EFFECT OF INSTRUCTOR-CREATED VIDEOS OF SCIENCE CONTENT
ON STUDENT ACHIEVEMENT

by

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in

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This project would not have been possible with the amazing support and encouragement of key people. First and foremost are my family whose patience and understanding of my absences did not go unnoticed while I toiled away. Gratitude is also extended to my students who traveled this voyage of first videos and data collection with me. My colleagues at Harper Creek Middle School and their expertise on creating videos and data collection were also significant factors in this project. Finally, I would like to show my appreciation to the entire faculty at Montana State University for their tireless support of students and learning, especially my advisor John Graves for his relentlessly supporting research that will impact my teaching, my science reader Lisa Brown for her invaluable feedback and insight, and the late Peggy Taylor whom helped me get started on my journey.
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ABSTRACT

In this classroom research project students were exposed to teacher-created videos. The videos were created as a means for students to have materials that would help review content outside of the classroom. Videos showed any hands-on experiments absent students may have missed and also offered the opportunity for students to review procedures. Videos also reviewed content from class discussions, explained key concepts, and included modeling as a means of explaining concepts. The goal of the study was to look at achievement on unit tests and compare the results between when the videos were accessible and when they were not. Results of the research suggested that the inclusion of the videos had no significant impact on student achievement on unit assessments and few students accessed the videos. The students that did access the videos had favorable reviews of the content.
INTRODUCTION AND BACKGROUND

I have taught in public schools for seven years and have seen an increase in the use of technology in the classroom. Many of my years teaching have been spent teaching science to fifth graders, including my current teaching position where I conducted my classroom research project. Harper Creek Middle School (HCMS) in Battle Creek, Michigan is a public school that services a student population of over 800 students from fifth to eighth grade with approximately 200 students in each grade. The demographic of my class was representative of the school as a whole: 95% white and 41% qualifying for the free or reduced lunch program ("Student Count Snapshot", 2016). The school is located outside of the city of Battle Creek and students that attend the school have a variety of backgrounds with many of our students coming from farming or rural families, or from the city proper.

At HCMS, I taught science to three separate classes of fifth grade general science. Students enter the middle school from our district elementary schools and from surrounding districts. For many students, fifth grade is the first year of daily science instruction with grades assigned throughout the year. Elementary teachers were not required to demonstrate any mark of students meeting science standards and many did not teach science consistently over the course of the year, which resulted in a wide differences in background knowledge and familiarity with science concepts among my students.

In our district elementary buildings, students have frequent access to Chromebooks. Many students were familiar with accessing information through a variety
media including Google Classroom and using their district-provided Google Drive to create, store, collaborate, and edit documents. They were also familiar with viewing videos on YouTube and EdPuzzle, a site that allows different editing techniques to its users. Recently HCMS purchased Chromebooks for use in the middle school. The availability of the Chromebooks allowed students frequent access to technology during school hours and a continuity of platforms from their elementary years. In this manner, student learning took place in a variety of settings and using multiple exposures to technology.

For my science instruction, I was responsible for implementing lessons from a science curriculum from the Battle Creek Area Math and Science Center. Throughout the units, I required students to illustrate and explain what happened in classroom investigations. My observations were that learning suffers when students do not accurately create and label illustrations, and do not record findings, notes, or appropriate concepts. One observation I made was that students lacked concrete resources to refer to in the science curriculum to review concepts. One challenge with the existing curriculum was the lack of written or illustrated examples for students to refer to during activities or to review after lessons have been taught. Class discussion, diagrams, and explanations were also a critical part of creating the conceptual understanding. The current curriculum lacks examples or explanations for students to refer. Without these resources, students have a difficult time reviewing concepts, returning to look at examples, or reviewing conceptual understandings for learning. When students did not comprehend content, they had no resources to review and to help make connection.
Student learning is a common concern for students, teachers, and administrators. Students are increasingly given access to technology to support their learning. Resources for my fifth grade students to review or receive instruction should be available as an online resource in order to aid in increasing student learning. Students are also more responsive to instruction given by their content teacher versus other teachers or hosts of Internet videos. This increase in responsiveness can be attributed to common vocabulary, presentation and explanation of concepts, and other factors by a familiar person. After looking at the need for resources and seeing the availability of technology for my students in and out of school led to the creation of my focus question, *What are the effects on student learning of instructor-created videos focused on explaining science concepts for a fifth grade general science class?*

**CONCEPTUAL FRAMEWORK**

When someone reads a recent newspaper, peer-reviewed education or technology journal, or pedagogy of teaching text, it is easy to see the increased exposure and inclusion of technology use in classroom teaching. The use of technology in schools is increasing at a substantial rate and has resulted in several positive trends (U.S. Department of Education, 2010b). Technology in the classroom enriches the educational experiences of students by exposing them to real-world tools while meeting grade level expectations. In addition, the benefits of increased technology including one-to-one laptop or tablet initiatives and more robust teaching tools in the classroom allow teachers to further challenge their students. There is also an educational trend towards a flipped classroom-teaching model, whereby students view videos of lectures or other content
instruction outside of class time and also allows deeper questioning and application in the classroom (U.S Department of Education, 2010a).

Increases in technology inclusion are occurring in all areas of education from preschool through post-secondary education. Over 7.1 million post-secondary students are engaged in online learning according to the Allen and Seaman report (2014). Online learning, according to the report, encompasses courses where 100% of instruction and work occur using an online format. Even greater numbers are being engaged in ways other than just online learning, including embedded learning or blended learning in which a combination of online and face-to-face learning exists. It is paramount to understand the implications of the use of technology in student academic achievement, given increased use of technology (Gulek & Demitas, 2005; Hegeman, 2015; Smith, 2015; U.S. Department of Education, 2010).

Based on the data from the United States Department of Education, ever-increasing numbers of school districts across the nation offer some form of online or blended learning. The study conducted by the Office of Planning, Evaluation, and Policy Development on using online learning demonstrated marginal increases in effective student learning (2010). There have been subsequent studies performed that highlight the added benefits made by students that participate in online or blended learning and also address the added benefits of using technology, specifically teacher-generated videos in education (Devlin 2013; Hegeman, 2015; Stockwell, 2013). According to Kimmons, few studies exist on the effects of technology in classrooms because use of online tools, including videos, simulations, texts, and homework problems by students are so varied in
application that consistent findings are difficult to demonstrate (2015). Many studies have noted that some teachers altered their teaching methods throughout the studies. Because their pedagogy changed, the outcomes of the technology used were not reliable. The Kimmons research also found with greater numbers of K-12 districts adopting technology to teach or practice skills, the understanding of the impact of blended learning techniques is becoming more and more relevant (2015).

Embedded blended learning, which is one type of blended learning, involves using multimedia to teach or reteach concepts in a classroom. This multimedia content can present itself in many forms including online platforms created by textbook publishers, simulations, and videos created by third parties or teachers. This differs from a flipped classroom in that students view lessons or use other sources in the classroom rather than outside of class time. Teachers are therefore are able to answer questions and guide learners as areas of confusion arise (Smith, 2015). Students then are able to access information as needed: to move on to the next concept, to review, to independently find solutions, and to access lessons either not understood or missed due to absences. Using teacher-generated videos to review concepts and assignments helps to increase knowledge and application of science standards (Hegeman, 2015).

As the use of technology increases, teachers will continue to change their methods of instruction to better pair with the possibilities allowed with the technology. Teachers may spend less time lecturing and feel a greater sense of empowerment in educating students for twenty-first century tasks (Gulek & Demirtas, 2005). With student exposure to and use of various forms of technology in their education, the impact of technology
will be found throughout various subject matters. Students will also develop skills such as time management, self-reliance, self-monitoring, and cooperative learning (Devlin, 2013). Technology allows students to spend more class time completing complex projects, including project-based learning, engage in more collaborative work, and have higher motivation than students in a traditional classroom. When students are working on complex projects, teachers have reported fewer classroom management problems, and a greater number of engaged students (Devlin, 2015; Gulek & Demirtas 2005; Smith, 2015).

The use of online platforms, whether they consist solely of videos or of assignments with text and videos are not as effective in assisting student learning as videos generated by the course instructor (Hegeman, 2015). Using teacher-generated videos as a means of concept review in a classroom aids in motivating students. This is due in part to the connection students have with their immediate teacher, the teacher’s ability to address common misunderstandings with his/her students, and the relatively short duration of the video (Develin, 2013; Hegeman, 2015; Smith, 2015). There are however, varying opinions on the attention span of students as they view videos of science content. According to some studies, students found themselves more apt to pay attention if the information given was offered one time, in a short, concise explanation (Devlin, 2013; Hegeman, 2015; Smith, 2015). Other studies demonstrated some students experience more mind wandering during video versus live lectures (Varao-Sousa, 2015). This difference may be based on the length of the videos, the decrease in outside stimuli, or other factors (Devlin, 2013; Smith 2015). Combining the aspects of research of online
or blended learning to determine the most beneficial presentation of learning goals is now
the subject of many pedagogical studies (Chen & Wu, 2014; Moes, 2013).

The Cognitive Theory of Multimedia Learning developed by Richard Mayer
(2009) is based on the ability of an individual to optimize the use of working memory and
create new knowledge that is integrated with prior knowledge. This theory looks at the
approach of load, or the amount of mental effort used in the working memory, and the
impact of multimedia on that load. The theory suggests that using multimedia allows for
optimal use of working memory therefore allowing more availability for load, or more
mental effort, to create more connections and hence more new knowledge (Chen & Wu
2014). The Mayer’s Cognitive Theory of Multimedia Load consists of three main
components when learning with multimedia:

1. Two separate channels exist for individuals, one to process auditory information
   and one to process visual information
2. Each channel has a fixed capacity
3. Learning is an active process of filtering, selecting, organizing, and integrating
   information based on prior knowledge. (JL, 2015).

Using multimedia would eliminate some of the load from the working memory in that
learners could have a visual representation of the problem being described thereby
allowing more working memory to focus on creating the new knowledge schema
(Sweller, 1999). This would remove some of the load from one processing auditory
information to processing visual information, freeing up mental effort to create more
connections.
METHODOLOGY

My educational research project was conducted over a three-month period, from the end of January 2017 through March 2017 at HCMS. I taught three sections of fifth grade general science to 82 students. The year was broken up into three units: physical science, Earth Science, and life science, with the Earth Science unit as the treatment unit. I taught using the curriculum created by the Battle Creek Area Math and Science Center’s outreach division, Cereal City Science. The physical science and Earth Science units are in their inaugural year as they were recently designed to align with the Next Generation Science Standards. The units involve many hands-on investigations and guide students through the process of discovering science and understanding concepts.

I created nine videos from three to seven minutes in length that described the findings of lessons for my fifth grade students. These were not videos of lectures but rather a cumulative explanation of lessons and concepts for students to review. Lessons lasted anywhere from two to five days and each video focused on explaining the science concepts and connections between concepts. These videos were viewed during class and also available on my class website. Students were encouraged to view the videos for review outside of class. I also created videos for each hands-on experiment to highlight the task and the findings from each one. The videos for the hands-on experiments were not shown in class but were available on my class website. Students that were absent were able to view the videos of activities they missed.

My classroom research project focused on whether or not the videos shown to students during class, and available to them outside class hours, increased their science
understanding. At my school students frequently had access to technology during their classes. One way they accessed technology to view videos was during the enrichment class. This class is dedicated to either enriching students that are meeting academic requirements or supporting struggling students and students are placed in the classes based on academic needs. Teachers have the ability to adapt their curriculum to helping students with what they truly need to meet academic standards, including completing work they missed. This offers access to the science videos. The research methodology for this project received an exemption from Montana State University’s Institutional Review Board and compliance for working with human subjects was maintained (Appendix A).

The physical science portion of my class lasted eleven weeks and hands-on investigations were done weekly and occasionally multiple times in a week. During this non-treatment unit, students that missed school spoke with me or other students to find out what activities they missed and recorded findings from the investigation from their group. Students used their notes from their science journal to review lessons. They frequently were prompted to look in their notes or their journals when they needed clarification on ideas or material.

The Earth Science unit, the treatment unit, lasted twelve weeks and was conducted much in the same manner with multiple hands-on investigations and students recording ideas in their science journal. If students were absent from class on the day of the investigation, they had access to a video that showed the experiment and reviewed many connections to prior learning. Students then completed work in their science
journals. When students needed clarification on a subject, they were directed to my class videos for help and to then directed to explain their ideas via a writing prompt (Appendix E).

To collect information on student attitudes towards the science class without any videos for review, I administered the Pre Attitude Survey (Appendix B). It consisted of six Likert-style questions concerning attitudes on the class, availability of materials to catch up after missing school, and materials used to review concepts. Students could respond as *strongly disagree, disagree, agree, or strongly agree* to the prompts. There were also three short answer questions where students could elaborate on their responses. This survey was given near the end of the first unit of the year and again at the end of the treatment. The data was averaged and analyzed to find trends in student attitudes when review materials were lacking and replications of student investigations were available. I looked for patterns of positive and negative attitudes towards science class and towards the availability of resources for students to review materials.

I also administered two unit tests created by Cereal City Science, Structure and Properties of Matter and Earth Systems. The pre- and post-unit tests were typical, summative assessments for my students. The Structure and Properties of Matter unit test scores were averaged with normalized gains and compared with the Earth Systems unit test averaged scores with normalized gains (Appendices C and D respectively). The Structure and Properties of Matter unit was the unit without the supports of teacher-made videos while Earth and Space Systems was done with the videos and thus, the treatment. I analyzed the scores using box plot data to find trends in positive or negative changes.
Richard Hake (1998) described his method of normalized gains in his paper on interactive engagement in a physics course. I modified the method to suit this study. The normalized gain \( g \), is the quotient of the absolute gain in test score divided by the potential gain in test score: \( g = \frac{(\text{pretest score}) - (\text{post-test score})}{100 (\text{maximum score}) - (\text{pretest score})} \) to assess the average actual gain. For the purpose of this study, I grouped the data in the same categories Hake utilized: high gains were those with \( g \geq 0.7 \), medium gains fell between \( 0.7 > g \geq 0.3 \), low gains were when \( g < 0.3 \). Using this method, I could analyze the true growth of student learning as shown on their unit test.

Students were also given writing prompts as formative assessments throughout the Earth Science treatment unit where I looked at students’ abilities to explain scientific concepts (Appendix E). These were responses students wrote in less than five minutes that either explained their scientific understanding or for students to explain where they struggled. Some writing prompts were given on topics that were taught in class then explained again in videos. Other prompts were given after a topic was addressed in class but no video review given. The writings were given as a type of review formative assessment. They were not given immediately after discussing the context or watching a video. Results were analyzed using bar graphs to highlight the differences between student-written explanations when provided with extra supports such as videos compared to explanations without video review.

Unit assessment and writing assessment data was also analyzed for differences between students that are frequently absent, or truant. I used our school policy to consider if a student was truant based. If a student missed ten or more days of school,
that equates to over two weeks of missed classes. This impacts not just content but also the practice of writing, discussing, explaining, and learning.

Student interviews were conducted at the close of the Earth and Space Systems unit. These Student Interview Questions added to the qualitative data collected (Appendix F). Four students were selected to participate in an interview group where I asked questions about the format of the class and the availability of resources. I recorded the conversations so I could easily review the discussion and explore common themes.

The data sources described above are summarized in the Triangulation Matrix in Table 1. The information provides the triangulated data for my research question regarding student success and instructor-created videos.

Table 1

<table>
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<th>Data Triangulation Matrix</th>
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<tr>
<td>Focus Question</td>
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<tr>
<td>Do instructor-created videos of science content increase student achievement on formative and summative assessments?</td>
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<tr>
<td>Post Attitude Survey</td>
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DATA AND ANALYSIS

The results of the Pre Attitude Survey for Science indicated that 80% of students strongly agree or agree with the statement “I enjoy science class” at the beginning of the treatment unit and 93% at the end of the treatment (N=82)(Figure 1). In addition, 44% of students disagree or strongly disagree that they have materials to use to catch up after
missing school before treatment while 18% responded the same at the end of the
treatment (Figure 2). Students stated in the interview that they have materials such as “a
computer to use” or a “chromebook” or their “science journal” available to use outside of
class time for review at home. Other students become frustrated stating, “I have hard
times learning” and “It’s a little hard to understand some of the things we do in class.”
Eighty percent agree or strongly agree that they have resources outside of school to
review science concepts before the treatment compared to 79% after (Figure 3). After the
treatment unit was completed these response were still present but they were countered
with other students stating, “our classmates are there to help” and they use “Mrs. Smith’s
website and YouTube videos” or “go on my teachers youtube channel and go on her
website.”

![Bar chart showing student responses to the question: I enjoy science class, (N=82).](image)

*Figure 1. Student response to the question: I enjoy science class, (N=82).*
Figure 3. Student response to the question: When I miss school, I feel I have materials to learn what I missed, \((N=82)\).

Figure 2. Student response to the question: I have enough resources outside of the classroom to review science concepts, \((N=82)\).

One theme I noticed, however, is that even though students were still struggling in classroom assignments and on the unit assessment, only sixteen of my 82 students in the study reported using my YouTube videos to review concepts. During the interview
portion two of the four students interviewed stated they, “didn’t feel like I needed a
review.” Another student said she, “forgot about the videos and looking on the website
and stuff.”

For the answer to my focus question, “Do instructor-created videos of science
content increase student achievement on formative and summative assessments?”
Students scored 82% and 82% on the non-treatment formative writing assessment and
83% and 89% on the writing assignment they completed during the treatment unit (Figure 4).

![Figure 4. Writing assessments, (N=82).](image)

The normalized growth from the pre to post test data was 12% and 18% growth
respectively between non-treatment and treatment summative unit test assessments
(Figure 5).
Figure 5. Growth on unit assessments between pre and post tests, \((N=82)\).

Of the 82 students in the treatment group, 21 students met truancy criteria showing one-fourth of my students are frequently absent. Truant students reached approximately the same achievement rate in both the treatment and non-treatment units as the population without the truancy issues (Figures 6 and 7). This trend continued in both the formative writing and summative unit assessments.
Figure 6. Writing truant vs. general population, \((N=82)\).

Figure 7. Unit assessments truant vs. general population, \((N=82)\).
INTERPRETATION AND CONCLUSION

The driving question focused on the impact of teacher created videos to improve student achievement as measured by formative and summative assessments. Though the data showed slightly higher increases in student achievement and engagement for the treatment unit, the videos did not impact student learning for my students with higher absenteeism rates nor does the data show much of an increase in academic achievement. The students that missed 10 or more days during the treatment unit made similar gains as the students who were in class often.

Gains between non-treatment and treatment posttests were not very different. This may be because students failed to access the videos for review or they simply did not gain deeper understanding even with the added resources. This would be one area for further study.

One area that should be addressed in future studies would be to gather data on who frequently utilized the teacher created videos. In this study, I was looking for students that would willingly use the videos as a means to review or watch in-class experiments to see what was covered in class. Unfortunately, not many viewed the videos as evidenced by the survey results with only sixteen of 82 students stating they watched videos on my YouTube channel and between twelve and twenty views of each video according to my YouTube view count. Of those sixteen students, fifteen of them have carried top marks all year in science class and had high grades in all other core classes. The one other student raised his letter grade from a B to an A from the second to third marking period and the other core classes had comparable grades.
I was unable to assign videos for students to review outside of class, as many students could not overcome the unavailability of technology. One aspect to consider in the future would be to allow science class time for students to review independently and ask clarifying or discussion questions during class time. As the website with my YouTube channel link is available on smart devices, the unfamiliarity with this format for review may be the hindrance. With in class time to explore and use the resource, this will increase familiarity with out of class resources. It is similar to using any reference material; the more often it is used, the more comfortable students become with it. The use of videos in class would allow all students access to the teaching tool and have deeper questions presented by peers. The videos would also be a resource I would like to introduce to parents during meet the teacher night and throughout the school year as reminders of outside resources.

However, this research is our schools first foray into a technology-embedded classroom and students are unfamiliar with the information on teacher websites. For 20% of my students to say they used a new technology independently and without a mandate to do so does show progress into the realm of technology-embedded schools. In the future, it would be beneficial to introduce students and parents to the web resources earlier in the school year.

VALUES

Over the course of the educational research project, I found that creating videos was a beneficial way for me to summarize classroom discussions and experiments and provide review material for students. Although it did not drastically change test scores, it
provided a resource for students. In previous years, this resource outside of class has been severely lacking. As this was the first year this curriculum has been taught, it will also serve as a resource for other grade-level teachers to understand what each lesson in the new curriculum will cover as well as for their students.

As a means to continue the work in creating resources, I will continue to make videos for students to access outside of class time and may incorporate watching review videos independently but in the classroom. When using these videos next year, I need to look at incorporating them in a more consistent fashion and forcing more interactions with them. This may include hosting the videos on such sites as EdPuzzle where I can imbed questions and places to summarize while students are viewing videos and track who watches the videos on a more consistent level. Plans are also in place to create summarizing videos for the first 12-week unit. If the year starts with review videos in place, by the time the Earth Systems unit begins, students will be familiar with the resources and websites available.

Reflection has been one of the most impactful skills throughout this educational research. As I worked through the project I was able to reflect on the overall conceptual understandings taught over the course of the units. I was forced to summarize at the end of each major lesson what students were to learn from each lesson and this forced me to be more targeted during my lessons, especially when introducing and concluding new lessons. This process that forced summarization of key questions reminded me how important it is to stay concise and on point with direct instruction. At this grade level, explicit instruction of major teaching points is one central way to ensure students are
exposed to correct themes that will influence their science learning. I will continue to use videos and imbed interactive elements to increase student engagement while looking for the impact on scientific understanding within a fifth grade science classroom.
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APPENDICES
APPENDIX A

INSTITUTIONAL REVIEW BOARD EXEMPTION
INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
FWA 0000165

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MEMORANDUM

TO: Amy Smith and John Graves
FROM: Mark Quinn
DATE: November 21, 2016
SUBJECT: "The Impact of Teacher-Created Video Ours and Learning in a Fifth Grade Science Class" [AS112116-EX]

The above research, described in your submission of November 21, 2016, 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 these 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, if wholesome foods without additives are consumed, or 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

ATTITUDE SURVEY
Pre Survey for Science

This survey is not a part of your grade. The results are just to help me teach better.

* Required

1. Type your name

2. I enjoy science class. *
   Mark only one oval.
   - Strongly Disagree
   - Disagree
   - Agree
   - Strongly Agree

3. I am good at explaining concepts in science class either to Ms. Smith or to a classmate
   Mark only one oval.
   - Strongly Disagree
   - Disagree
   - Agree
   - Strongly Agree

4. I am good at writing to explain science concepts *
   Mark only one oval per row.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
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<tr>
<td>Response</td>
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</tbody>
</table>

5. I have enough resources outside of the classroom to review science concepts from class *
   Mark only one oval.
   - Strongly Disagree
   - Disagree
   - Agree
   - Strongly Agree

6. List anything you used to review concepts from science when you weren't in class. If you haven't reviewed anything, just write "not done"
7. When I miss school, I feel I have materials to learn what I missed
   
   Mark only one oval.
   
   [ ] Strongly Disagree
   [ ] Disagree
   [ ] Agree
   [ ] Strongly Agree

8. What materials do you have to learn what you missed?

   ___________________________ ____________________________

9. When I need a review, I feel the materials supplied are helpful
   
   Mark only one oval.
   
   [ ] Strongly Disagree
   [ ] Disagree
   [ ] Agree
   [ ] Strongly Agree

10. Is there anything else you would like to tell me?

   ___________________________ ____________________________
   ___________________________ ____________________________
   ___________________________ ____________________________
APPENDIX C

STRUCTURES AND PROPERTIES OF MATTER TEST
Name ____________________________

Date ____________________________

1. Carla and Marcos raced to the cookie jar to find one whole cookie and one cookie that was broken cookie. "I want the whole cookie" announced Marcos. "I will have more cookie if it is not broken."
   "Not true!" argued Carla. "Two broken pieces are more than one."

Do you agree with Carla, Marcos, or neither? Explain why.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

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2. Draw a model of what happens when ice cream melts. Label your model.

3. Write a description of what happens when a solid turns to a liquid.

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

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4. Ted and Sam were playing basketball on the court in the schoolyard. Ted wanted to keep playing but Sam thought the ball needed more air. Choose one reason how Sam could tell the ball needed more air.
   a. Sam had trouble hanging on to the ball.
   b. Sam was unable to make a basket.
   c. The ball felt too soft.
   d. The ball felt too hard.

5. Write why you chose that answer. Explain how adding air would help Sam.

   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________
6. Choose the **BEST** example of evidence that matter is made up of particles too small to be seen.
   a. An odor moving across the room.
   b. A ball rolling down a hill.
   c. A hot dog roasting on a campfire.
   d. The texture of different material.

7. Draw and label a model to demonstrate how your answer provides evidence of how particles are too small to be seen.
8. Choose the best method to determine if air has weight.
   a. Throw an air filled ball up into the air, measure the distance it travels and time it takes to come back to the ground. Compare with a ball with no air.
   b. Pump as much air as possible into a basket ball and record the pressure when it bursts.
   c. Measure the weight of a deflated ball, fill it with as much air as possible, measure the weight of the inflated ball and compare.
   d. Measure the volume of an inflated ball and compare it with the volume of a deflated ball.

9. Explain how the method you chose will provide evidence that air has weight or that air is weightless.
10. Mr. Edwards kept a bird feeder and bird bath in his backyard. It had been a warm and sunny summer and the birds were regular visitors at the feeder and bath. Every morning Mr. Edwards checked the level of the water in his bird bath. "Those must be dirty birds, they sure use a lot of water," he commented. "It's not the birds that use up the water," replied Mrs. Edwards. "It's the sun!"

Do you agree with Mr. Edwards or Mrs. Edwards or both? Explain why you agree and write how you think the water level in the bird bath decreases.
APPENDIX D

EARTH AND SPACE SYSTEM UNIT TEST
1. Mrs Carlson’s fifth grade classroom was studying the components of the biosphere and how they are connected to the geosphere, hydrosphere, and atmosphere. They went on a field trip to a nearby forest to make and record observations of different plants and animals. After the outing students were given the following assignment:

   a. Choose one plant or animal from your observations.
   b. Develop a model using your selected plant or animal to describe ways the biosphere, atmosphere, geosphere, and hydrosphere interact.

Charles decided to use a blue jay he observed as his example. Draw and label a model of one way Charles could complete the assignment.
2. Angela and Rene were evaluating the different materials that were placed in the trash in the classroom. They collected the following data:

<table>
<thead>
<tr>
<th>Material</th>
<th>Paper</th>
<th>Plastic</th>
<th>Wood</th>
<th>Metal</th>
<th>Styrofoam</th>
<th>Food scraps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Items</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>notebook paper</td>
<td>dry erase markers</td>
<td>pencil stub</td>
<td>yogurt cup lid</td>
<td>coffee cup</td>
<td>banana peel</td>
</tr>
<tr>
<td></td>
<td>Post-it Notes</td>
<td>plastic cups</td>
<td></td>
<td>aluminum foil</td>
<td></td>
<td>apple core</td>
</tr>
<tr>
<td></td>
<td>paper bags</td>
<td>pens</td>
<td></td>
<td></td>
<td></td>
<td>1/2 PB&amp;J</td>
</tr>
<tr>
<td></td>
<td>paper towel</td>
<td>yogurt cups</td>
<td></td>
<td></td>
<td></td>
<td>sandwich</td>
</tr>
<tr>
<td></td>
<td></td>
<td>fruit cup</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>take out salad</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>containers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>0.50 lbs</td>
<td>0.25 lbs</td>
<td>0.01 lbs</td>
<td>0.10 lbs</td>
<td>0.01 lbs</td>
<td>0.25 lbs</td>
</tr>
</tbody>
</table>

Make a graph to demonstrate the amount of different materials discarded.
3. Write a conclusion for the information you can learn from your graph.

4. Using the data Angela and Rene collected, write a plan to reduce the amount of classroom waste. Use data from the chart to support your plan.
5. The surface of the Earth is seventy one percent water and 97.2% of Earth's water is in the form of salt water in the ocean and salt water lakes. Plants and animals depend on fresh water to meet their needs for survival. The amount of water available for living things is a 2.8% of the water on Earth.

Use the data from the chart to graph the distribution of water on Earth. Indicate the water supply available to plants and animals.

<table>
<thead>
<tr>
<th>Water Source</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>All water on Earth</td>
<td>100%</td>
</tr>
<tr>
<td>Oceans and salt water lakes</td>
<td>97.2%</td>
</tr>
<tr>
<td>Total Fresh Water Supply</td>
<td>2.8%</td>
</tr>
<tr>
<td>- ice caps and glaciers</td>
<td>2.3%</td>
</tr>
<tr>
<td>- groundwater</td>
<td>0.4%</td>
</tr>
<tr>
<td>- Rivers, lakes, springs</td>
<td>0.07%</td>
</tr>
<tr>
<td>- Atmosphere</td>
<td>0.03%</td>
</tr>
</tbody>
</table>
6. What conclusion can you reach based on the information on the graph.
   a. There is sufficient fresh water on Earth for all living things.
   b. Salt water from the ocean can be treated and salt removed for use.
   c. There is only a trace amount of water in the atmosphere that can be used.
   d. The amount of fresh water on Earth is very small compared to the total water.
7. Draw and label a model of one way the atmosphere affects the geosphere.
8. Water falls from the sky as precipitation. What happens to the water after it falls to the Earth?
   a. It evaporates and forms clouds and falls back in the ocean.
   b. It creates rivers, streams, lakes, puddles, and ponds.
   c. It falls on the ground and seeps into the ground or moves over the surface to lakes, ponds, streams, rivers, and the ocean.
   d. It moves as runoff into the storm sewers where it is treated and put back into the aquifer.

9. Jesse and Rana walked to and from school on sunny days. When it was raining they rode the bus. They noticed that when walking to school in the morning their shadows were long and narrow and led them all the way to school. On the way home in the late afternoon, their shadows were long and narrow and led them all the way home. Choose the answer that best explains their observations.
   a. Shadows point in the direction you are travelling when it is a sunny day.
   b. The sun moves across the sky from east to west so the students traveled west to go to school and east to return home.
   c. The students walked in the direction of the traffic and headlights made their shadows appear in front of them.
   d. The Earth spins on its axis making day and night and the sun to appear to move across the sky from east to west.
Name ____________________________  Pre and Post Assessment
Date ____________________________

10. Draw and label a model that describes the science that supports your answer.
APPENDIX E

WRITING PROMPTS
Writing Prompt 1

Name: 

Date: 

Write a scientific statement or conclusion to your investigation that explains what happens to the sugar. Include the claim, evidence, and reasoning in your conclusion.

Claim: (The claim answers the question you were investigating.)

Evidence: (The evidence comes directly from the data collected in the investigation and should use actual numbers or observations from a table, chart, or graph.)

Reasoning: (The reasoning ties what you know about weight and volume to the claim and evidence.)
Write a scientific explanation or conclusion for your investigation.
Claim: (The claim should be supported by evidence directly from the investigation.)

Evidence: (The evidence comes directly from the data collected in the investigation and should cite actual numbers or observations from a data table, chart, or graph.)

Reasoning: (Reasoning ties what you know about the cause and effect relationship in phase change.)
1. Draw and write how using the bottle model demonstrates how clouds are formed. Explain what the components of the model represent in cloud formation in the atmosphere.
Graphing and Modeling the Uneven Lighting and Heating of the Earth

Write a scientific statement or conclusion for the class investigation.
Claim: (The claim answers the question you were investigating.)

Evidence: (The evidence comes directly from the data collected in the investigation and should use actual numbers or observations from a table, chart, or graph.)

Reasoning: (The reasoning ties what you know about the effect of uneven lighting on temperature to the claim and evidence.)
APPENDIX F

INTERVIEW QUESTIONS
1. Do you feel like you understand concepts in science?
   
a. Possible probing questions:
   i. Can you explain what causes wind?
   ii. What was a difficult/easy concept for you to explain?

2. How do you practice explaining ideas? What helps you understand?
   
a. Do you practice outside of school?
   i. Retelling to parents
   ii. Talking to classmates after class time
   iii. Reviewing science journals
   iv. Watching videos
      1. Ms. Smith’s YouTube Videos
      2. Other science videos
      3.

3. Do you feel like the science videos helped you at all during the unit?
   
a. What caused you to utilize the videos?
   b. What prevented you from using the videos?

4. Do you feel like the science videos are a useful addition to the science curriculum?
   
a. What could improve their impact?
   b. What other materials could be added as a science resource?

5. If you were assigned to watch a video and respond to it outside of class, what are the chances you would complete the assignment?
   
a. What challenges would prevent you from completing the task?
   b. Is there anything I could do to help overcome those challenges?