

STANDARDS BASED GRADING MODELS IN 9TH GRADE

EARTH SCIENCE CLASSROOMS

by

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DEDICATION

I would like to dedicate my work to my amazing husband, Brendon. Without him, this project would never have been possible. He was my foundation through all the frustrations and breakthroughs. He made sure day to day life carried on as normal for our family, so that I could focus on researching, planning, and prepping.

I would also like to dedicate my work to my two daughters, Reagan and Reece for the time that was sacrificed away from them. Not only did I pursue a Master's Degree for myself and my personal growth as an educator, but I also did it for them to provide an example of independent, strong female in the workforce.

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ABSTRACT

The purpose of this study was to identify the effects of incorporating standards-based grading models into a freshman Earth science classroom, as well as researching the impacts on the learning process of special education students and regular education students. Both qualitative and quantitative data analysis methods were implemented, and various data collection tools were studied. Students were administered a Rock Cycle Summative Assessment pretreatment and post treatment. Students were also evaluated on their performance through various mineral and rock identification labs. Through the Rock Cycle Pre and Post Summative Assessments, students showed growth towards the two learning targets identified. The What's in a Grade Likert Survey, Pre and Post Test Report Cards, and one-on-one interviews identified positives and negatives for goal setting, communication, feedback and differentiation.

INTRODUCTION AND BACKGROUND

Fergus High School (FHS) is located in Lewistown, Montana. Beautifully located in the heart of Central Montana between the Judith, Moccasin and Snowy Mountain Ranges, Lewistown is considered a rural, agricultural community. As of 2017, Lewistown's population was recorded at 5,942, an increase of 1.2% from the previous year. The median household income was also reported at \$40,612 (datausa.io). There are 333 students currently enrolled in our high school. Of these 333 students, 40% of our students qualify for free and/or reduced lunch. The majority, 93%, of our student population identifies as Caucasian (K. Durbin, personal communication, January 7, 2019). For the past four years, I have been teaching one section of Advanced Placement (AP) Physics 1, four sections of general Earth science, and one section of Title Earth Science (TES). At FHS, Title courses are designed within the core subject areas for students on Individualized Education plans and students needing extended academic interventions. These courses are supported by Title I funding.

My experiences with teaching TES have varied depending on the academic level of my students from year to year. This year, more than ever, I have students who struggle with basic writing skills and have reading levels below grade level. Needless to say, cognitive processing skills are also low. I learned quickly that my focus for what they achieve in my class this year is more than just science content. My focus for individual student achievement has been more geared towards organizational skills, processing information, basic skills such as reading and writing, and learning to be an advocate for their individual needs to become successful.

After being asked multiple times by various students, “what’s my grade?” “Did I get an A?” I noticed that students did not understand that their grade was a representation of their learning progression. They were only concerned about the letter grade earned and if it was good enough to be considered passing my class. I quickly started implementing more rubric-based grading approaches and had students self-score many of their own assignments before I looked at their work. Next, we would discuss the difference in scores if there was any. I found that students had a better understanding of where they were in the learning process and understood what it took to earn an A. At FHS, an A is considered any grade between a 92.5 and 100 percent (Appendix A). My experiences with my current classes lead to the creation of my focus statement: What are the effects of standards-based grading models in Earth science courses? Besides the main focus question, a sub-question was created as follows:

1. How does standards-based grading models impact the learning process of special education students and regular education students?

CONCEPTUAL FRAMEWORK

Evaluation and classification of student learning are continuous challenges for many educators, and the evaluation process can often times become messy. Educators are presented with curricula full of standards that need to be taught, and hopefully retained, over the course of the school year. However, they are left to figure out assessments and evaluations on their own. Many teachers across America assess their students not solely on achievement, but also effort in completing various tasks and

responsibility. The student's grade becomes a jumble of information that becomes challenging to interpret and can become meaningless (Muñoz & Gusky, 2015).

Numerous non-achievement factors, such as effort and punctuality, have worked their way into a student's grade. This is especially the case in secondary classrooms (Tierney, Simon, & Charland, 2011). Punctuality, both in showing up to class on time and turning assignments in on time, is one of the major issues in a secondary classroom setting. The quickest and easiest way for teachers to punish students for a lack of punctuality is by affecting their grade. This can be expressed as a percentage off of the student's assignment or point deductions for a category such as soft skills.

There are three learning criteria teachers have used to create what they believe to be a meaningful, fair, and well-rounded grade: product, process, and progress. Product criteria focus on student achievement through summative and performance-based assessments. The "what students know and are able to do at a particular point in time" (Gusky, 2015, p.75). Process criteria account for achievement scores and how the student got to their end results. This would include the student's overall effort in completing the tasks in a timely manner and routine work habits. Progress criteria evaluate how far a student has come from the beginning of a unit or school year; their progress or growth, rather than focusing on where they are currently (Gusky, 2015). By intertwining more process and progress grades into a student's end grade, the interpretation can become jumbled, and "the more subjective and biased grades become" (Guskey, 2015, p.76).

Classroom assessment policies are being revised within all levels of educational systems in response to standards-based reform (Tierney, Simon, & Charland, 2011).

Standards-based grading (SBG) has been defined as “a highly effective system to evaluate students’ learning and to advance them to higher levels of proficiency” (Vanhook, 2014, p.1). So how is a fully standards-based classroom established?

First, it is imperative to identify the learning targets or teaching standards. “Learning targets provide clear, specific skill destinations and give students the confidence they need to start the journey” (Rinkema & Williams, 2019, p.23). Not only do these learning targets need to be identified, but they also need to be communicated to the students. A key aspect of the SBG learning environment is that students understand what the learning targets are. So, not only do the targets need to be presented to the students, but they also need to be communicated in a way that they can comprehend. An example of this would be using “I can” statements such as, “I can analyze and interpret data from a graph.” Techniques such as “I can” statements and learning target rubrics allow students to monitor their learning progression on their own. When students can track their own learning and self-asses, “the more they develop ownership of their learning” (Vatterott, 2015, p. 47). A way for students to monitor their own progress is through goal setting. “Goal setting is a metacognitive process that motivates students and helps them modify their learning behaviors” (Heflebower, et.al, 2019, p.48). This should be a continuous process that allows students to focus on their personal strengths and weaknesses and how they can achieve a mastery level of the learning target.

Secondly, a crucial factor in the success of a SBG learning environment is the incorporation of feedback. It is widely accepted that learning and personal growth do not come without mistakes or failure in some form. Providing ample opportunities for students to grow academically without the fear of earning a failing grade will help students progress towards mastery of that particular learning target. For example, a teacher may provide students with formative feedback and allow them to adjust their work accordingly. Feedback does not always need to be conducted in a formal fashion and recorded, and it is not always the teacher providing feedback to the students. This is a two-way conversation between students and their teacher. By having a routine two-way conversation, teachers are able to assess if further interventions are necessary to help students reach the learning target (Vatterott, 2015). This is known in many classrooms as formative assessment. Formative assessments allow students numerous opportunities to grow within their learning without the fear of judgement from their teacher, or low grades in the gradebook. “Students often feel that assessment equals test equals grade equals judgement. That association leads many discouraged students to give up rather than to risk another failure” (Tomlinson, 2014, p.11). In a personal study, Jeanetta J. Miller, expresses frustration with not providing adequate feedback to her students through grading individual assignments. Her students began completing assignments for the sake of a score in the gradebook. The emphases and primary use of grades at the secondary education level is toward student grade point average, honor roll, higher education applications, and scholarship applications. This becomes a number or score to compare one student to another in a pool of applicants. Miller decided that instead of placing

individual assignments such as Plate Tectonics Worksheet into the gradebook, she would enter the learning standard instead. Student scores would then be based on proficiency levels and ranked on a scale of zero (not proficient) to 10 (mastery). Since the ultimate goal is student mastery of learning targets or standards, it didn't matter the number of assignments students were completing within a unit. The focus geared towards what the student was learning, rather than how much the student was doing. Results showed that time was no longer spent grading individual assignments, but rather conferencing with individual students and providing more in-depth feedback on tasks and assignments. This process naturally created a student-centered classroom through both the learning and assessment process (Miller, 2013).

The final step in SBG is to identify what is calculated into the grade based on school and/or district policies. In a purely SBG classroom, only summative assessments or the product grade is calculated into the student's final grade. One study reported that teachers struggled with separating student achievement and non-achievement factors, such as effort and responsibility, within the final grade. However, it was noticed that there was a clear transition for the students from completing assignments for the sake of a grade to completing tasks for the sake of learning. Although soft skills, such as completing tasks and turning them in on time are an important life-long skill, the ultimate goal of the education system is student learning (Tierney, Simon, & Charland, 2011).

One way to put this into perspective is to think of a volleyball team. Practice is the feedback provided on a daily basis. Athletes are continuing to work towards mastery of their skills. Regular season games act as formative assessments. Win or lose there is

no weight on the outcome, only reflection on what can be done better. The State tournament is the summative assessment. This is the final chance to prove what has been mastered over the course of the season, the only thing that counts.

Standards-based grading is especially valuable for special education students and their parents or guardians. By using a SBG approach for students with special needs, students, parents, and educators can make more informed intervention and course placement decisions. Parents know where their child is in the learning process, which is of greater value than a letter grade alone. When special education students are fully included in general education courses, standards-based grading will make the grading process more streamline and easier for students and parents to interpret (Jung & Gusky, 2007). “When we acknowledge and respect differences in learners, we adjust our classroom routine to make success possible for all students” (Vatterott, 2015, p.79).

METHODOLOGY

The purpose of this study was to determine the effects of standards-based grading models in freshman Title Earth Science and Earth science classrooms during an eleven-week unit on the rock cycle. Twenty students participated in this study, and half of the treatment population are students on Individualized Education Plans. Two learning targets were established for the rock cycle unit: 1) minerals have specific and quantifiable properties, 2) rocks are made of one or more minerals and are formed in different ways. These learning targets provided the direction for the instruction and assessments that would be graded for the treatment period. Qualitative and quantitative data was collected and analyzed for trends in student responses and growth from the start of the unit to the

end (Table 1). This project received an exemption by the Montana State University Institutional Review Board and compliance for working with human subjects was maintained (Appendix B).

Table 1
Chronological Representation of Data Collection

Treatment Phase	Data Collection Tool
Pre-Treatment Reflection	Student reflection of semester one grades. Students complete, What's in a Grade Likert Survey and one-on-one interviews with teacher
Goal Setting	Rock Cycle Summative Pre-Treatment Assessment and Pre-Test Report Card
Inquiry-Based Instruction	Inquiry-based mineral and rock identification labs
The Big Picture	Rock Cycle Comic
Mastery of Content	Rock Cycle Summative Post Treatment Assessment and Post-Test Report Card
Post Treatment Reflection	Students reflect on unit scores, mastery level of content, and whether goals were reached. Post treatment What's in a Grade Likert Survey and one-on-one interviews

The first phase of treatment consisted of students reflecting on their grades from the previous quarters. Each quarter consists of nine weeks. After looking over a report of their first and second quarter grades, students were asked to complete the What's in a Grade Likert Survey via Google Forms (Appendix C). The survey was broken up into four themes: communication, goal setting, feedback, and differentiation. The survey consisted of 17 Likert-style questions and students were provided the options of strongly agree, agree, disagree, or strongly disagree. Students were encouraged to think deeply on their content knowledge and what they retained from the previous semester and choose the best option that fit their skill base. At the conclusion of the eleven-week treatment period, students completed the survey once their grades were finalized. Data was

compared to look and see if there were any trends in student thinking and/or changes in student outlook towards school, their teachers, and their science grade.

To collect more data and insights on student thoughts pertaining to their grades, one-on-one student interviews were conducted (Appendix D). Students were asked if science was a strong subject for them, and if they felt they have been successful in the subject area previously. Once getting an understanding for their comfort and confidence level in science, students were asked to elaborate on if their grades in science have been a true reflection of what they learned in class. Lastly, students were asked to think about what a letter grade meant and explain their interpretations of their grade from first and second quarters. Since these responses are lengthier in nature, one-on-one interviews were more appropriate than survey responses. These interviews were conducted pre and post treatment and responses were compared for trends or any changes in student outlook over the course of the eleven-week treatment period.

Once students completed the What's in a Grade Likert Survey and interviews, the Rock Cycle Summative Assessment (Appendix E) was administered pretreatment to establish a starting point for this unit. This also allowed students to become familiar with the terminology that would be used throughout the treatment period. This assessment is set up into three parts: vocabulary, multiple choice, and short response and/or diagrams. Based on the skills we worked on through the unit, students are asked various types of questions within the assessment that reflect the use of those skills. For example, during the unit, students completed a Mineral Identification Lab. On the assessment, descriptions of various minerals are provided and students need to take the information

provided and identify the mineral using their Dichotomous Keys. A Dichotomous Key is a tool that divides physical properties of a natural object such as plants and minerals into two categories. This means that while scientists are navigating through the Dichotomous Key, they are always provided two responses per identifying question. The assessment is also set up so that students can use the test for clues. Using the same example, there are questions in other sections of the test pertaining to luster, streak, hardness, etc. so that when they get to the mineral identification question, the terminology can be referenced in other sections of the assessment. The pretest score was used for students to work on goal setting. This was conducted using a Pre-Test Report Card (Appendix F). Students were provided their pretest score and asked to record it on the report card. They were also asked to identify a goal score for their post treatment test and reflect on what they believed they would need to do to achieve that goal. Students were also asked if they felt it was beneficial to take the test before the unit. At the completion of this unit, students were once again administered The Rock Cycle Summative Assessment. Pre and post treatment scores were further analyzed using normalized gains. The normalized gain was calculated to determine differences in student knowledge. Normalized gains of less than 0.3 were considered low gains 0.3 to 0.7 was considered a medium gain, and normalized gains greater than 0.7 were considered high gains (Hake, 1998). Students also completed a Post Test Report Card (Appendix G). The Post Test Report Card asked students to record both test scores and reflect on whether or not they achieved their goal, and if they didn't, what they could have done differently moving forward. Students were encouraged to reflect on if they felt their rock cycle unit grade was a true reflection of

their understanding of the material and what they learned? Finally, students were asked to assess their proficiency level of the learning targets as a four, three, two or one.

The treatment period consisted of direct and inquiry-based activities pertaining specifically to mineral and rock formation and identification. With the learning targets established, assessment was only conducted once I felt students had reached a level of understanding ready for assessments. The first assessment conducted was the Mineral Identification Lab (Appendix H). Students were presented with eight different minerals and instructed to conduct the physical properties tests hardness, luster, streak, cleavage, fracture. Students also needed to make note of observations such as color, feel, smell, and if there were any special properties such as magnetism. The Mineral Identification Lab Rubric (Appendix I) was used to assess student understanding of the various terminology of each physical property and their overall performance. Students were provided feedback via Google Classroom and allowed the opportunity to make corrections. The same process was conducted for the Igneous Rock, Sedimentary Rock, and Metamorphic Rock Identification Labs (Appendix J).

As a preparation for The Rock Cycle Summative Assessment, students were assigned to complete a comic strip of the rock cycle. This allowed students to use their creative side to create a visual representation of how each rock type was formed and how they are interconnected within the rock cycle. This was assessed using the Rock Cycle Rubric (Appendix K).

At the completion of the treatment period, a final one-on-one student interviews were conducted (Appendix L). This interview had students focus on their performance

for the eleven-week treatment period. Students were presented with their letter grade for this treatment period and asked to reflect on if they felt this was an accurate representation of their knowledge and skill base. Students were asked once again to explain the meaning of a letter grade. This information was further compared to their responses from the beginning of the treatment period to see if trends changed or remained the same. Students were also asked to reflect on the skills or learning targets they had mastered versus skills they still needed to work on. Finally, students were asked to reflect on a standards-based grading approach versus traditional grading methods from first semester; did they feel they understood the expectations of the learning process more clearly and what their grade represented? The data collection instruments are summarized in the triangulation matrix below (Table 2).

Table 2
Data Triangulation Matrix

Focus Questions	Data Source 1	Data Source 2
<i>Primary Question:</i> 1. What are the effects of standards-based grading models in Earth science courses?	Pre and Post What's in a grade Likert Survey	Pre and Post one-on-one student interviews
<i>Sub-Question:</i> 2. How does standards-based grading models impact the learning process of special education students and regular education students?	Pre and Post Rock Cycle Summative Assessment; Pre and Post Test Report Cards	Rock Cycle Unit Standards-Based Grading Rubrics

DATA AND ANALYSIS

The results for The Rock Cycle Summative Assessment (RCSA) pre and post-test showed an average normalized gain of 0.62, medium gain (Hake, 1998) for all 20 students in both Title Earth Science and Earth science. This was further demonstrated through the pre-test median of 28.5% and the post-test median increasing to 72%. Title Earth Science showed a normalized gain of 0.74 compared to Earth science at 0.52 (Figure 1).

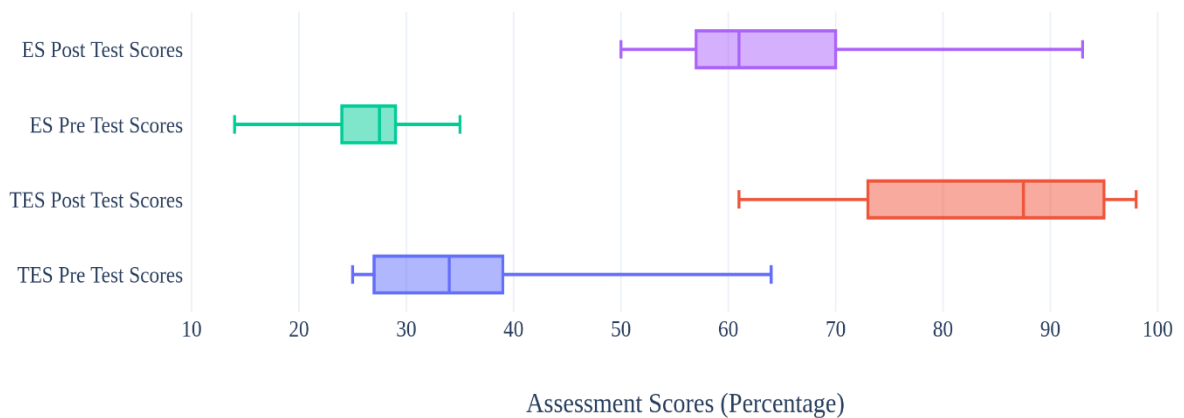


Figure 1. Title Earth Science vs. Earth science rock cycle summative assessment scores, (N=20).

Through the What's in a Grade Likert Survey, students expressed conducting more goal setting with their teachers and parents prior to treatment than after (Figure 2). Forty percent of students within the treatment population actually met or exceeded their goals. Of the 40%, 75% of those students were in the Title Earth Science class. Students who did not meet or exceed their goals expressed a need for better note taking and study habits; "I didn't use my notebook and didn't have my notes all in one place, I should have

been more responsible.” Another student referenced not meeting their goal unit score, “I could have studied more because I would like an 85% or above.”

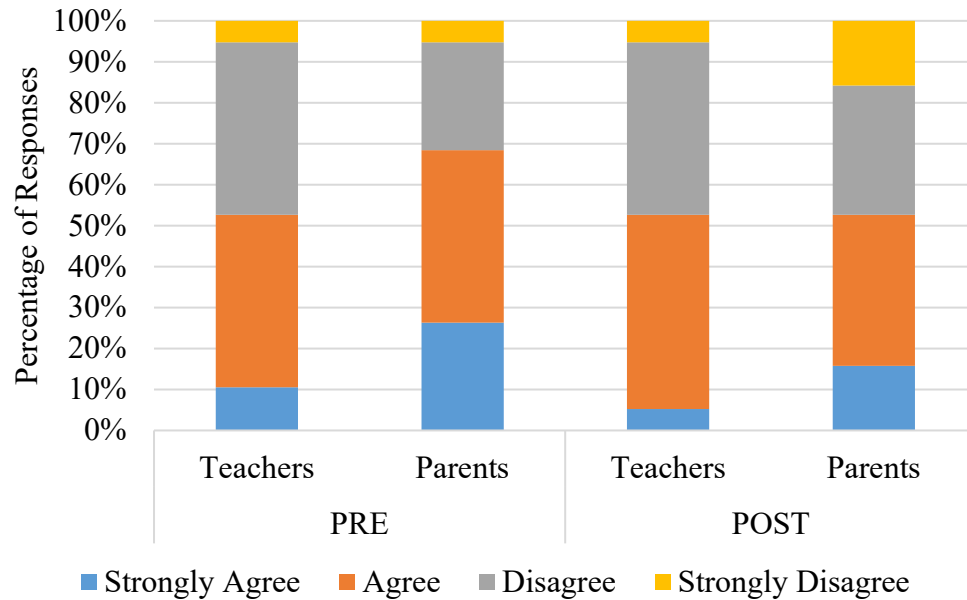


Figure 2. What’s in a Grade Likert Survey: goal setting responses, “I set goals with my teachers/parents for how I will do in school,” (N=19).

When it came to communication between teachers and students, a large percentage of students felt that expectations were clearly expressed and understood how their grades were calculated in both the pre and post What’s in a Grade Likert Survey results (Figure 3). One student expressed being in favor of standards-based grading methods, “I feel the standards-based grading approach was better because it helped me understand the requirements for the assignments.” However, another student expressed the standards-based grading model as being more challenging.

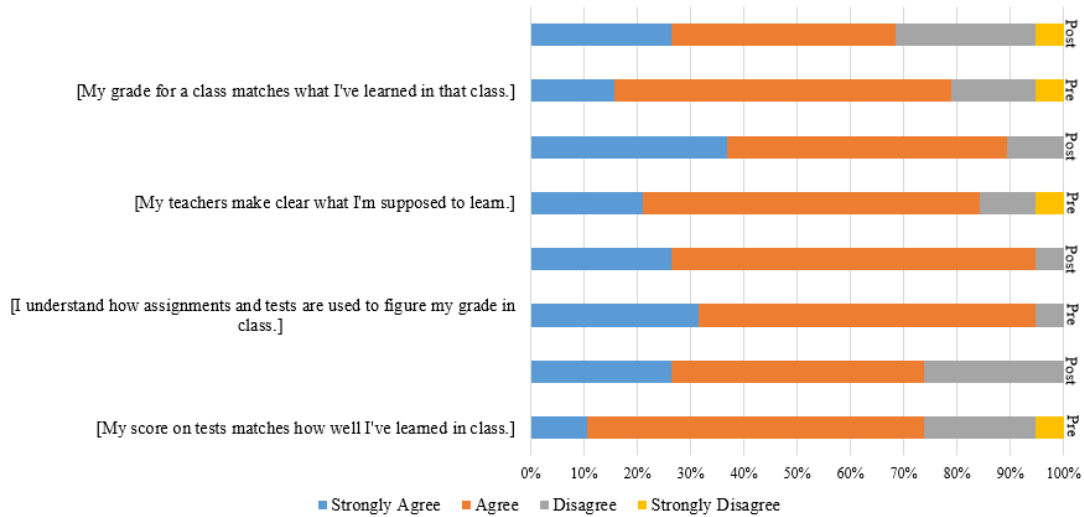


Figure 3. What's in a Grade Likert Survey: communication responses, ($N=19$).

The primary form of feedback for students were their report cards. More than 50% of students within the treatment population agreed that report cards help them understand how they are doing in school (Figure 4). However, there was a small percentage of students who expressed that their teachers provide them feedback about specific assignments or periodically throughout the year. Students were provided a breakdown of their assessment scores at the completion of the unit.

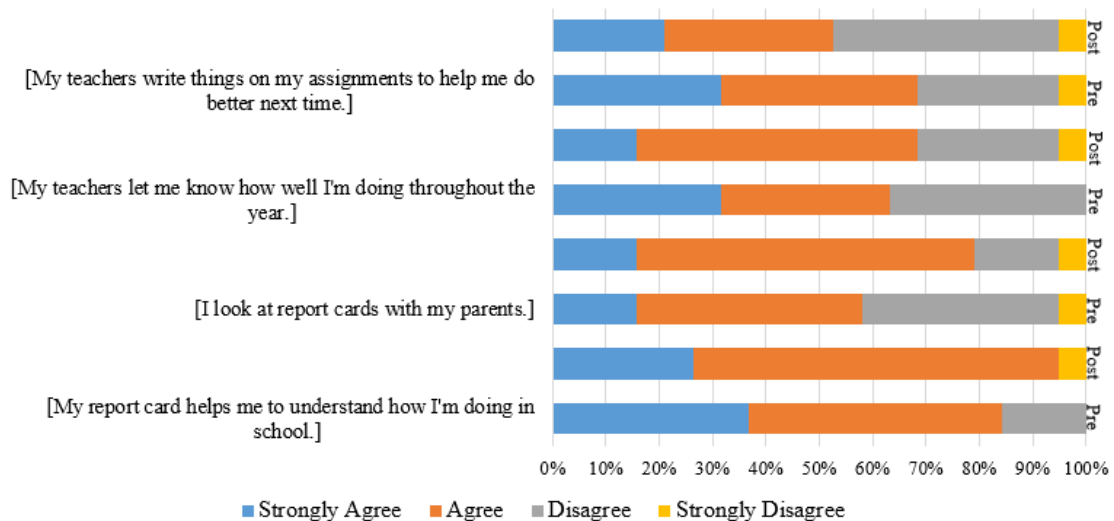


Figure 4. What's in a Grade Likert Survey: feedback responses, ($N=19$).

On the Post Test Report Card, students were asked to rank their level of proficiency pertaining to the two learning targets for the unit based on their assessment scores throughout the unit (Figure 5). A four represents mastery of the learning targets and a one represents no understanding of the learning targets. Mastery was not accomplished by the majority of the treatment population.

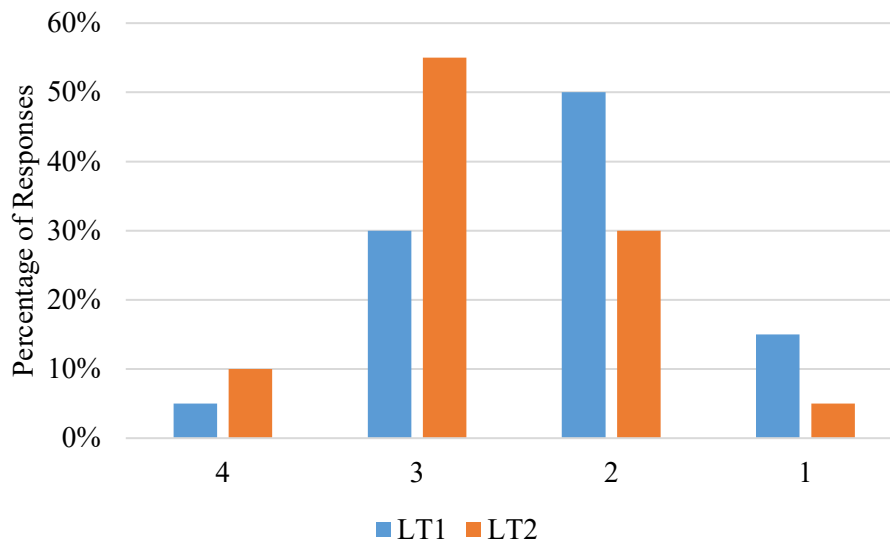


Figure 5. Learning target proficiency levels, ($N=20$).

As for differentiation, student responses remained the same. A good majority of students feel that teachers provide alternative learning methods for content that may not be understood immediately (Figure 6). There were mixed emotions as to whether differentiation was being provided during the treatment period. One student expressed frustrations, “I’m not able to understand what the teacher is talking about. I’m putting forth the effort to try and understand, but I’m not understanding what she is talking about.” Other students expressed more confidence in science because I was able to spend more time with them and help them with whatever they may have needed.

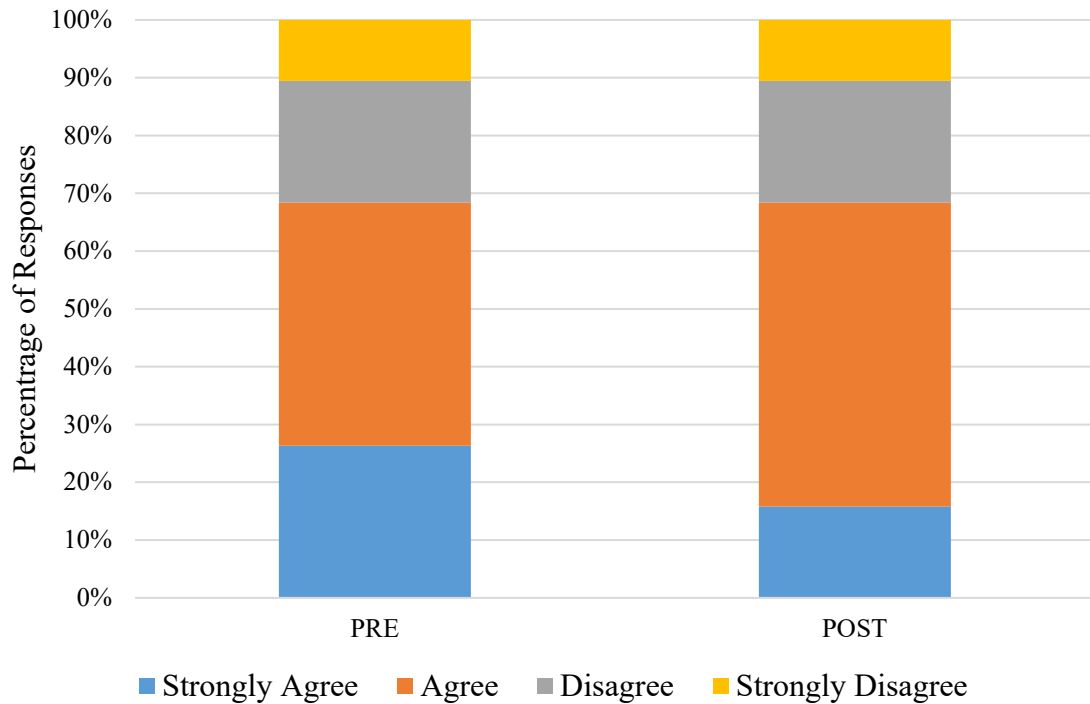


Figure 6. What's in a Grade Likert Survey: differentiation responses, ($N=19$).

INTERPRETATIONS AND CONCLUSIONS

The purpose of this study was to identify the effects of incorporating standards-based grading (SBG) models into freshman Title Earth Science and Earth science classrooms. Both qualitative and quantitative data analysis methods were implemented, and various data collection tools were studied. Through the Rock Cycle Pre and Post Summative Assessments, students showed growth towards the two learning targets identified. The What's in a Grade Likert Survey, Pre and Post Test Report Cards, and one-on-one interviews identified positives and negatives for goal setting, communication, feedback and differentiation.

Through the What's in a Grade Likert Survey and the Pre and Post Test Report Cards, it was evident that students need to work on goal setting. This was the first

attempt of my students working on goal setting. The majority of their goals were rather vague; study more, get better grades, pay attention and take good notes. The majority of the goals pertained to the end result, how to get a better grade. Transitioning from the thought process of doing whatever is needed to be done to earn the grade to doing what is needed to be done to master the learning target is going to take time and practice.

Communication was provided through formal and informal feedback. Formative feedback was provided through the lab rubrics and written comments regarding student work. Informal feedback was provided at the time of the lab or assignment as I walked around the room and monitored students. There were a few students who really blossomed and began to open up more to myself about their frustrations, and even their breakthroughs from day to day in working towards the mastery of their learning targets. I saw more concentration from the Title Earth Science students than the Earth science students. I have to wonder if this is due to the amount of structured accommodations provided through their Individualized Education Plans. My Earth science students struggled more through the day to day activities because I was not standing in the front of the room telling them exactly what to write down every day. I acted more as a guide and a larger responsibility was put on them for their learning process. I recall one student writing on their Pre-Test Report Card that in order for them to achieve their goal they needed to care more about their learning. When things got challenging for my students, the first instinct for many of my Earth science students was to give up. During pre and post treatment interviews, my Earth science students were unsure of how honest to be with me in their responses. It would take them some time to finally respond. I had to

allow one student to write her responses on paper after I read her the question. She opened up way more in her writing than talking with me. There is still work to be done in opening the communication door within my classroom. My students have the interpretation that the teacher is the only one who communicates about the learning process; rather than them communicating with me about their needs and/or breakthroughs in their learning.

There seemed to be a disconnect when it came to the amount of feedback provided throughout the treatment period. Students expressed a lack of feedback conducted by the teacher through the What's in a Grade Likert Survey. Maybe they were grouping all of their teachers into this response; however, during the treatment period, students conducted four performance-based assessments that were scored based on grading standards identified in the rubric. These rubrics were provided prior to the assessment so students knew exactly what the expectations were. At the completion of each lab, I read through their data table in Google Classroom and provide comments pertaining to corrections needing to be made, what was correct or incorrect, as well as a positive attribute of their assignment. This was delivered back to the students digitally within one day of the completion of their lab. From there, students were given the opportunity to work on corrections for that particular assessment before moving onto the next lab. I felt there was an ample amount of timely feedback provided to students.

Due to the lack of time spent on grading multiple assignments per week, I was able to provide differentiated instruction when necessary. Prior to each performance-based lab, multiple direct and inquiry-based activities were provided along with whole

class practice labs and individual performance based pre labs. Students were monitored closely on their level of proficiency before being administered their performance-based lab assessment. One reason for the lengthy duration in the treatment period was the fact that this ended up transitioning itself into a self-paced unit. I worked with students one-on-one when needed and provided individual instruction if necessary.

The focus of this study was to research the effects of standards-based grading models in Earth science classrooms, as well as the impacts of the learning process for both regular education and special education students. In order to create a standards-based learning environment, it is imperative to establish effective goal setting, communication, feedback, and differentiation practices within your teaching. A major gap within my study was the lack of communication, or students understanding the feedback that I was providing them was how their progress was being communicated to them. Transitioning to a standards-based grading model in my classroom is going to take practice not only for myself, but also for my students. Students need to understand the level of responsibility put on them for their own learning in my classroom.

VALUE

This was one of the more challenging projects I have ever pursued. Not only did my students grow in their knowledge base of the rock cycle, but I grew professionally, and learned a lot about my students. I also encountered many frustrations when it comes to the education system as it stands today. Through all the research that I conducted, I realized that the way I have been grading all along is messy and unclear. I have been incorporating too much process and progress scores in combination with product scores.

No wonder why I have students only focused on what they need to do to earn the grade.

In order for a fully standards-based grading model to be implemented there needs to be full support administratively to hold students accountable for completing their work. We currently do not have a solid discipline policy in place at Fergus High School; however, we do have a CORE/FLEX period in place. Twenty-five minutes every morning, students who are failing or have multiple missing assignments are assigned to that particular core teacher. This does not have to be a core class, but more often than not it is. Teachers also have the ability to request a student to be in their CORE for the week. This is reassessed every Monday. Students in good standing with all of their classes are in FLEX, and they can go to any common area within the building. They cannot leave the building unless they have an appointment and prior arrangements have been made with the office. If students skip their CORE, they are administered a detention with the high school administration; however, there is no progress on their work for my class during that time. The communication for when that student is serving the detention is lacking. When students do show up to CORE, there are usually five or more students in my room working on various assignments. The time it takes me to sit with each one individually and help them with their needs is time consuming and by the time I have sat with each of them, the CORE period is over. I feel there is great potential with this system, but it is just going to take time to find the right process in my classroom.

As an additional intervention with CORE/FLEX, administration not only monitors failing grades, but also missing and late assignments. One restriction that was presented to me in my project was to still monitor late or missing assignments. If students didn't

complete an assessment throughout the treatment period, they received a zero. Also, if the assignment was late, their score was deducted points to account for the lack of responsibility. This goes against all the research and by doing so does not monitor the true learning progression of the student. This was never much and if they completed corrections to mineral and rock identification labs, they still had the opportunity to earn an A or increase their score.

I predicted that by allowing students to work on goal setting and be reflective of their performance throughout the treatment period, as well as being transparent with the students and providing the grading standards for each assessment, there would be more buy in from the students. When students can track their own learning and self-asses, “the more they develop ownership of their learning” (Vatterott, 2015, p.47). This only seemed to be the case with my Title Earth Science students. As I have previously stated, I wonder if this had to do with the structured accommodations already set in place due to their Individualized Education Plans. Another factor that was different between the two classes was that my Title Earth Science students keep an Interactive Notebook and at the completion of each chapter, complete a self-assessment rubric. Here they are monitoring their organizational skills. Every student in this class has an accommodation for organizational assistance.

Moving forward, I plan to further transition my classroom into a fully standards-based grading (SBG) environment. I am interested to see how a SBG approach looks in different units. Student interest during the rock cycle unit seems to be down compared to others such as astronomy, earthquakes and volcanoes. This is going to take time and

won't happen overnight, but I truly believe it has benefits that promote a student-centered learning environment. The classroom becomes more than just a teacher standing in front of a group of students teaching at them. Rather, this becomes a learning environment that is collaborative between the teacher and the students. Students learn to self-advocate for their needs; communication influences self-advocating. The teacher is able to provide differentiated instruction to those who need it because less time is spent on grading and more times is spent on teaching and providing feedback.

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APPENDICES

APPENDIX A

FERGUS HIGH SCHOOL GRADING SCALE

Fergus High School Grading Scale

Letter Grade	Grading Scale	Grade Point Equivalent
A	92.5	4.00
A-	89.5	3.67
B+	86.5	3.33
B	82.5	3.00
B-	79.5	2.67
C+	76.5	2.33
C	72.5	2.00
C-	69.5	1.67
D+	66.5	1.33
D	62.5	1.00
D-	59.5	0.67
F	< 59.5	0

APPENDIX B
IRB APPROVAL



INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
FWA 0000165

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MEMORANDUM

TO: Adrienna DeCock and John Graves

Quinn CJ

DATE: November 28, 2018

RE: "Standards-Based Grading Models in 8th Grade Earth Science Classrooms" (AD112618-EX)

The above research, described in your submission of November 28, 2018, 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 C

WHAT'S IN A GRADE LIKERT SURVEY

What's in a Grade?

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

Please read through the following questions carefully and respond accordingly.

	Strongly Agree	Agree	Disagree	Strongly Disagree
I can learn everything my teachers are teaching.				
There is enough time in class for my teachers to teach me what I'm supposed to learn.				
My teachers make learning interesting.				
I have to try hard to be successful in school.				
My teachers expect very good work from me.				
How I do on tests is more important than how I do on homework assignments.				
Goal Setting				
I set goals with my teachers for how I'll do in class.				
I set goals with my parents/guardians for how I'll do in school.				
Communication				
My report card helps me to understand how I'm doing in school.				
I look at report cards with my parents.				
My teachers let me know how well I'm doing throughout the year.				
My teachers write things on my assignments to help me do better next time.				
Feedback				
My score on tests matches how well I've learned in class.				
My teachers make clear what I'm supposed to learn.				
My grade for a class matches what I've learned in that class.				
I understand how assignments and tests are used to figure my grade in class.				
Differentiation				
If I'm having trouble learning something, my teachers usually find another way to help me understand.				

APPENDIX D

PRE-TREATMENT STUDENT INTERVIEW QUESTIONS

Pre-Treatment Student Interview Questions

1. Do you enjoy science?
2. What would you consider your favorite subject?
3. What grades did you earn for Quarter 1 and Quarter 2 and first semester?
4. Do you feel your grades are an accurate reflection of what you learned last semester? Why or why not?
5. How would you explain the meaning of a letter grade?
6. What grades do you typically earn in science class? Was last semester the best or worst (or somewhere in between) you have done in science? Please explain your answer.
7. What do you consider your strengths?
8. What do you consider your weaknesses?
9. What are some goals you have for yourself for 2nd semester?
10. Is there anything else you'd like to share with me?

APPENDIX E
ROCK CYCLE SUMMATIVE ASSESSMENT

Rock Cycle Summative Assessment
Chapters 7 and 8 (56 PTS)

Name _____

I. VOCAB (17 Pts)

A. Chemical Weathering	G. Kettle Lake	M. Sediment
B. Cleavage	H. Mass Wasting	N. Soil Conservation
C. Crystallization	I. Meander	O. Streak
D. Foliated	J. Metals	P. Valley Glacier
E. Humus	K. Metamorphic Rocks	Q. Weathering
F. Igneous Rocks	L. Mineral	

- _____ Metamorphic rocks that have their grains arranged in parallel layers or bands.
- _____ Small, solid pieces of material that come from rocks or remains of living things such as shells.
- _____ Forms when existing rocks are changed into a new form by undergoing intense heat and pressure.
- _____ Created when magma or lava cools and crystallizes to form a new rock.
- _____ Minerals are the source of these products: aluminum, iron, copper, or silver.
- _____ Process by which atoms are arranged to form a material with crystal structure.
- _____ Color of a mineral's powder.
- _____ If a mineral breaks easily and evenly along smooth, flat surfaces.
- _____ Naturally, occurring, inorganic solid that has a crystalline structure and definite chemical composition.
- _____ Process that breaks down rock and other substances of Earth's surface.
- _____ Process that breaks down rock into sediments by a chemical reaction.
- _____ Dark colored substance within the soil created from decayed organic matter.
- _____ The management of soil to prevent destruction.
- _____ Look-like bend in the course of a river, or stream, and becomes more curved over time.
- _____ Downhill movement of a large mass of rocks or soil due to gravity.
- _____ Long, narrow glacier that forms when snow and ice buildup high in mountain valleys; Alaska, Glacier National Park, and the Himalayas.
- _____ Small depression that forms when a chunk of ice is left in till then eventually melts.

II. MULTIPLE CHOICE (28 Pts)

- _____ Minerals form by
 - Cooling and crystallization of magma or lava
 - Crystallization of minerals dissolved in water
 - Both A and B
- _____ The three main groups (families) of rocks are
 - Sedimentary, Clastic and Foliated
 - Igneous, Sedimentary and Metamorphic
 - Extrusive, Granitic and Chemical
- _____ All rocks can be recycled and transformed into a new rock.
 - True
 - False

21. _____ Igneous rocks are formed by
 - a. Existing rocks undergoing intense exposure to heat and pressure
 - b. Sediments from other rocks being compacted and cemented (lithified) together
 - c. Cooling and crystallization of magma or lava
22. _____ Sedimentary rocks are formed by
 - a. Existing rocks undergoing intense exposure to heat and pressure
 - b. Sediments from other rocks being compacted and cemented (lithified) together
 - c. Cooling and crystallization of magma or lava
23. _____ Metamorphic rocks are formed by
 - a. Existing rocks undergoing intense exposure to heat and pressure
 - b. Sediments from other rocks being compacted and cemented (lithified) together
 - c. Cooling and crystallization of magma or lava
24. _____ You can determine whether and Igneous rock is extrusive or intrusive by
 - a. Its color
 - b. Its size
 - c. The crystal size (if you can see them without magnification or not)
25. _____ Biochemical rock is created from
 - a. Chemicals
 - b. Inorganic material
 - c. Organic material (something that was once living)
26. _____ Clastic, Sedimentary rocks are further broken up into the three following categories
 - a. Fine grained, Chemical and Biochemical
 - b. Extrusive, Granitic and Coarse grained
 - c. Coarse grained, Medium grained and Fine/Very Fine Grained
27. _____ The rock pictured to the right is considered to be
 - a. Foliated
 - b. Non-foliated
 - c. Chemical
28. _____ Which of the following Metamorphic rocks is created from sand particles undergoing long exposure to increased heat and pressure?
 - a. Slate
 - b. Quartzite
 - c. Soapstone
29. _____ Where in the United States would you find lots of Chemical, Sedimentary rocks?
 - a. Glacier National Park
 - b. The Great Salt Lake
 - c. Lewistown, MT



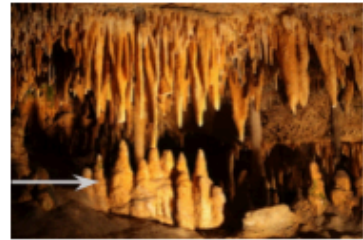
30. ____ All rocks are composed of minerals.
- a. True
 - b. False
31. ____ What is an example of mechanical weathering?
- a. Climate
 - b. Ice wedging
 - c. Oxygen
32. ____ The measure of how well soil can support plant growth.
- a. Loam
 - b. Till
 - c. Fertility
33. ____ Soil horizon primarily composed of weathered bedrock.
- a. Horizon O
 - b. Horizon A
 - c. Horizon B
 - d. Horizon C
34. ____ Type of chemical weathering responsible for rust.
- a. Carbon dioxide
 - b. Acid rain
 - c. Oxygen
35. ____ Living organisms, such as plants, are a source of chemical weathering due to the weak acids they produce through their root systems.
- a. True
 - b. False
36. ____ Acid rain is created by
- a. The burning of fossil fuels
 - b. Carbon dioxide in the atmosphere
 - c. Water vapor in the air
37. ____ The most common depositional feature of wind-blown sediment.
- a. Arete
 - b. Loam
 - c. Sand dunes
38. ____ Which soil horizon contains the most humus (nutrients)?
- a. Horizon O
 - b. Horizon A
 - c. Horizon B

39. _____ The type of soil conservation where farmers do not plant the same crops in the same field year after year.
- Contour plowing
 - Conservation plowing
 - Crop rotation

40. _____ This river feature is left behind when an oxbow lake has dried up.
- Meander
 - Meander scar
 - Floodplain

41. _____ Which EROSIONAL force is more responsible for shaping the earth's surface?
- Wind
 - Water
 - Ice
 - Gravity

42. _____ The arrow is referring to which cave feature?
- Stalactites
 - Stalagmites
 - Columns



43. _____ This cave feature is when a stalagmite and stalactite become one.
- Group
 - Column
 - Cone

44. _____ What type of glacier is pictured to the right?
- Continental
 - Valley
 - Ice Sheet



45. _____ Where would you find the glacier in the image to the right?
- Glacier National Park
 - Antarctica
 - Greenland

III. SHORT ANSWER & DIAGRAM (11 Pts)

46. (2 pts) Match the following descriptions of mineral physical properties with its term. Use the word bank.

CLEAVAGE

FRACTURE

HARDNESS

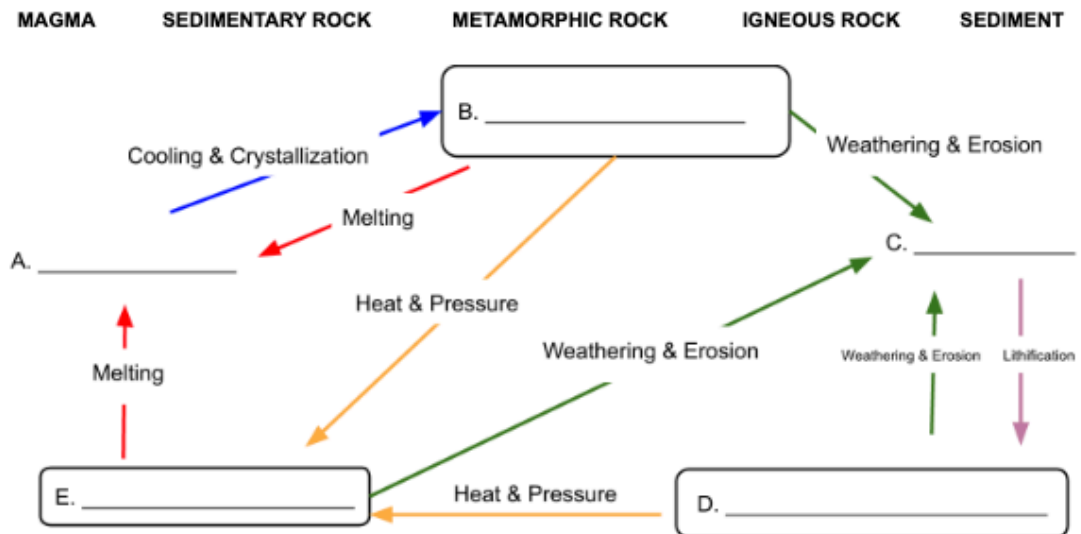
LUSTER

STREAK

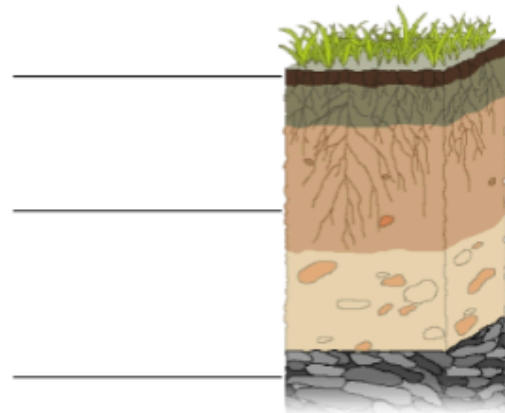
- a. Breaks with rough and jagged edges:

- b. Shines like a metal:

47. (5 pts) Fill in the missing pieces on the rock cycle diagram below. Use the word bank provided for assistance.



48. (3 pts) Correctly identify the soil horizons on the diagram to the right.



49. (1 pt) Identify the type of mass wasting (mass movement) in the picture below.



APPENDIX F
PRE-TEST REPORT CARD

PRE-TEST REPORT CARD

Name _____ Class Period _____

Please Record your Pre-Test Score and % Below:

Pre-Test Score _____ % _____

What is your goal for the Post test? % _____**What do you think you will need to do to achieve this goal?**

Did you think this was beneficial to take the test before the unit? Please explain.

APPENDIX G
POST-TEST REPORT CARD

POST-TEST REPORT CARD

Name _____

Class Period _____

Please Record your Pre-Test and Post-Test Scores Below:

Pre-Test Score _____ % _____

Post-Test Score _____ % _____

Did you achieve your goal? If not, what are some things you could do differently moving forward?

Do you feel your scores from the Rock Cycle Unit are a true reflection of your understanding of the material and what you learned? Please explain.

Learning Target	Mastery Level
Minerals have specific and quantifiable properties.	4 3 2 1
Rocks are made of one or more minerals and are formed in different ways.	4 3 2 1

APPENDIX H
MINERAL IDENTIFICATION LAB

Mineral Identification Lab

You and your lab partners have been provided eight mineral samples in your lab kits. Please write the number of the lab kit that you are working with at the top of your lab sheet.

Next, conduct the following physical property tests of each sample and record your data on your lab sheet:

- Hardness
- Luster
- Streak
- Cleavage
- Fracture

Also be sure to write down any distinct properties or observations, such as color, you have for each sample and record this information on your lab sheets.

Using the information collected on each sample, work through your Dichotomous Key to identify each sample.

Mineral # _____ Color _____ Luster _____ Streak _____ Hardness _____ Cleavage ☐ Fracture ☐ Mineral Name _____	Mineral # _____ Color _____ Luster _____ Streak _____ Hardness _____ Cleavage ☐ Fracture ☐ Mineral Name _____
Mineral # _____ Color _____ Luster _____ Streak _____ Hardness _____ Cleavage ☐ Fracture ☐ Mineral Name _____	Mineral # _____ Color _____ Luster _____ Streak _____ Hardness _____ Cleavage ☐ Fracture ☐ Mineral Name _____
Mineral # _____ Color _____ Luster _____ Streak _____ Hardness _____ Cleavage ☐ Fracture ☐ Mineral Name _____	Mineral # _____ Color _____ Luster _____ Streak _____ Hardness _____ Cleavage ☐ Fracture ☐ Mineral Name _____
Mineral # _____ Color _____ Luster _____ Streak _____ Hardness _____ Cleavage ☐ Fracture ☐ Mineral Name _____	Mineral # _____ Color _____ Luster _____ Streak _____ Hardness _____ Cleavage ☐ Fracture ☐ Mineral Name _____

APPENDIX I

MINERAL IDENTIFICATION LAB RUBRIC

Mineral Identification Lab Grading Rubric

Standard	Met?	Not Met?
Lab report is legible and organized in Google Docs.		
Students correctly identified all 8 minerals in their lab kits.		
The color of the mineral was observed and a description was reported for all samples.		
The hardness test was conducted and correctly reported for all samples.		
Luster was observed and correctly reported for all samples.		
The streak test was conducted and correctly reported for all samples.		
Each samples was identified as exhibiting fracture or cleavage correctly.		
An appropriate picture was provided for each mineral sample.		

__8__ All standards met and/or exceeded (A; 100%)

__7__ 1 standard not met (B; 87.5%)

__6__ 2 standards not met (C; 75%)

__5__ 3 or more standards not met (D; 62.5%)

__7.2__ All standards were met with **corrections** (A; 90%)

APPENDIX J

ROCK IDENTIFICATION LAB RUBRICS

IGNEOUS Rock Lab Grading Rubric

Standard	Met?	Not Met?
Students completed the lab and turned in by the date assigned		
Lab report is legible and organized in Google Docs.		
Students correctly identified all rock samples.		
Dominant Mineral for each rock was correctly identified.		
Igneous Rock category was correctly identified for each rock.		
Rocks were correctly categorized as Extrusive or Intrusive.		
An appropriate picture was provided for each rock sample.		

__8__ All standards met and/or exceeded (A; 100%)

__7__ 1 standard not met (B; 87.5%)

__6__ 2 standards not met (C; 75%)

__5__ 3 or more standards not met (D; 62.5%)

__7.2__ All standards were met with **corrections** (A; 90%)

Sedimentary Rock Lab Grading Rubric

Standard	Met?	Not Met?
Students completed the lab and turned in by the date assigned.		
Lab report is legible and organized in Google Docs.		
Students correctly identified all rock samples.		
Students provided a description of their observations for each sample.		
Students correctly identified the Sedimentary Rock Category for each sample.		
Sediment size was correctly identified for each Clastic SR sample.		
An appropriate picture was provided for each rock sample.		

__8__ All standards met and/or exceeded (A; 100%)

__7__ 1 standard not met (B; 87.5%)

__6__ 2 standards not met (C; 75%)

__5__ 3 or more standards not met (D; 62.5%)

__7.2__ All standards were met with **corrections** (A; 90%)

METAMORPHIC Rock Lab Grading Rubric

Standard	Met?	Not Met?
Students completed the lab and turned in by the date assigned		
Lab report is legible and organized in Google Docs.		
Students correctly identified all rock samples.		
Students identified the correct texture for all rock samples.		
Students correctly identified parent rock and/or mineral composition for each rock.		
A picture was provided for each rock sample		

__6__ All standards met and/or exceeded (A, 100%)

__5__ 1 standard not met (B; 83.3%)

__4.5__ 2 standards not met (C; 75%)

__3.75__ 3 or more standards not met (D; 62.5%)

__5.4__ All standards were met with **corrections** (A-; 90%)

APPENDIX K
ROCK CYCLE COMIC RUBRIC

THE ROCK CYCLE COMIC

Standard	Met?	Not Met?
Student clearly outlined every phase of the rock cycle -- how rocks and minerals transition through the cycle in a logical order hitting each of the following phases: • Each rock group (Igneous, Sedimentary, and Metamorphic) • Magma • Sediments • Cooling • Melting • heat/pressure • weathering/erosion • lithification		
Student provided detailed panels with color.		
Comic is legible and easy to understand. Labels are provided where necessary/appropriate.		
Comic is not purely informational; instead, fun and informative		
Comic was submitted by the DUE DATE (March 27th) with RUBRIC!		

__20__ Standards met and exceeded (A+; 100%)

__19__ Standards met (A, 95%)

__17__ 1 standard not met (B, 85%)

__15__ 2 standards not met (C, 75%)

__14__ 3 standards not met (C-, 70%)

__12__ 3+ standards not met (D-, 60%)

APPENDIX L

POST TREATMENT STUDENT INTERVIEW QUESTIONS

Post Treatment Student Interview Questions

1. Do you feel more confident in your abilities in science class? Please explain.
2. What grade did you earn for Quarter 3?
3. Do you feel your grade is an accurate representation of what you learned over the quarter? Why or why not?
4. How would you explain the meaning of a letter grade?
5. What skills or learning targets do you feel you have mastered through the rock cycle unit? Are there any skills you feel you still need to work on?
6. What are your thoughts on a standards-based grading approach (rock cycle rubrics) versus the grading methods used first semester?
7. Is there anything else you'd like to share with me?