

THE 5E LEARNING CYCLE VS. TRADITIONAL TEACHING METHODS AND  
HOW THEY AFFECT STUDENT ACHIEVEMENT, INTEREST, AND  
ENGAGEMENT IN A THIRD GRADE SCIENCE CLASSROOM

by

Joe Colin Crider

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

of

Masters of Science

in

Science Education

MONTANA STATE UNIVERSITY  
Bozeman, Montana

July 2013

STATEMENT OF PERMISSION TO USE

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

Joe Colin Crider

July 2013

## TABLE OF CONTENTS

INTRODUCTION AND BACKGROUND .....	1
CONCEPTUAL FRAMEWORK.....	2
METHODOLOGY .....	5
DATA AND ANALYSIS .....	8
INTERPRETATION AND CONCLUSION .....	12
VALUE.....	13
REFERENCES CITED.....	16
APPENDICES .....	18
APPENDIX A: Soils Test.....	19
APPENDIX B: Properties of Matter Test.....	22
APPENDIX C: Soil Attitude Scale.....	25
APPENDIX D: Properties of Matter Attitude Scale.....	28
APPENDIX E: Student Interview and Survey.....	31
APPENDIX F: Engagement Tally Sheet .....	33

LIST OF TABLES

1. Data Triangulation Matrix .....	8
2. Student Comparison Table.....	15

LIST OF FIGURES

1. Off-task Behavior Incidents .....	10
2. Soils Tests .....	11
3. Properties of Matter Tests .....	12

**ABSTRACT**

In this investigation, two third grade science classes were studied to determine whether the 5E Learning Cycle or traditional teaching methods were more effective in improving student achievement, interest and engagement. Both classes participated in a three-week 5E Learning Cycle unit and a three-week traditional teaching method unit. Results revealed higher student scores, interest and engagement during the 5E Learning Cycle units than the traditional teaching method units.

## INTRODUCTION AND BACKGROUND

In my role as third grade teacher at Smith Elementary in Helena, Montana, I teach science to two third grade classes. Smith school is one of 11 elementary schools in Helena School District #1, and the third grade at Smith Elementary consists of 36 students. There are 19 girls and 17 boys total in the third grade. Out of the 36 students, 84% are Caucasian, 7% are American Indians, 6% are Asian and 3% of the students are African American (Power Teacher, 2013).

During my first four years of teaching, I have been trying to find the best ways to increase student achievement, interest, and engagement in my science instruction. In my first year of teaching I taught almost exclusively by traditional methods. We read the textbook as a class and I would lecture. The students would complete a worksheet after the reading or lecture. Then, I was introduced to the 5E Learning Cycle through Science and Inquiry Learning in Classrooms (SILC) in the fall of 2009. I have been using the 5E Learning Cycle and traditional teaching methods to teach science concepts for the last three years. Every week, both classes receive 90 minutes of science instruction. Students learn by reading the textbook, experiments, lectures, worksheets and exploring materials. The main science concepts that are taught in the third grade are plants and animals, Earth's land, cycles on Earth and in Space, matter, and energy and forces.

I started implementing 5E lessons in my second year of teaching and have preferred using that method, rather than traditional teaching methods, to teach science. Therefore, the purpose of the action research-based project was to discover which teaching method produced the highest student achievement rate, interest, and engagement.

My focus question was, which teaching strategy, the 5E Learning Cycle or traditional teaching methods, produces a higher student interest, engagement, and achievement rate?

## CONCEPTUAL FRAMEWORK

The 5E Learning Cycle is a model of learning that is built on the constructivism theory of knowledge. Constructivists believe that people learn best when they construct their own understanding to new ideas, rather than being told information (Ansberry, 2009). Building on the notion that learners construct their own knowledge, the five Es include *engagement, exploration, explanation, elaboration, and evaluation* (Bybee et al., 2006).

The 5E Learning Cycle has evolved from instructional models that date back to the early 1900s. In 1901 Johann Friedrich Herbart's instructional model proposed two ideas that he believed were the basis of teaching: student interest and conceptual understanding. He believed students should be interested in what they are learning in order for instruction to be effective. Next, he thought that each new idea should be connected with an existing one. His model also included a social piece that provided students opportunities for social interaction with their peers and their teachers (Bybee et al., 2006).

In the 1960s, J. Myron Atkin and Robert Karplus were the original proposers of the Learning Cycle. Then, Karplus and Herbert Thier used it as a foundation for their Science Curriculum Improvement Study (SCIS) program in 1967. Originally, it was a three-stage model that consisted of exploration, concept development, and application. Another model, created by Martin, Sexton, and Gerlovich suggested a 4E model



(exploration, explanation, expansion, and evaluation), leaving out the engagement piece (Llewellyn, 2007). Finally, in the mid 1980s, Biological Science Curriculum Study (BSCS) designed the 5E Learning Cycle.

There are five phases in the 5E Learning Cycle. First, the *engagement* stage initiates the learning task. The activity should connect past and present learning experiences (Coe, 2001). By the end of this phase, students should be mentally engaged. Examples of engaging activities include asking questions, showing discrepant events, and defining or acting out a problem. Discrepant events are counterintuitive outcomes that create cognitive disequilibrium that surprises observers and temporarily throws them mentally off-balance (O'Brien, 2010). During the engagement phase, students should ask and respond to questions and show interest in the lesson. The teacher should generate interest and curiosity, raise questions and problems, and discover students' prior knowledge (Barufaldi, 2002). After the students are engaged, they have time to explore their ideas in the *exploration* phase. The activities in the explore phase are designed so that students share similar experiences and build more of their own ideas of the concepts. Students and teachers use their experiences from this phase to make meaning of concepts. Students are given time to investigate and manipulate materials throughout this stage. In the time that is given, students should think creatively, try a variety of problem solving strategies, make predictions, listens to peers, records observations and ask questions. The teacher's responsibility is to act as a facilitator (Barufaldi, 2002).

After the students have had enough time to explore, the teacher begins the *explanation* phase. During this stage, the teacher discusses the engagement and exploration activities. Throughout the explanation, the concepts and ideas should

become clear. The stage begins with the students explaining their findings. Then the teacher provides direct instruction to clarify the concepts and information. While the students and the teacher are explaining, the students should listen and ask questions, discuss the experiences in the prior stages, and communicate new understandings. Teachers provide definitions to new vocabulary, use previous stages to explain concepts, encourage questions and participation, and ask students to clarify thoughts. After the students and teacher have explained their experiences, it is important to elaborate on the concepts. During the *elaborate* phase, the teacher provides opportunities for the students to apply their learning in different contexts. Students apply new definitions and skills, ask questions, propose solutions and develop experiments to test their theories. Teachers expect students to use new vocabulary and encourage them to apply their new skills to different situations (Barufaldi, 2002).

The final E is *evaluation*. The evaluation to determine each student's level of understanding can be formal or informal. At this point in the cycle, the students receive feedback on their explanations. Based on the evaluation, teachers can determine if their students met their performance indicators. During the evaluate phase, students demonstrate their level of understanding of concepts, answer open-end questions, and assess his/her progress. Teachers ask open-ended questions and evaluate his/her students' knowledge (Barufaldi, 2002).

The learning cycle is important because cognitive scientists believe that students need to relate new ideas to their experiences (Abell & Volkmann, 2006). The 5E Learning Cycle allows students to explore an experience before they explain it. Abraham

and Renner (1986) found that students' learning improves when concepts are introduced after exploration.

The 5E Learning Cycle is an effective teaching strategy that enhances students' understanding and achievement. One study concluded that the 5E Learning Cycle encouraged students to develop their own understanding of science concepts (Bevenino Dengel & Adams, 1999). The National Science Teachers Associations (NSTA) agrees, as is evidenced by their position statement on Elementary School Science (2002). They stated that students learn science best when they are provided with first-hand exploration and instruction is built on their conceptual framework.

The 5E Learning Cycle produces an increase of student engagement (Beeth & Hewson, 1999). Students also score higher on scientific reasoning tests (Cavallo, Gerber & Marek, 2001). Overall, the 5E Learning Cycle produces greater student achievement and higher retention rates (Renner et al., 1988).

## METHODOLOGY

The purpose of this study was to determine whether third grade students learn more successfully from traditional teaching methods or from the 5E Learning Cycle. Students from two third grade classes participated in the study that covered two science units. Both classes had the same number of students ( $N = 36$ ). Each unit spanned three weeks and the students received 90 minutes of instruction per week. Each class had the opportunity to learn through the 5E Learning Cycle and traditional teaching methods. While one class was learning all concepts of soils through the 5E learning cycle, the other group learned all concepts through traditional teaching methods, which included lecture,

taking notes and reading the textbook. After the soils unit, I switched the teaching methods for both groups. The class that learned about soil through the 5E Learning Cycle learned all the concepts of the properties of matter unit through traditional teaching methods. The class that learned the soil concepts through traditional teaching methods learned about the properties of matter through the 5E Learning Cycle. Both classes completed the same tests and assignments. By the end of the study I was able to determine which strategy produced a higher retention rate, the strategy that students prefer, and the strategy that produces a higher percent of engagement. 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.

First, to determine a baseline of students' prior knowledge in both units, students completed the Soils Test and the Properties of Matter Test (Appendices A & B). Both tests were made of different parts, which included vocabulary, science concepts and understanding and critical thinking. The Properties of Matter Test had an extra part called a matter concept map. At the end of the units, they took the same test to determine how much they learned and retained. The data was analyzed by finding the average of each test question and overall score. Then, I calculated how much each group improved from the pretest to the posttest. Next, I compared the averages of the posttest for class.

Throughout the units I collected students' assignments and journal entries from each class. I also observed the classes and kept a journal of my observations. Observations that I made included students' level of interest, student quotes, difficulty of assignments, and overall engagement.

Next, the students completed the Soil Attitude Scale and the Properties of Matter Attitude Scale at the end of each unit (Appendices C & D). This gave the students an opportunity to tell me which strategy they preferred. The attitude scales included several questions related to how they felt about the topics covered in the units. After each question, the students were asked to circle either the *smiley face* if they agreed, the *frown face* if they disagreed, or the *neutral face* if they were indifferent. I compared the number of positive responses between the class completing the unit through the 5E Learning Cycle and the traditional teaching methods to determine if the students preferred one teaching method to the other. In addition to the attitude scale, students also completed the Student Interview and Survey when the two units were completely done (Appendix E). I randomly selected ten students to interview, while the other students completed the survey. The interview and the survey asked the same questions. I compared the responses from both classes to determine which strategy the students preferred.

To determine which strategy produced a higher percent of engagement, my principal observed a total of four lessons, two lessons from each class. She observed each class during a 5E Learning Cycle lesson and a traditional teaching method lesson. I created the Engagement Tally Chart that she filled out while she observed (Appendix F). We created a list of off-task behaviors that would indicate that students were not engaged in the lesson. The off-task behaviors included playing with objects, calling out, talking during lecture, making noise, eyes wandering around the room, laying their heads on their desk and being redirected. I also videotaped four additional lessons of the groups. I recorded two videos of each class, once during a 5E Learning Cycle lesson and once during a traditional teaching methods lesson. After recording the lessons, I watched the

videos and completed The Engagement Tally Chart for each lesson. I compared the results of the checklists to determine which method produced a higher level of engagement. The data sources and research questions are summarized in the Data Triangulation Matrix (Table 1).

Table 1  
*Data Triangulation Matrix*

Research Questions	Data Source #1	Data Source #2	Data Source #3
1. What strategy produces a higher retention rate?	Teacher Made Pretest	Teacher Made Posttest	Student-Generated Artifacts
2. What strategy do the students prefer?	Attitude Scales	Student Survey	Student Interviews
3. What strategy produces a higher percent of engagement?	Principal Observations	Engagement Tally Chart	Teacher Video Recording Observations

## DATA AND ANALYSIS

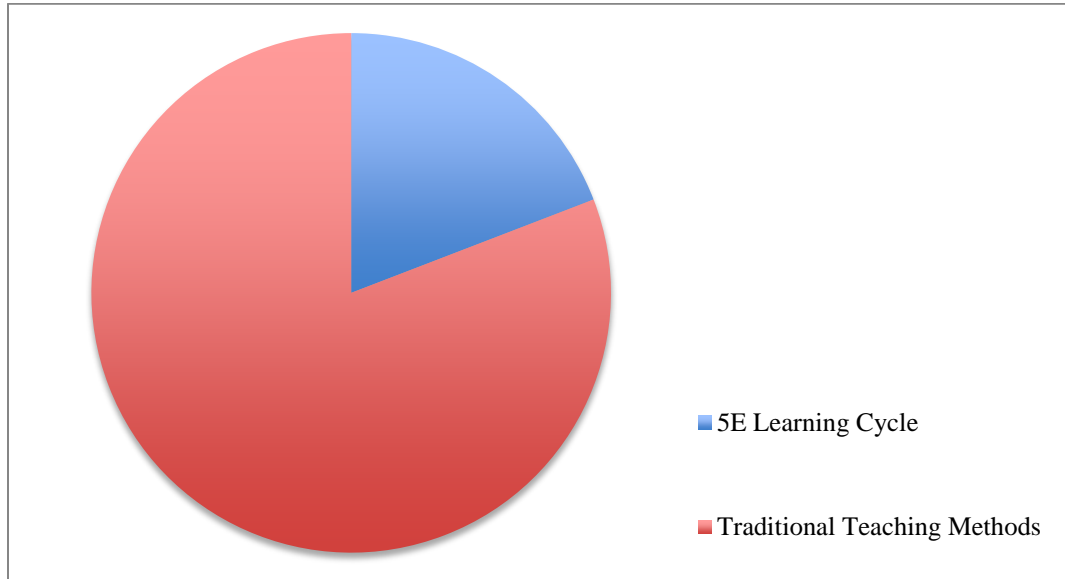
The results of the Student Interview and Survey indicated that 83% of students preferred to learn about science by completing the 5E Learning Cycle instead of traditional teaching methods ( $N = 36$ ). One student said, “It is hard for me to keep up with the other students when we read because I don’t read very fluently. It’s not fair so I don’t really pay attention when we read about science.” Another student wrote, “I feel more involved in the lesson when we are doing the 5E Learning Cycle. It just makes more sense and it’s more fun.”

When asked whether they learn more about science while listening to lectures and reading from the textbook or completing the 5E Learning Cycle, the results of the Student Interview and Survey indicated that 86% of students learned more from the 5E Learning Cycle. A student said, "I learn more from the 5E Learning Cycle because it is more interesting and I pay more attention when I'm more involved." Another student said he learned more because, "I can feel and touch things." According to another student, "The 5E Learning Cycle shows kids how, why and what happens." Another student said, "The 5E Learning Cycle helps us remember and use our (processing) skills we learned like predicting."

The Soils Posttest showed that the students who completed the 5E Learning Cycle averaged 72%, while students who completed the traditional teaching methods averaged 42%. The Properties of Matter Posttest produced similar results. The students who completed the 5E Learning Cycle averaged 87% on the Properties of Matter Posttest, while the traditional teaching methods group averaged 70%.

After a total of eight observed lessons, the Engagement Tally Chart showed 81% of off-task behaviors occurred during the traditional teaching method lessons (Figure 1). During the traditional teaching methods lessons, 65% of the off-task behaviors were students laying their heads on their desk while reading the textbook. When asked if they liked to read about soil, the results of the Soil Attitude Scale showed that 72% of the Traditional Group disagreed ( $n = 18$ ). It also showed that 83% of the students who completed the soil unit in the 5E Group agreed that they like to explore soil ( $n = 18$ ). The Properties of Matter Attitude Scale showed that 67% of the students who completed the properties of matter unit in the Traditional Group disagreed with the statement *I like to*

*read about properties of matter.* It also showed that 94% of the students who completed the properties of matter unit in the 5E Group agreed that they like to explore the properties of matter.



*Figure 1.* Off-task behavior incidents, ( $N = 47$ ).

The results of the Soils Pretest indicated that 91% of students in both groups scored a 50% or lower overall. The 5E Group averaged 33% on the pretest and the Traditional Group averaged 29%. After completing the Soils Unit, The 5E Group raised their average by 39% and scored an average of 72% on the Soils Posttest, while the Traditional Group raised their average by 18% and ended with an average of 47% (Figure 2). The results of Soils Posttest showed that the 5E Group averaged a higher score than the Traditional Group in all parts of the test. They scored an average of at least 20% higher in all parts, with the largest difference being in the critical thinking part of the test. The 5E Group averaged a 70% while the Traditional Group averaged 38%.



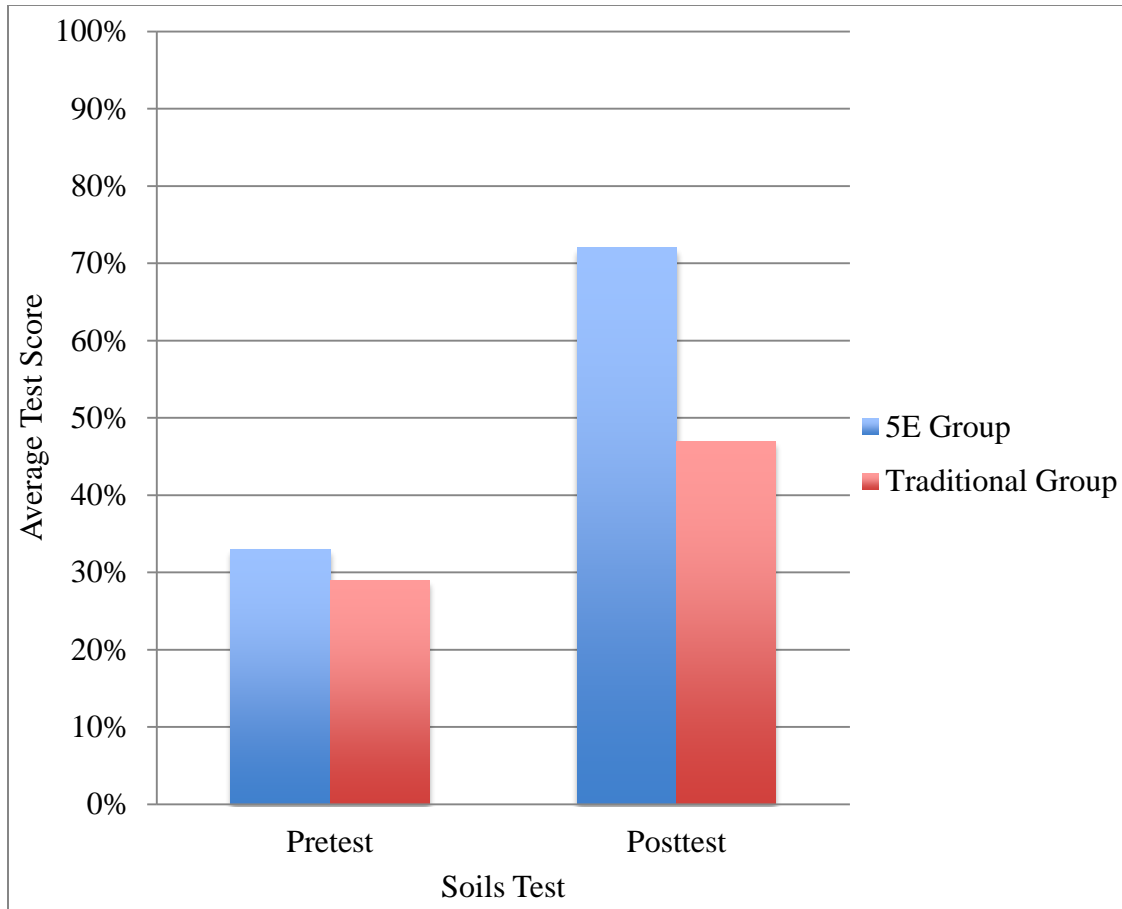


Figure 2. Soils tests, ( $N = 36$ ).

After completing the Soils Unit, both groups began the Properties of Matter Unit. Before beginning the lessons, the Traditional Group averaged a 39% on the Properties of Matter Pretest compared to the 32% the 5E Group averaged. After the lessons, the Traditional Group raised their average by 31% and ended with an average of 70% on the Properties of Matter Posttest while the 5E Group raised their average by 55% to an 87% average (Figure 2). The results of the Properties of Matter Posttest indicated that the 5E Group scored higher than the Traditional Group in all parts of the test. They scored at least 10% higher in all parts, with the largest difference being in the critical thinking part of the test. The 5E Group averaged 100% while the Traditional Group averaged 63%.

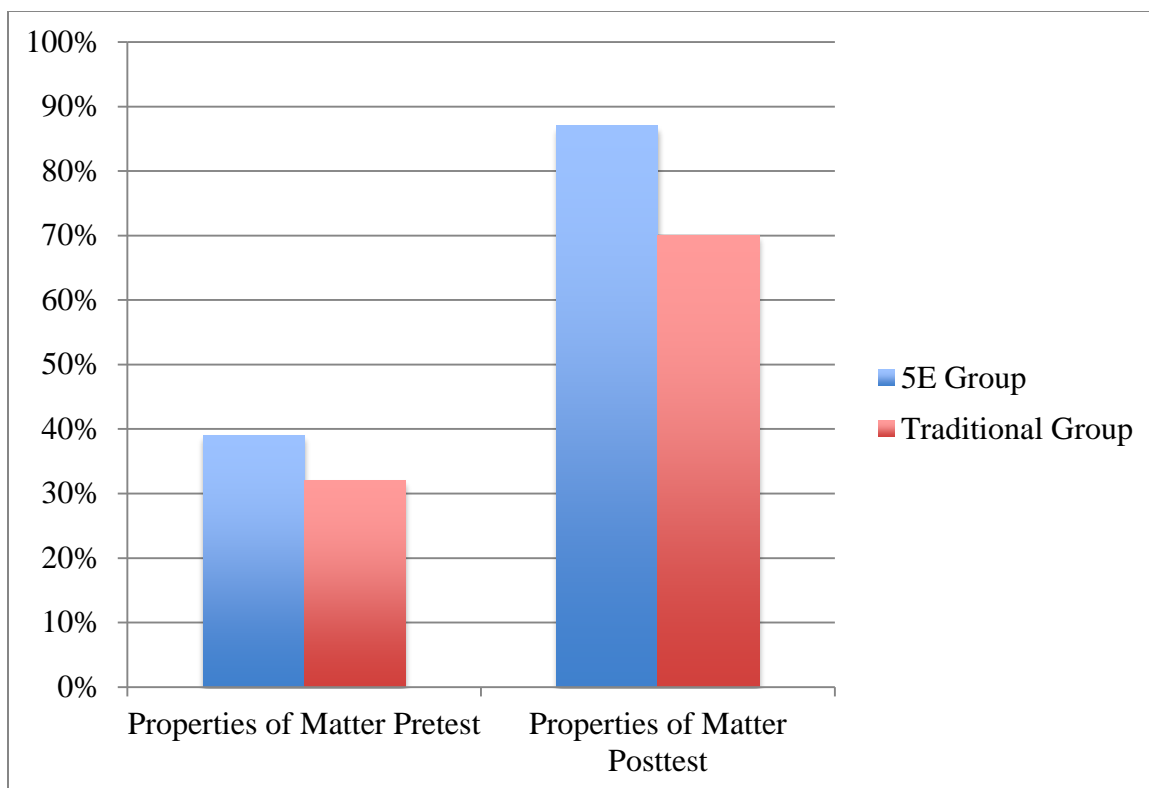


Figure 3. Properties of matter tests, ( $N = 36$ ).

### INTERPRETATION AND CONCLUSION

Students reported a higher level of interest, were more engaged and scored higher on tests while learning with the 5E Learning Cycle than traditional teaching methods. Through surveys and interviews students were able to communicate that they not only prefer the 5E Learning Cycle to traditional teaching methods, but also believe they learn more about science, which is true based on their test scores.

It was very clear to see which strategy produced a higher rate of engagement. While observing the traditional teaching methods, students would constantly lay their heads on their desks and let their eyes wander around the room. During 5E Learning Cycle lessons, students would be hooked for the entire lesson after the engage phase. The

majority of their off-task behaviors were shouting out and that was because they were excited about what they were learning.

Achievement rates soared when students were engaged and interested in what and how they were learning. In both units, the groups that were working through the 5E Learning Cycle improved their scores drastically from the pretest to the posttest. The groups increased their scores if they were learning by traditional teaching methods as well, although the amount in which they increased was not as dramatic. When the groups learned by reading and lectures, the students either scored very high or extremely low. There were not a lot of scores in between. The students who are strong readers did well while the students who are still developing their reading skills struggled. The 5E Learning Cycle is a way to make it fair for all students and to even the playing field.

## VALUE

I learned science by reading it out of a textbook in elementary school. It was boring and I dreaded science every day. This study has provided me with an amazing set of skills that I would not possess otherwise. As soon as I learned about the 5E Learning Cycle, I was all in. I wanted to learn everything I could about it and teach as many 5E lessons as possible. I started by converting all of the third grade science units into 5E lessons. Next, I asked my teaching partner if I could teach science to her students so I could get more practice. Instead of dreading science, my students can't wait for it and cheer when they hear it's a science day.

Before this study, in all my excitement about the 5E Learning Cycle I forgot to stop and ask the students how they felt about it. I just assumed they liked it since I

thought it was so great. This study has given me the opportunity to have many discussions with my students about exploring science through the 5E Learning Cycle. Throughout the discussions I heard the words fun, exciting, interesting, cool, helps me learn, and awesome. Out of all the words that were used to describe how they felt about the 5E Learning Cycle, I will always remember the student who said that made learning fair. It is amazing to see their excitement about learning and hopefully it will lead to lifelong learning for them.

The lasting impression I will have moving forward is the body language of the two groups. The group completing a 5E lesson would be full of smiles, laughter and an eagerness to learn when I would explain that it was a science day. The group who was reading from the textbook or listening to a lecture would moan and groan when it was announced. They would lay their heads on their desk and completely tune out. I can't imagine teaching without the 5E Learning Cycle and the skills I have gained because of this study.

The 5E Learning Cycle provides equal opportunities for all students to succeed. During my study I discovered that it allows the higher achieving and lower achieving students to meet in the middle and achieve close to the same level. Helena Public Schools use aimsweb to track reading comprehension. By the end of the 2012-2013 school year, the reading benchmark for third grade students was 119 words per minute (wpm). At the end of the year I compared how two of my students (Student A and Student B) scored on the Soils and Properties of Matter Posttests. Student A was reading well above benchmark at 157 wpm and Student B was reading well below benchmark at 90 wpm. On the Soils test, which the students completed after learning all of the concepts through

traditional teaching methods, Student A scored 88% and Student B scored 50%. On the Properties of Matter test, which the students completed after learning all concepts through the 5E Learning Cycle, Student A scored 83% and Student B scored 78%. The test scores The 5E Learning Cycle closed the gap between higher achieving students and lower achieving students and is shown in the Student Comparison Table (Table 2).

Table 2  
*Student Comparison Table*

Third Grade Reading Fluency Benchmark = 119 Words Per Minute			
	Words Per Minute (wpm)	Traditional Teaching Methods Test Scores	5E Learning Cycle Test Scores
Student A	157 wpm	88%	83%
Student B	90 wpm	50%	78%

## REFERENCES CITED

- 5E model of instruction. *Cscope*. (n.d.) Retrieved 4 March 2012 from <http://www.cscope.us/5E.pdf>
- Abell, S., & Volkmann, M. (2006). *Seamless assessment in science: A guide for elementary and middle school teachers*. 11-12. Portsmouth, NH: Heinemann.
- Abraham, M.R., and J.W. Renner. 1986. The sequence of learning cycle activities in high school chemistry. *Journal of Research in Science Teaching*, 23(2), 121-143.
- Ansberry, K. (Performer) (2009, January 22). Overview of the 5e learning model. *NSTA*. [Video podcast]. Retrieved from [http://learningcenter.nsta.org/search.aspx?action=quicksearch&text=5e learning cycle](http://learningcenter.nsta.org/search.aspx?action=quicksearch&text=5e%20learning%20cycle).
- Barufaldi, J. (2002). The 5e model of instruction. *Eisenhower Science Collaborative Conference*.
- Beeth, M. and Hewson, P. (1999) Learning goals in an exemplary science teacher's practice: cognitive and social factors in teaching for conceptual change. *Science and Education*, 83(6), 738-760.
- Bevevino, M., Dengel, J., & Adams, K. (1999). Constructivist theory in the classroom: Internalizing concepts through inquiry learning. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, 72(5), 275-278. doi: Taylor & Francis Online
- Bybee, R. W., Taylor, J. A., Gardner, A., Scotter, P. V., Powell, J. C., Westbrook, A., & Landes, N. (2006 July) *The BSCS 5E instructional model: Origins, effectiveness, and applications*. Retrieved from BSCS.org March 4, 2012 from <http://www.bscs.org/pdf/bscs5eexecsummary.pdf>
- Coe, M. A. (2001, November). Inquiry approach: The 5 E learning cycle. Retrieved 4 March 2012 from <http://faculty.mwsu.edu/west/maryann.coe/coe/inquire/inquiry.htm>
- Gerber, B.L., A.M.L. Cavallo, and E.A. Marek. 2001. Relationship among informal learning environments, teaching procedures, and scientific reasoning abilities. *International Journal of Science Education* 23(5), 535-549.
- Llewellyn, D. (2007). *Inquire Within: implementing inquiry-based science standards in grades 3-8*. Thousand Oaks, CA: Corwin Press.

National Science Teachers Association. (2002). *Official position on elementary school science*. Retrieved from <http://www.nsta.org/about/positions/elementary.aspx>

O'Brien, T. (2010). *Brain-powered science: Teaching and learning with discrepant events*, xii-xiii. Arlington, VA: NSTApress.

Pearson. (2013). *Power teacher*. Retrieved from <https://psapp1.hsd1.org/teachers/pw.html>

Renner, J. W., Abraham, M. R., et al. (1988). The necessity of each phase of the learning cycle in teaching high school physics. *Journal of Research in Science Teaching* 25(1), 39-58.

APPENDICES



APPENDIX A

SOILS TEST

Name: \_\_\_\_\_

Soils Test

Date: \_\_\_\_\_

## Soils

## Part 1- Vocabulary

Match each term in Column B with its meaning in Column A.

Column A	Column B
_____ 1. Saving resources by using them carefully	A. Bedrock
_____ 2. Soil that has small grains and holds water easily	B. Clay
_____ 3. Material found in nature that living things use	C. Conservation
_____ 4. Material made up of decayed parts of once-living things	D. Humus
_____ 5. Richest layer of soil	E. Loam
_____ 6. Rich soil with a lot of humus	F. Resource
_____ 7. Layer of solid rock under soil	G. Topsoil

Write the letter of the term in the Word Bank that best completes each sentence.

Farmers need 8. _____ to grow crops. Sometimes farmers use 9. _____ to save the soil by planting thick grass or clover between rows of other crops. To keep the water from washing the soil away from the sides of hills, farmers use 10. _____ .	H. contour plowing I. strip cropping J. soil
---	--

## Part 2- Science Concepts and Understanding

Circle the letter of the best choice.

11. Which would turn into soil the fastest?

A. compost

C. bedrock

B. gravel

D. plastic

12. Some farmers plant rows of alfalfa between rows of corn. Doing this is known as-

A. tiling

B. contour plowing

C. strip cropping

D. clear-cutting

13. Clay is a good material for making pots. Why?

A. Clay has lots of humus

B. Clay has both large grains and small grains.

C. Clay has large grains that hold little water.

D. Clay is sticky and holds water easily.

14. Which type of soil would be best for growing plants?

- A. loam
- B. clay
- C. compost
- D. sand

15. Which soil is best for growing corn?

- A. loam
- B. sand
- C. humus
- D. clay

Part 3- Critical Thinking

Write complete sentences to answer Questions 16-18

16. What is one way that farmers use compost?

---

---

17. How is water good for topsoil? How can water harm topsoil?

---

---

18. Describe how minerals from the soil end up inside your body.

---

---

APPENDIX B

PROPERTIES OF MATTER TEST

Name: \_\_\_\_\_

## Properties of Matter Test

Date: \_\_\_\_\_

## Properties of Matter

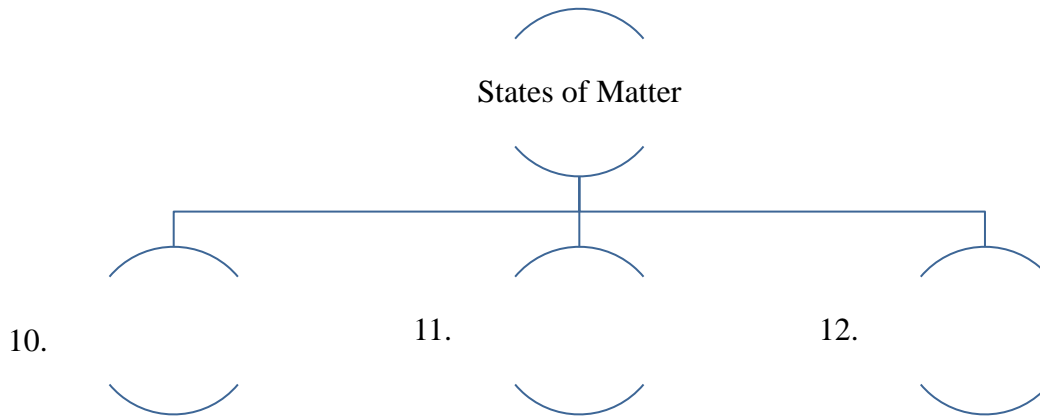
## Part 1- Vocabulary

Write the word from Column B that best fits the sentence in Column A

Column A	Column B
1. A _____ is matter that has a definite shape.	matter
2. All matter is made of _____.	physical property
3. Stickiness is a _____ of matter.	solid
4. _____ is the amount of matter in an object.	liquid
5. Everything that takes up space is _____.	gas
6. The amount of space that matter takes up is its _____.	atoms
7. A _____ has no definite shape but a definite volume.	evaporation
8. A _____ has no definite shape and no definite volume.	volume
9. When a liquid changes into a gas, the process is called _____.	mass

## Part 2- Matter Concept Map

Write the terms needed to complete the concept map.



## Part 3- Science Concepts and Understanding

Circle the letter of the best choice.

13. There are two jars that are the same size. One is filled with peanut butter, and the other is filled with jelly. They have the same volume, but they may not have the same-

- |         |                |
|---------|----------------|
| A. heat | C. evaporation |
| B. mass | D. gas         |

14. One physical property that a football and a soccer ball share is that both-

- |            |            |
|------------|------------|
| A. bounce  | C. fold    |
| B. stretch | D. crackle |

15. A shallow pond can dry up because of-

- A. ice
- B. cold weather
- C. heat and evaporation
- D. snow falling during the winter

## Part 4- Critical Thinking

Write complete sentences to answer the following question.

16. Explain what happens to a liquid when heat is added to it.

APPENDIX C

SOIL ATTITUDE SCALE

Soil Attitude Scale

Please respond to the following statements by drawing a circle around the response that most closely reflects your opinion.

1. I am excited to learn about soil.



2. I think it is important to learn about soil.



3. I know a lot about soil.



4. I like to read about soil.





5. I like to explore soil.



APPENDIX D

PROPERTIES OF MATTER ATTITUDE SCALE

### Properties of Matter Attitude Scale

Please respond to the following statements by drawing a circle around the response that most closely reflects your opinion.

1. I am excited to learn about the properties of matter.



2. I think it is important to learn about the properties of matter.



3. I know a lot about the properties of matter.



4. I like to read about the properties of matter.



5. I like to explore the properties of matter.



APPENDIX E

STUDENT INTERVIEW AND SURVEY

1. Which unit did you like best? (Soil or Properties of matter)
  - What was your favorite part of the soil unit?
  - What was your favorite part of the properties of matter unit?
2. Why was that your favorite part?
3. Do you prefer to learn about soil by reading from the textbook or by completing the 5E Learning Cycle?
4. Why?
5. Do you feel like you learn more about science by reading from the textbook or completing the 5E Learning Cycle?
6. Why?
7. What did you like least about the units?
8. Why?

APPENDIX F

ENGAGEMENT TALLY CHART

Off-Task Behavior	Tally
Out of Seat	
Playing with objects (e.g. pencil, toys, etc.) and/or other children	
Calling out	
Talking to someone during listening time	
Making Noise	
Eyes wandering around room	
Laying head on desk	
Redirection from teacher	



