2020

Identification of trends in scientific communication by minority students in an integrated and advanced ninth grade science curriculum

Loren Thalacker
University of Northern Iowa

Identification of trends in scientific communication by minority students in an integrated and advanced ninth grade science curriculum

Abstract

In the United States, the population of minorities is rapidly increasing. Our nation is facing a shortage in students pursuing STEM careers and it is vital to improve all students' scientific communication abilities. As our population of minority students is also growing, it is especially important to tap into our potential STEM resources. While the Midwest is less diverse than the rest of the nation, the Waterloo Community School District in Waterloo, Iowa has a large population of minority students. When the district implemented the Next Generation Science Standards it created a problem for students wanting to take advanced science courses. The solution was to create a class that covered three years of science standards but took place over two years. This class was designed for advanced ninth-grade students. The purpose of this project was to analyze curriculum looking for similarities and differences between white and minority students within their argumentative writing. By understanding the similarities and differences within their writing the teacher will be able to help them grow in their scientific communication abilities and to help them feel more comfortable in the science classroom. This analysis looked at four different papers from four different topics: gene editing, solutions to human impacts on the environment, nitrates and eutrophication, and enzyme activity. This analysis found a few key differences between white and minority students. First, minority students tended to provide more than what is asked for in the rubric, whether it is sources or pieces of evidence. Second, minority students tended to be less likely to desire a gene edited child in the future, compared to their white peers. For the aspects of argumentative writing such as stating a claim, providing evidence and reasoning their argument all students, white and minority, seemed to be at about the same level.

IDENTIFICATION OF TRENDS IN SCIENTIFIC COMMUNICATION BY MINORITY STUDENTS IN AN INTEGRATED AND ADVANCED NINTH GRADE SCIENCE CURRICULUM

Submitted

in Partial Fulfillment

of the Requirements for the Degree

Master of Arts Education

Loren Thalacker

University of Northern Iowa

August 2020

Abstract

In the United States, the population of minorities is rapidly increasing. Our nation is facing a shortage in students pursuing STEM careers and it is vital to improve all students' scientific communication abilities. As our population of minority students is also growing, it is especially important to tap into our potential STEM resources. While the Midwest is less diverse than the rest of the nation, the Waterloo Community School District in Waterloo, Iowa has a large population of minority students. When the district implemented the Next Generation Science Standards it created a problem for students wanting to take advanced science courses. The solution was to create a class that covered three years of science standards but took place over two years. This class was designed for advanced ninth-grade students. The purpose of this project was to analyze curriculum looking for similarities and differences between white and minority students within their argumentative writing. By understanding the similarities and differences within their writing the teacher will be able to help them grow in their scientific communication abilities and to help them feel more comfortable in the science classroom. This analysis looked at four different papers from four different topics: gene editing, solutions to human impacts on the environment, nitrates and eutrophication, and enzyme activity. This analysis found a few key differences between white and minority students. First, minority students tended to provide more than what is asked for in the rubric, whether it is sources or pieces of evidence. Second, minority students tended to be less likely to desire a gene edited child in the future, compared to their white peers. For the aspects of argumentative writing such as stating a claim, providing evidence and reasoning their argument all students, white and minority, seemed to be at about the same level.

TABLE OF CONTENTS PAGE

TABLE PAGE

Chapter 1: Introduction

Teaching is a job of continuous improvement. Some years teachers teach the same subject and modify work from previous years, and some years teachers start from scratch with brand new subjects or curriculum. This project will evaluate the scientific communication of minority students in a curriculum implemented in a newly created integrated science class for freshmen in the Waterloo Community School District in Waterloo, Iowa. The district developed this integrated science class for advanced freshmen interested in taking classes in the International Baccalaureate or Advanced Placement program in their junior year. Iowa introduced the Next Generation Science Standards (NGSS) in 2015, and when the Waterloo School District implemented them, it was decided to no longer allow 8th graders to take high school science. These new standards also meant students would be required to take three years of science: earth science, life science, and physical science before being able to take their advanced science classes in their junior and senior year. Scheduling three years of credits in two years became problematic, so this freshman integrated science class was proposed. In this class, students would be able to get their three years of science standards in two years. This would pave the way for them to take advanced classes in their junior and senior year without having to double up on science classes in their freshmen and sophomore years.

The curriculum was broken into six units per year for two years. For their freshman year, the curriculum mainly focused on earth and life science. The class began with a unit on the origins of the universe and our planet and then moved on to cycling of material on our planet and how humans impact the world around us. This unit included a field trip to the local watershed to test water quality in areas leading to the Cedar River. Rounding out semester one of 9th grade, we talked about cells and energy, including photosynthesis and cellular respiration. The second semester's three units were DNA and protein synthesis, heredity and multicellularity, and evolution.

At the time of writing this paper, year two had not yet been taught, but it will follow the same format of six units per year. The second year will focus more on physical science and chemistry. Semester one will cover the structure of matter, chemical reactions and chemical reactions. Semester two will cover energy conversions, motion and waves and electronics. While these students will not be covering every topic that would typically be covered in your biology, chemistry and physical science classes, they are receiving the standards required by the state and the key standards that will help them to succeed in advanced science classes.

Creating this class was crucial for the Waterloo Community School District so it could meet the needs of its large population of minority students. As a city, Waterloo has one of the highest population percentages of minorities with a 14.6% non-white population compared to the rest of the state of Iowa having approximately an 8.6% non-white population (U.S. Census Bureau, n.d.).

We live in a nation that is becoming increasingly diverse. By the year 2060 it is projected more than 50% of our nation will be non-white (Colby & Ortman, 2015). As our nation becomes increasingly diverse, it is important to consider how the school system is serving this growing population. One area of national concern regarding minority populations is the achievement gap, especially in the underrepresentation of Black and Latinx students within advanced programs in secondary schools and post-secondary science careers.

The lack of minorities in post-secondary science careers is important because the United States is facing a crisis regarding students pursuing science, technology, engineering and mathematics (STEM) careers, and it is even worse for underrepresented minorities, like Blacks and Latinxs (compared to Asians). Black and Latinx students are less likely to pursue STEM careers than Asian and Caucasian students. A 2012 report from the President's Council of Advisors on Science and Technology shows that 15.9 percent of White undergraduate students pursue STEM degrees while only 11.2 percent of Black/African American, and 11.9 percent of Hispanic/Latinx undergraduate students do the same

(President's Council of Advisors on Science and Technology, 2012). In addition to this, current projections estimate the number of underrepresented minorities in STEM careers would need to triple in order to match population proportions found in the rest of the United States (Schneider, Judy, & Mazuca, 2012). If 50% of our population will be non-white by 2060, it is vital we tap into this currently underrepresented population to fulfill our STEM career needs (Colby & Ortman, 2015).

Black and Latinx students are also less likely to participate in Advanced Placement (AP) courses and take AP exams. Districts across the nation have noted large gaps in the participation of these minority populations in their advanced programs (Handwerk, Tognatta, Coley, & Gitomer, 2008; Ndura, Robinson, & Ochs, 2003; Solorzano & Ornelas, 2006). One study found both African American and Mexican American/Puerto Rican students enroll in AP classes less than half as often as one would expect if race were not related to population size, while White students enroll about one and a half times more than would be expected by population alone (Burton, Whitman, Yepes-Baraya, Cline, & Kim, 2002). The United States is becoming more diverse and it is imperative we do not leave this growing population behind. As we work to include this growing population, it is important to review the work of all students, white and non-white, to identify themes in their scientific writing and work.

The reasons why minority students do not participate in advanced science classes specifically are more complex. These include: poor school experiences, perception of science careers as too difficult, difficult science classes undermining students' identities, lack of interesting extracurricular science opportunities, and family focus on other priorities (Aschbacher, Li, & Roth, 2010). Students from low socioeconomic status are also more likely to have their science aspirations challenged at home and school. This makes them less likely to continue their pursuit of science classes and STEM careers (Aschbacher et al., 2010). In order to make this science identity available to students, others must recognize an individual as capable of achieving science and be accepted for this capability. This

capability comes from competence in science, and finding meaning in this competence (Carlone & Johnson, 2007).

The purpose of this study is to review work completed by students in the 9th grade integrated science and to identify themes and patterns in their work based on their status as white or minority. By identifying themes in writing and scientific communication, I will have a deeper understanding of my students, and will be able to formulate ways to improve the feedback I provide their scientific writing, help them improve their writing, generate success in the science classroom and make them more likely to continue in advanced science classes. Because I teach in an area with such a high percentage of minority students, this project will hopefully improve the outcomes for my minority students in the science classroom and help them to continue with advanced science classes.

Chapter 2: Literature Review

Importance of Advanced Science Courses

The United States is facing a STEM crisis and our nation's leaders have noticed. The House of Representatives Committee on Space, Science and Technology states the need for scientifically literate individuals at all levels of the workforce is increasing (STEM Education in Action, 2011). The U.S. Congress Joint Economic committee backs this up by stating the current STEM workforce is not adequately meeting demands for STEM occupations, (Casey, 2012). The President's Council of Advisors on Science and Technology (2012) further supports this by stating the U.S. would need to increase production of undergraduate STEM majors by 34 percent in order to match the predicted demand for STEM workers in our nation.

One way to fill these gaps in STEM careers is to encourage students towards advanced courses in science. Studies of student enrollment in undergraduate courses after AP courses suggest students pursue substantial coursework in disciplines closely related to the AP course they took. Furthermore, students are more likely to major in a discipline closely related to the AP exam they took. The highest percentage of AP graduates with closely related majors lies with the Physics exams and Calculus BC exams (Morgan & Klaric, 2007). By increasing enrollment in advanced science courses, we can potentially increase the number of students pursuing science courses and degrees.

To prepare students to enter STEM fields, schools in the United States will need to bolster their advanced programs like AP and IB in science courses. Advanced programs provide a perfect route for this through AP classes. In the post-secondary setting, students in intermediate level courses with AP grades of 3 or higher, but no introductory courses had higher grades in their intermediate level courses related to their AP class than non-AP students who started with introductory courses (Morgan & Klaric, 2007; Klopfenstein & Thomas, 2009).

Minorities in Advanced Science Courses

As we help students prepare for STEM careers, it makes sense to focus on the ever-growing population of minorities in the United States. As a whole, African American and Latinx students are not participating in upper-level science classes and STEM careers. Klopfenstein (2004) found that African American and Latinx students of both sexes actively avoid AP math and science classes. Researchers have noted the achievement gap identifies not only low achievement, but also underachievement. In the 2003-2004 school year, there were major discrepancies in make-up of students taking at least one AP exam. When comparing the population of graduating seniors in 2006 to the population of AP examinees from public schools, there is a discrepancy of -6.8 percent for African American students. This means, of the graduating senior population, 13.7 percent was African American, but only 6.9 percent took an AP exam. Comparatively, there was a -3.2 percent discrepancy for white students with 65 percent of the graduating senior population being white and 61.8 percent taking an AP test. There was no discrepancy for Hispanic/Latinx students, meaning the proportion of Hispanic/Latinx students that took an AP exam was identical to the proportion of the graduating seniors that identified as Hispanic/Latinx, and a +5.3 percent discrepancy for Asian, Asian American and Pacific Islander students. This population made up 5.5 percent of the graduating class, but 10.8 percent of the AP examinee population (Handwerk et al., 2008).

There are many reasons why minority students do not participate in advanced programs. These include: institutionalized racism, negative teacher expectations, fear of 'acting white'(McDonald, 2014), and low recommendations for gifted services (Elhoweris, Mutua, Alsheikh, & Holloway, 2005). Institutionalized racism can take many forms including: a) insufficient for funding schools with large proportions of African American and low income students; b) using culturally inappropriate or unresponsive curriculum; c) and inadequately preparing teachers to effectively teach African American and minority students (Blanchett, 2006). It is also important to note that teachers' perception of Latinx

and White parents were more positive than their perception of African American parents, and these perceptions are transferred to the teachers' perceptions of the students (Hughes, Gleason, & Zhang, 2005). If teachers have less positive or even negative perceptions of students and their parents it is unlikely they will recommend these students for advanced courses and other opportunities for advancement.

Another important factor affecting underrepresented minority participation is income level. In a study by Ndura et. al (2003), Latinx students were the group with the lowest family income and were also the smallest population of participants in AP classes in the district. In this same study, students with the highest family income had the largest population of participants in AP classes. Both of these statistics compared the number of AP participants to the total numbers of each ethnicity in grades 11-12. In general, coming from a low-income household decreases the likelihood of participation in AP classes for students of all races. However, African American and Latinx students are three times as likely to come from low-income families (Klopfenstein, 2004). This means they are much less likely to participate in AP classes compared to their White classmates.

Interventions used to Equalize Achievement

The effort to equalize achievement between white and minority students is an initiative pursued by schools throughout the nation. There are many reasons minorities achieve at levels below their white classmates. For example, minorities are more likely to be in low-income schools, and these schools are more likely to have low curriculum rigor, larger class sizes, and less instructional technology. In addition, minorities are more likely to be in classrooms with underprepared teachers who have less experience. These teachers also have higher rates of absences and turnover. Outside of school, these students are more likely to experience low parent to pupil ratio, low parent participation, high student mobility, large summer achievement losses, hunger and poor nutrition, and environmental damages (Barton, Coley and Richard, 2009).

Because the achievement gap between minority students and white students is so prevalent throughout our entire country, a variety of interventions have been implemented with the goal of closing this achievement gap and improving underrepresented minority participation within advanced programs. One way to close the achievement gap is to increase access to rigorous courses within the school setting (Barton, Coley & Richard, 2009). By providing more rigorous content students will be better prepared to participate and succeed in advanced courses when the time comes. Students are also more likely to enroll in advanced courses if they feel prepared. Another factor, found by Young and Young (2018), is increasing out-of-school time enrichment. They explain that out-of-school time enrichment increases the number of underrepresented minorities participating and achieving in advanced science classes. They examined a sample of 3,173 African American students and compared the activities they participated in (science clubs, competitions, camps and tutoring) to their advanced science participation (AP science credits, science credits and science grade point average). Their results demonstrate overall low participation in out-of-school activities, but when students participated in these activities, these students were more successful in advanced science classes.

However, the extra extra-curricular after school programs that can bolster interest are not always available. Both middle-class and working-class parents see the importance of organized activities like after school programs, but working-class parents are often constrained by time and finances to the programs in their neighborhood offered by schools and churches, which do not always include science programs. In contrast, middle-class parents have more choice in the after-school programs they send their children to. (Bennett, Lutz, & Jayaram, 2012).

Finally, parental involvement is crucial to student participation in advanced science classes. One study found parents are the biggest influence on students taking AP classes, regardless of race (Ndura et al., 2003). However, parents of minority children tend to be less involved, whether consciously or unconsciously, in the school culture. This can be due to exclusion by the school system, which often

hosts events that require knowledge of the majority's culture. Parents of minority students are less likely to have found success in school and therefore are more likely to avoid school functions, or be unsure how to navigate the school system. Schools can help parents to be more engaged in the education process by using multiple forms of communication, such as email, phone and in-person conversations (Contreras, 2011) and also using conventional involvement like open houses and conferences (Delgado-Gaitan, 1991). This process will actively include parents who often feel excluded by lack of knowledge or understanding of how the school system works.

Overall, there is no strategy for closing the achievement gap. Rather it is recommended that a comprehensive set of strategies is evaluated and continuously implemented in order to see the most success (James, Jurich, & Estes, 2001).

Importance of minorities in advanced programs

The importance of increasing participation in advanced programs for underrepresented minorities cannot be understated. First, students participating in advanced programs, like AP and IB, are engaging in academically rigorous content. Lack of rigorous content is one factor that contributes to the achievement gap (Barton, Coley & Richard, 2009). Participation in AP and IB courses is a quick way to increase the rigor of the classes a student is taking and consequently, take steps to closing the achievement gap. One example of this is seen in a Nassau County study where the de-tracking of classes led to an increase in the number of students earning their Regent's diploma (Burris, Wiley, Welner, & Murphy, 2008). This de-tracking of classes led to increased rigor for all students as well as an increase in achievement for students.

Second, students are also able to earn college credit through AP courses. This can help them get a head start on earning their college degree. Of students who took AP coursework 62.8 percent graduate college within four years, compared to 44.8 percent of students who did not take AP coursework. Specifically, 47.9 percent of African American AP students graduated in 4 years, compared

to 39.7 percent of African American non-AP students (Morgan & Klaric, 2007). This head start on their college degree is especially important because in 2011, the median earnings of a person with a bachelor's degree earned $21,100 more than those that simply had their high school degree (Baum, Ma, & Payea, 2013). Minorities are more likely to live in poverty. In 2016 26.2% of Blacks and 23.4% of Latinxs lived in poverty compared to 12.4% of Whites ("Poverty USA," n.d.). By getting more students into advanced programs they will be more likely to graduate from college, more likely to earn more money and less likely to live in poverty.

As we increase the success of these students through participation in advanced programs, we are actively working to improve the success of our nation. As stated before, the minority population is rapidly increasing in the United States. By creating opportunities for success for this ever growing population we are increasing the number of students who will go on to obtain professional degrees and who by improving themselves will move our society forward in areas like research, medicine, and education (Ndura et al., 2003).

Early Participation in Advanced Science Education Success Predicts Success in Science Later

When preparing minority students for careers in science, it is vital for them to have exposure to advanced science classes early on. In a qualitative study, interviews were conducted with college minority students majoring in a STEM degree. In this study students reported strong high school preparation in advanced science classes helped them to build a firm foundation that led to success in STEM in college (Palmer, Maramba, and Dancy, 2011). Other studies and programs support these statements. For example, from the 1980s to the 1990s, Xavier University more than doubled the number of African-American students pursuing health professions through STEM summer enrichment programs (Carmichael Jr and Sevenair, 1991).

Description of the Next Generation Science Standards

As stated in the last section, early exposure is important for generating interest. As students get older, it is important to provide a rigorous curriculum. The Next Generation Science Standards (NGSS) were implemented in Iowa during the 2014-2015 school year. A national committee developed these standards to improve college and career readiness for students (NGSS Lead States, 2013). The development of these standards intend to do more than teach content, these standards are developed for students to improve skills like communication, collaboration, inquiry, problem solving and flexibility. These standards are designed to give students opportunities to create and design solutions to real world problems while also learning content. These standards also give students the opportunity to integrate math and literacy skills into their science work.

Scientific Communication in the Classroom

Scientific communication in the classroom is essential to developing well rounded students. By integrating literacy into science, students are able to make deeper connections. Research on scientific communication by Reveles, Cordoba and Kelly (2004) argues that scientific communication in third graders is linked to the development of academic identity. When students are allowed to develop their thoughts through speaking and writing, they form a deeper understanding and closer relationship with the content. This is essential for maintaining student interest in furthering their studies in science.

It is also important to teach these skills of scientific communication. A study by Spektor-Levy, Eylon, and Scherz (2009) showed junior high students who received direct instruction on scientific communication skills and then were given opportunities to practice performed better on complex tasks compared to students who were not given opportunities to practice or did not receive direct instruction. In this study, all students were given direct instruction on scientific communication skills and opportunities to practice. This scientific communication will be evaluated for all students in a ninth grade classroom.

CHAPTER 3: Methodology

Research Question

Due to the large population of Blacks and Latinxs in the urban Midwestern setting that is the focus of this study, it is necessary to investigate ways we can close the achievement gap and help all students reach their potential. With the increase in need for STEM jobs around the nation, this study focuses on these students in the context of science classes.

The research question is as follows:

- What trends in scientific writing by minority students can be identified in an integrated advanced ninth grade science class?

Theoretical Framework

As the population of non-whites in our nation grows, examination of race in education and the stories students bring will become more and more important. Culture and race relate closely for many people. Students bring a wide variety of cultural backgrounds and social interactions with them to school. These intertwine intricately with what students are interested in and how they view their capabilities. Critical Race Theory, a guiding framework for the development of this study, brings together this intertwining of race, culture and social interactions. Critical Race Theory (CRT) is focused on 2 main points: 1) race is a factor in determining inequity in the United States and 2) researchers can use critical race theory to identify, analyze, and transform the systemic and structural inequalities founded in race (Graham, Brown-Jeffy, Aronson, & Stephens, 2011). This study will use CRT to tease out factors affecting the inequitable participation rates of minorities in the study's school district and then analyze the data to improve participation.

Because racial biases are a conscious and unconscious part of our society, this study will also use a transformative paradigm as a guiding principle. Researchers use a transformative paradigm in studies addressing social justice and inequalities that also aim to implement social change (Mertens, 2007).

When using a transformative paradigm, “The role of the researcher in this context is reframed as one who recognizes inequalities and injustices in society and strives to challenge the status quo, who is a bit of a provocateur with overtones of humility, and who possesses a shared sense of responsibility” (Mertens, 2007, p. 212). This study aims to do just that. By examining the differences in the writing of minority and non-minority students, the researcher hopes to improve instruction in advanced science classes and reach students more effectively. Specifically, As Ndura et al. (2003), so eloquently stated, “Until issues of educational inequity are confronted and resolved, social justice will remain an elusive dream and fruitless polemic” (p. 34).

Researcher Role

The researcher in this study began working as a classroom teacher for the district in the fall of 2015. The researcher has taught general biology to underclassmen at both traditional high schools in the district as well as general chemistry and IB Sports Exercise and Health Science class to juniors and seniors at the smaller of the two high schools. In the 2019-2020 school year she also taught advanced integrated science to 9th graders. She is seeking to be an active part of the equity solution and closing the achievement gap within the district.

District Goals

The goal of this paper aligns with goals of the district in this study. The district in this study is currently employing a variety of interventions to close the achievement gap. The first and foremost intervention is a focus on “big rocks” as a means to close the achievement gap. The “big rocks” the district has chosen to focus on include equity, special education, and writing. This study would supplement the district’s focus on equity. Currently, the district is leading its teachers in professional development on implicit bias and giving students equitable treatment, regardless of race or gender.

Site and Participants Setting

Currently, the Midwestern state in this study has approximately an 8.6% non-white population. This study takes place in an urban setting in the most diverse county in the state with a 14.6% non-white population (U.S. Census Bureau, 2017). Within this county, the study is taking place in the most diverse city. The district has two traditional high schools and one alternative high school.

In 2015 the district was working on a plan to implement the new Next Generation Science Standards (NGSS) that were mandated. As part of this plan, a two-year integrated science class was developed. This class provided three years of science standards and allowed advanced science students to begin taking advanced science classes as juniors without having to double up on science classes. The group of students being studied included 31 freshman students in an integrated life and earth science class. These students covered six units over the course of the year: Earth's Place in the Solar System, Human Impacts on the Cycling of Earth's Matter, Cells and Energy, DNA and Protein Synthesis, Reproduction, Multicellularity and Heredity, and Evolution. A more detailed outline of the curriculum can be found in Appendix A. The students taking this class consisted of 17 males and 14 females broken down into 11 white students, and 20 minority students.

Data Collection Procedures

This evaluation will compare four different assignments from two different units. Two of the assignments follow the claim evidence reasoning (CER) format. In the district being studied it was called ACES+C. This stands for Answer the question, Cite evidence, Explain, Summarize, and Conventions of writing. The first of these assessments focused on the impact of nitrate-based fertilizer on algae growth. The second ACES+C focused on factors influencing enzyme rate of reaction.

The other two assignments were written assessments with more creative writing. The first of these was a research paper in which students chose a topic about human impacts on the environment and potential solutions to these problems. The second paper was an opinion essay about gene editing.

Students provided basic information about gene editing and its pros and cons and ended with a paragraph about whether they would choose to gene edit their children. These assignments can be found in Appendix B.

Within these assignments different aspects were analyzed. In the ACES+C assignments I focused on: the strength of claim, the strength of the evidence cited, the use of qualitative evidence, the use of quantitative evidence, and the strength of the scientific explanation. In the opinion and research paper these were evaluated for: topic choice, accuracy of statements, strength of evidence and opinion on gene editing for their children (Table 1).

Table 1 Aspects Evaluated for Each Assignment

Aspects Evaluated	**Assignment Name**			
	Nitrates and Algae	Enzyme Reactions	Human Impacts	Gene Editing
Turned in	x	x	x	x
Claim Strength	x	x	x	
Evidence Strength	x	x		
Presence of Qualitative Evidence	x	x		
Presence of Quantitative Evidence	x	x		
Strength of Scientific Explanation	x	x		
Number of Evidence Statements			x	
Accuracy of Statements				x
Number of Sources			x	x
Opinion on Gene Editing				x

CHAPTER 4: Results of Project and Reflection of Project

Results

Nitrates and Algae Argumentative Writing.

The analysis of this assignment began with the number of students who turned the assignment in. Of the 12 white students, there was a 75% turn in rate and of the 19 minority students, a 74% turn in rate. I then evaluated the strength of the claim. A strong claim would answer the question "To what extent does nitrate based fertilizer influence the eutrophication of an aquatic system?" with a clear relationship stated and a clear understanding of the question. An example of a student response that was awarded a "2" would be "The more fertilizer you add the more eutrophic the aquatic environment will be." When evaluating this statement, I rated the statement a "1" if the student did not state a clear relationship or if the student did not clearly state the environment was aquatic. An example of an unclear relationship would be "Nitrate based fertilizer influences the eutrophication of an aquatic system by a lot." An example of the student not clearly stating the aquatic environment would be "The more fertilizer the more eutrophic the environment is." An example of a student who received a "0" for their claim said "When there is nitrate in a body of water it isn't available to crops." This student did not answer the question. When evaluating the average strength of the claim I found the average score of all the students who turned the assignment in while comparing white students to minority students. When comparing these averages, white students claim strength averaged 1.78 while minority students averaged 1.79.

Providing evidence was a tougher job for students. Students were evaluated for the presence of qualitative and quantitative evidence on a 1 or 0 system, either they had it or they didn't. Of the 9 white students that turned in their writing, 100% of the students used qualitative evidence, but only 22% of them used quantitative evidence. For minority students 100% used qualitative evidence and 64% used quantitative evidence. Of the three students that did not use qualitative evidence, two did not provide

any evidence and one only provided quantitative evidence. When evaluating the overall strength of the evidence, if students only provided qualitative evidence the highest they could score was a "1", seeing as this is not sufficient evidence to support their claim. When evaluating evidence strength, white students averaged 1.22, while minority students averaged 1.64.

Finally, I evaluated the strength of the scientific explanation. This proved, not surprisingly, to be the toughest aspect of writing for students. Many students were able to explain pieces of evidence, but had a more difficult time linking it all together to describe how their evidence supported the idea that increased fertilizer leads to eutrophication. One common misunderstanding was about turbidity. In their experiment students used a mini secchi disk to measure the turbidity of the water. If the water was more turbid, their measurements would have been lower. This led many students to say that less turbid water is more eutrophic which is technically inaccurate. I believe they understood the idea of turbidity, but did not understand the vocabulary word and how to use it. Because of this, I did not take off points if they stated that less turbid water is more eutrophic. Overall, students could clearly link the idea of more fertilizer to more algae growth, but really struggled to link it to deeper ideas like eutrophication. Overall, when evaluating their scientific explanation, white students averaged a score of 2.22 out of 4 and minority students averaged a score of 1.71 out of 4.

Table 2 Summary of Nitrates and Algae Assignment Analysis

Nitrates and Algae Assignment							
Race (n)	Number Turned in	Percentage Turned in	Claim Strength (2)	Evidence Strength (2)	Use of Qualitative Evidence (1)	Use of Quantitative Evidence (1)	Strength of Scientific Explanation (4)
White (12)	8	75	1.78	1.22	1.00	0.22	2.22
Minority(19)	14	74	1.79	1.64	1.00	0.64	1.71

This table summarizes the results of the Nitrates and Algae assignment. Of the 12 white students, 75% turned in the assignment and of the 19 minority students, 74% turned in the assignment. The use of qualitative and quantitative evidence was rated as a 0 or a 1. The strength of the claim and evidence were all rated on a 0, 1 or 2 scale. The strength of the explanation was rated on a 0, 2 or 4 scale. The scores represent the average score of the students that turned work in.

Enzyme Activity Argumentative Writing.

The enzyme activity proved to be more difficult overall, but the students were also able to provide a stronger scientific explanation than the Nitrates and Algae assignment. This assignment had a lower turn in rate with 42 percent of white students and 63 percent of minority students turning it in. The claim strength was also weaker in this activity, with white students averaging 1.60 out of 2 and minority students averaging 1.58 out of 2. I attribute this to the fact that the enzyme graph did not have a linear relationship and was much more difficult to describe. In the future I would have students think more deeply about how they would write their claim to represent both the rise and fall of the enzyme activity.

Evidence strength was much stronger than the Nitrate activity for white students at 1.80 out of 2 and remained relatively constant for minority students with 1.67 out of 2. In this activity the use of quantitative evidence grew considerably for white students and increased a little for minority students. One interesting aspect of the evidence was the use of units. Of the 9 students that used quantitative evidence, 4 did not have any units, 2 used wrong or inconsistent units and only 3 used the correct units consistently. This was an interesting finding and in the future I would like to emphasize the use of units. I do believe if we had been able to finish out the school year I would have focused on this aspect.

When it came to the strength of the scientific explanation students did a good job of correctly explaining the shape of the graph by using the term “denature”. However, very few students actually explained what a denatured enzyme was. A few did use the term “melting” when describing the enzyme denaturing, which is not exactly correct, but a good start to showing an understanding of the term. In general, there was a decrease in the average scores, decreasing to 1.60 out of 4 for white students and 1.83 out of 4 for minority students.

It is interesting to note that in the first activity minority students averaged better scores than white students, but by the second activity, although both groups improved, the white students had much larger gains.

Table 3 Evaluation of Enzyme Assignment

Enzyme Assignment							
Race (n)	Number Turned in	Percentage Turned in	Claim Strength (2)	Evidence Strength (2)	Use of Qualitative Evidence (1)	Use of Quantitative Evidence (1)	Strength of Scientific Explanation (4)
White (12)	5	42	1.60	1.80	1.00	0.80	1.60
Minority (19)	12	63	1.58	1.67	1.00	0.75	1.83

This table summarizes the results of the Enzyme Assignment. Of the 12 white students, 42% turned in the assignment and of the 19 minority students, 63% turned in the assignment. Turning the assignment in was rated on a 1 or 0, as was the use of qualitative and quantitative evidence. The strength of the claim and evidence were rated on a 0, 1 or 2 scale. The strength of the scientific claim was rated on a 0, 2, or 4 scale. The scores represent the average score of the students that turned work in.

Solutions to Human Impacts Research Paper.

This activity gave students a lot of freedom to choose topics and support their claims in ways that made sense to them. Because of this, it became difficult to objectively analyze their reasoning. However, I was able to describe the turn in rate, and analyze the students' claims, the number of evidence they used to support their claim, and the number of sources they provided. Starting with the turn in rate, 8 of 12 white students turned in the paper for a turn in rate of 67%, while 10 out of 19 minority students turned the paper in for a turn in rate of 53%. In reality, 11 minority students turned their paper in, but one was blatantly plagiarized, so I did not count it as turned in. Overall, the students had strong claims with an average of 1.75 out of 2 for white students and 1.5 out of 2 for minority students. This high number did not surprise me because we had talked about our Nitrate assignment only a few weeks before, and students had just received practice and feedback on writing strong claims. The number of evidence provided is simply an average of how many were provided. Most students provided three pieces of evidence to support their claim, while the low was one piece of evidence and the high was four pieces of evidence. An interesting note is that no white students provided four pieces of evidence while three minority students did and zero minority students provided one piece of

evidence while one white student did. This is interesting to me, because it appears that minority students are more likely to go above and beyond what is asked of them compared to their white peers.

Finally, the number of sources was evaluated. The rubric asked for five sources and white students averaged 4.25 and minority students averaged 4.20. In this average there were students who did not cite any sources within their paper or at the end of their paper, so this was counted as zero sources. This could have significantly decreased the average. One white student and two minority students had zero sources. Besides the one zero, among white students, one had six sources, five had five sources and one had three. Among minority students, one had seven sources, two had six, and five had five sources. Something interesting to note was that the required number of sources was five, and most students attained that number, but did not go above that. To me, the most logical explanation of this is that many students want to meet expectations, as long as they are reasonable. For example, If I had asked for three sources, I'm certain most students would have reached that, but not gone above and beyond that. On the other hand, if I had asked for 15 sources, I know there would have been some students reaching that number, but the percentage would be much lower.

Table 4 Evaluation of Solution to Human Impacts Assignment

Solutions to Human Impacts Assignment					
Race (n)	Number Turned in	Percentage Turned in	Strength of Claim	Number of Evidence	Number of Sources
White (12)	8	0.67	1.75	3.00	4.25
Minority (19)	10	0.53	1.50	3.40	4.20

This table summarizes the results of the analysis of the Solutions to Human Impacts Assignment. As in the first two assignments, turned in is rated as a 1 or 0 and the decimal in the table represents a percentage of students who turned the assignment in. The strength of claim is rated on a 0, 1 or 2 using the rubric in appendix B, and the number of evidence and number of sources is an average of all students who turned the assignment in.

Gene Editing Opinion Paper.

This paper had the highest turn in rate of all the assignments. 11 of 12 white students turned the paper in for a turn in rate of 92%, with one that was incomplete and 16 of the 19 minority students turned the paper in for a turn in rate of 84%, with two that were incomplete. These incomplete papers

affected the average number of sources as well as the opinion section of the paper. I believe this paper had the highest turn in rate because it was a straightforward assignment. The directions broke the assignment into six different sections with subpoints to complete. Many of the subpoints had been covered in class or the students were able to research on the internet. When the assignment is straightforward, I believe it makes it easier for students and they are more likely to complete it.

I also did an analysis of the accuracy of student work. Each paper was evaluated for inaccuracy and then marked with the number of inaccuracies. In this instance, the lower the number of inaccuracies, the better. Zero would mean the paper had no inaccurate statements and one would be one inaccurate statement. No student had more than one inaccuracy, and I believe this was due, again, to the straightforward nature of the assignment. Most of the inaccuracies came from student misconceptions of DNA mutations.

Finally, I looked at the number of sources used. The rubric stated that students needed three sources, and most students did that. The number is slightly skewed, because incomplete papers did not have any sources, but were still included in the calculations. We can see, like we did in the Solutions to Human Impacts, that most students will meet the bare minimum of the requirements.

Table 5 Evaluation of Gene Editing Assignment

Gene Editing Assignment				
Race (n)	Number Turned In	Percentage Turned In	Accuracy	Number of Sources
White (12)	11	92	0.27	2.45
Minority (19)	16	84	0.25	1.94

This table summarizes the results of the analysis of the gene editing assignment. Again, turned in was rated on a 1 or 0. Accuracy represents the average number of errors in the paper and the number of sources is an average of all students who turned the paper in.

When it came to evaluating students' opinions on if they would choose to gene edit their children, the results were very interesting. Seven white students were for editing their children’s genes, three were against it, one would only edit them under certain conditions and one did not have an

opinion stated. For minority students, only five students would edit their children's genes, five were against it, two would edit under certain conditions and three did not have an opinion stated. This seems to be the area where the most discrepancy could be found. I found it interesting that some students said they would choose not to edit their child's genes because they would not have enough money for it. Specifically, one white student referenced money being an obstacle and three minority students referenced money.

Table 6 Evaluation of Student Opinions on Gene Editing

Student Opinions on Gene Editing				
Race (n)	For	Against	Conditional	No opinion
White (11)	5	3	3	0
Minority(16)	6	3	3	3

This table represents students' views on if they would choose to genetically modify their child. The "for" group would modify, the against group wouldn't. The "conditional" group would modify, but only in cases of illness and extreme need. The "none" group did not state an opinion, but all of the students in this category, except for one, had incomplete assignments.

Reflection

Teaching Scientific Writing.

Teaching students scientific writing is a long process. It begins with the basics and grows as the year goes on. First, we emphasize how to write basic claims with evidence supporting them. Then, we emphasize the quantitative aspect of evidence and finally we focus on really explaining our thought processes. Looking at these assignments in detail has been very interesting and really helped me to see my students' thought processes. Typically, I am not able to have enough time to do this type of thorough of an analysis. This project has allowed me to do this.

When looking at trends in white students compared to minority students in my freshman classes, I didn't really see a lot of big differences. On some assignments, minority students were better able to present quantitative data, but then on other assignments white students were able to. The same goes for the claims. The one big difference I found was in the opinions on gene editing. It seems to me that more white students would choose to gene edit their child, while more minority students would

not. One aspect of this was related to cost for the minority students. Three minority students mentioned that gene editing would be expensive and therefore they would not do it. This could be attributed to minority students being more likely to come from low-income families. It is also worth noting minorities have been subjected to horrific medical trials at the expense of science, such as the Tuskegee Airmen, and may be more skeptical of scientific breakthroughs related to medicine as a result.

Looking at how I would teach this class differently, it seems like it could be beneficial to start the writing process by giving students a very clear checklist to follow. I typically give assignments with the requirements listed out in bullet points to break it down, but adding a line for a check mark might make it even clearer. I also believe students' work improved significantly as the year went on, and that shows me that we just need to continue practicing. The more they write, the better they get. Teaching the writing process has been one of the things I've had to work on a lot as a teacher. It was something that I didn't feel was really covered in undergrad, but when I got into the schools, there was a lot of emphasis put on it.

Master's Program and Future Plans.

Overall, this master's program has been a beneficial experience for me. One thing that I have really enjoyed is deepening my content knowledge, especially in the earth and space science discipline. This made me a better educator in the sense that I was better able to relate each science content together. One class I really enjoyed, but was also very challenging, was Chemistry of Space. This class pushed my math and chemistry abilities, but also allowed for some very hands-on experiences. Over spring breBBak we were also able to take a trip to South Dakota and do research in caves, which is about as close to space as you get here on Earth. This class taught me how to think about the bigger picture in my teaching. We learned a lot of content in the class, but it also had a huge special project that had real-life applications and taught us even deeper content.

I will not be continuing with high school education after I earn this degree, but I know that the skills I learned in teaching will be with me forever. I will be beginning my education as a nurse starting the fall semester of 2020, and it is my hope that someday I can get back to working with young adults. The students were my favorite part of teaching, and I will miss them!

References

Aschbacher, P. R., Li, E., & Roth, E. J. (2010). Is science me? High school students' identities, participation and aspirations in science, engineering, and medicine. *Journal of Research in Science Teaching*, *47*(5), 564–582. https://doi.org/10.1002/tea.20353

Barton, P. E., & Coley, C., Richard J. (2009). *Parsing the Achievement Gap II*. Educational Testing Service.

Baum, S., Ma, J., & Payea, K. (2013). Education Pays: The Benefits of Higher Education for Individuals and Society. Retrieved February 12, 2018, from https://trends.collegeboard.org/sites/default/files/education-pays-2013-full-report.pdf

Bennett, P. R., Lutz, A. C., & Jayaram, L. (2012). Beyond the Schoolyard: The Role of Parenting Logics, Financial Resources, and Social Institutions in the Social Class Gap in Structured Activity Participation. *Sociology of Education*, *85*(2), 131–157. https://doi.org/10.1177/0038040711431585

Blanchett, W. J. (2006). Disproportionate Representation of African American Students in Special Education: Acknowledging the Role of White Privilege and Racism. *Educational Researcher*, *35*(6), 24–28. https://doi.org/10.3102/0013189X035006024

Burris, C. C., Wiley, E., Welner, K., & Murphy, J. (2008). Accountability, Rigor, and Detracking: Achievement Effects of Embracing a Challenging Curriculum As a Universal Good for All Students. *Teacher College Record*, *110*(3), 571–607.

Burton, N. W., Whitman, N. B., Yepes-Baraya, M., Cline, F., & Kim, R. M. (2002). Minority Student Success: The Role of Teachers in Advanced Placement Program® (ap®) Courses. *ETS Research Report Series*, *2002*(2), i–81. https://doi.org/10.1002/j.2333-8504.2002.tb01884.x

Carlone, H. B., & Johnson, A. (2007). Understanding the science experiences of successful women of color: Science identity as an analytic lens. *Journal of Research in Science Teaching*, *44*(8), 1187–1218. https://doi.org/10.1002/tea.20237

Carmichael Jr., J.W., & Sevenair, J.P. (1991). Preparing minorities for science careers: what's the secret of a small university's big success? *Issues in Science and Technology, 7(3),* 55-60.

Casey, B. (2012). *STEM Education: Preparing for the Jobs of the Future* (pp. 1–17). U.S. Congress Joint Economic Commission. https://www.jec.senate.gov/public/_cache/files/6aaa7e1f-9586-47be-82e7-326f47658320/stem-education---preparing-for-the-jobs-of-the-future-.pdf

Colby, S. L., & Ortman, J. M. (2015, March). Projections of the Size and Composition of the U.S. Population: 2014 to 2060. Retrieved February 11, 2018, from https://census.gov/content/dam/Census/library/publications/2015/demo/p25-1143.pdf

Contreras, F. (2011). Strengthening the Bridge to Higher Academically Promising Underrepresented Students. *Journal of Advanced Academics*, *22*(3), 500–526.

Delgado-Gaitan, C. (1991). Involving Parents in the Schools: A Process of Empowerment. *American Journal of Education*, *100*(1), 20–46.

Elhoweris, H., Mutua, K., Alsheikh, N., & Holloway, P. (2005). Effect of children's ethnicity on teachers' referral and recommendation decisions in gifted and talented programs. *Remedial and Special Education*, *26*(1), 25–31.

Graham, L., Brown-Jeffy, S., Aronson, R., & Stephens, C. (2011). Critical race theory as theoretical framework and analysis tool for population health research. *Critical Public Health*, *21*(1), 81–93. https://doi.org/10.1080/09581596.2010.493173

Handwerk, P., Tognatta, N., Coley, R. J., & Gitomer, D. H. (2008). *Access to Success:Patterns of Advanced Placement Participation in U.S. High Schools. Policy Information Report*. Educational Testing Service.

Hughes, J. N., Gleason, K. A., & Zhang, D. (2005). Relationship influences on teachers' perceptions of academic competence in academically at-risk minority and majority first grade students. *Journal of School Psychology*, *43*(4), 303–320. https://doi.org/10.1016/j.jsp.2005.07.001

International education. (n.d.). Retrieved April 24, 2018, from International Baccalaureate® website: http://www.ibo.org/

James, D. W., Jurich, S., & Estes, S. (2001). *Raising Minority Academic Achievement: A Compendium of Education Programs and Practices*. Retrieved from https://files-eric-ed-gov.proxy.lib.uni.edu/fulltext/ED473901.pdf

Klopfenstein, K. (2004). Advanced Placement: do minorities have equal opportunity? *Economics of Education Review*, *23*(2), 115–131. https://doi.org/10.1016/S0272-7757(03)00076-1

Klopfenstein, K., & Thomas, M. K. (2009). The link between advanced placement experience and early college success. *Southern Economic Journal*, *75*(3), 873–891.

McDonald, J. (2014). The Role of Invitational Theory on Minority Student Enrollment in Advanced Placement Courses. *Electronic Theses and Dissertations*. Retrieved from http://stars.library.ucf.edu/etd/4767

Mertens, D. M. (2007). Transformative Paradigm: Mixed Methods and Social Justice. *Journal of Mixed Methods Research*, *1*(3), 212–225.

Morgan, R., & Klaric, J. (2007). AP Students in College: An Analysis of Five-Year Academic Careers. *College Board Research Report*, (2007–4), 22.

Ndura, E., Robinson, M., & Ochs, G. (2003). Minority Students in High School Advanced Placement Courses: Opportunity and Equity Denied. *American Secondary Education*, *32*(1), 21–38.

NGSS Lead States. (2013). Next Generation Science Standards: For States, By States. Retrieved from https://www.nextgenscience.org/

Nugent, S. A., & Karnes, F. A. (2002). The Advanced Placement Program and the International Baccalaureate Programme. *Gifted Child Today*, *25*(1), 30. https://doi.org/10.4219/gct-2002-52

Palmar, R., Maramba D., & Dancy T. (2011). A Qualitative investigation of factors promoting the retention and persistence of students of color in stem. *The Journal of Negro Education, 80(4),* 491-504

Poverty USA. (n.d.). Retrieved August 9, 2019, from https://www.povertyusa.org/facts

President's Council of Advisors on Science and Technology. (2012). *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering and Mathematics*. Retrieved from https://files-eric-ed-gov.proxy.lib.uni.edu/fulltext/ED541511.pdf

Reveles, J. M., Cordova, R., & Kelly, G. J. (2004). Science literacy and academic identity formulation. *Journal of Research in Science Teaching*, *41*(10), 1111–1144. https://doi.org/10.1002/tea.20041

Schneider, J. (2009). Privilege, equity, and the Advanced Placement Program: tug of war. *Journal of Curriculum Studies*, *41*(6), 813–831. https://doi.org/10.1080/00220270802713613

Solorzano, D. G., & Ornelas, A. (2006). A Critical Race Analysis of Latina/o and African American Advanced Placement Enrollment in Public High Schools. *High School Journal*, *87*(3), 15–26.

Spektor-Levy, O., Eylon, B.-S., & Scherz, Z. (2009). Teaching scientific communication skills in science studies: does it make a difference? International Journal of Science and Mathematics Education, 7(5), 875–903. https://doi.org/10.1007/s10763-009-9150-6

STEM Education in Action: Communities Preparing for Jobs of the Future. , 2011. Committee on Science, Space and Technology. United States House of Representatives.

U.S. Census Bureau QuickFacts: Iowa. (2017). Retrieved February 11, 2018, from https://www.census.gov/quickfacts/fact/table/blackhawkcountyiowa,waterloocityiowa,IA/PST045217

Young, J., & Young, J. (2018). The Structural Relationship Between Out-of-School Time Enrichment and Black Student Participation in Advanced Science. *Journal for the Education of the Gifted*, *41*(1), 43–59. https://doi.org/10.1177/0162353217745381

Appendix A- Outline of 9th Grade Curriculum

- Unit 1- Earth's Place in the Solar System
    - Week 1- Big Bang Theory/ Formation of the Universe
    - Week 2- Structure and function of the sun and our place in the solar system
    - Week 3- Orbit of planets and gravity
    - Week 4- Early Earth
    - Week 5- What is a goldilocks planet?
    - Week 6- Assessment
- Unit 2- Human Impacts on the Cycling of Earth's Matter
    - Week 1- How does water move through our environment? How do we measure water's health?
    - Week 2-Water quality issues in Iowa
        - **Assignment: Nitrate and Algae ACES+C**
    - Week 3- Air quality, pollutants and greenhouse gases
    - Week 4- Carbon Cycle and global climate change
    - Week 5- Sustainability, biodiversity and mitigating human impacts on the environment
    - Week 6- Assessment
        - **Assignment: Solutions to Human Impacts Project**
- Unit 3- Cells and Energy
    - Week 1- Co-Evolution and cell membranes
    - Week 2- Chemical reactions and photosynthesis
    - Week 3- Photosynthesis and cellular respiration
    - Week 4- Cycle of oxygen and carbon
    - Week 5- Macromolecules and nutrition
    - Week 6- Assessments
- Unit 4- DNA and Protein Synthesis
    - Week 1- The discovery, role and structure of DNA
    - Week 2- Enzymes and DNA replication
        - **Assignment: Enzyme ACES+C**
    - Week 3- DNA Transcription and Translation
    - Week 4- Mutations and genotyping
    - Week 5- Genetic and chromosomal disorders
        - **Assignment: Genetic Edition Opinion Piece**
    - Week 6- Assessment
- Unit 5- Reproduction, Multicellularity and Heredity
    - Week 1- Why do cells divide? Cell cycle, mitosis and chromosomes
    - Week 2- Cancer, stem cells and cell differentiation
    - Week 3- Tissues, organs, systems, and methods of reproduction
    - Week 4- Meiosis and genetic diversity
    - Week 5- Punnett squares, heredity and pedigrees
    - Week 6- Assessment

- Unit 6- Evolution
    - Week 1- Ecological niches, carrying capacity and symbiotic relationships
    - Week 2- Predators and Prey, Natural and artificial selection
    - Week 3- Stickleback lab and intro to Darwin
    - Week 4- Evidence for Evolution: Geology, fossil record, early earth, geography
    - Week 5- Evidence for Evolution: Embryology, genetics and phylogenetic trees
    - Week 6- Assessment

Appendix B- Assignments and Rubrics

Assignment 1: Effect of Nitrate Based Fertilizer on Algae Growth ACES+C Assignment

Research Question: To what extent does nitrate based fertilizer influence the eutrophication of an aquatic system

A- Answer the Question
C- Cite Evidence
E- Explain your Evidence
S- Summarize
C- Communication (grammar, punctuation, spelling, etc)
Write this in paragraph form, please! Don't forget an intro and conclusion. This should be *detailed* writing.

		0	1	2
Conclusion *Scientific Explanation*	**Claim** *Statement or conclusion that answers the original question/problem*	Does not make a claim, or makes an inaccurate claim	Makes an accurate but vague or incomplete claim	Makes an accurate and complete claim
		0	**1**	**2**
	Evidence *Scientific data that supports the claim. The data needs to be appropriate and sufficient to support the claim.*	Does not provide evidence, or only provides inappropriate evidence (evidence that does not support the claim)	Provides appropriate, but insufficient evidence to support claim. May include some inappropriate evidence.	Provides appropriate and sufficient evidence to support claim.
		0	**2**	**4**
	Reasoning *Justification that links the claim and evidence and includes appropriate and sufficient scientific principles to defend the claim and evidence*	Does not provide reasoning, or only provides reasoning that does not link evidence to claim.	Repeats evidence and links it to some scientific principles, but not sufficient.	Provides accurate and complete reasoning that links evidence to claim. Includes appropriate and sufficient scientific principles.

Rubric source: https://www.chemedx.org/article/implementing-claim-evidence-reasoning-framework-chemistry-classroom

Assignment 2: Solution to Human Impacts on the Environment Assignment

Claim *(How does (topic) affect the environment?)*
__/2__ Question being investigated is narrowed /refined and clearly stated to identify an environmental problem impacted by humans
2 points
__/2__ Claim draws a conclusion addressing how humans are impacting their topic.
2 points

Evidence *(What is your evidence/support that (topic) affects the environment?)*
__/2__ Multiple examples of data (observations, and numbers) are provided
2 points

__/2__ Data is thoroughly analyzed, interpreted, and summarized into useful information
2 points

__/2__ Data identifies patterns observed in research (how has issue changed/progressed)
2 points

Reasoning *(Construct explanation(s) and apply scientific reasoning to link evidence to claim)*
__/3__ Rationale that connects data to explain and support claim/conclusion provided
3 points
- What are the reasons how/why this data supports/refutes the claim?

__/2__ Applied appropriate and sufficient scientific reasoning to link evidence to claim
2 points

Solution *(What solutions have already addressed this issue?)*
__/3__ Researched solution is thoroughly explained
3 points

__/3__ Solution addresses change in human behavior to correct environmental issue
3 points
__/4__ Solution tradeoffs are addressed
- Disadvantages (Cost Analysis) provided (2 points)
- Advantages (Benefit Analysis) provided (2 points)

Project Presentation and Google Slide
__/2__ Well-organized, easy to read and/or follow for understanding
2 points
__/2__ Proper grammar mechanics/usage, spelling, punctuation
2 points
___/5__ Citation of work in APA format and at least 5 reliable sources
5 points
___/8__ Google Slide PSA presents the most important information, is attractive, and engaging
8 points

Teacher Comments: **Total Pts. =** __/42__

Assignment 3: Enzymes ACES+C Assignment

Make one graph (temperature OR pH) using the data in the attached file. You only need to make ONE graph and do not need to answer the questions. JUST use the data.
Write an ACES+C about the effect of temperature or pH (choose the one you graphed) on enzyme activity.
A- Answer the question: What is the effect of temperature/pH on enzyme activity.
DO NOT JUST SAY "pH affects enzyme activity).
C-Cite evidence: Use data points from the graph you made
E- Explain: Use what you learned in class today to explain why your graph looks the way it does
S-Summarize: Wrap up your ideas in a short 1-2 sentence summary

		0	1	2
Conclusion *Scientific Explanation*	**Claim** *Statement or conclusion that answers the original question/problem*	Does not make a claim, or makes an inaccurate claim	Makes an accurate but vague or incomplete claim	Makes an accurate and complete claim
		0	**1**	**2**
	Evidence *Scientific data that supports the claim. The data needs to be appropriate and sufficient to support the claim.*	Does not provide evidence, or only provides inappropriate evidence (evidence that does not support the claim)	Provides appropriate, but insufficient evidence to support claim. May include some inappropriate evidence.	Provides appropriate and sufficient evidence to support claim.
		0	**2**	**4**
	Reasoning *Justification that links the claim and evidence and includes appropriate and sufficient scientific principles to defend the claim and evidence*	Does not provide reasoning, or only provides reasoning that does not link evidence to claim.	Repeats evidence and links it to some scientific principles, but not sufficient.	Provides accurate and complete reasoning that links evidence to claim. Includes appropriate and sufficient scientific principles.

Rubric source: https://www.chemedx.org/article/implementing-claim-evidence-reasoning-framework-chemistry-classroom

Assignment 4: Genetic Editing Opinion Assignment

Objective: To write a 5 paragraph essay discussing gene editing, the realized and potential positive and negative uses, and your opinion on whether or not individuals should have the ability to edit genes.

Outline:

1. **Introduction:**
    a. _____ What is DNA and how does it hold information?
    b. _____ What is a mutation and what are some reasons they may occur?
    c. _____ Why are gene mutations important to understand?
    d. _____ What is the purpose of gene editing?
2. **Positive Impacts:**
    a. _____ What are some positive outcomes of gene editing?
    b. _____ How could gene editing positively influence an individual's life?
    c. _____ How has gene editing helped improve medicine?
    d. _____ What impact could it have on the future of medicine?
    e. _____ Can you provide any specific examples?
3. **Negative Impacts:**
    a. _____ How could gene editing be misused?
    b. _____ What are some individual's concerns with gene editing?
    c. _____ How reliable is the information obtained from genotyping?
    d. _____ How could gene editing negatively impact an individual's life?
    e. _____ How could gene editing negatively impact society or the world?
    f. _____ Can you provide any specific examples?
4. **Opinion Statement**
    a. _____ Would you consider gene editing your child (if you chose to have one)? Why or why not?
    b. _____ Do you believe that others should have the option to edit their children's genes? Why or why not?
    c. _____ Do you believe that in the long run gene editing will help or hurt society? Why?
5. **Conclusion**
    a. Summarize what was discussed in the article.
        i._____ What is gene editing
        ii._____ What are positive aspects?
        iii._____ What are negative aspects?
        iv._____ What is your opinion and what most persuaded you?
        v._____ Should you warn or encourage others?
6. **Sources**
    a. _____ Include at least three outside sources and their citations (3 points)