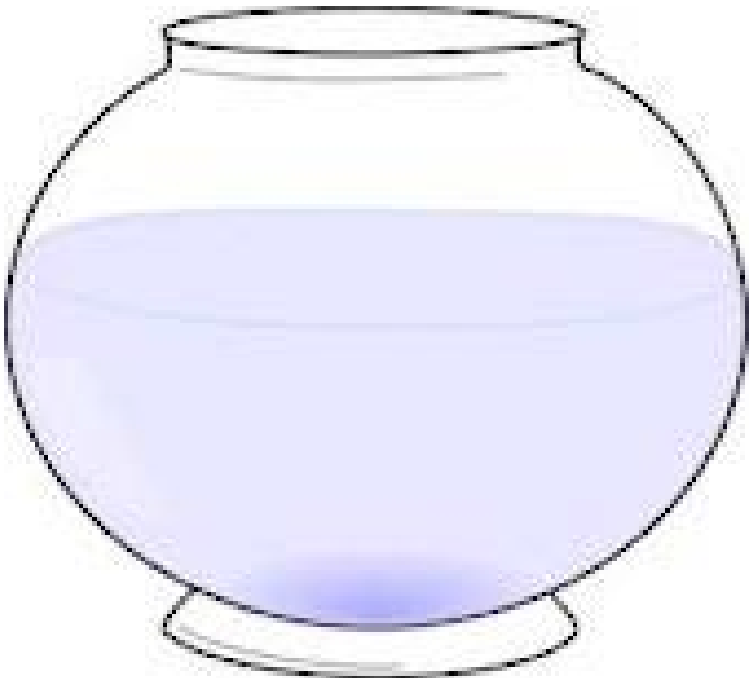
7. **Shape** can change if something sinks or floats.

True False

8. **Density** is the amount of "stuff" in an item.

True False

9. Please draw something that floats and something that sinks below. Color the object that **floats green** and the object that **sinks purple**.



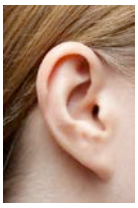
5 Senses Pretest

Name: _____

1. Please circle the senses.







2. Choose one of the words in the box to complete the sentences below.

taste buds
three
brain
blood
five
four

a. We taste with our _____.

b. Our senses send messages to our _____.

c. We have _____ senses.

5 Sense Posttest
Name: _____

1. Color the box that correctly lists the senses.

a.

dime
nickel
quarter
penny
dollar

b.

sight
hearing
talking
touch

c.

sight
hearing
taste
touch
smell

d.

eyes
ears
nose
hands
tongue

2. What sense do we use our eyes for? _____

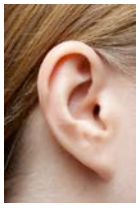
a. smelling b. walking c. sight

3. We use our _____ to taste.

a. mouth b. taste buds c. hands

4. What do we use to hear?

a. 

b. 

c. 

5. What do our eyes have to help us see.

a. cones and rods b. eyelashes c. color

6. Our taste buds taste:

a. everything b. good and bad c. sweet, salty and bitter

7. Draw a picture of something you can:

a. TASTE

b. SMELL

c. HEAR

d. SEE

e. FEEL

8. Circle the senses you would use while eating a piece of pizza:

a. sight b. smell c. touch d. hear e. taste

9. Circle the senses you would use while picking flowers:

a. sight b. smell c. touch d. hear e. taste

10. Why are senses so important?

_____

_____

_____

_____

_____

Pretest
Name: _____

1. Color the pictures that show living things **blue** and the pictures showing non-living things **orange**.






2. Circle the word that names the pictures.



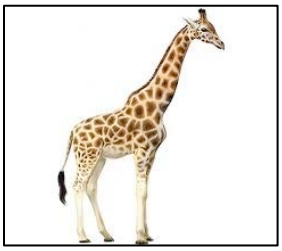
living nonliving

3.



living nonliving

4. Circle each word that tells what these living things need.



water food air water

4. Circle each word that tells what these living things do.

grows hears changes sees

5. Circle the nonliving thing.

Post-Test
Name: _____

1. Circle the word that names the pictures.



living nonliving

2.



living nonliving

3. Circle each word that tells what these living things need.


water food air water

4. Circle each word that tells what these living things do.

grows eats changes sees

Cut and paste the words in the correct sentences.

1. Living things need _____,

_____, and _____.

2. Nonliving things do not

_____.

air	food	grow
sight	air	water
fun		

Name: _____

Spiders versus Insects
pretest

1. A spider has _____ legs.

2. An insect has _____ legs.

3. Draw the number of body parts that a spider has.

4. Draw the number of body parts an insect has.

5. A spider as antennae.

True False

---

6. A spider spins a web.

True False

---

7. Some insects have wings.

True False

---

8. Spiders eat insects.

True False

---

9. Spiders have one eye.

True False

---

10. Insects need food.

True False

Name: _____

Spiders versus Insects
posttest

1. A spider has _____ legs.

2. An insect has _____ legs.

3. How many body parts do insects have?

_____

4. How many body parts do spiders have?

_____

5. A spider has antennae.

True False

---

6. A spider spins a web.

True False

---

7. Some insects have wings.

True False

---

8. Spiders eat insects.

True False

---

9. Spiders can have up to eight eyes.

True False

---

10. Spiders can fly.

True False

---

11. Insects eat spiders.

True False

---

12. All spiders live in webs.

True False

---

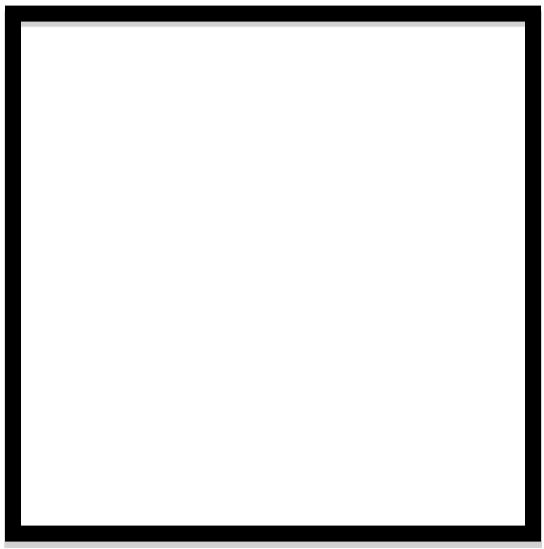
13. Insects need food.

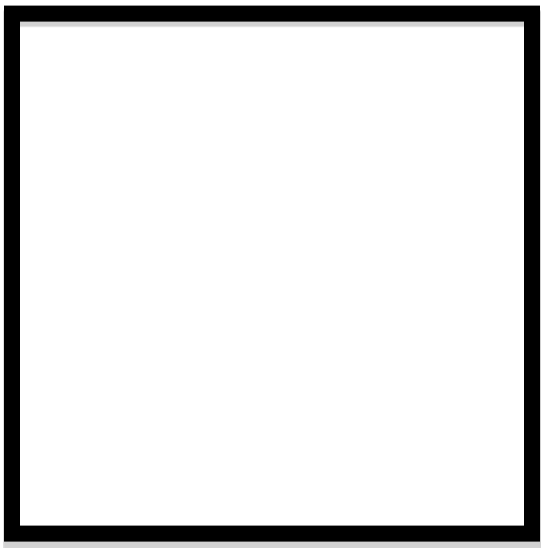
True False

---

14. Draw a spider.

15. Draw an insect.





Name: _____

Seasons Pretest

1. There are _____ seasons in a year.

2. List the name of the seasons below:

_____

_____

_____

_____

_____

3. Plants start to grow again in _____.

4. Leaves change color in the _____.

5. Snow is common in _____.

6. Every place in the world gets snow during Winter.

True False

_____

8. Summer months bring us lots of rain and wind.

True False

_____

9. School starts in the Spring.

True False

_____

10. The season that comes after Summer is Fall.

True False

APPENDIX F

SCIENCE NOTEBOOK RUBRIC

Unit: _____

Teacher Name: **Milbrandt**

Student Name: _____

CATEGORY	3	2	1
Understanding of the Process Skill	- Unique drawings/writings are present - All labels and details included.	- Drawings/writings are present with partial labels. - Accurate, but not complete information gathered.	- Student entry includes a simple drawing or writing sample with no detail.
Understanding of Science Topic/Information	- Accurate explanations of the science content. - Able to generate their own understanding.	- Partially accurate explanation of science content. - Attempts to generate explanation and understanding.	- Inaccurate explanations - Student has unclear view of science content.
Individual Thinking	- Fresh and original thoughts and ideas present. - Many unique illustrations/examples provided.	- Has some original thoughts and ideas included. - Minimal information provided.	- Few examples - No information/details provided.

APPENDIX G

END OF PROJECT SUMMATIVE ASSESSMENT

Science Summative Assessment

Name: _____

1. All heavy things sink. True False

2. We have _____ senses.

a. five b. three c. four d. six

3. **Shape** can change if something sinks or floats.

True False

4. Living things need air, food and _____.

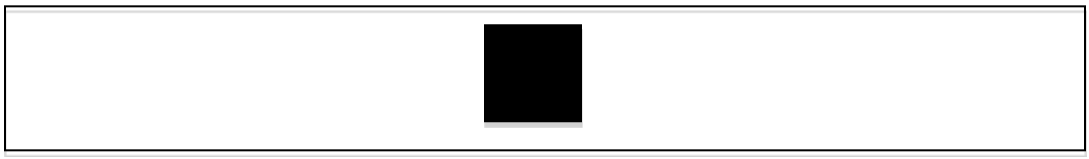
a. fun b. water c. dirt d. eyes

5. How many body parts do spiders have? _____

6.All living things change over time. True False

7. There are _____seasons in a year.

8. If you pushed the box, where would it go?



9.Moving from one place to another is called:

a. ramp
b. smooth
c. motion

10. Insects have 6 legs. True False

11. Color the box that correctly lists the senses.

a.
dime
nickel
quarter
penny
dollar

b.
sight
hearing
talking
touch

c.
sight
hearing
taste
touch
smell

d.
eyes
ears
nose
hands
tongue

12. It only snows in the winter. True False

13.A force that makes it harder to move things is called:

a. friction
b. speed
c. pull

14. A force is as push or a pull. True False

---

15. Winter comes after Summer. True False

---

16. Watermelons sink because they are heavy. True False

---

17. Fire is a living thing because it moves. True False

---

18. The cones in our eyes help us see _____.

a. black and white b. danger c. color

---

19. _____ makes up things and helps determine if something will sink or float.

a. Water
b. Density
c. Mud

---

20. Our sense of touch helps us smell. True False

---

21. Insects have antennae. True False

---

22. Spiders and insects have wings. True False
23. All living things _____ and _____.

a. breathe and talk b. jump and swim c. grow and change

---

24. Senses can help keep us _____.

a. safe b. funny c. not hungry

---

25. When you rub two surfaces together it causes friction.

True False

---

26. All light weight things float. True False

---

27. Our whole body has the sense of _____.

a. sight b. touch c. smell

---

28. Spiders use spinnerets to spin their webs. True False

---

29. Nonliving things do not:

a. move b. talk c. breathe

---

30. Please list the 3 seasons in order after Winter.