

THE EFFECTS OF COMPACTED SCIENCE UNITS ON STUDENT RETENTION OF
SCIENCE CONCEPTS

by

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ABSTRACT

Class lengths were manipulated to see if condensed science units could have the same effect as typical teaching. Five teachers taught two science units for 45 minutes a day for a couple weeks while others taught 180 minutes a day for 3-4 days. Students who learned in a daily format consistently scored higher than students in the condensed format, but the difference was not large.

INTRODUCTION AND BACKGROUND

Project Background

Tukes Valley Middle School (TVMS) is located in Battle Ground, Washington. Battle Ground is 25 minutes from the Portland, Oregon airport. There are 428 students from grades 5 to 8. TVMS is a rural school where 86% of the students are Caucasian, and 5.8% of students are transitional bilingual. TVMS performs above the state average on all state standardized tests and performs very well in science, with 79.3% of 5th graders and 81.2% of 8th graders passing the science Measurement of Student Progress (MSP) in 2012. Statewide 66.3% of 5th graders and 66.4% of 8th graders passed the science MSP (Washington State Report Card, 2012).

A factor that affects TVMS classrooms is the number of students who attend the same church. Approximately 30-40% of the student-body attends the Apostolic Lutheran Church. This religion is known for not owning televisions, computers, or other technology. It is not uncommon for Apostolic families to have more than six children. Many of the fathers work in a trade such as electrician, plumbing, and construction. Most of the mothers stay at home to be with the children.

For the past five years I have taught at TVMS and have been there since the school opened. From 2008 through 2012 I taught seventh grade math and science. For the 2012-13 school-year I taught a sixth grade self-contained class. One hundred thirty two students are divided into 5 6th grade classrooms, each with 25 to 27 students. There are 5 students recognized as highly capable, 16 are served as English language learners, and 20 students have Individual Education Plans.

TVMS runs on an eight period schedule (Table 1). There are 5 core subjects taught daily for 45 minutes each. Teachers are afforded flexibility with the schedule since students stay with the same teacher for all core subjects.

Table 1
Tukes Valley Daily Schedule

Time	Subject
8:10-8:55	Reading
8:57-9:42	Language
9:44-10:29	Math
10:31-11:16	Science
11:18-11:48	Lunch
11:50-12:35	History
12:37-1:22	Collaboration
1:24-2:09	Preparation
2:11-2:40	Advisory/Academy

Teaching five different subjects independent of each other is difficult. Since there is flexibility with the schedule, teachers are tempted to spend more minutes teaching subjects that are tested by the state in their grade-level. Since science is tested only in fifth and eighth grade, other grades will gloss over science in an effort to help students pass the current year's tests. If subjects are taught without any integration this makes the task even more difficult.

My focus for this study was what are the effects of week-long science units on sixth grade student's long-term and short-term memory of science concepts? My sub-questions were did students enjoy having science all day and how did the all-day science units affect teacher planning? At the same time, I integrated reading, writing, and math into the science curriculum.

CONCEPTUAL FRAMEWORK

A well-designed schedule can help teachers and students succeed in middle school. Likewise, a poorly designed schedule may not only stop the progression of middle school students but may also eliminate progress that has already been made (Hackmann & Valentine, 1998). The ultimate goal of any school schedule should be to, “bring together people, materials, and curriculum at a designated time and place for the purpose of instruction” (Ubben & Hughes, 1992, p. 257). To accomplish this goal schedules need to have an interdisciplinary focus where teachers have flexibility in how they use class time (Hackmann & Valentine, 1998; Fang & Wei, 2010).

When teachers have a say in the schedule, they can begin to employ best practices. Teachers, whether part of an integrated team or a self-contained classroom, should be able to decide how much time is devoted to core subjects. Classroom teachers should also plan on thematic and/or integrated instruction. The schedule should be planned with these strategies in mind. The teachers should not have to plan these strategies around the schedule (Hackmann & Valentine, 1998).

When teachers have flexibility in how they use their time, they can inject other best practices into their teaching that will help students master the material for each subject. Too often school schedules give “equal time to unequal subjects” (George & Alexander, 1993, p. 371). Many students fail to master the material when each subject is taught for the set 40–55 minutes. Flexible use of class time also has merit with middle and high school student’s developmental stage. Students at this age usually have an attention span for lessons that varies between 30-65 minutes. After lessons of this length students are ready for varied instruction that will advance in-depth learning. This varied

instruction could include cooperative learning, technology, experiments, individual research, and interdisciplinary instruction (Hackmann & Valentine, 1998).

Students' experience in school is also at odds with the working world. "Life is not divided into subjects" (Moffett, 1992, p. 82). When students are taught to focus on each subject individually, they miss the ability to make connections life will demand of them. Each subject is a piece to the life puzzle. If students are not taught where the pieces fit, or even that the pieces can be put together, they miss a big part of what school and life has to offer (Jankowski, 2002).

Integration of subjects has taken a back seat to high-stakes testing in the last number of years. A natural consequence of high-stakes testing is teachers are prone to teach for memorization and rote skills rather than enriched learning through more hands-on, inquiry-based, and cross-curricular means. Each subject is being taught individually with a focus on specific skills and knowledge that will be tested rather than using a student-centered curriculum. If students are to be properly educated and prepared for the future employment and life experiences, they must be in charge of their own learning rather than passive bystanders (Brand & Tripplett, 2011).

To make integration of subjects effective, teachers should plan the curriculum using backward design. Backward design occurs in three stages. One, teachers identify the standards and knowledge they want students to attain. Two, teachers identify how they will know when students have reached the previously mentioned standards. Three, teachers plan classroom activities that will help students succeed to attain the skills and knowledge. Using backward design as a guide, teachers will be ready to integrate subjects effectively (Brand & Tripplett, 2011; Wiggins & McTighe, 2005).

State and national science standards have focused on inquiry practices the last number of years. One of the basic intents of education is to help students become literate. There is currently a gap in many schools between learning science through inquiry and literacy practices in science. Many scholars believe that to have scientifically literate students and citizens, reading and science need to be integrated in schools (Fang & Wei, 2010).

While students learn to read in elementary school, they still need to learn literacy tools in middle and high school. Science texts are highly specialized and complex. Science reading can also be difficult for students because of their lack of life experience with scientific principles and language. Because of these factors students should be taught reading strategies to help them manage difficult topics. Strategies such as predicting, questioning, note-taking, summarizing and recognizing text-based features are taught in schools but not explicitly taught in science classrooms. Middle and high school students need these reading skills taught in their science classrooms (Fang & Wei, 2010).

It is also important to use quality and engaging literature to introduce science topics. Age-appropriate literature can put science into context for students, and can be fun and engaging. After using literature to introduce science topics, students will be able to connect the topics back to the story they read. Learning science through literature can be fun and retained longer because it is learned more efficiently. Students are able to make more inter-curricular connections in their learning (Bintz, Moore, Hayhurst, Jones & Tuttle, 2006).

METHODOLOGY

This project was designed to determine if teaching science for 180 minutes a day for 3 days would help students achieve mastery of Washington State Space Science Standards and Washington State Physics Standards more efficiently than teaching 45 minutes per day for 3 weeks (Appendices A & B). The project also measured how effectively teachers planned for the condensed units and if students enjoyed studying science all day. Five self-contained sixth grade classroom teachers participated in the study by teaching two units. One unit was taught in three days while the other was taught in two to three weeks. There were 126 students who participated in the study. I asked all five teachers to participate to increase the sample size. We taught two units, one condensed and one daily unit, so teaching ability would be less of a factor. 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.

Before the first unit, teachers filled out the Teaching Minutes Survey to find out how many minutes per week they taught core subjects (Appendix C). This was to get a feel for what subjects teachers focused on and what subjects were not taught as regularly. Teachers also indicated how comfortable they were teaching each core subject and how they decided how often to teach them. This information was graphed to compare what subjects were taught more in sixth grade.

I also had all students take the Phases of the Moon Test and Graphing Motion Test to gather prior knowledge of the subject matter (Appendices D & E). Students knew the test was scored and recorded but would not count toward their semester grade. This

information was not graphed because no students scored above 25% of the points possible. The reason I collected the data was to find out if students had any knowledge of the content beforehand.

The first unit was the Phases of the Moon Plan (Appendix F). Students made models and learned about the motion of the moon, lunar and solar eclipses, and how and why there are tides. Two teachers taught this unit in 15 days for 45 minutes per day to 51 students. Three teachers taught Phases of the Moon Plan in 4 days for 180 minutes per day to 75 students. The teachers used their collaboration time to plan lessons and common assessments, and there was also a concerted effort to include reading, writing, and math standards in the lesson plans. Each teacher taught the same lessons for approximately the same amount of time to ensure that students received the same teaching in different concentration levels. At the end of the unit, students took the Phases of the Moon Test and knew it would be graded and entered into the grade book.

After the test was graded and recorded, I found the mean, median, and mode scores for the condensed group and the daily group. I found what percentage of student scores lay in different groups by increments of 10% (90-100%, 80-89%, etc.) and graphed the data. The data for the condensed group and the daily group were placed on the same graph for easy comparison. I then analyzed the scores to see which group, condensed or daily, had the highest scores and which score increment was most represented. This analysis helped me to see which format of teaching was more effective for short-term memory.

After the tests had been graded and recorded, teachers returned the tests to the students and went over the correct answer for each question. Three weeks after the test,

students took the same Phases of the Moon Test. Between the time students took the first post-test and the second post-test teachers did not review the content. Students were not told about the second post-test beforehand, but they did know the grade would not be entered in the grade book. I did not want stress to play a factor in the results, nor did I want students to study. The second post-test was compared to the first post-test to see the difference in the two scores by student. Individual difference in test scores were grouped by how much they went up or down. For example, up 1 meant the student's score went up by 10-19%, down 2 meant the student's score went down by 20-29%. The percentage of students whose difference fell in the categories was graphed, and both condensed and daily scores were placed on the same graph. I then analyzed the data to see which group retained the information to see how long-term memory was affected.

The second unit was the Graphing Motion Plan (Appendix G). The same 126 students learned about a one-quadrant graph and how to graph motion. The specific type of motion students graphed was: constant, increasing speed, decreasing speed, return to start, and head start. The two teachers who taught for four weeks previously taught this unit in three days. Science was taught for 180 minutes for 2 of the days and 135 minutes the third day. The 3 teachers who taught the previous unit in 4 days taught the unit in 11 days for 45 minutes a day. Teachers spent approximately the same amount of time teaching each type of graph. While the time taught was the same, teachers had more liberty to teach the subject matter how they wanted. One teacher used role-playing to teach the students about motion. Students therefore received different lessons for the same amount of time in different concentration levels. After the unit students took the

Graphing Motion Test. This test was graphed and analyzed the same way the Phases of the Moon Test was.

Three weeks after taking the test, students took the same test. Between the time students took the first post-test and the second post-test teachers did not review the content. Students were not told about the second post-test beforehand, but they knew the grade would not be entered into the grade-book. I did not want stress to play a factor in the results nor did I want students to study. This test was graphed and analyzed the same way the Phases of the Moon post-test was.

When all the data from the tests had been collected, I combined the condensed scores from the Phases of the Moon Tests with the condensed scores from the Graphing Motion test and the daily scores from both tests. The post-tests were compared to get an overall feel for how short-term memory was affected by condensed science units. Since there are Highly Capable clusters and English Language Learner clusters in different classrooms, combining the scores would lessen the chance of the test results being skewed. The test students took three weeks after the post-tests were graphed based on learning format to get an overall feel for how student's scores changed. This added to the ability to analyze long-term memory.

After students completed the post-test for their condensed unit, and while the experience of the science unit was fresh in their head, they filled out the All Day Science Questionnaire (Appendix H). The students were first asked to rate their core classes based on what subject they thought was most important to their teacher and what classes they enjoyed the most. The scale was from one to five, one being most important or favorite and five been least important or least favorite. The next questions used a Likert

scale to measure how the students enjoyed the science unit and if they would like to have a condensed science unit again. The scale used rankings from one to five, five being the best and one being the worst. The answers were graphed and analyzed to see if students enjoyed learning science all day. There were also open-ended questions to elicit information not contained in the survey. Answers were grouped based on common themes and graphed.

After all the data had been collected, the five teachers conversed about the Round Table Discussion Questions (Appendix I). Each teacher received the discussion questions and the data beforehand. I was both a participant and the moderator. I used this method instead of interviewing each teacher to gather more free-flowing information. The discussion took 45 minutes, and I took notes on the computer that were projected on the board. These data were used to analyze how students' short-term memory, long-term memory, and student and teacher engagement were affected.

I graphed data collected from the Teaching Minutes Survey, All Day Science Questionnaire, and Round Table Discussion Questions. This data was compared to determine if students and teachers enjoyed the all-day science unit and if they would want to teach or learn in this format again (Table 2).

Table 2
Triangulation Matrix

Primary Question: What is the impact of teaching week-long science units on a student's long-term and short-term science achievement? Secondary Questions: How will students enjoy the all-day science unit? How will all-day science units effect teacher planning?							
	Phases of the Moon Test	Graphing Motion Test	Phases of the Moon Post Test	Graphing Motion Post Test	Teaching Minutes Survey	Teacher Round Table Discussion	Student Survey
Short Term Memory	x	x				x	
Long Term Memory			x	x		x	
Teacher/Student Engagement					x	x	x

DATA AND ANALYSIS

Short Term Memory

The average score of all students combined on the Phases of the Moon Test was 61%. Students who learned the material in a condensed format averaged 59%, while students who had science daily averaged 63%. The overall median was 62%, with condensed learning students having a median score of 62%, and the daily learning students had a median score of 72%. The overall mode of the test was 53%. The condensed learning students had a mode of 44% while the daily learners had a mode of 93% and 96% (Table 3).

Table 3
Phases of the Moon Measures of Central Tendency

	Mean	Median	Mode
Condensed Learning Students	59%	62%	44%
Daily Learning Students	63%	72%	93 and 96%
Combined	61%	62%	53%

Results of the Phases of the Moon Test indicated that 22% of daily learning students scored between 90-100%, while 4% of condensed learning students earned similar scores. The scores also showed that 14% of daily learning students earned between 80-89%, and 11% of condensed learning student's scores were in that range. Eighty-five percent of condensed learning students scored below 80% (Figure 1).

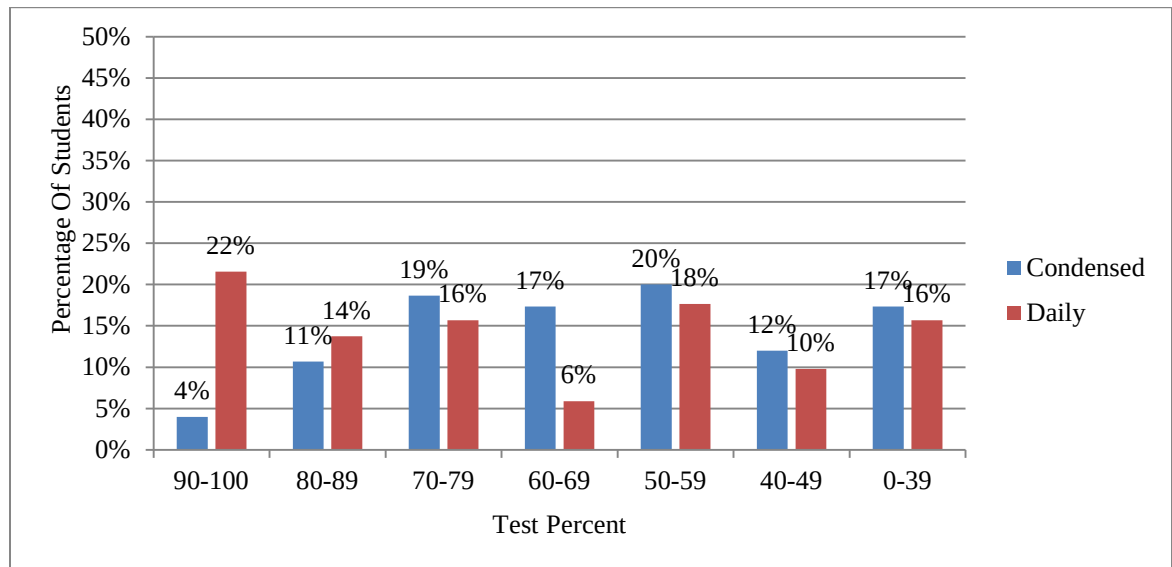


Figure 1. Phases of the moon test results; condensed, ($N = 75$), vs. Daily, ($N = 51$).

The average score of all students on the Graphing Motion test was 68%. Students in the condensed learning group averaged 63% while students in the daily learning group averaged 71%. The combined median was 76% and the combined mode was 96%. The

median for the condensed learning group was 68% and the mode was 92%. The median for the daily learning group was 76% and the mode was 96% (Table 4).

Table 4
Graphing Motion Measures of Central Tendency

	Mean	Median	Mode
Condensed Learning Students	63%	68%	92%
Daily Learning Students	71%	76%	96%
Combined	68%	76%	96%

Results of the Graphing Motion Test showed 35% of students in the condensed learning group scored in the 90-100% range, compared to 27% of students in the daily learning group scoring in the 90-100% range. Thirty-six percent of daily learning students scored between 70-89% opposed to 12% of condensed learning students in this range. Fifty-four percent of condensed learning students scored below 70%, while 37% of daily learning students scored below 70% on the test (Figure 2).

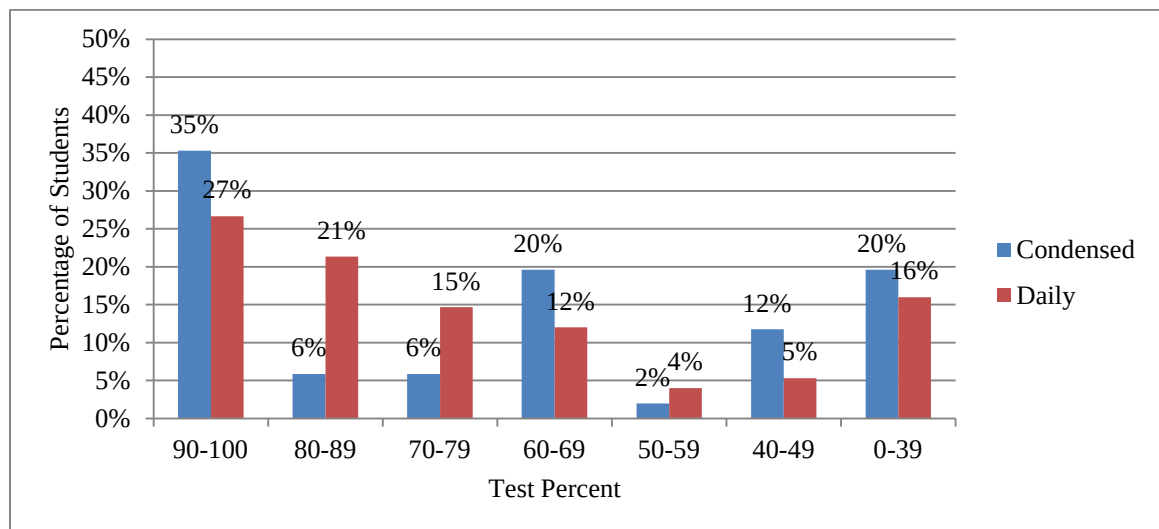


Figure 2. Graphing motion test results; condensed, (N = 51) vs. Daily, (N = 75).

When the daily test scores from the Graphing Motion Test and the Phases of the Moon Test were combined, 25% of students scored between 90-100%, 18% scored between 80-89%, and 15% between 70-79%. When added together 58% of daily learning students scored between 70-100%. When the condensed test scores were combined, 17% of students scored between 90-100%, 9% scored between 80-89%, and 13% scored between 70-79%. Thirty-nine percent of condensed learning students scored between 70-100% (Figure 3).

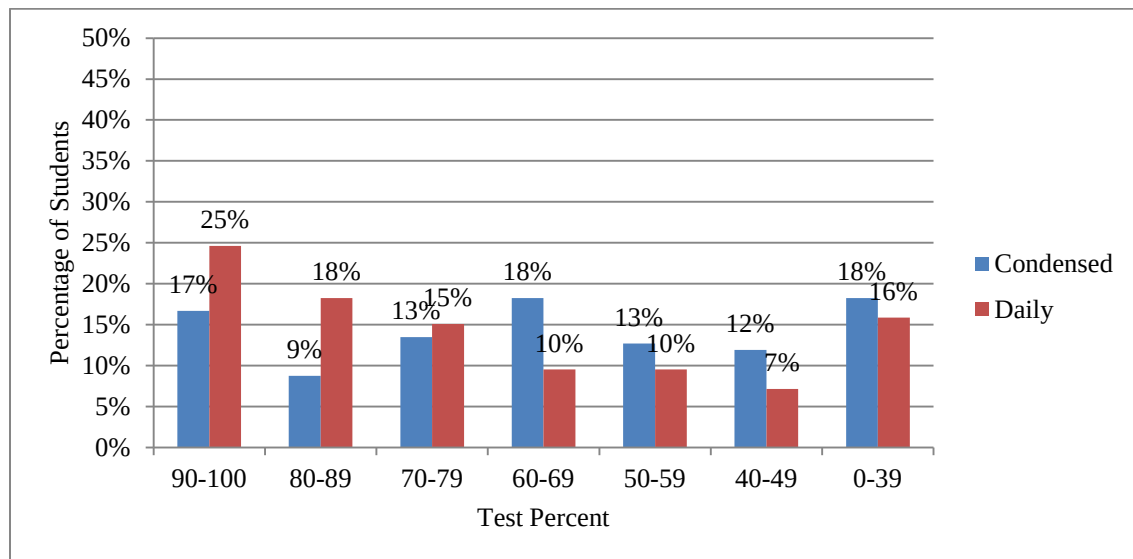


Figure 3. Condensed tests vs. daily tests, ($N = 126$).

When conversing about the Round Table Discussion questions, teachers gave their insight on the daily students scoring consistently higher than the condensed students. One teacher stated, “If students were absent (on a condensed day) it was impossible to catch them up.” This same teacher also pointed out, “I have special education students who are pulled out at certain times of the day. They missed some key instruction and review.”

Another teacher said:

Unlike with 45 minute class, [with the condensed classes] I wasn't able to have a backup plan. Sometimes you can tell a class isn't 'getting it.' With 45 minute classes I will sometimes end the lesson and start again at a later date. With all day science we had to push through [the confusion].

A couple teachers pointed out the lack of engagement students felt after a couple days. One teacher said, "On the 3rd or 4th day [of condensed units] my students got bored with science." Another teacher echoed the sentiments; "Even my students who liked science were like, 'more science?'" When students were asked what they didn't like about having science all-day 22% of them said that it got boring.

Long Term Memory

Student's long-term memory was analyzed according to how much their grade on the tests changed after three weeks. Forty-four percent of condensed learning students and 43% of daily learning students stayed within 10% of their initial score on the Phases of the Moon Test ($n=75$, $n=51$). Twenty-seven percent of condensed students scored at least 10% higher on the post-test than on the original test. Of the 27%, 13% raised the score by 10-19%, 13% by 20-29%, and 1% of students raised their grade by 30% or greater ($n=75$). The daily learning students had 30% of their scores raise by at least 10%. Twenty percent raised their score by 10-19%, 6% of students raised their score by 20-29%, and 4% of daily students raised their score by 30% or greater (Figure 4).

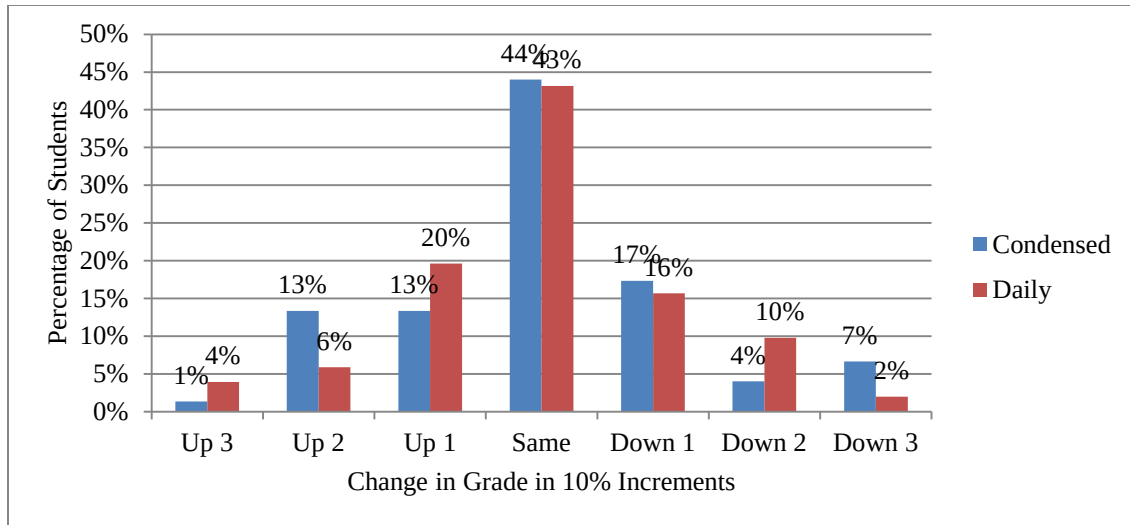


Figure 4. Long-term retention; improvement/decline of student test grades; phases of the moon; condensed, ($N = 75$) vs. Daily, ($N = 51$).

On the Graphing Motion Test, 49% of condensed learning students stayed within 10% of their initial score. Twenty-eight percent of students raised their score by more than 9%. Of the 28%, 8% raised their score by 10-19%, 10% raised their score by 20-29%, and 10% of students raised their score by greater than 29%. Twenty-four percent of students' scores declined by greater than 9%. Twelve percent of students' scores declined by 10-19%, 8% of students declined by 20-29%, and 4% of students declined by greater than 30%.

The daily learning students had 51% of students stay within 10% of their initial score. Sixteen percent of student's test scores raised by at least 10%. Of the 16%, 8% improved by 10-19%, 4% raised by 20-29%, and 4% of student's scores raised by at least 30%. Thirty-three percent of daily students' scores declined by at least 10%. Of the 33%, 9% declined by 10-19%, 8% declined by 8%, and 16% of daily student's scores dropped by at least 30% (Figure 5).

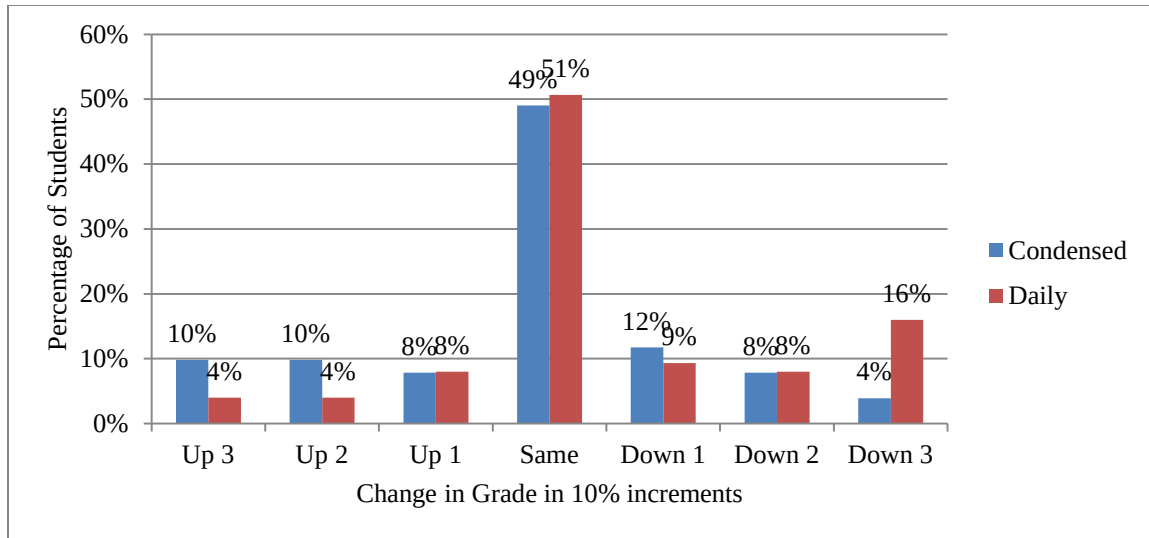


Figure 5. Long-term retention; improvement/decline of student test grades; graphing motion; condensed ($N = 51$) vs. Daily, ($N = 75$).

When both tests were combined based on the format of the curriculum delivery, 46% of condensed learning students stayed within 10% of their initial score. Twenty-eight percent of condensed learning students' scores improved by at least 10%: 11% by 10-19%, 12% by 20-29%, and 5% improved by at least 30%. Twenty-seven percent of condensed learning students' scores declined by at least 10%: 15% by 10-19%, 6% by 20-29% and 6% by at least 30%.

Daily learning students had 48% of their test scores stay within 10% of their initial test score, 22% improved by at least 10%, and 31% declined by at least 10%. Of the 22% who improved, 13% improved by 10-19%, 5% by 20-29%, and 4% by more than 30%. Of the 31% who declined, 12% declined by 10-19%, 9% by 20-29%, and 10% declined by at least 30% (Figure 6).

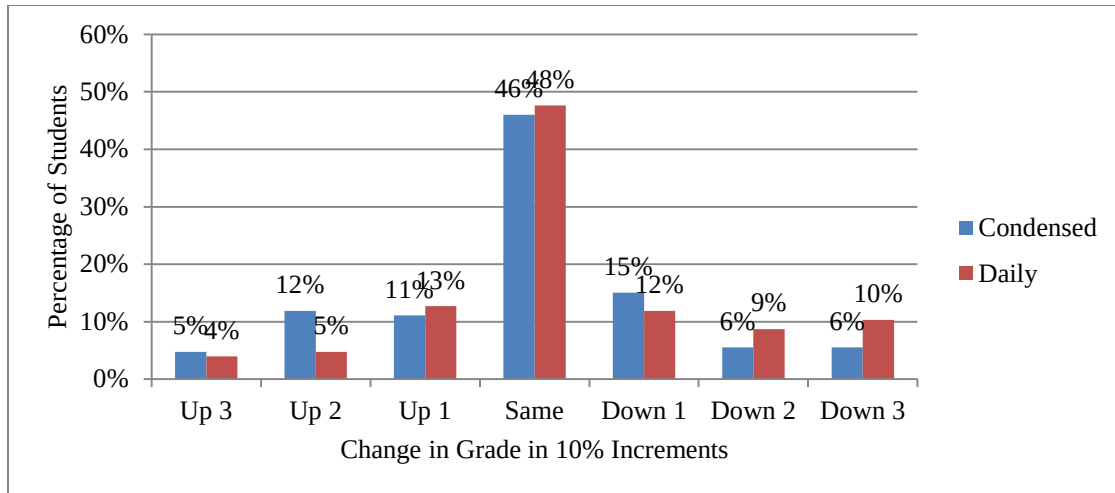


Figure 6. Long-term retention; improvement/decline of student test grades: both tests, ($N = 126$).

When asked what they liked most about having all-day science one student wrote, “I worked on [the science unit] so frequently that it stuck in my brain and it was fun.” Another student wrote, “You get to know more instead of only getting a little and having to switch subjects.” When asked what she thought of Figures 4, 5, and 6, a teacher said about the condensed teaching that, “The ‘ah-ha’ moment came for a lot of my students when we reviewed the test. It took that one review session for them to understand and they remembered the information three weeks later.” Another teacher said, “There may be something to letting students have time off from a subject to revisit later. When we revisited the unit when we went over the answers it seemed to click.”

Teacher and Student Engagement

The results of the sixth Grade Teacher Survey showed that 60% of respondents teach science for less than 90 minutes a week ($N=5$). The results also indicated that 80% of respondents taught math for over 180 minutes a week and 100% teach reading for at least 135 minutes a week (Figure 7).

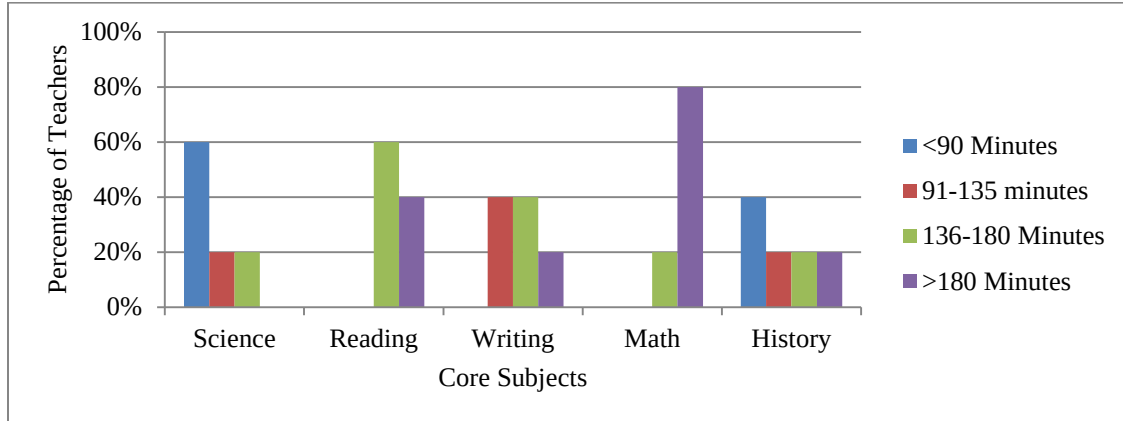


Figure 7. Teaching minutes per subject, ($N = 5$).

When asked how they decide how many minutes to devote to each subject one teacher responded, “I end up taking minutes from science and history to do additional math.” Another teacher stated, “I try to abide by the schedule...however, I have noticed that my current students struggle most with math, so I often spend more time in that subject area.” When asked how often they would teach science without any outside influences, one teacher stated:

Most of my students enjoy science, so I think I would still teach it for the scheduled length of time. However, I think it would be more logical to teach science labs in longer periods of time. Instead of five 45-minute periods a week, I think two or three 90 minute periods a week would work better.

Another teacher stated, “With no outside influences....I would teach science every day! I love science, and so do the kids.” Another teacher stated, “This is an easy question: DAILY. The pressure to perform and raise standards in math and reading seems to drive everything.”

When students were asked what subjects they thought were most important to their teachers 58% of them said math was most important to the teacher, 14% said writing, 12% said reading, 12% said history, and 4% said science. The same ranking showed that 36% of students said reading was least important, 26% said writing, 24% said history, 8% said math, and 6% said science, (Figure 8).

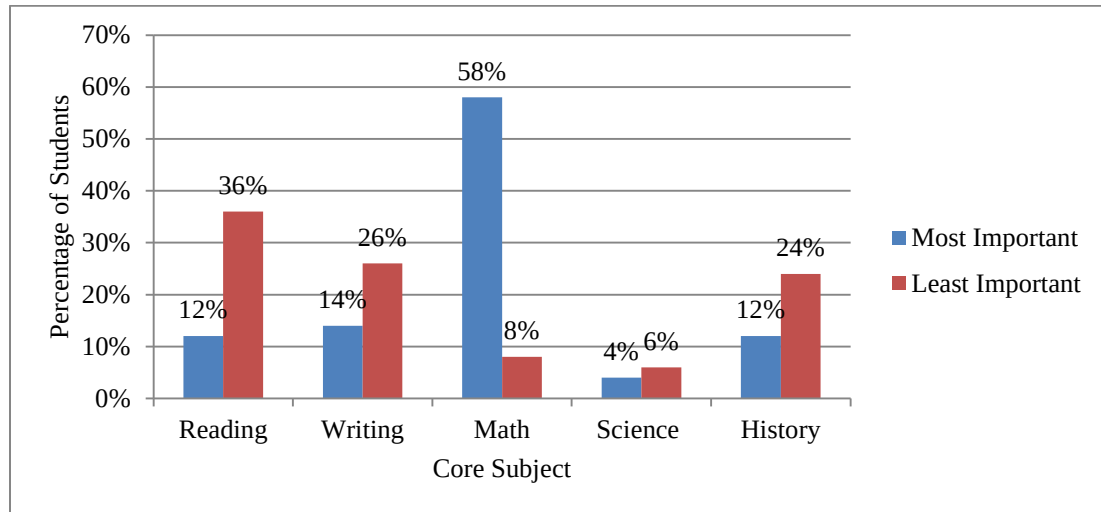


Figure 8. Student opinion on teacher's most important and least important core subject, ($N = 50$).

When students were asked to rank order their favorite subject, 40% said reading was their favorite, 22% said science, 14% said math, 14% said history, and 10% said writing. When students rank ordered the core subjects 38% said math was their least favorite, 32% writing, 20% history, 6% science, and 4% said reading (Figure 9).

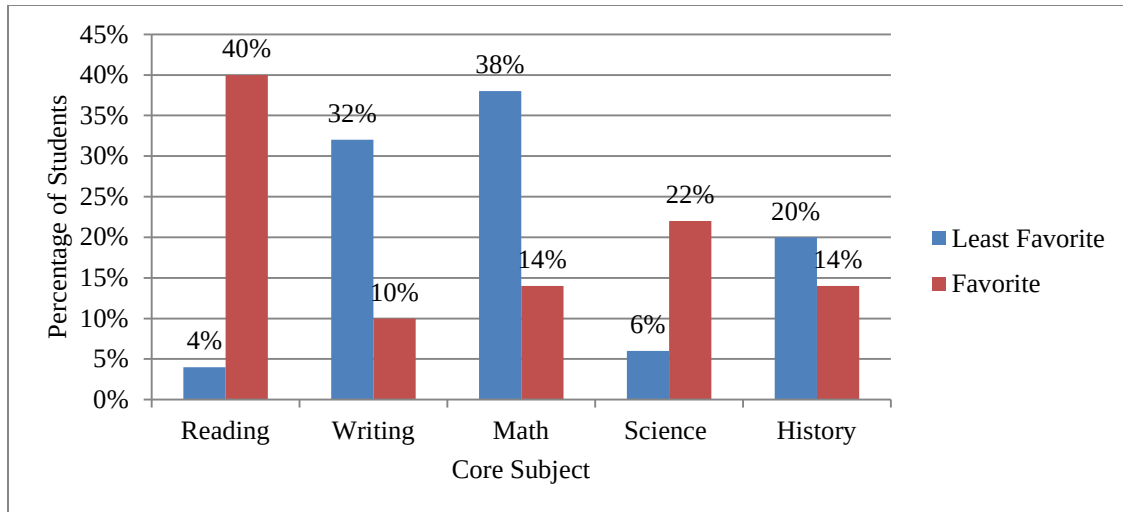


Figure 9. Student's favorite and least favorite core subjects, ($N = 50$).

When students were asked what their favorite part of having science all day was 24% said they were happy they didn't have to do any math, 23% said they like science, and 14% said they enjoyed focusing on one subject (Figure 10). When students were asked what they didn't like about having science all day, 22% said it got boring, 18% said they wanted to have the other subjects, 7% said they don't like science, and 17% said there was nothing negative about the unit (Figure 11).

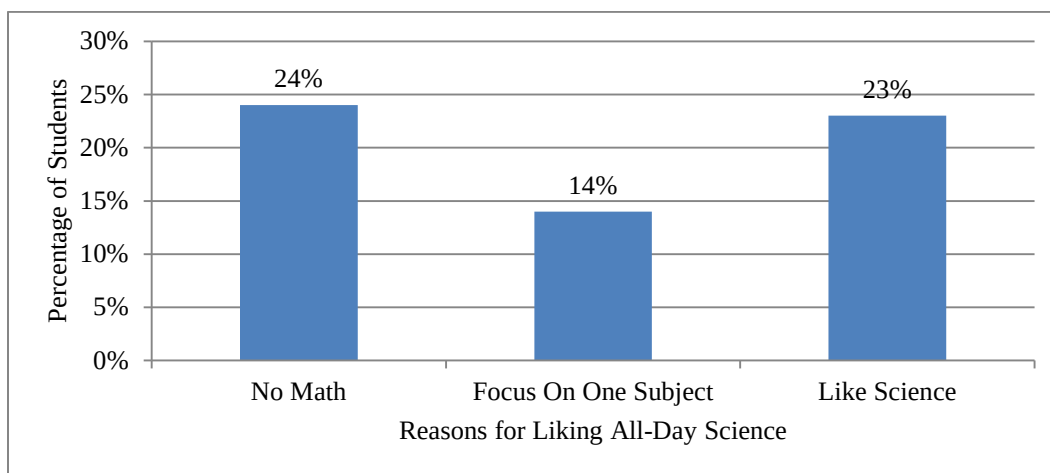


Figure 10. Free response reasons for liking all day science unit, ($N = 50$).

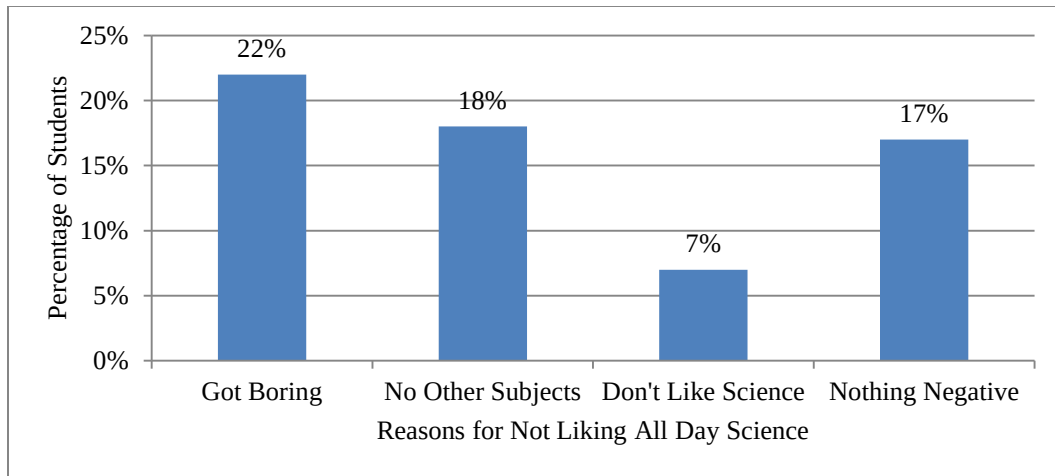


Figure 11. Free response reasons for not liking all day science unit, ($N = 50$).

After the science units, students were asked how much they enjoyed having science all day. A score of five meant they loved it, three meant they thought it was okay, and one meant the student didn't like the unit at all. Twenty percent of students rated the unit a 5, 31% said 4, and 33% said 3. This means that 85% of students either liked the unit or thought it was okay. Students were asked to use the same Likert scale and say whether they would like to do an all day science unit again. Of the 61 students who took the survey, 47% of them rated their desire to have another all-day science unit as a 5 or a 4. Twenty-six percent of students rated their desire to have another all day science unit was a 2 or a 1 (Figure 12).

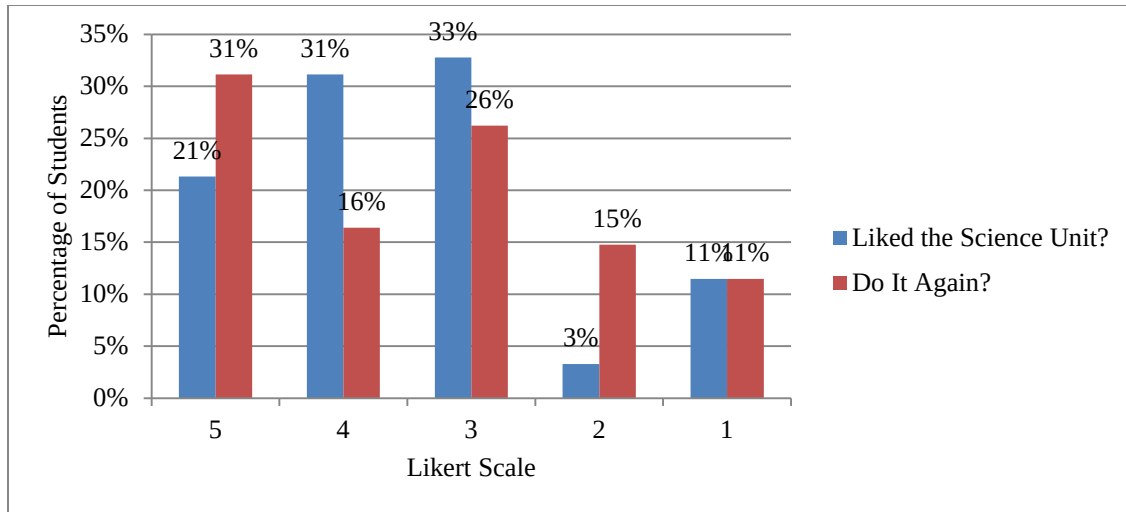


Figure 12. Student opinion of all day science unit, ($N = 61$).

When teachers were asked how they enjoyed the experience one teacher said, “I would do all day science Monday, then take a break from it. It’s nice to have a break, for both the student and the teacher.” Another teacher said, “I would like to do more of the integration of subjects.” Another teacher said, “It would be fun to teach a completely integrated unit where students don’t even know what ‘subject’ they’re learning.” All five teachers said they would definitely want to try an all-day unit again. All five also said they could see themselves teaching an all-day history unit, or any other subject.

INTERPRETATION AND CONCLUSION

The main question I had after completing the Capstone Project was what is the middle ground? I could safely conclude that at the very least student learning was not harmed with all day science units. Students who learned in a daily format consistently scored higher than students in the condensed format, but the difference was not large. The majority of teachers and students enjoyed the condensed units but said it got boring

at the end. A continuation of this project would be to teach two units simultaneously for more minutes than usual, but not all day. For example, have a week-long science unit with a week-long history unit, teaching both for 90 minutes a day.

A flaw in my research was that none of the teachers had taught the units before. The good thing was that teachers were able to collaborate and gain more in-depth knowledge of the topics. However, our lack of knowledge may have hindered the students' learning, particularly with the condensed students who didn't have a break from the topic. If someone were to replicate this project, I would suggest using a unit that all teachers have taught before and are comfortable with. Part of our collaboration was figuring out how long each lesson should take, a guess we weren't always correct with.

Most important to me was that students and teachers enjoyed all-day science units. I think the engagement was not directly linked to the concentration of teaching time but to how prepared teachers were. Teachers also integrated subjects that gave students the illusion that they were only studying one topic. Evidence of the illusion was students enjoyed not having math class even though math was integrated into the science they were learning. Students made it clear through their responses to survey questions that they do not enjoy math. Part of the problem was students don't have a frame of reference for the math in their learning. Just the way I worded the survey questions; "How many minutes per week do you teach science?" showed that learning is broken into content areas.

VALUE

The experience of developing and conducting this capstone project has led me to three conclusions that will change the way I teach in the future: 1) teaching science in a

condensed format is a viable option, 2) teachers will benefit from a more concentrated schedule, 3) subjects should be integrated more effectively.

First, teaching science in a condensed format is a viable option. Even though the test scores were consistently higher for the students who learned daily for 45 minutes, the difference wasn't very big. This showed me that at the very least students learning capability was not harmed. One of the participating teachers also mentioned, "This was our first time teaching this way. If we did this again we could fix some mistakes and I think it would improve quickly." One change I will make in the future is to teach 2 lessons for 90 minutes each instead of 1 lesson for 180 minutes. The point of teaching for more minutes and less days is to decrease the number of transitions and give students and teachers less standards to plan and think about. I have a meeting scheduled with my building principal to discuss the option of having 2 lessons per day that would both be about 90 minutes. The schedule would account for math facts to be studied daily, silent reading, and writing time as well as the two lessons. This type of schedule will help students focus on subjects taught. As one student said, "You didn't have to worry about other classes." One teacher explained the benefit of concentrated lessons by saying, "My students seemed to ask really in depth questions." I firmly believe that students will benefit by concentrating on fewer standards for longer periods of time.

Second, teachers will benefit with a more concentrated schedule. One thing I noticed during the capstone project was how effective collaboration became. We focused on science and created a common assessment, common lesson plans, discussed teaching strategies and struggles, and it felt like we accomplished more. Our individual planning time was also more efficient. One teacher stated, "I thought it was the easiest thing to

plan. It was a lot of planning in the beginning, but once I started teaching it was three days already thought through.” Through this more in-depth study another teacher said, “I liked that we focused on one thing and went really in depth with it. For future years my students will understand [phases of the moon] better because I know it better.”

The biggest way I have changed as a teacher is my resolution to integrate subjects more effectively. When 18% of students in a free-response mention that they didn’t like only studying one subject, even though reading, writing, and math were integrated, then they didn’t understand that “life is not divided into 45 minute periods” (Moffett, 1992, p. 82). Next year I will be intentional about teaching reading and writing skills in math, science, and history. I will also find areas in science that teach math skills seamlessly. When I effectively integrate subjects I believe students will learn at a faster pace. In my opinion, integrating subjects is the best part about teaching a self-contained class.

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APPENDICES

APPENDIX A

WASHINGTON STATE SPACE SCIENCE STANDARDS

	Content Standards	Performance Expectations
	<i>Students know that:</i>	<i>Students are expected to:</i>
6-8 ES1A	The <i>Moon's</i> monthly cycle of phases can be explained by its changing relative position as it <i>orbits</i> Earth. An <i>eclipse</i> of the <i>Moon</i> occurs when the <i>Moon</i> enters Earth's shadow. An <i>eclipse</i> of the Sun occurs when the <i>Moon</i> is between the Earth and Sun, and the <i>Moon's</i> shadow falls on the Earth.	• Use a physical <i>model</i> or diagram to <i>explain</i> how the <i>Moon's</i> changing position in its <i>orbit</i> results in the changing phases of the <i>Moon</i> as observed from Earth. • <i>Explain</i> how the cause of an <i>eclipse</i> of the <i>Moon</i> is different from the cause of the <i>Moon's</i> phases.
6-8 ES1C	Most objects in the <i>Solar System</i> are in regular and predictable <i>motion</i> . These <i>motions</i> <i>explain</i> such <i>phenomena</i> as the day, the year, <i>phases of the Moon</i> , and <i>eclipses</i> .	• Use a simple physical <i>model</i> or labeled drawing of the Earth-Sun-Moon system to <i>explain</i> day and night, <i>phases of the Moon</i>, and <i>eclipses</i> of the <i>Moon</i> and Sun.

APPENDIX B

WASHINGTON STATE PHYSICS STANDARDS

Content Standards	Performance Expectations
<i>Students know that:</i> 6-8 PS1A <i>Average speed</i> is defined as the distance traveled in a given period of time.	<i>Students are expected to:</i> - Measure the distance an object travels in a given interval of time and calculate the object's <i>average speed</i>, using $S = d/t$. (e.g., a battery-powered toy car travels 20 meters in 5 seconds, so its <i>average speed</i> is 4 meters per second).^{*a} - Illustrate the <i>motion</i> of an object using a graph, or <i>infer</i> the <i>motion</i> of an object from a graph of the object's position vs. time or <i>speed</i> vs. time.^{*b}

APPENDIX C

TEACHING MINUTES SURVEY

1. How many minutes per week do you teach science?
 - a. <90
 - b. 90-135
 - c. 135-180
 - d. >180
2. How many minutes per week do you teach reading?
 - a. <90
 - b. 90-135
 - c. 135-180
 - d. >180
3. How many minutes per week do you teach writing?
 - a. <90
 - b. 90-135
 - c. 135-180
 - d. >180
4. How many minutes per week do you teach math?
 - a. <90
 - b. 90-135
 - c. 135-180
 - d. >180
5. How many minutes per week do you teach history?
 - a. <90
 - b. 90-135
 - c. 135-180
 - d. >180
6. On a scale of 1-5 (5 being very comfortable, 1 being not comfortable) how comfortable are you teaching science?
7. On a scale of 1-5 (5 being very comfortable, 1 being not comfortable) how comfortable are you teaching reading?
8. On a scale of 1-5 (5 being very comfortable, 1 being not comfortable) how comfortable are you teaching writing?
9. On a scale of 1-5 (5 being very comfortable, 1 being not comfortable) how comfortable are you teaching math?
10. On a scale of 1-5 (5 being very comfortable, 1 being not comfortable) how comfortable are you teaching history?
11. How do you decide how many minutes to teach each subject?
12. How often do you purposefully integrate subjects?
13. If there were no outside influences (i.e. state testing, school or district schedules, etc) how often would you teach science?

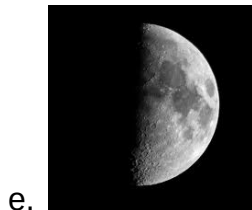
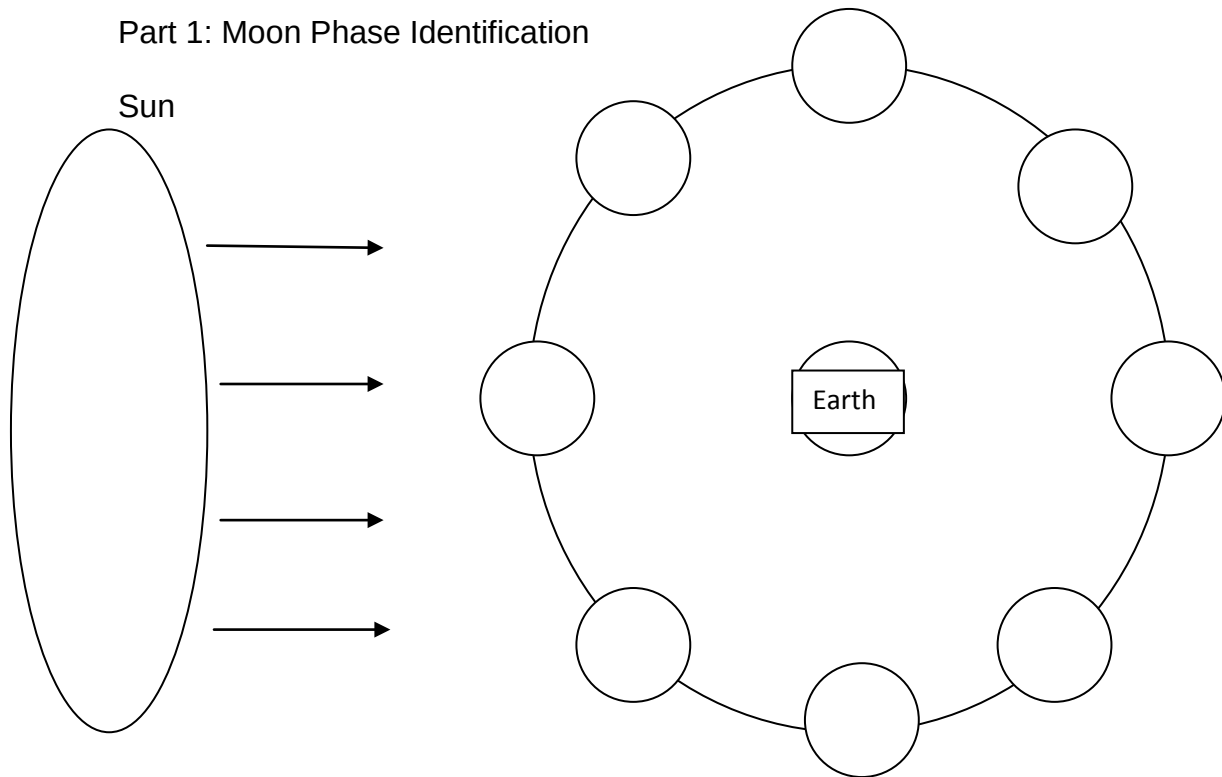
APPENDIX D

PHASES OF THE MOON TEST

PHASES OF THE MOON TEST

Name _____

Part 1: Moon Phase Identification



3. Label the diagram at the top of the page with the letters a-h to show where the Moon would be in its orbit when it is showing the phase shown in photos a-h.

Part 2: Moon Phases and Tides Short Answer

4. You have been kidnapped and knocked out for some time. When you wake up cold and frightened all you can think about is when will the sun come up? You see a full moon directly overhead. Approximately how many hours until the sun is up? How do you know this? (Assume the sun comes up at 7 am).

5. While sitting on the beach on a lazy summer evening you accidentally fall asleep. When you awaken you remember that your mom wanted you home at 10:00 pm. You have no time-piece but you see a 1st quarter moon setting in the western sky. Are you late for curfew? Why or why not?

6. When do high tides occur? Why?

7. When do low tides occur? Why?

8. Your friend tells you that it's best to go fishing when it's high tide. You saw a full moon last night. What time of the DAY would you suggest your friend go fishing in order to fish at high tide? Why?

Part 4: Expository Essay

9. Your friend is getting annoyed because you continually talk about the moon and its relationship to the earth. Create a **cluster map** that would help you write a multiple paragraph essay that explains why learning about the moon is important.

Part 5: Extra Questions

10. What time will a 1st quarter moon rise?

11. Can you see a waxing crescent moon at midnight? Why or why not?

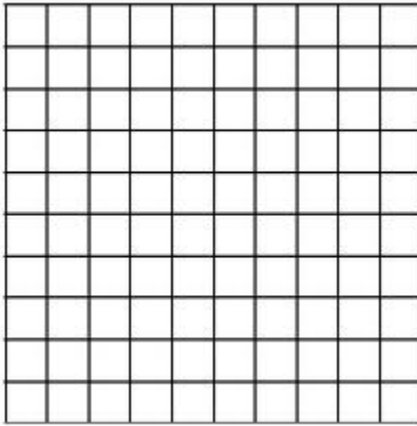
12. Draw and label a SOLAR ECLIPSE with as much detail as possible.

13. Draw and label a LUNAR ECLIPSE with as much detail as possible.

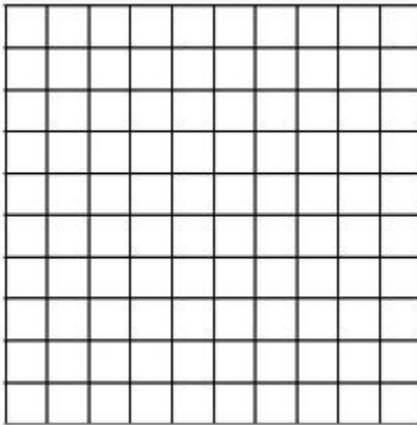
APPENDIX E

GRAPHING MOTION TEST

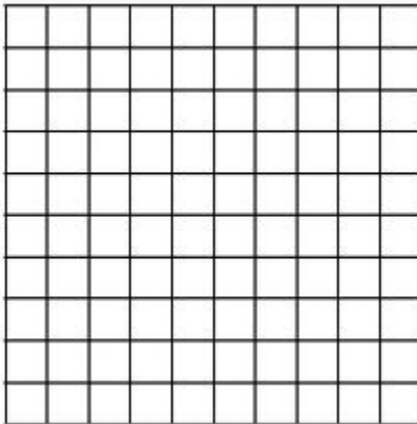
1. Jordyn ran 5 miles at a constant speed. The run took Jordyn 60 minutes to complete. Label the graph below to describe Jordyn's run. What was Jordyn's rate of speed (minutes per mile)?



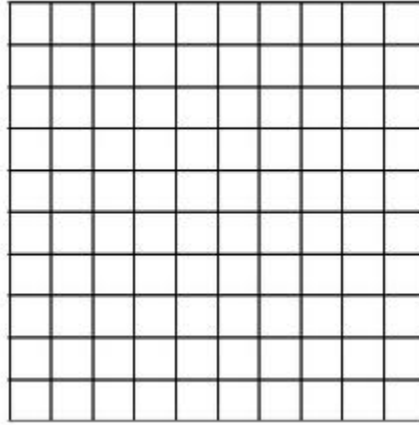
2. Label the graph below to show increasing speed.



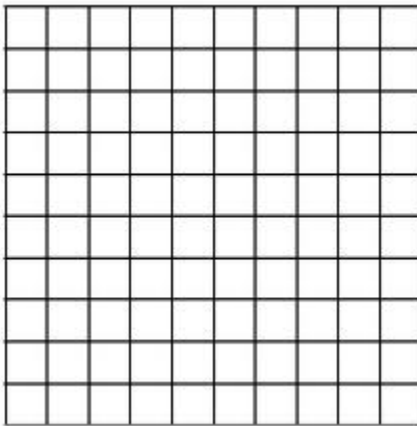
3. Label the graph below to show decreasing speed.



4. The Jones family went on a picnic. It took them 1 hour to walk from their car to their picnic spot. They spent 3 hours at their picnic spot and took 1 hour to get back to their car. Label the graph below to describe their picnic. Use their car as their point of origin.



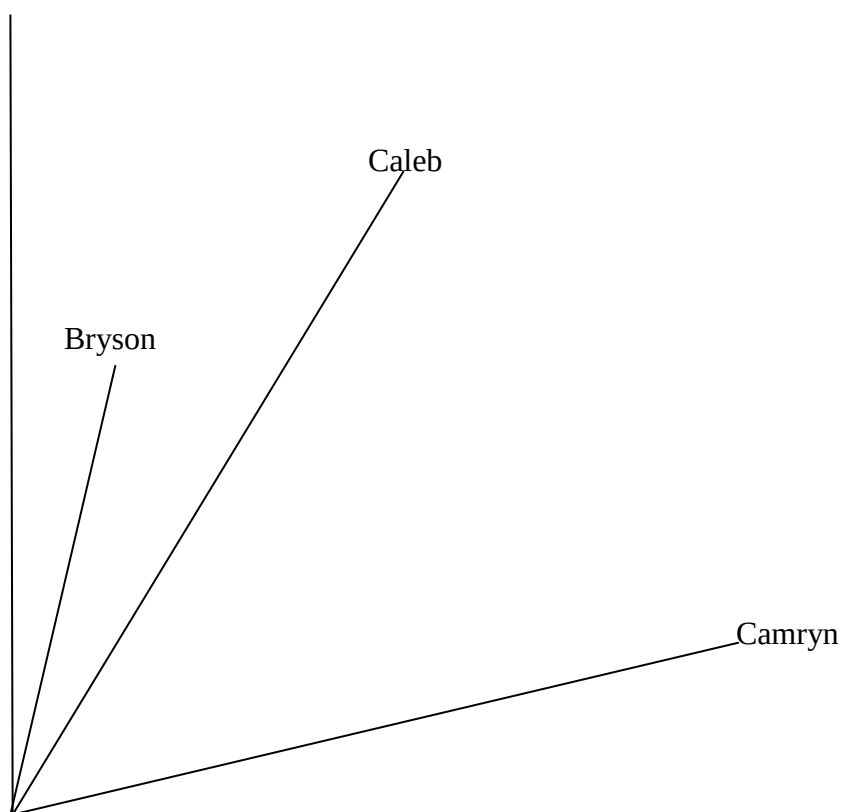
5. Sammy is going to race his younger brother Carl. Sammy will give Carl a 10 meter head start to make the 100 meter race more even. The race ends in a tie. Label the graph below to describe this race.



USE GRAPH 6 FOR #6-8.

The graph below shows Bryson, Caleb, and Dale power walking in downtown Battle Ground.

6. Who ran for the longest period of time?
7. Who ran the farthest?
8. Who ran the fastest?



APPENDIX F

PHASES OF THE MOON PLAN

Class 1: Read Chapter 1 section 3 of Astronomy textbook. Stem questions

Class 2: Make Phases of the Moon flipbook.

Class 3: Make Phases of the Moon flipbook.

Class 4: Analyze moon logs

END OF DAY 1

Class 5: Analyze moon logs

Class 6: Moon Phase challenge

Class 7: Moon Phase worksheet

Class 8: Moon phase challenge

END OF DAY 2

Class 9: Lunar and Solar eclipse videos

Class 10: Color pictures of Lunar and Solar eclipses

Class 11: Model of high and low tide.

Class 12: Video on tides.

END OF DAY 3

Class 13: Review Moon phases

Class 14: Study Guide/Review

Class 15: Study Guide/Review

Class 16: Phases of the Moon Test

END OF DAY 4

APPENDIX G

GRAPHING MOTION PLAN

Day 1: Tortoise and the Hare story and video

Day 2: Introduce the 1 quadrant graph

Day 3: Graph our walking (Constant Speed)

Day 4: Graph our walking (constant speed)

END OF DAY 1

Day 5: Graph increasing speed

Day 6: Graph decreasing speed

Day 7: Graph a return to start

Day 8: Graph a head start

END OF DAY 2

Day 9: Revisit Tortoise and the hare story. Graph the Race

Day 10: Review

Day 11: Take Graphing Motion Test

END OF DAY 3

APPENDIX H

ALL DAY SCIENCE QUESTIONNAIRE

All-Day Science Questionnaire

Taking this survey is optional. Your grade and/or your standing with the teacher has nothing to do with this survey. Thank you for taking the time to complete it.

1. Which subject is most important to your teacher? (#1-5, 1 being most, 5 being least)
 - a. Reading____
 - b. Writing____
 - c. Math____
 - d. Science____
 - e. History____
2. What class is your favorite? (#1-5, 1 being favorite, 5 being least)
 - a. Reading____
 - b. Writing____
 - c. Math____
 - d. Science____
 - e. History____
3. On a scale of 1-5 (5 meaning I loved it, 1 meaning I didn't like it at all) how much did you like having science all day? (Circle Answer)
1 2 3 4 5
4. On a scale of 1-5 (5 meaning Yes, 3 maybe, 1 no) would you like to have an all-day science unit again? (Circle Answer)
1 2 3 4 5
5. What was something you liked about having science all day?
6. What was something you didn't like about having science all day?

APPENDIX I

ROUND TABLE DISCUSSION QUESTIONS

Teachers came into the discussion with their own scores for both units, post and post-post

1. What was it like planning for only science during your all-day science unit?
 - a. What were your stress-levels like?
 - b. How was your work-load?
2. How do you think the students liked having science all day?
 - a. Did they seem happier?
 - b. Does anything stand out to you?
3. Do you feel that the students learned more, less, or the same amount during a condensed science unit as opposed to a “normal” science unit?
4. What conclusions have you taken away from this experience?