

THE EFFECT OF ENGAGING ASSIGNMENTS ON STUDENT PERFORMANCE IN  
THE SCIENCE CLASSROOM

by

Christina L. Wallace

A professional paper submitted in partial fulfillment  
of the requirements for the degree

of

Master of Science

in

Science Education

MONTANA STATE UNIVERSITY  
Bozeman, Montana

July 2014

STATEMENT OF PERMISSION TO USE

In presenting this professional paper in partial fulfillment of the requirements for a master's degree at Montana State University, I agree that the MSSE Program shall make it available to borrowers under rules of the program.

Christina L. Wallace

July 2014

## TABLE OF CONTENTS

INTRODUCTION AND BACKGROUND .....	1
LITERATURE REVIEW .....	3
METHODOLOGY .....	6
DATA AND ANALYSIS .....	11
INTERPRETATION AND CONCLUSION .....	16
VALUE .....	17
REFERENCES CITED.....	20
APPENDICES .....	21
APPENDIX A: IRB Exemption.....	22
APPENDIX B: Daily Assignment 2012-2013.....	24
APPENDIX C: Study Guide 2012-2013 .....	26
APPENDIX D: Cut and Paste Vocabulary .....	28
APPENDIX E: Memory Matrix, Misconception Probe .....	31
APPENDIX F: The Wallace Student Survey.....	35
APPENDIX G: Student Generated Test Question Rubric .....	37
APPENDIX H: Study Guide 2013-2014 .....	39
APPENDIX I: The Wallace Post Treatment Interview .....	41

LIST OF TABLES

1. Data Triangulation Matrix .....	11
2. Student Responses to Pre and Post Survey Question Scores .....	12

LIST OF FIGURES

1. Student Survey Response Improvement .....	12
2. Student Assessment Scores .....	15

## ABSTRACT

Textbook resources were changed to teacher created resources to determine if it would lead to an improvement in student performance. The assignments were evaluated to verify not only if students completed them but if they improved assessments scores. Students were given an assortment of assignments of varying difficulty to see which type would most improve their understanding of concepts taught in the physical science classroom. Student surveys were used to evaluate student's attitude towards the old assignments and the new assignments. Students showed an improvement in assignment completion along with moderate gains in assessment scores.

## INTRODUCTION AND BACKGROUND

After seven years of teaching I began to notice a recurring trend in my classroom, students who completed their homework and assignments on time were able to do a better job demonstrating understanding of the content on assessments. Students who frequently did not complete assignments or did not complete them until after the assessment was taken scored below their capabilities. When those same students completed assignments on time, they scored much better on assessments. Students and parents often focused only on the grade, making sure an A was attained with little to no focus on learning. As a teacher, my focus was on content learned. A pattern began to emerge which showed when students completed the assignments in a timely manner; they did a better job retaining the material taught in class.

I teach at Gainesville High School (GHS) in Gainesville, Missouri. The city of Gainesville's population is 747, with a demographic breakdown of 95.2% white, 1.7% Hispanic, 1.4% American Indian, and 1.6% two or more races. The estimated median household income in 2009 was \$23,964 (<http://www.city-data.com/city/Gainesville-Missouri.html>). One and one half percent of students are minorities. We are a rural school with many of our students living on farms. The income level in our community is far below the national average, but the cost of living is also far below the national level. GHS has 284 students with 86.2% qualifying for free or reduced lunches and a graduation rate of 88.9% overall (<http://mcids.dese.mo.gov/quickfacts>). GHS has received the honor of making the *US News and World Report's* Best High School bronze award for the last five consecutive years.

I am in my seventh year of teaching and my fifth year at GHS. I currently teach ninth grade physical science, Earth science, and two junior high lab classes. Physical science is a requirement for graduation at GHS, which means I see all students who pass through the ninth grade. I have taught Earth science for two years and have had my junior high classes all five years I have taught at GHS.

The physical science class was initially taught using the resources provided by the textbook supplier. This included power points to supplement the lecture and standard textbook worksheets for students to complete. These resources seemed ineffective at helping students retain the material taught in class. The chapter assessments indicated as much with subpar scores even by the students who completed those assignments. Students were not engaged in the learning process. This led to the creation of some teacher generated power points and worksheets, along with note taking sheets during the 2012-2013 school year. This adjustment seemed to improve student retention of content. With each change the students saw improvement in their performance on assessments. Students completing the tasks showed significant improvement. Students who did not complete the assignments prior to the assessment showed little to no improvement and continued to do poorly.

I observed students seemed to find the worksheets I created easier to complete than the textbook resources. The questions were more direct and students quickly saw the benefit of learning the answers because they were likely to see similar questions on later assessments. Unfortunately, the students who needed improvement the most were infrequently turning in assignments on time. Soon after the novelty of the new worksheets wore off, the assignment completion levels dropped off. When I gave more

time in class, I had better results receiving the assignments completed on time, but it required a great deal of hovering over students and prodding them to finish.

This led to the creation of my focus statement, *What are the effects of engaging assignments on student performance in the science classroom?* In addition, the following questions were researched.

1. Does the amount of work assigned and time in class affect completion rates?
2. What type of assignment did they tend to complete more often, application or practice?

### CONCEPTUAL FRAMEWORK

The arguments for and against homework are ongoing. Advocates and opponents of homework often use the same data, interpreted differently, to promote their cause. Those who support the effect of homework on student performance point to gains made by students, while those against homework claim only marginal gains in performance of students who receive homework. Opponents point out homework interferes with students' home lives, citing that only marginal gains do not outweigh the damage done to the family unit (Vatterott, 2009). Proponents use student data on unit tests to prove homework does work. When students were carefully chosen in order to provide consistency between the two groups and given equal treatment other than homework versus no homework, the results were considered fairly accurate. This research indicated students who were given homework did show improvement (Cooper, 2007).

Kohn (2003), the prominent author leading the anti-homework charge, cannot seem to produce any conclusive evidence in which assigning homework results in a decrease in academic performance. He states homework interferes with students' home

lives. He points out parents' complaints of helping their children with homework; however, nowhere does he document that homework decreases student achievement. Kohn cites studies, which show inconclusive results on homework data, and he points to the studies, which show only moderate academic success. His position cites issues with the amount and types of homework assignments with regard to the age of students and the subsequent interference with family time.

Kohn seems to hold in disdain any author who disagrees with his assessment of homework. He repeatedly points to Cooper's (2007) studies as being flawed. He admits Cooper is a leading researcher in the pro-homework field, but finds issue with his data. Studies to assess homework's effectiveness use different types of assessments to analyze results. Often, standardized tests or modified tests are used; at other times, grades or unit tests are used (Cooper, 2007; Kohn, 2003).

Teachers view the value of homework from a different perspective. Teachers understand students need practice to master certain aspects of curriculum. Each subject has different approaches to mastery (Sallee & Rigler, 2008). Science focuses on inquiry and content. Truworth (2006) points out while inquiry is challenging, it should be addressed at every grade level, taking it to a higher order of thinking each year. Content should increase in difficulty as a student progress through each grade level. Vocabulary becomes more complex and difficult as students continue through grade levels. Some practice and association with new terms must be addressed. Conversely, simply writing the word and definition is not effective in mastering the terms. Students need homework, which ties the content taught in the classroom to application outside of the classroom. When students are assigned homework in which they are encouraged to make

connections to "real" science, they are better able to retain the information (Trueworth, 2006).

Students' ability to make connections to the content learned will make the material easier to digest and retain. Teachers who are willing to search for answers are required to take a complex methodical examination of assignments. Are the assignments effective in reinforcing the content learned in class or is it simply busy work requiring only rote recall? When teachers examine the assessments they give students to evaluate content knowledge, those questions can be answered (Sallee & Rigler, 2008).

Each piece of curriculum requires different levels of mastery. One question that comes up is, "Why isn't homework being used more effectively?" (Sallee & Rigler, 2008, p. 48). Options to increase homework completion are directly related to the type of assignment given for each unit of study. Students who are given the same type assignment of copying the vocabulary words and definitions for each chapter are going to be bored. When teachers assign students in-depth reading of material, which is above their ability it will only frustrate them. Finding the middle ground should be the goal set by educators (Cooper, 2007).

One aspect of homework assignments to ability is to incorporate technology. Today's students have access to an array of devices and resources which were not imagined even twenty years ago. Often the use of online homework can help students with concepts that are known to cause difficulty (Arasasingham, 2011).

Allowing students to have a voice in their assignment type is another option shown to increase homework completion. When a homework assignment choice is given, students will become more invested in the assignment. Allowing students to choose a

more relevant assignment will give the student more motivation to complete the task and retain the material. Giving students fewer but more in depth assignments and a choice of assignments to complete will lead to use of higher level thinking skills. If the assignment is personal to the student, they will put more time and emphasis on the assignment (Trueworth, 2006).

A combination of relevancy, type of assignment, and content covered will all factor into student completion of the assignment (Cooper, 2007). Rewards also play a role in homework completion. Students want to know what constitutes their compensation for completing the homework assigned. Teachers also need to be prepared to provide students with instruction for the task assigned and their expectations of the assignment, along with exemplary examples. Clear, consistent assignment objectives need to be laid out for the students. Not every student will gain the knowledge needed in the classroom setting to achieve all assignments (Kohn, 2003). To overcome this barrier, the teacher needs to make herself available to the students who may be struggling. Some modifications may be necessary for individual students due to their Individual Learning Plans or learning styles. By providing a number of options for assignment choices teachers may be able to overcome this dilemma.

## METHODOLOGY

The purpose of this study was to improve student performance in the science classroom. It was accomplished by changing student assignments, using intervention strategies included in the Response to Intervention Program (RTI), and allowing students more time in class to complete assignments. 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 maintained (Appendix A).

The study was conducted at Gainesville High School and included all students enrolled in physical science ( $N = 45$ ). In the 2012-2013 school year, students were given teacher created assignments as a replacement for textbook resources. These assignments were modified to contain some test questions and a few practice questions from the end of the section reading (Appendix B). The students were given a study guide to complete while the teacher gave the daily lecture (Appendix C). They were then able to use those resources to study for end-of chapter-assessments.

The students who did not complete their assigned work on time had the option to make up the work for reduced credit until the day before the summative assessment. The day before the assessment, students were given the answers to the assignments for use as study material. The students who did make up the work were required to complete it on their own time before the answers were given in class. GHS did not have a time set aside during the school day in the 2012-2013 school year for students who were struggling with concepts in the classroom or who were simply falling behind in their assigned work, resulting in the large percentage of incomplete assignments, which in turn resulted in poor grades on report cards.

The students enrolled in physical science during the first three quarters of the 2013-2014 school year were assigned the same course work as the previous year's students and were documented as the pre-treatment group. The study began during the fourth quarter of the 2013-2014 school year. RTI was introduced school-wide at the beginning of the 2013-2014 school year to help improve student performance and offer

enrichment opportunities for students who were not struggling. During treatment, the students in physical science were assigned a variety of new assignments. Included in these were some modified assignments from the previous year along with cut and paste vocabulary (Appendix D). The assigned coursework was changed during treatment to be more engaging for the students and more time was allotted in class for completion of the assigned tasks.

The treatment incorporated different types of assignments including a model of Page Keeley's Misconception Probe, Student Generated Test Questions, and Concept Maps assessment techniques (CAT) as described by Anglo and Cross (1993), (Appendix E). Students who were still struggling or not completing assignments were required to attend RTI class time instead of being allowed to choose an enrichment class. The students who were placed into physical science RTI were given individualized instruction for difficult concepts and were allowed to make up missing assignments without penalty to their grade.

Prior to the treatment, the Wallace Student Assignment Survey asked students their opinions about the purpose of daily assignments, along with their completion practices (Appendix F). The survey was administered to students pre and post-treatment. Results were analyzed to determine student opinions about the amount, purpose, and interest in daily assignments. Pre and post treatment results were compared to see if student attitudes about assignments changed. The Likert scoring scale was used to determine student opinions. The scores ranged from a six for *strongly agree*, five for *agree*, two was *disagree*, and one was *strongly disagree*. There was not a neutral option.

The students used concept maps to make connections with the material they learned in the science classroom. They were required to identify the relationship between simple machines, compound machines, forces, and work (Appendix E). The students participated in writing Student Generated Test Questions which were included on the summative assessment for the Newton's Laws unit. Those questions were discussed and decided upon as a class. Each question was analyzed for depth of knowledge and whether it tied into the objectives for the unit's lesson.

Student Generated Test Questions allowed students to contribute to writing the summative unit assessment. The objectives were written on the board and the students were required to align the questions to them. They were assessed on their ability to write three types of questions addressing different levels of Depth of Knowledge. Each student was assigned to write three multiple choice, two fill in the blank, and one constructed response question as their daily assignment. Student grades were based on the quality of question, relevancy to the daily objective, and the students' ability to correctly answer their own question (Appendix G).

The Assessment Study Guide students used to prepare for assessments changed from pre-treatment to treatment so students had to answer the questions independently as opposed to retrieving the answers by following along the PowerPoint (Appendix H). Students were no longer given test questions to answer on their homework, they were expected to be responsible for completing those on the Assessment Study Guide independently. The study guide continued to follow the lecture, but required more effort to complete by requiring students to research most of the answers in the book or from the

PowerPoint at home. The students were given a review the day before chapter assessments to insure their answers were correct.

The Response to Intervention program was incorporated into daily schedule for the 2013-2014 school year by allowing 25 minutes during the school day for intervention strategies to be used on students who were failing. Students required to attend a support class were allowed to make up missing assignments without a penalty to their grade. Students who were struggling but not failing could choose to go into a support class or the teacher could suggest students who needed extra help with difficult concepts.

The success of the treatment was assessed by comparing first, second, and third quarter student grades to fourth quarter grades. The Wallace Post Treatment Interview (Appendix I) asked students which of the assignments were the most effective and engaging for them. The students' missing assignment totals for pre and post treatment were compared. Data sources used are included in the Data Triangulation Matrix (Table 1).

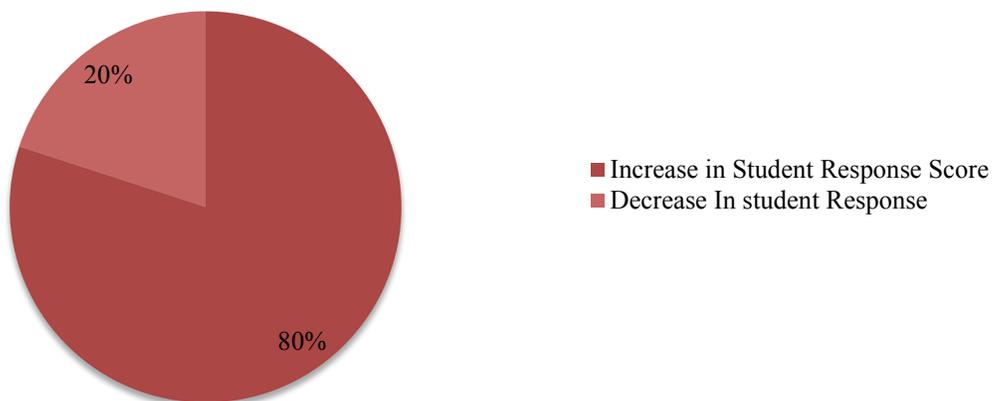
Table 1  
*Data Triangulation Matrix*

Focus Questions	Data Source 1	Data Source 2
<p><i>Primary Question:</i></p> <p>What are the effects of engaging assignments on student performance in the science classroom?</p>	Wallace Assignment Survey, Misconception Probe, Student Generated Test Questions, Concept Map, RTI	Pre-treatment and post-treatment grade comparison, Wallace Post Treatment Interview
<p><i>Secondary Questions:</i></p> <p>1. Does the amount of work assigned and time in class affect completion rates?</p>	Wallace Assignment Survey, Misconception Probe, Student Generated Test Questions, Concept Map, RTI	Pre-treatment and post-treatment grade comparison, Wallace Post Treatment Interview
<p>2. What type of assignment did they tend to complete more often, application or practice?</p>	Wallace Assignment Survey, Misconception Probe, Student Generated Test Questions, Concept Map, RTI	Pre-treatment and post-treatment grade comparison, Wallace Post Treatment Interview

## DATA AND ANALYSIS

The Wallace Pre- and Post-Treatment Surveys indicated students felt they made improvement on homework completion ( $N=39$ ). Students saw improved reasoning to the purpose of assignments assigned in class (Appendix F). Using the Likert scale, average scores for each question increased for eight of the ten questions posed in the two surveys (Figure 1). When asked if science was hard, the average student score decreased,

indicating a positive change in the students' view of science (Table 2). There was not a change in the number of students who completed the Assessment Study Guide or the students who took uncompleted assignments home to finish. However, there was an increased score for students who completed their homework on time, did not turn in late work, and finished their work in class. Students' opinions about the purpose of homework and its importance to improving assessment scores also improved from 4.2 to 4.9.



*Figure 1. Student Survey Response Improvement, (N=39).*

Table 2

*Student Responses to Pre and Post Survey Question Scores, (N=39)*

Survey Question	Pre-Survey	Post Survey
I always complete my assignments on time.	4.1	5
The work assigned for this class is just the right amount.	4.6	5
I complete my assignments before we leave the classroom.	3.7	4.4
If I do not finish in class I take my assignment home to complete.	4.5	4.5

I never turn work in late.	3.6	3.9
The assignments in the class are interesting.	4.2	4.1
I see the purpose of the assignments given by the science teacher.	4.2	4.9
The homework helps me do better on the tests.	4.3	4.8
I complete my study guide for every chapter.	3.4	3.4
Science is hard for me.	3.1	2.8

*Note.* 6=Strongly Agree, 5=Agree, 4=Somewhat Agree, 3=Somewhat Disagree, 2=Disagree, 1=Strongly Disagree

The Misconception Probe addressed a common mistake students make in which they believe only speeding up is acceleration (Appendix E). When the probe was administered pre-treatment, 29% of students ( $N=37$ ) chose both incorrect options. One student wrote, "Mike is right because when they went around the corner the acceleration was constant because they stayed the same speed." Another student wrote, "Cale was right because going downhill at a constant speed is not acceleration." The remaining 71% understood going downhill was acceleration. However, all 100% incorrectly chose going around a corner was not acceleration. A student wrote, "When they go around the corner, they have changing velocity not acceleration." The students were then assigned the Cut and Paste Vocabulary for the lesson on acceleration the day after they completed the Misconception Probe. When the students finished the Cut and Paste and a short lesson on acceleration, they were handed the Probe back to see if they still agreed with the answer they gave previously. This time 100% of students changed their earlier answer to both

correct choices with the correct reasoning this time. The student who wrote going around the corner was a change in velocity but not acceleration now wrote, "Riley was right because acceleration is the rate a change of velocity which includes speed and direction." The 32% of students who correctly chose going downhill was acceleration but reasoned it was only because the speed increase now said, "Even if his speed was constant going downhill it would be acceleration because going downhill would be a change of direction which is a change in acceleration."

The Student Generated Test Questions (SGTQ) assessment scores averaged 77.46%, which was lower than 78.5% pretreatment scores. Three students scored well below the average with scores 29%, 29%, and 36%. When those outliers were not figured into the equation, the average score post-treatment score was 80.67%. The assessment scores of the other treatment instruments averaged 82.8% (Figure 2). Student questions were graded using a rubric with a scale of *exemplary response* score of five, *average response* of three, or *poor response* score of one (Appendix G). A student with a score of five wrote the test question, "Explain why a crumpled piece of paper hits the ground before a piece of uncrumpled paper." The daily objective included air resistance and its effects on falling objects. A student with an average score of three wrote, "Does a bowling ball have the same inertia as a tennis ball?" The student had the right idea, inertia was on the objectives but they did not expound on the topic. The students who scored a one asked, "Is gravity real all the time?" and then answered it "no."

When the students were interviewed, only 23% of students responded positively to SGTQ ( $n=25$ ). One student said, "It made me really think, I had to search for a question and an answer instead of just remembering what you told us in class." Another

student said, "I know I complained how hard it was but I think I learned better from doing those questions." Eighteen percent of students answered at least one of their own questions wrong. When asked why they would want to put a question on the test they were not able to answer they responded with, "I don't know."

The SGTQ had the most late or missing assignments during treatment with 37% of students having at least one assignment not turned in on time compared to only 9% with other instruments. This percentage matched with pretreatment late or missing assignments of 36% of students routinely not completing tasks on time. The other 77% of students interviewed were all very vocal in their distaste for SGTQ. They all agreed it was hard and they did not like coming up with their own questions. When the students were interviewed, the 77% agreed SGTQ required more effort than they wanted to give. One student said, "I learned but it was much harder to come up with questions on my own, I like it when you just give us a question to answer." Another student stated, "Geez Mrs. Wallace, it was really hard and I didn't like it." Most agreed to learning from it but did not want to do it again.



*Figure 2.* Student Assessment Scores, ( $N=45$ ).

Nine percent of students who were still not turning their completed assignments on time were placed in Response to Intervention Support Classes (RTI) ( $n=5$ ). One hundred percent of the students who were placed into the support class raised their grade. One student whose class average was 57% in the first quarter chose to spend rest of the school year in Physical Science Support and ended the year with a 71% as his fourth quarter grade. In the previous five years of teaching physical science at least one student per year failed a semester, in the 2013-2014 school year 100% of students passed both semesters.

#### INTERPRETATION AND CONCLUSION

The data shows an increase in student scores. After five years of teaching, this is the greatest increase I have seen in assessment scores and grades. The research certainly had some room for improvement due to 25 snow days in the 2013-2014 school year. Two and half percentage points may not seem like a huge gain, but when consideration is given to the short treatment period, the potential is there for even more improvement. The data ended up stronger than anticipated with the time frame that was allowed for treatment, three different months had seven to eight days missed from them. Had there been more time, I believe the increases would have been even better, more time would have allowed for more instruments of treatment to be used. The instruments chosen were strong, but more would have been better.

It is interesting how the teacher's viewpoint can vary so much from the students' viewpoints on what works and what does not. I thought the Student Generated Test Questions were a wonderful learning tool, but the students disagreed strongly with me. They did, however, grudgingly admit to it helping them somewhat, but in the end it

boiled down to the amount of work required to complete them. When the scores were analyzed without the three outliers, there was slight improvement in assessment scores. It was interesting that there was one student in each section who scored far below the norm. Not surprising, all three were part of the 37% of students who did not turn in that assignment on time, if at all. When asked after the assessment why they did not do the questions all three said it was too much work. Which begs the question, does more work equal more learning?

The Misconception Probe did not require a lot of work but was successful in terms of student understanding of acceleration. It did not take students a lot of time to complete and the learning was apparent. I was amused by the difficulty the high achieving students had completing the probe. They did not want to be wrong. One student was truly pained by the exercise, his grade each semester was a 100%, and he absolutely did not want to write the incorrect choice down. He immediately grabbed his book after turning in his paper to look up acceleration and began shaking his head. The students seemed to take a lot away from the Misconception Probe, many of them had an "aha" moment during the process. They liked that I addressed a misconception and felt it made them remember more to call them out on it. I like the Misconception Probe because no one likes to be wrong and when the students were proven wrong in the choice it seemed to stick better in their memory. Misconceptions are common in science and when they are addressed students remember.

#### VALUE

This study demonstrated that when a teacher is willing to go beyond the textbook and use tools created for student engagement, student learning can improve. In the five

years of teaching this class, I have tried a variety of different activities but nothing was as student-driven as my treatment. This treatment looked at ways to get the students more involved in the learning process. The students seemed to enjoy their involvement and appreciated when I gave consideration to their feedback. Some were amused at their teacher being a student at the same time they were, and it seemed to make them realize I understood their point of view. The physics aspect of physical science has always been difficult for students at Gainesville High School, but this year students seemed to take away a deeper understanding than students in the past. This was the first year not a single student received a failing grade.

While not put in the original design of the study, Response to Intervention helped answer some of the study questions. RTI allowed students to have the extra attention and help some of them needed to complete assignments. However, during and after the treatment period, most of the students who were in Physical Science Support were there by choice, not as a requirement due to failing grades. During the last RTI support session, 66% of the students in Physical Science Support were there for study hall, not support.

As a teacher, I will continue to look at ways to increase student engagement. One aspect of my literature review I wanted to incorporate was to allow students to have a say in the assignment type. Due to time constraints, that was not incorporated into the study. Based on the research, students enjoyed giving feedback and trying new things. I think allowing them a voice in choosing assignments will engage them even more. I will continue to stay away from textbook generated worksheets and resources. Student engagement will be a priority in my classroom. During the 2014-2015 school year I will

be teaching a new subject area, and I am already working on a curriculum which incorporates some of the assessment techniques learned in my research.

The research conducted while a student at Montana State has shown me the importance of keeping an eye for ways to improve student learning. Learning the proper way to conduct action research will make it easier the next time I need to make a change. Next year will be a challenging year with the change to fifth and sixth grade science, I will have to take a different approach to my teaching. I now have a good foundation of data collection strategies and a method to analyze the data collected to determine if it is a good strategy.

## REFERENCES CITED

- Arasasingham Ramish, I. M. (2011). Online Homework and Student Achievement in a Large Enrollment Introductory Science Classroom. *NSTA Journal*, 70-79.
- Cooper, H. (2007). *The Battle Over Homework, Common Ground for Administrators, Teachers, and Parents*. Thousand Oaks, California: Corwin Press.
- Kohn, A. (2003). *The Homework Myth, Why Our Kids Get too Much of a Bad Thing*. Cambridge, MA: Da Capo Press, kindle edition.
- Sallee Buffy, & R. (2008). Doing Our Homework on Homework: How Does Homework Help? *The English Journal*, 46-51.
- Truworth, M. (2006). *Science Homework Overhall*. Retrieved from NSTA Publications: <http://www.nsta.org/publications/news/story.aspx?id=52981>
- Vatterott, C. (2009). *Rethinking Homework, Best Practices that Support Diverse Needs*. Alexandria, Virginia: ASCD, kindle version.

APPENDICES

APPENDIX A  
IRB EXEMPTION



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

960 Technology Blvd. Room 127  
 c/o Immunology & Infectious Diseases  
 Montana State University  
 Bozeman, MT 59718  
 Telephone: 406-994-6783  
 FAX: 406-994-4303  
 E-mail: cherylj@montana.edu

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

**MEMORANDUM**

**TO:** Christina Wallace and John Graves  
**FROM:** Mark Quinn, Chair *Mark Quinn CJ*  
**DATE:** December 5, 2013  
**RE:** "The Effect of Engaging Assignments on Student Performance In The Science Classroom" [CW120513-EX]

The above research, described in your submission of December 5, 2013, 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:

- (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.
- (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  
DAILY ASSIGNMENT 2012-2013

## Chapter 16 Lesson 1

1. Explain what two opposing forces are acting on an object floating in water.

---



---

2. Explain what will happen, according to Archimedes' Principle, if the buoyant force of a fluid is less than the weight of an object placed in the fluid.

---



---

3. What is Pascal's Principle? Explain how it works in a tube of toothpaste.

---



---

4. Use Bernoulli's Principle to explain how a roof is lifted off of a house during a tornado.

---



---

5. When it was time for Aunt Flossie to head home Marvin hired a pineapple eating woman to use her hydraulic forklift to apply a force of 1500 N on a 25 m<sup>2</sup> piston to lift Flossie's scooter. What force needs to be exerted on the .8 m<sup>2</sup> piston to lift the scooter? *5 POSSIBLE POINTS~1 each for given, formula, work, answer, unit*

given	work
answer:	

6. How much pressure is exerted when Aunt Flossie rides over a board with an area of 5m<sup>2</sup> on her cherry red scooter with a force of 1250 N?

given	work
answer:	

APPENDIX C  
STUDY GUIDE 2012-2013

## Chapter 16 Study Guide

## Section 1

1. \_\_\_\_\_ states that matter is made of small particles that are in constant motion.
2. Has a definite volume and a definite shape \_\_\_\_\_  
the atoms are held tightly in place
3. Has a definite volume but not shape \_\_\_\_\_
4. Has no definite shape or volume \_\_\_\_\_, able to move freely in all directions till it spreads evenly throughout the container.
5. Gas-like, has not definite volume or shape and is made of positively and negatively charged particles \_\_\_\_\_, found in stars
6. The most common state of matter in the universe \_\_\_\_\_
7. Amount of energy needed to change material from solid to liquid is the \_\_\_\_\_
8. Amount of energy needed to change a material from a liquid to gas is the \_\_\_\_\_
9. Matter \_\_\_\_\_ when heated.
10. Particles move \_\_\_\_\_ when a sample is heated.

## Section 2

11. \_\_\_\_\_ determines whether an object sinks or floats.
12. \_\_\_\_\_ explains hydraulic machines.
13. The formula to calculate Pascal's Principle \_\_\_\_\_
14. \_\_\_\_\_ explains why planes fly.
15. \_\_\_\_\_ is a fluid's resistance to flow.

## Section 3

16. \_\_\_\_\_ is the SI unit of pressure.
17. The formula to calculate Pressure \_\_\_\_\_
18. \_\_\_\_\_ states if you decrease the volume of a container of gas and hold the temperature constant the pressure of the gas will increase (decrease volume, constant temp)
19. The formula to calculate Boyles Law \_\_\_\_\_
20. \_\_\_\_\_ states the volume of a gas increases with increasing temperature as long as the pressure does not change. (increase temp, constant pressure)

APPENDIX D  
CUT AND PASTE VOCABULARY

Acceleration

Distance

Velocity

Instantaneous Speed

Inertia

Force

Average Speed

Net Force

Speed

Balanced Force

Displacement

Newton's 1st Law

Directions: Cut out the definitions below and paste them next to the correct vocabulary word.

Describes how far an object has moved

The distance and direction of an object's change in position from the starting point

The distance an object travels per unit of time.

The speed at a given point in time

The total distance traveled divided by the total time of travel

The speed in a given direction

The tendency of an object to resist any change in its motion

Forces on an object that are equal in size and opposite in direction

When two or more forces act on an object at the same time and are combined

The rate of change of velocity

An object at rest will remain at rest, an object in motion will remain in motion

A push or pull one body exerts on another.

APPENDIX E  
STUDENT GENERATED TEST QUESTIONS, MISCONCEPTION PROBE,  
CONCEPT MAP

## Student Generated Test Questions

1. Explain the Law of Gravity and use it to describe your weight on Jupiter.
2. Explain how distance affects gravity.
3. If you drop a hammer and a feather on the moon which will hit first? Explain
4. To reduce friction on a door hinge you coat it with oil. How does the oil reduce friction?
5. Explain why a crumpled piece of paper hits the ground before a piece of uncrumpled paper.
6. Explain the difference between static and sliding friction.
7. Explain what happens in a car crash to a person not wearing a seatbelt.
8. Does a bowling ball have the same inertia as a table tennis ball?
9. Explain how acceleration can be negative?
10. Explain how acceleration changes as go up a hill then down the other side.
11. Contrast distance and displacement.
12. Describe the velocity of a merry go round.
13. What are two examples in which instantaneous speed changes?
14. What is the difference between force and net force?
15. If you drop a ball and throw a ball from shoulder height, which will hit first?  
EXPLAIN.
16. Contrast velocity and acceleration.
17. If you drop an acorn and a leaf, which will hit first? Explain.
18. What happens to the momentum of two objects when they collide while both are going to the same direction?
19. Using Newton's third law explain how a swimmer moves in water.
20. How does weight differ from mass?



Four science students are having a great time arguing about speed and acceleration as they ride a roller coaster. As they are roaring downhill Casey screams, "Wow! What acceleration!" Cale shouts, "No, this is not acceleration. This is just going fast!" As the ride progresses, the students go around a curve while maintaining a speed of 50 miles per hour. Riley screams "Now this is acceleration!" But Mike replies, "No, we're still going the same speed, that's not acceleration!"

Which two students were correct?

Casey, Cale, Riley, Mike

Please explain your reason. \_\_\_\_\_

---

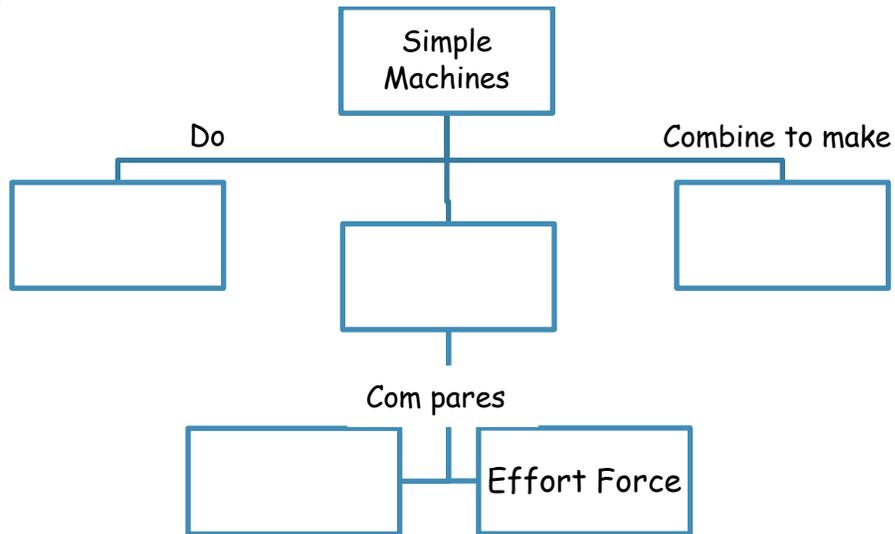
---

---

---

Chapter 5 Lesson 2

1. What is a machine? \_\_\_\_\_  
\_\_\_\_\_
2. How does a ramp make lifting an object easier? \_\_\_\_\_  
\_\_\_\_\_
3. Explain why  $W_{out}$  is always less than  $W_{in}$ . \_\_\_\_\_  
\_\_\_\_\_
4. Explain why adding oil to the moving parts of a machine can increase its efficiency. \_\_\_\_\_  
\_\_\_\_\_
5. Contrast effort and resistance force. \_\_\_\_\_  
\_\_\_\_\_
6. Explain how machines can make work easier without violating the law of conservation of energy. \_\_\_\_\_  
\_\_\_\_\_
7. How can you calculate the efficiency of a machine? \_\_\_\_\_  
\_\_\_\_\_
8. Use the terms to complete the concept map: *Compound machine, mechanical advantage, resistance force, work*



APPENDIX F

THE WALLACE STUDENT PRE & POST SURVEY

## The Wallace Student Homework Survey

	1 Strongly Disagree	2 Disagree	3 Somewhat Disagree	4 Somewhat Agree	5 Agree	6 Strongly Agree
I always complete my assignments on time.						
The work assigned for this class is just the right amount.						
I complete my assignments before we leave the classroom.						
If I do not finish in class I take my assignment home to complete.						
I never turn work in late.						
The assignments in the class are interesting.						
I see the purpose of the assignments given by the science teacher.						
The homework helps me do better on the tests.						
I complete my study guide for every chapter.						
Science is hard for me.						

APPENDIX G

STUDENT GENERATED TEST QUESTION GRADING RUBRIC

	Exemplary Response 5	Average Response 3	Poor Response 1
	Clear connection to the objectives, question addressed at least a DOK of 2 or higher, and the question was answered correctly.	The questions used the objective but did used only a level 1 DOK.	No connection to the objective, DOK recall used or the question answer was wrong.

Student Generated Test Question Rubric

APPENDIX H

ASSESSMENT STUDY GUIDE 2013-2014

## Newton's Laws Study Guide

1. If you drop a hammer and a feather on the moon which will hit first? Explain
2. To reduce friction on a door hinge you coat it with oil. How does the oil reduce friction?
3. Which has a greater inertia, a jumbo jet sitting on a runway or a baseball traveling 70 km/s? Which has greater momentum? Explain.
4. Explain how acceleration changes as you travel up a hill then down the other side.
5. Describe the velocity of a merry go round.
6. If you drop a ball and throw a ball from shoulder height, which will hit first? EXPLAIN.
7. Using Newton's third law, explain how a swimmer moves in water.

## Define

- Three types of friction
- Displacement
- Distance
- Gravity
- Velocity
- Acceleration
- Net force
- Force
- Mass
- Weight

APPENDIX I

WALLACE POST TREATMENT INTERVIEW

Wallace Post Treatment Interview

1. Which assignment did you think was the most effective for you?
2. Which assignment did you find the most interesting and/or engaging?
3. What is your opinion of the Student Generated Test Questions?
4. Do you think they helped you? Why or why not?