WORCESTER POLYTECHNIC INSTITUTE

# TEACHING PRACTICUM IQP AT DOHERTY MEMORIAL HIGH SCHOOL

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## Abstract

This paper outlines my experience as a student teacher at Doherty Memorial High School in Worcester, MA in the spring of 2016. During this time I observed and taught four Honors Precalculus courses totaling ninety students. I will outline the culture in Worcester public schools, provide evidence that I have achieved competence in the main components of the student teaching practicum, and describe my students and the challenges they faced. In the appendix I have included sample lessons plans, survey responses, and examples of student work.

## Dedication and Thanks

I would like to dedicate this project and paper to several people. First, Mr. Dunbar taught me how important mathematics is and how significantly an educator can affect a student or group of students. My mentor teacher and department head at Doherty, Kathleen O'Leary and Renah Razzaq respectively, were phenomenal mentors who were always willing to talk about ideas, frustrations, and extracurricular interest. I value the bond that I created with them and am grateful that we are still in touch on a regular basis. I would also like to thank Shari Weaver, Katie Elmes, and John Goulet for helping me navigate the state requirements and paperwork necessary to complete this practicum. Last but certainly not least, I would like to thank my students for changing my life and my perception of what my dream career looks like.

# Chapter 1: Background

## 1.1 Introduction

The goal of this paper is to explore the legislative, cultural, and economic factors that influence the location of my student teaching practicum, Doherty Memorial High School (hereafter referred to as "Doherty"). Legislation on the federal and state level as well as the unique socioeconomic and cultural makeup of Doherty are all crucial to understanding how best to enter the school environment and be an effective educator.

## 1.2 Legislation Overview and its Effects

The Education Reform Act of 1993 was the first step in making Massachusetts one of the leaders in consistent educational standards and one of the states that Common Core was later modeled on due to its exemplary record. The main goal of this act was to increase financial support for school districts by mandating a foundational level of spending, which was broken down by local and state contribution amounts. To maintain consistent expectations, this act also laid out specific standards that every student was expected to meet, as well as the form of assessment that would be used to judge proficiency regarding each of these standards. The graph below depicts the budgetary breakdown, where Chapter 70 refers to financial assistance given to districts, maintaining a base level of 87.8% (or approximately 4.4 billion dollars).

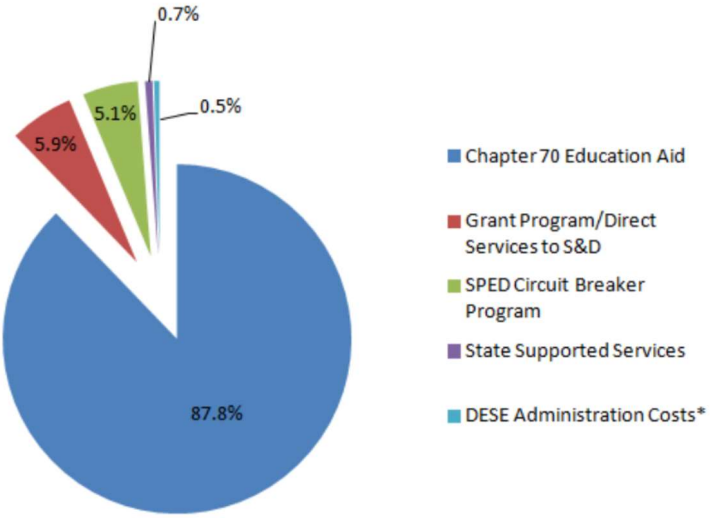


Figure 1

Source: "Building on 20 Years of Massachusetts Education Reform." Mitchel D. Chester, Massachusetts Department of Elementary and Secondary Education. November 2014.

Another piece of educational legislation that has significantly impacted school systems across the country is the No Child Left Behind (NCLB) Act. NCLB, which was adopted in 2001, was the first of several major efforts to put the onus of high quality public school education on the federal government. This was done to ensure international competitiveness. Particular emphasis was placed on improving the performance of English Language Learners, minority students, and students with IEPs or 504 plans. While participation in NCLB was considered voluntary, states that did not comply were threatened with the loss of federal Title 1 funding.

In order to meet the goals and expectations of NCLB, schools must make Adequate Yearly Progress (AYP), and all schools were required to be "proficient" by the 2013-2014 school year; however, the definition of the "proficiency" in question was left under the jurisdiction of each individual state. Schools failing to maintain AYP were subject to a range of penalties, from allowing students to

transfer to better performing schools in the district to a 10% loss of Title 1 funding. NCLB also incorporated a great deal of standardized testing, which was one of the main aspects that received a great deal of criticism.

More recently, the Every Student Succeeds Act (ESSA) was passed to improve upon NCLB. In addition to reducing the amount and types of standardized testing that was required under NCLB, ESSA also redirects funds into schools with the highest dropout rates and largest achievement gaps instead of depriving these schools of funds, another aspect of NCLB that encountered a great deal of criticism. This piece of legislation was passed fairly recently, so it still remains to be seen how it influences American education standards and accountability, but many educational experts and advocates believe it is a positive change that will continue to compound the benefits reaped by the implementation of Common Core.

Common Core was created by education chiefs and governors in 48 states who wanted a universal guideline for the necessary competence in math, English, and literacy that high schoolers should strive for in order to be successful at two and four year colleges and in the postsecondary workforce. This program attempts to ensure that students across the country are held to a universal set of standards and have theoretically universal experiences, removing the long-held stigma (and in some cases, genuine disadvantages) of attending public schools in certain geographic regions that are historically economically or socially disadvantaged.

Common Core State Standards outline what students need to learn in each subject, but teachers still have a great deal of freedom regarding the creation of lesson plans and the delivery of content. The standards for each subject and subtopic were largely determined by intensive research regarding which skills are most essential to college and career readiness. Specific to mathematics education, the Common

Core standards attempt to change the course of mathematics education from its historic tendency to be incredibly broad yet lacking in depth.

Massachusetts was involved in the creation of Common Core due to its record of academic excellence. On the Trends in International Mathematics and Science Study (TIMSS), Massachusetts is a consistently high performer. The TIMSS collects data from 4th and 8th grade students every 4 years since 1995. In 2011 (the most recent year for which results have been released), Massachusetts had an average mathematics score above the national US score, joining the ranks of other states such as Minnesota, Indiana, and North Carolina.

All of these legislative changes, recent and more antiquated, are critical components of understanding the current education system in Massachusetts and America. Many experts agree that the move to common core and ESSA is in the best interest of students, educators, parents, and communities across the country. Although no education system can be perfect or satisfy all possible stakeholders, the goals outlined by the current programs provide a good guideline for delivering high quality and consistent education to students of all age groups.

### 1.3 Socio-Economic and Demographic Profile

At Doherty 56% of students are classified as minorities, many of whom are English Language Learners (ELLs). Furthermore, 59% of the students at Doherty are considered "economically disadvantaged." This statistic is determined by the number of students who qualify for the free lunch program and the reduced price lunch program (52% and 7% respectively). The graph below depicts the demographic breakdown of students at Doherty.

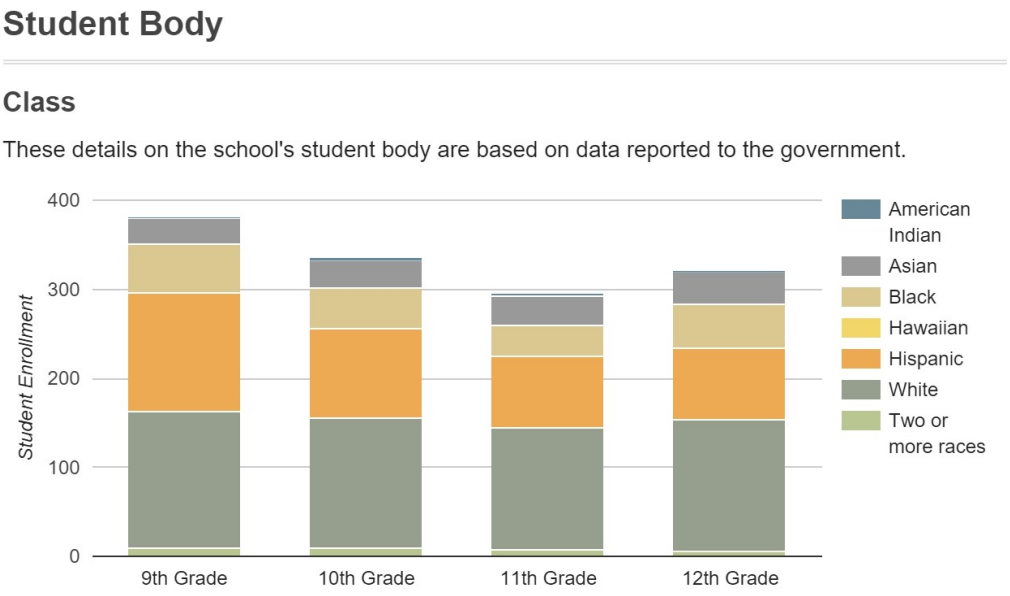


Figure 2

"Doherty Memorial High School Study Body" U.S. News and World Report: Education. http://www.usnews.com/education/best-high-schools/massachusetts/districts/worcester-public-schools/doherty-memorial-high-school-9573/student-body

With such a high proportion of ethnically and culturally diverse students, it is natural that many students are also linguistically diverse. The next section outlines the specific ELL statistics for Worcester and Doherty.

## 1.4 English Language Learners at Doherty

English Language Learners are those students who do not speak English as their first language. When a new student enters the district, their English proficiency must be assessed so that the school can determine if and how to offer them special support as they strive to become more proficient in English and grasp content presented in a language that is fairly foreign to them. ELLs are classified into six levels and are regularly reassessed to determine what progress they have made and what program

support is still required. The levels bridge from 1 (Entering) to 6 (Reaching), the last stage of which describes a student who is fully fluent and is labeled as FLEP (Formerly Limited English Proficiency).

To ensure that ELLs are receiving a high quality, comparable education to their native-speaking peers, teachers are trained in the skill set of sheltering content, or Sheltered English Immersion (SEI). Subject teachers must become SEI certified to ensure that mainstreamed ELLs have access to comprehensible content simultaneously with their continued instruction in speaking, reading, and writing in the English language.

According to information on the Massachusetts Department of Education website, the ELL population across Massachusetts has grown from 49,000 students to 71,000 students between 2002 and 2011. This equates to a percentage growth from 4.7% to 7.1%. ELL students are most prevalent in grades PK through 3, with a steady downward trend over time excepting grade 9, which can probably be attributed to families moving at an advantageous time for a life transition, such as beginning high school. The majority of ELL students identify as Hispanic Ethnicity. Black and Asian students are also prevalent.

Over half of all ELL students in Massachusetts are concentrated in only five districts, with Worcester holding the second largest portion with ~11.3% of the state's ELLs (approximately 8,318 students). Similar to the state level, most ELLs in Worcester are Spanish speakers. In Worcester, the majority of ELLs are concentrated in grades 3-8, a different trend than the rest of the state. Please note that these numbers are based on the most recent study on the DOE website, which includes an experience period through 2011.

On average, it takes ELLs in Massachusetts 3.5 years to transition out of LEP status. The more ELL students present in a school/district, the higher the average time until transition is, probably due to

limited resources. In Worcester, 20.16% of Level 5 ELLs transitioned during the experience period. Overall, the average time it takes for an ELL in Worcester to transition is 4.4 years, nearly one year greater than the state average, which is concerning.

To gain further insight into the ELL situation in Worcester, I reached out to several district members who work with ELLs. I spoke with Alice Garcia, who runs an after school program and teaches English to students and their parents. She has mentioned that there is a great deal of enthusiasm from parents regarding this course; they have a strong desire to learn how to communicate in English to further their opportunities and help their children with school. It is encouraging to hear that families are so invested in learning English and helping their children with such a daunting endeavor as well. I have also witnessed this while tutoring at the Computer Learning Center, where many of the children are ELLs. When parents come at night to pick up their children, they are very interested in what they did that day and how much homework they completed.

I also spoke with Hope Oliveras, an ELL coach in the Worcester District. While she was uncomfortable with making generalizations about the ELL population, she did say that most ELLS and their families came to America and Worcester for better career, economic, educational, and health opportunities. She also emphasized that many immigrants are not ELLs and are here as refugees, asylees, and legal immigrants, so no broad assumptions can be made regarding the relationship between immigrants and ELLs.

Ms. Oliveras also mentioned that ELL students and their families bring “culture, communicative competence, and knowledge of their community.” The sense of community is observable within the classroom as well. During my time observing at Doherty, I have noticed that students who speak the same first language tend to gravitate towards each other and appear to have relationships outside of school as well.

Finally, I spoke briefly with Mr. Levinson, whom I observed for SEI. He teaches a sophomore-level geometry class and the ELLs in his course grasp English well enough to manage the course with some content sheltering. Mr. Levinson did mention that there is an ESL class that many students are pulled out for as well.

Although many challenges face the Worcester district with regard to teaching ELLs effectively, through this assignment I have been exposed to multiple people who are committed to providing ELLs with the best education possible.

### 1.5 Diverse Learners

Throughout the education courses I have taken at WPI, combined with my SEI observation and observation with my Mentor Teacher, I have come to appreciate what diversity can bring to a classroom and school community. When I think of diverse learners, the obvious consideration that comes to mind is students' ethnic and cultural background and the experiences they have had (or not had) as a result. ELLs also bring a unique aspect to any classroom or school and enhance the diversity of the environment, as do students with IEPs and 504 plans. However, I also think of diverse learners as students who have had unique experiences that may not necessarily be a product of their culture; essentially, I never want to make assumptions about what my students can or cannot bring to the table without knowing a great deal about their previous experiences. I also recognize that students have very diverse interests, strengths, talents, and weakness that make them favor certain styles of content presentation, which is why I will always attempt to vary my instructional style to reach as many students as possible through as many mediums as possible. Furthermore, differing personal identities and social and political viewpoints can also affect how a student learns and the perspective they will bring into the classroom.

## Chapter 2: Organized Lesson Plans

There are various theories on the best way to write and execute an organized lesson plan. Throughout my practicum this is a skill that I honed. Key components of my lesson plans include an objective ("student will be able to" statement), Do Now activity, description of learning activities and formal or informal assessments on this learning, and a plan for homework or continued work. I also outline clear goals for what ELL students at various levels will be able to produce in English by the end of the lesson. Appendix A contains an example of one of my early lesson plans, on which my first formal observation was based. Appendix A contains this lesson plan.

## Chapter 3: Safe Learning Environment

I believe I created a safe learning environment where students understood that making a mistake creates an opportunity for significant learning. Aside from openly stating this, I also laid out the expectation that every student would spend time at the board or answering a question verbally. There were several class periods where I had many review questions, and we would go around the class in order and everyone was expected to at least attempt a solution. In this way, everyone was in the same situation, and although some students were slightly out of their comfort zone, they were never alone. I was also honest about how new I was to teaching, and that I would appreciate a safe environment as I learned how to be a teacher, and informed them that I would try to create a similar environment for them when I was teaching. Appendix B contains a lesson plan and evaluation form for a lesson that this was particularly important, because students were frustrated with the new, challenging topic. I believe we were able to productively work through their frustration because I created a safe space for thinking, learning, and sharing.

## Chapter 4: Adjustments to Practice

Throughout the course of my practicum I feel that I grew significantly in my ability to adjust my practice to the needs of the students. At the beginning of my teaching experience, I had trouble deviating from my plan in the moment and I relied on my mentor teacher's feedback to improve my instruction and maximize student understanding. However, as I gained more experience and confidence I was able to adjust my explanations in the moment and respond to students' expressions of confusion.

As I got to know the personality, strengths, weaknesses, and habits of each individual class, I began tailoring my style for each group. Although I taught four sections of Honors Precalculus in which I delivered all of the same material, I would change my emphasis and instructional style slightly for each class. The four groups were very distinct and teaching them as such strengthened our relationship and made content delivery more effective. Appendix C contains the lesson plan, candidate reflection form, and mentor teacher form for the unannounced observation to assess my ability to adjust my practice.

## Chapter 5: Meeting Diverse Needs

While many of my students were very high-performing, I still needed to be very cognizant of diverse learning styles and preferences among my classes. Not only did I consider how the students learned best, but I also gave thought to which skills, technical and communicative, needed the most improvement. In all of my classes I had several students who could correctly complete lengthy, complex math problems, and several who struggled with the technical calculations but were good communicators regarding their approach.

The lesson that I believe best illustrates my efforts to meet diverse needs—for instruction and for improvement—is the biorhythm project. This project took several class and homework periods, and it

was individually tailored to each student's exact age. It required students to perform analysis, create meaningful graphs, and answer critical thinking questions in paragraph form. While many students were initially frustrated with the writing requirement and the extended nature of this project, it ultimately strengthened their understanding of the material. Appendix D contains the lesson plan and reflection form for this project.

## Chapter 6: High Expectations

To convey my high expectations, I made it clear to my students that strengthening their problem solving and independent learning skills were a priority for me. At first this created some tension because it was a very different approach than they had previously experienced in a math classroom. The tension and frustration the students expressed taught me that I needed to actually teach the students how to leverage resources appropriately. To this end, we had a discussion about how to read the textbook, search the web for information, and how to find useful YouTube or Kahn Academy tutorials. Once students demonstrated competence in this area, I was able to start planning my lessons accordingly. There were many classes where I would provide some structure around how to prove and/or derive a formula they needed, and then left them to their own devices (as individuals or in small groups) to solve the problem while I walked around. Although this definitely stretched students to the edge of their comfort zone, the concepts seemed more meaningful to them and they remained engaged throughout the class period because they were completely responsible for their own learning, which would enable them to complete the homework. Appendix E contains an example of a lesson plan that required students to work through a derivation.

## Chapter 7: Reflective Practice

An important component of teaching is learning to leverage reflective practice to improve upon performance. To this end, I would have regular discussions with my mentor teacher, the department head, and other teachers in the math department about things I struggled with and how to improve. I found this to be extremely useful in assessing my strengths and weaknesses and brainstorming ways to utilize or improve them, respectively. Aside from the conversations I had within the context of Doherty, I also discussed these issues and ideas in our weekly seminar meeting led by Shari Weaver. This time was useful because I could hear about what other student teachers were experiencing and how they handled tricky situations. I learned from their approaches to delivering content and handling material, and utilizing that bond ultimately made me a better teacher. We also had weekly journal reflections that we would submit; I appreciated that structured time to reflect on what I was doing and how I could move forward. I definitely noticed that when I put time into reflecting on my work, the quality of my instruction would improve. A sample of one of these journal entries is available in Appendix G.

## Chapter 8: My WPI Education

I believe that my major and minor, Actuarial Mathematics and Writing and Rhetoric respectively, were extremely helpful in my teaching practicum. Although I was initially concerned that I was not coming in with a more traditional Mathematics major, the applied nature of my major was ultimately a huge asset. I was able to draw on my experience as an intern at a Fortune 500 insurance company to highlight the relevance of mathematics and how it empowers businesses to make important decisions. In fact, before I took over as the teacher of record, I spent a class period giving a presentation on the actuarial career and what my experiences had been so far. I believe this provided me with some ethos once I started teaching since I had utilized math in the real world and had significant financial

responsibility within a business. It also allowed me to create a bond with several students who were considering pursuing a career in mathematics and wanted to learn more about the actuarial field. Based on my experiences, I tried to emphasize the importance of communication, attention to detail, and reasonableness checks in my lessons and grading.

Surprisingly, my minor was also very helpful. I personally believe that many mathematics curricula do not sufficiently emphasize the importance of communicating mathematical findings, and it was a personal goal of mine to work on that in my classroom. I frequently integrated writing assignments into take home exams and projects. Although students initially resisted my request that they write well in a math class, they ultimately accepted the culture change, and I believe I made a lasting impact on some students in this area.

Since I was teaching Precalculus, which I learned before attending college, my major courses were not particularly useful when teaching. However, I found the courses I took as part of the Teaching Certification Program extremely useful. In particular, ID3100 prepared me to enter a classroom and handle the many challenges I would face, from technical to time management to behavioral. ID3100 gave me significant insight into how to write thorough lesson plans that would be practically useful. We also practiced different discipline strategies and learned about the cultural makeup of Doherty.

More formal instruction on pedagogical theories was provided in our course The Psychology of Education, where we learned about positive and negative reinforcement and the psychology behind assessments. Sheltered English Immersion, beyond providing us with a valuable certification, also taught us strategies to shelter content for the many ELL students we would encounter in our practicum.

## Chapter 9: Classes

During my time at Doherty, I taught four sections of Honors Precalculus totaling 90 students per day. Each class had a distinct personality, and they responded to different tactics and levels of discipline. Two of the classes had twenty seven students, while the other two had only eighteen students. This drastic difference in size was extremely noticeable, and it affected the dynamic I had with each class. I will now outline each of the classes, describe their personality, and identify the presence of ELLs or students with IEPs.

Block 2 was a class of twenty seven students, and was by far the rowdiest class. In Block 2 I had several ELL students: one student who originally spoke Vietnamese, and several who originally spoke Albanian. The Albanian students were fluent in English at the level five proficiency level, and the Vietnamese student was a level four. I also had one student with an IEP; he had a visual processing delay and was given the accommodation of having extra time on assessments. However, during the fifteen weeks of my practicum, there was only one assessment for which he requested extra time. This class had a broad range of academic skill and motivation. There were several extremely bright students, several who struggled and would have been better served in a non-honors level course, and the majority of the class was proficient. However, this was the class that tended to have the lowest homework completion rate, which would sometimes affect the pace at which we were able to move. Compounding this issue was the presence of several extremely disruptive students who would continually talk and distract those around them. Creating the best seating arrangement to mitigate disruption was by far one of the most challenging aspects of teaching this class. The large class size combined with the constant behavioral management made it difficult to build a bond with this class as strong as the bonds I had with my eighteen student classes. However, I did manage to create a strong bond with several students, one of whom I met with outside of class time on multiple occasions to discuss his options for college.

One of my most challenging students was in period 2. He was extremely bright, but got bored easily and was generally disrespectful and distracting. He would frequently talk during the lecture, answer questions before other students who were called on had the chance, and point out if I or another student made a mistake on the board in the most disrespectful manner. He would get an A on almost every assessment, but he never did his homework and had a D average in the class. I struggled for a significant portion of my practicum with how to manage his behavior. I would try to give him extra challenges during class time to keep him occupied while other students completed the basic assignment. Some days this would be helpful, while on other days he would choose to talk with his classmates or walk around the class over completing the additional work. Next, I tried to have a conversation with him to explain that while he was very gifted, some students in the class struggled with the material and would benefit from a quieter working environment with minimal distractions. However, this did not make an impact either.

At this point I conferred with my mentor teacher to determine the best course of action, which ended up being a dual approach. First, we contacted the student's mother and outlined the issue for her. While she had been aware of and concerned about the situation prior to when we reached out, this definitely sparked a new conversation and we saw some slight improvement. The second piece of behavior management was to contact the coach of the baseball team, an extracurricular that this student was eager to join. The coach was very supportive of our aim and was quick to support us in the capacity he could. Although these actions did not completely solve the issue, the student's behavior did improve significantly and allowed for a more safe and productive learning environment for the entire class. From this experience I learned that it is important to persevere in finding a solution to a student's distracting or disrespectful behavior. While I originally tried to have a rational discussion with him and provide other outlets for his mental energy, it became clear that a more strict approach was necessary for his particular

personality. While I probably will always attempt to first solve these issues with an open conversation, I feel more secure now having a behavioral management repertoire that includes reaching out to other stakeholders such as parents and sports coaches.

My fourth period class was significantly smaller at eighteen students. In this class I had one student with an IEP. She had trouble hearing and processing auditory cues. To accommodate this, I always made sure to repeat directions and write them out on the board/worksheet as well. The majority of students in this class were a part of the same close friend group, and they were very inclusive of other members of the class. The students had a wonderful sense of humor, and we were able to joke around and truly get to know one another without detracting from instructional time. Teaching them was truly a pleasure, and I was touched when they gave me a parting gift on the last day of my practicum. The ability level within this class was fairly consistent across the board, so we were able to maintain a pace that was comfortable for most students. Many of the students in this course were acting in the school's production of the musical *Anything Goes*, and were thrilled when I attended their performance, which I believe is the best example of the bond that I formed with this class. I had many discussions with these students about their college choices and potential career paths. I felt like I had a good idea of each student's personality, their academic strengths and weaknesses, and what they needed to succeed in my classroom. This class was the most amenable to—and productive during—group work. I was very pleased with this because I believe that group work is an incredibly important component of mathematics education.

Sixth period was the class with which I undoubtedly formed the closest bond. While many classes at Doherty are ethnically diverse (and mine were no exception), my sixth period was undoubtedly the most diverse. I had several Spanish-speaking ELLs who were all level five proficient. This class had the lowest mathematical proficiency level out of all of my sections, but they were also

definitely the hardest working. We quickly formed a positive rapport when they saw that I was willing to put in as much effort as they were. With hard work and some unconventional lesson plans they showed significant improvement in math skills—and their attitude towards math—for the most part. They were all extremely friendly and I was able to connect with every single student on a personal level. This class also had a fantastic sense of humor and I felt that I got to share a significant part of who I am with them while still maintain a professional and respectful relationship. On the last day of my practicum this class threw me a surprise party and all of the students brought in snacks and baked good and they gave me a Doherty sweater. The card they gave me contained truly heartfelt messages that I still read regularly. Several students said that I completely changed their attitude about math and said that I was the most competent student teacher they had experienced. This was the class that made me change my career path and commit to becoming a teacher.

My other most challenging student was in period six, although it was not a behavioral issue. When I first started observing during the first two weeks of my practicum, I noticed that one of the students was very quiet, wore gloves, and did not take notes. However, she appeared to watch the lecture closely. After noticing this behavior for several days in a row, I asked my mentor teacher if she was alright and why she never appeared to take notes. My mentor teacher replied that she was consistently a C student and that the gloves and lack of note taking was new. However, the teacher had not received a 504 form yet and was wary of confronting the student directly because she was painfully shy. After clearing it with my mentor teacher, I approached the student and asked if she would like some help taking notes. She replied that she would appreciate it since her hands were in a lot of pain and she could not hold a pencil. I decided not to pry but would sit with her during every class and take notes with her and help her work through the example problems. When the time came for the first exam of the term, I took her to a separate room and told her that I would write whatever she told me orally so that she could

participate in the assessment. She started to have an anxiety attack (which was apparently common for her during assessments), so I taught her a few breathing exercises. After she calmed down, she was able to complete a significant portion of the exam, and almost every question she answered was correct. This was a huge turning point for her and it boosted her confidence. She quickly came out of her shell and started answering questions in class, going so far to offer presenting her solution to a practice problem on the board if I would write it for her.

When I took over as the teacher of record, I made sure to print out a copy of notes for her every day and offered alternative ways for her to prove that she had spent time thinking about and working on the homework. During class when students were working through practice problems, she would get up and walk around to help other students or pair up with someone to work through the problem so that they could write down the answers. She quickly proved to be one of the brightest students in the class; after that first assessment that we worked on together, she consistently had the highest or second highest score on every test out of all 90 students and her grade shot up to an A. She gained a great deal of comfort in math and expressed gratitude for that. The experience taught me that a seemingly average student can excel when given the necessary accommodations if they know that their teacher has faith in them. Towards the end of my practicum she confided that she had recently been diagnosed with lupus, and she was so grateful that her experience in math had turned around. She is currently attending medical school with the intent of becoming a doctor. The work I did with this student is undoubtedly the part of my practicum of which I am most proud.

Finally, my seventh period group was also a class of 27 students. There was one ELL student who struggled due to chronic absence in addition to the language barrier. This was by far my most social group of students; this sometimes made them difficult to reign in, but it did make it easy to learn their personalities and to form bonds with them. Seventh period was the strongest academically, and I

frequently needed to plan extra examples to fill our time. Unfortunately, chronic absence was a prominent issue for this class, and the amount of make-up work to keep track of became overwhelming at time.

Overall, my classes were well-mannered and reasonably motivated. Having four classes of honors juniors and seniors definitely gave me a unique experience at Doherty. In speaking with other student teachers, I realized that my classes were significantly more manageable in terms of behavior and attitude. However, I still faced a few of the challenges endemic to urban public school districts. For example, several of my students had unreliable computer and internet access, so I needed to be cognizant of that when assigning homework, sending out useful study guides, or making announcements through Engrade email. Luckily, the school library was open several days of the week after school, so it was possible to assign computer-reliant homework if I gave sufficient notice. I also had many students who worked part time jobs to help support their family or save for college, which sometimes made it difficult to put enough time into their homework. It took me a while to fully understand and appreciate this fact, but once I did I made an effort to assign homework assignments that were high quality in terms of learning potential so that students could review the important concepts even if their time was limited.

## Conclusion

Throughout the course of my practicum I learned a significant amount about interacting with students, delivering content effectively, understanding socioeconomic challenges, and creating an environment where truly amazing learning can happen. I have demonstrated competency in all of the professional standards on which a teacher is assessed, and I believe I made a difference in the mathematics education that my students received. I had an amazing experience thanks to a wonderful school community and a supportive Mentor Teacher. Prior to this practicum, I was determined to enter the insurance industry as an actuary; however, this experience showed me that I have the potential to

make a much bigger impact and that I am better suited to a career in education, which I am actively pursuing.

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11. “Transitioning English Language Learners in Massachusetts: An Exploratory Data Review” Massachusetts Department of Elementary and Secondary Education, March 2012. http://www.nciea.org/publications/Transitioning%20ELL_CD12.pdf

# APPENDIX A: EVIDENCE FOR WELL-STRUCTURED LESSON PLANS

## STAGE 1 – DESIRED RESULTS

**Unit Title: ___Trigonometric Functions_____**

**Established Goals:**

- Evaluate and graph trigonometric functions, their inverses, and their reciprocals.
- Understand and leverage the unit circle.
- Use knowledge of trigonometric functions to model and evaluate real-world applications.

| **Understandings:** *Students will understand that…* | **Essential Questions:** |
|---|---|
| • Radians are an alternate way to measure angles, and have the benefit of being without units.<br>• There are 2π radians in each circle. | • How many radians are in each circle?<br>• How do the arc length, radius, and angle measure relate in terms of radians?<br>• How can we convert between radians and degrees? |
| Students will know:<br><br>• That a radian is the ratio of the arc length to the radius of the circle. | Students will be able to:<br><br>• Convert degrees to radians and radians to degrees.<br>• Define and identify coterminal angles.<br>• Justify why there are 2π radians in each circle. |

## STAGE 2 – ASSESSMENT EVIDENCE

| **Performance Tasks:** | **Other Evidence:** |
|---|---|
| • "Voting" response to Do Now<br>• Correct completion of circle activity<br>• Successful completion of conversion questions. | • Homework assignment that will be checked the following day.<br>• P. 261 13-16, 25,26<br>P.262 31-33,47,49,51,52 |
| **Key Criteria:** | |

- Completion of problem/task.
- Careful to cancel units appropriately and show work.

## STAGE 3 – LEARNING PLAN

**Summary of Learning Activities:**

- Going over Do Now, have students put their heads down and "vote" for the quadrant option they believe to be the correct answer. Tailor detail level of explanation to the results of the class—how many were correct, and if there were common mistakes.
- Provide a brief explanation about the history of degrees as a unit of measure. Ancient Egyptians identified four seasons of approximately 90 days each; since they chose to represent their calendar as a circle, this naturally led to 360 "degrees."
- Give each student a paper circle with the radius drawn on and a piece of string. Have students cut or mark the string to be the exact length as the radius. There should be circles with different radii throughout the classroom so that students can see that radian measures hold for circles of all sizes. Have each student take the string, measure the radius, and then lay it on the circumference of the circle and mark where it ends to create a sector. Have them repeat until they've made it all the way around the circle. Sketch a circle on the whiteboard and label a radian, and present it as an alternate way to measure angles.
- Ask students, based on the activity, how many radians they believe are in each circle. (Good time to show animation).
- Explain (with examples) how to convert between degrees and radians. Put up several questions on the board and circulate as students solve, have correct answers present their work on the board. Stress the importance of keeping track of units.
- If time allows, introduce supplementary and complementary angles. (For ELLs, stress that alphabetical order with respect to angle size holds—i.e. complementary goes with 90 degrees and supplementary goes with 180 degrees).

# APPENDIX B: EVIDENCE FOR SAFE LEARNING ENVIRONMENT

## Figure B.1: Lesson Plan

### Lesson Plan Title: Unit Circle and Trigonometric Identities

Teacher's Name: Gabrielle Amarosa  Subject/Course: Honors Precalculus

Unit: Trigonometric Functions  Grade Level: 11-12

Overview of and Motivation for Lesson:

Strengthening student's understanding of the trigonometric functions and the relationships between them will give them the skills necessary to solve more complex, applied trig problems.

| Stage 1-Desired Results | |
|---|---|
| Standard(s):<br>• CCSS.MATH.CONTENT.HSF.TF.A.3<br>• CCSS.MATH.CONTENT.HSF.TF.C.8 | |
| Understanding(s):<br>*Students will understand that . . .* | Essential Question(s):<br>How are trig functions interrelated? How can we prove this relationship? |

| | |
|---|---|
| • Trigonometric functions are interrelated and we can use geometry knowledge to derive relationships. | |
| **Content Objectives:**<br><br>**Knowledge:** *Students will know . . .*<br><br>• How to evaluate a trig function using only the first quadrant and the ASTC pneumonic.<br>• The 3 Pythagorean trig identities<br><br>**Skills/Performance:** *Students will be able to . . .*<br><br>• Derive the Pythagorean trig identities<br>• Use the Pythagorean trig identities to solve problems | **Language Objectives:**<br><br>ELD Level 5 *Students will be able to . . . in English*<br><br>• Write cohesive reflection sentences to answer the follow-up questions.<br>ELD Level 4 *Students will be able to . . . in English*<br><br>• Write cohesive reflection sentences to answer the follow-up questions. |
| **Key Vocabulary**<br><br>Pythagorean trig identity, sine, cosine, tangent, secant, cosecant, cotangent | |
| **Stage 2-Assessment Evidence** | |
| **Performance Task(s) or Key Evidence**<br><br>• Derive Pythagorean trig identities<br>• Evaluate trig functions | **Other Evidence:**<br><br>• Utilize trig identities to solve problems |
| **Key Criteria to measure Performance Task (s) or Key Evidence**<br><br>• Completed derivations | |
| **Stage 3- Learning Plan** | |
| **Learning Activities:** | |

Do Now/Bell Ringer/Opener: Review ASTC pneumonic and practice evaluating trig functions using that strategy.

Learning Activity 1:

Review homework for further reinforcement and derive Pythagorean identities.

Closing

**Review main components of the lesson and highlight which homework problems should be attempted again.**

**Multiple Intelligences Addressed:**

| | | | |
|---|---|---|---|
| ☒ Linguistic | ☒ Logical-Mathematical | ☐ Musical | ☐Bodily-kinesthetic |
| ☒ Spatial | ☐ Interpersonal | ☐Intrapersonal | ☐Naturalistic |

**Student Grouping**

☒ Whole Class ☐ Small Group ☐ Pairs ☒ Individual

**Instructional Delivery Methods**

| | | |
|---|---|---|
| ☒ Teacher Modeling/Demonstration | ☒ Lecture | ☒ Discussion |
| ☐ Cooperative Learning | ☐ Centers | ☒ Problem Solving |
| ☐ Independent Projects | | |

| Accommodations | Modifications |
|---|---|
| Leave model up on board throughout class period for student with visual processing delay. | N/A |

**Homework/Extension Activities:**

Retry difficult homework problems from previous evening using new skills.

| Materials and Equipment Needed: |
|---|
| • Paper<br>• Pencil<br>• Textbook |

Adapted from Grant Wiggins and Jay McTighe-*Understanding by Design*

## Figure B.2: Candidate Reflection Form

Model Observation Protocol: Candidate Self-Reflection Form

Directions: Following an announced or an unannounced observation, please use the form below to reflect on the lesson. Submit the form to your Supervising Practitioner/Program Supervisor within 24 hours of the observation.

| **Observation Details** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date: | 2/25 | | | Time (start/end): | 6th period (12:13-12:55) | | |
| Content Topic/ Lesson Objective: | Students will be able to evaluate trig functions by only referencing the first quadrant of the unit circle and the "ASTC" pneumonic. Students will be able to verify statements using trig identities. | | | | | | |
| Type of Observation: | | | | Observed by: | | | |
| | Announced | X | Unannounced | X | Supervising Practitioner | | Program Supervisor |

| **Reflection Prompt**: *What do you think went particularly well? How did this strength impact your students' learning?* |
|---|
| **I think that the review of several challenging homework problems went well. Students proposed various methods of approaching the tricky problems and we were able to have a dialog about why I would be inclined to start a program a certain way. I believe it gave them more insight into how to think about problems and that they learned how to think more strategically rather than just following an explicit method they previously learned.** |
| **Reflection Prompt**: *If you could teach this lesson again, is there anything you would do differently? How would this have impacted your students' learning?* |
| I would have had students come up to the board. Typically I ask students to present their work at one point in the class or another. I used cold-call in this lesson; while this is effective, I prefer to mix both techniques together. I think students may have benefited from hearing a slightly different explanation, and having students go up to the board promotes a more dynamic class environment. |

| Essential Element | **Evidence:** Where possible, provide one piece of evidence that you believe demonstrates your performance relative to the quality, consistency or scope of each element. |
|---|---|
| 1.A.4: Well-Structured Lessons | Lesson plan |
| 1.B.2: Adjustments to Practice | I adjusted this lesson from the earlier times I taught it during the day as I saw what specific types of problems students were struggling with. |
| 2.A.3: Meeting Diverse Needs | I always try to incorporate the strategies I learned in my SEI course, such as avoiding idioms, speaking clearly, and reinforcing my verbal communication with written examples. |
| 2.B.1: Safe Learning Environment | I treated students with respect while also maintaining the ability to joke around and have a lively classroom atmosphere. |
| 2.D.2: High Expectations | I gave students cues about how quickly students should be able to complete problems with limited references. |

# APPENDIX C: EVIDENCE FOR ADJUSTMENT TO PRACTICE

## Figure C.1: Lesson Plan

**Lesson Plan Title: Law of Cosines Application**

**Teacher's Name: Gabrielle Amarosa** **Subject/Course: Honors Precalculus**

**Unit: Law of Sines and Cosines** **Grade Level: 11-12**

**Overview of and Motivation for Lesson:**

**Law of Cosines can be used in real-life applications such as navigation and surveying. This activity provides an example of the latter.**

| **Stage 1-Desired Results** |
|---|
| **Standard(s):**<br>• CCSS.MATH.CONTENT.HSG.SRT.D.10<br>• CCSS.MATH.CONTENT.HSG.SRT.D.11 |

<table>
<tr><td>Understanding(s):<br><br>Students will understand that . . .<br><br>• The Law of Cosines can be used to solve real life problems when a triangle can be constructed such that all three sides are known or two sides and their included angle is known.</td><td>Essential Question(s):<br><br>How can the Law of Cosines help a surveyor find the distance across a lake? What other similar problems could be tackled with this formula?</td></tr>
<tr><td>Content Objectives:<br><br>Knowledge: Students will know . . .<br><br>• The formula for the Law of Cosines and what each variable represents.<br><br>Skills/Performance: Students will be able to . . .<br><br>• Use the Law of Cosines properly to solve for the missing information.</td><td>Language Objectives:<br><br>ELD Level 4 Students will be able to . . . in English<br><br>• Discuss the problem solving process with their group mates and compare steps and answers.<br>ELD Level 5 Students will be able to . . . in English<br><br>• Discuss the problem solving process with their group mates and compare steps and answers.</td></tr>
<tr><td colspan="2">Key Vocabulary<br><br>Law of Cosines<br><br>SSS, SAS</td></tr>
<tr><td colspan="2">Stage 2-Assessment Evidence</td></tr>
<tr><td>Performance Task(s) or Key Evidence<br><br>• Ask students to calculate their percent error at the end of the activity. With high error, determine and discuss whether the issue is stemming from poor measurement or incorrect use of the formula.</td><td>Other Evidence:<br><br>• Observing students while they perform the task.</td></tr>
</table>

**Key Criteria to measure Performance Task (s) or Key Evidence**

- Percent error

**Stage 3- Learning Plan**

**Learning Activities:**

Do Now/Bell Ringer/Opener: Have students gather the materials that they will need.

Learning Activity 1:

Explain what they will be doing outside and what the deliverables will be.

Learning Activity 2:

Have students go outside, draw their "lakes," and take the necessary measurements to calculate the distance.

Closing

**Return inside to complete their calculations. Share percent error and discuss what could have been the cause of that error.**

**Multiple Intelligences Addressed:**

| | | | |
|---|---|---|---|
| ☒ Linguistic | ☒ Logical-Mathematical | ☐ Musical | ☐Bodily-kinesthetic |
| ☒ Spatial | ☒ Interpersonal | ☐Intrapersonal | ☐Naturalistic |

**Student Grouping**

| | | | |
|---|---|---|---|
| ☒ Whole Class | ☒ Small Group | ☐ Pairs | ☐ Individual |

**Instructional Delivery Methods**

☒ Teacher Modeling/Demonstration ☐ Lecture ☐ Discussion

| | |
|---|---|
| ☒ Cooperative Learning ☐ Centers ☒ Problem Solving<br>☐ Independent Projects | |
| **Accommodations**<br>One student cannot write and they worked with a partner. | **Modifications**<br>None |
| **Homework/Extension Activities:**<br>Further practice with the Law of Cosines.<br>p. 417 7-12, 31-33 | |
| **Materials and Equipment Needed:**<br>• Yardstick, sidewalk chalk, protractor, notebook, pencil, graphing calculator | |

**Adapted from Grant Wiggins and Jay McTighe-*Understanding by Design***

## Figure C.2: Candidate Self-Reflection Form

Model Observation Protocol: Candidate Self-Reflection Form

Directions: Following an announced or an unannounced observation, please use the form below to reflect on the lesson. Submit the form to your Supervising Practitioner/Program Supervisor within 24 hours of the observation.

| **Observation Details** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date: | 4/27 | | | Time (start/end): | 2nd period (8:09-8:51) | | |
| Content Topic/ Lesson Objective: | Students will be able to use the Law of Cosines to model a fairly realistic situation and calculate their percent error. | | | | | | |
| Type of Observation: | | | | Observed by: | | | |
| ☐ | Announced | X | Unannounced | X | Supervising Practitioner | ☐ | Program Supervisor |

| **Reflection Prompt**: *What do you think went particularly well? How did this strength impact your students' learning?* |
|---|
| **I think it was an asset to have a lesson plan that got students out of their seats, working with classmates, and modeling a situation that they could imagine happening in the real world. I believe that this engaged students and gave them the opportunity for clarification through working with their peers.** |
| **Reflection Prompt**: *If you could teach this lesson again, is there anything you would do differently? How would this have impacted your students' learning?* |
| I would have one group present their work on the board and speak critically about the percent error they got and the potential reasons for it. That would have been a better wrap-up to the lesson. |

| **Essential Element** | **Evidence:** Where possible, provide one piece of evidence that you believe demonstrates your performance relative to the quality, consistency or scope of each element. |
|---|---|
| 1.A.4: Well-Structured Lessons | Lesson plan |
| 1.B.2: Adjustments to Practice | Throughout the day I made the instructions increasingly more clear so that our time outside could be used efficiently. |
| 2.A.3: Meeting Diverse Needs | I always try to incorporate the strategies I learned in my SEI course, such as avoiding idioms, speaking clearly, and reinforcing my verbal communication with written examples. |
| 2.B.1: Safe Learning Environment | I treated students with respect while also maintaining the ability to joke around and have a lively classroom atmosphere. |
| 2.D.2: High Expectations | I believe I am explicit about the quality of work and behavior I expect from my students. |

## Figure C.3: Mentor Teacher Assessment

Observation Form: Unannounced Observation #2

| What: | **Observation # 2** | How: | **Unannounced** |
|---|---|---|---|
| Who: | Supervising Practitioner Kathleen O'Leary | | |
| Focus Elements: | 1.B.2: Adjustment to Practice & Others as identified during the Formative Assessment | | |
| **Observation Details** | | | |
| Date: | April 27, 2016 | Time (start/end): | 8:10-8:51 am |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Content Topic/Lesson Objective: | | | Students were using the Law of Cosines to solve a practical application. This involved the students (in small groups) constructing models of a lake, outside, measuring sides and angles needed to calculate (individually) a missing side. Then students found the percent error | | | | |
| x | Whole Group | x | Small Group | | One-on-One | | Other |

*Active Evidence Collection occurred during the observation and is synthesized and categorized below.*

| **Element*** | **Evidence**** |
|---|---|
| 1.A.4 | |
| 1.B.2* | Gabrielle has been able adjust her teaching style to engage all students. This was evident in this lesson, as the students worked outside in small groups, after receiving a little instruction, then transitioned back to the class to solve problems individually. This lesson appealed to a variety of learning styles and brought the topic to life with a genuine application. |
| 2.A.3 | |
| 2.B.1 | |
| 2.D.2 | |
| 4.A.1 | |

| **Focused Feedback** | |
|---|---|
| Reinforcement Area/Action: *(strengths)* | Gabrielle has strong subject knowledge, is well prepared for every class, is able to answer questions, treats all of the students with respect and dignity, demonstrates professionalism and flexibility. |
| Refinement Area/Action: *(areas for improvement)* | Consider extensions for students who finish quicker than others. |

# APPENDIX D: EVIDENCE FOR MEETING DIVERSE NEEDS

## Figure D.1: Lesson Plan

### Lesson Plan Title: Biorhythms Project

Teacher's Name: Gabrielle Amarosa  Subject/Course: Honors Precalculus

Unit: Graphing Sine and Cosine  Grade Level: 11-12

Overview of and Motivation for Lesson:

Application of graphing sinusoidal waves to model a real-world system. Will expose students to working with more realistic data and graph alterations.

<table>
<tr><th colspan="2">Stage 1-Desired Results</th></tr>
<tr><td colspan="2">Standard(s):<br><br>• CCSS.MATH.CONTENT.HSF.TF.B5</td></tr>
<tr><td>Understanding(s):<br><br>Students will understand that . . .<br><br>• Sinusoidal waves are useful for modeling real-world systems. Students will understand that real data does not always "fit" nicely and that they will need to adjust their equations to accommodate realistic data.</td><td>Essential Question(s):<br><br>How can various aspects of equations and graphs (i.e. amplitude, period, phase shift) be useful in modeling real-world scenarios?</td></tr>
<tr><td>Content Objectives:<br><br>Knowledge: Students will know . . .<br><br>• That biorhythms can be modeled by sinusoidal waves.<br>• Phase shift is determined by the student's current age in number of days.<br><br>Skills/Performance: Students will be able to . . .</td><td>Language Objectives:<br><br>ELD Level 5 Students will be able to . . . in English<br><br>• Write cohesive reflection sentences to answer the follow-up questions.<br>ELD Level 4 Students will be able to . . . in English<br><br>• Write cohesive reflection sentences to answer the follow-up questions.</td></tr>
</table>

| | |
|---|---|
| • Adjust phase shift and period appropriately given the cycle and age in days.<br>• Graph neat, accurate graphs over one full period. | |

**Key Vocabulary**

Amplitude, period, phase shift.

## Stage 2-Assessment Evidence

| Performance Task(s) or Key Evidence | Other Evidence: |
|---|---|
| • Complete computations and graphing correctly. | • Content and depth of responses to culminating reflection questions. |

**Key Criteria to measure Performance Task (s) or Key Evidence**

- Completed graphs, equations, and reflection questions to be collected on Monday.

## Stage 3- Learning Plan

**Learning Activities:**

Do Now/Bell Ringer/Opener: Due to limited time, this will consist of students gathering their materials and getting out the pre-work they were assigned (calculating their age in number of days).

Learning Activity 1:

Present example of how to approach graphing one curve. Use example of own birth date to show how to calculate period and phase shift of physical cycle and then sketch graph.

Learning Activity 2:

Have students work individually on their own graphs while circulating to answer their questions.

Closing

Since this will be a multi-day project, may let students work until the bell. If there were clearly areas of confusion I will stop their individual work a few minutes before the end of class to address their concerns and possibly run through another example and reiterate the expectations.

## Multiple Intelligences Addressed:

| | | | |
|---|---|---|---|
| ☒ Linguistic | ☒ Logical-Mathematical | ☐ Musical | ☐Bodily-kinesthetic |
| ☐ Spatial | ☐ Interpersonal | ☐Intrapersonal | ☐Naturalistic |

## Student Grouping

☒ Whole Class ☐ Small Group ☐ Pairs ☒ Individual

## Instructional Delivery Methods

| | | |
|---|---|---|
| ☒ Teacher Modeling/Demonstration | ☐ Lecture | ☐ Discussion |
| ☐ Cooperative Learning | ☐ Centers | ☒ Problem Solving |
| ☒ Independent Projects | | |

| Accommodations | Modifications |
|---|---|
| Leave model up on board throughout class period for student with visual processing delay. | N/A |

## Homework/Extension Activities:

Complete project and discussion questions due next Monday.

## Materials and Equipment Needed:

- Rulers
- Graph Paper
- Calculators

Adapted from Grant Wiggins and Jay McTighe-*Understanding by Design*

# Figure D.2: Candidate Self-Reflection Form

Model Observation Protocol: Candidate Self-Reflection Form

Directions: Following an announced or an unannounced observation, please use the form below to reflect on the lesson. Submit the form to your Supervising Practitioner/Program Supervisor within 24 hours of the observation.

| **Observation Details** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date: | March 16, 2016 | | | Time (start/end): | 8:09-8:51 | | |
| Content Topic/ Lesson Objective: | Applications of graphing sine and cosine using biorhythms. | | | | | | |
| Type of Observation: | | | | Observed by: | | | |
| x | Announced | | Unannounced | x | Supervising Practitioner | x | Program Supervisor |

**Reflection Prompt***: What do you think went particularly well? How did this strength impact your students' learning?*

**I think the structure of the lesson where I gave a brief example and then circulated to answer students' questions individually while they worked through the project was useful because they learn more through individual explanation than lecture, even if both seem to contain the same content.**

**Reflection Prompt**: *If you could teach this lesson again, is there anything you would do differently? How would this have impacted your students' learning?*

There were some aspects of the directions that seemed to confuse students which I did not anticipate, so I would probably be more explicit based on that. However, I did adjust my explanations when I taught the lesson three times later in the day based on my experience with this class.

| **Essential Element** | **Evidence:** Where possible, provide one piece of evidence that you believe demonstrates your performance relative to the quality, consistency or scope of each element. |
|---|---|
| 1.A.4: Well-Structured Lessons | Lesson plan attached |
| 1.B.2: Adjustments to Practice | Have adjusted to each class' strengths and weaknesses and adjust my explanations and what I emphasize accordingly. |
| 2.A.3: Meeting Diverse Needs | Provided written directions in addition to verbal instruction to accommodate ELLs and students with IEPs. |
| 2.B.1: Safe Learning Environment | Try to maintain a comfortable environment where everyone is expected to participate and emphasize the role of mistakes as learning opportunities. |

| | |
|---|---|
| 2.D.2: High Expectations | Make it clear that I expect everyone to present their best effort and practice learning concepts on their own and provide resources to do so. Hold everyone to the same standard. |

# APPENDIX E: EVIDENCE FOR HIGH EXPECTATIONS

## Figure E.1: Law of Sines Lesson Plan

### Lesson Plan Title: Deriving the Law of Sines

Teacher's Name: Gabrielle Amarosa  Subject/Course: Honors Precalculus

Unit: Graphing Sine and Cosine  Grade Level: 11-12

Overview of and Motivation for Lesson:

The Law of Sines is a useful tool for solving trigonometric problems in theoretical and applied settings. Deriving this equation will lead students to a deeper understanding of the formula and provide the skills necessary to recreate it should they forget the equation.

<table>
<tr><th colspan="2">Stage 1-Desired Results</th></tr>
<tr><td colspan="2">Standard(s):<br><br>CCSS.MATH.CONTENT.HSG.SRT.D.10</td></tr>
<tr><td>Understanding(s):<br><br>Students will understand that . . .<br><br>• The Law of Sines is a relationship between opposite sides and angles that can be used to solve unknown information about a triangle.</td><td>Essential Question(s):<br><br>If we have a non-right triangle, how can we solve for missing side lengths and angle measures?</td></tr>
<tr><td>Content Objectives:<br><br>Knowledge: Students will know . . .<br><br>• The formula for the Law of Sines, how it is derived, and how the pieces of information are related.</td><td>Language Objectives:<br><br>ELD Level 5 Students will be able to . . . in English<br><br>• Write cohesive reflection sentences to answer the follow-up questions.<br>ELD Level 4 Students will be able to . . . in English<br><br>• Write cohesive reflection sentences to answer the follow-up questions.</td></tr>
</table>

| Skills/Performance: *Students will be able to . . .*<br><br>• Defend the derivation of the Law of Sines and apply it to realistic situations | |
|---|---|
| Key Vocabulary<br><br>Altitude, vertex, sine | |
| **Stage 2-Assessment Evidence** | |
| Performance Task(s) or Key Evidence<br><br>• Correct Law of Sines formula | Other Evidence:<br><br>• Ability to use the Law of Sines to solve a triangle |
| Key Criteria to measure Performance Task (s) or Key Evidence<br><br>• Completed derivation that students can defend verbally. | |
| **Stage 3- Learning Plan** | |
| Learning Activities:<br><br>Do Now/Bell Ringer/Opener: Review of the definition of altitude and AAS, ASA, and SSA triangles.<br><br>Learning Activity 1:<br><br>Have students work independently or in small groups to follow the derivation guidelines to ultimately arrive at the Law of Sines formula. Teacher will circulate to answer questions and guide work.<br><br>Closing<br><br>Review of the derivation process and confirmation of the final formula. Will also present an example of how to use this law to solve a triangle. | |

**Multiple Intelligences Addressed:**

| | | | |
|---|---|---|---|
| ☒ Linguistic | ☒ Logical-Mathematical | ☐ Musical | ☐ Bodily-kinesthetic |
| ☐ Spatial | ☐ Interpersonal | ☐ Intrapersonal | ☐ Naturalistic |

**Student Grouping**

☒ Whole Class ☒ Small Group ☐ Pairs ☒ Individual

**Instructional Delivery Methods**

| | | |
|---|---|---|
| ☐ Teacher Modeling/Demonstration | ☐ Lecture | ☐ Discussion |
| ☒ Cooperative Learning | ☐ Centers | ☒ Problem Solving |
| ☒ Independent Projects | | |

| Accommodations | Modifications |
|---|---|
| Every student will get a written copy of the instructions so that those who need extra processing time will have access to the information at all times. | N/A |

**Homework/Extension Activities:**

Law of Sines application problems

**Materials and Equipment Needed:**

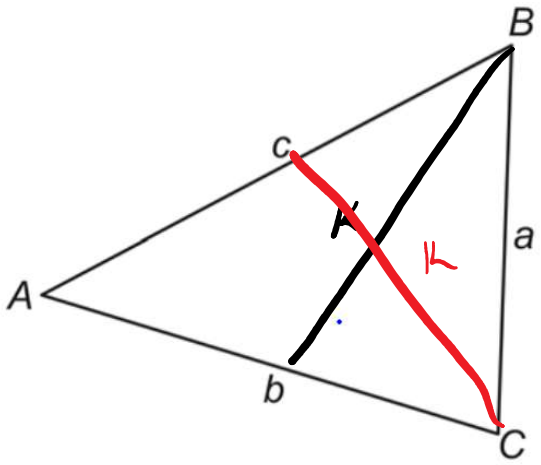
- Pencil
- Paper
- Instruction sheet

Adapted from Grant Wiggins and Jay McTighe-*Understanding by Design*

## Figure E.2: Law of Sines Lesson Worksheet

4.25 Lesson

*useful for AAS, ASA, and SSA triangles. However, SSA triangles can yield no solution or multiple solutions.




$\sin A = \frac{k}{c} \rightarrow k = c\sin A$

$\sin C = \frac{k}{a} \rightarrow k = a\sin C$

$c\sin A = a\sin C$

$\frac{a}{\sin A} = \frac{c}{\sin C}$

$\sin A = \frac{k}{b} \rightarrow k = b\sin A$

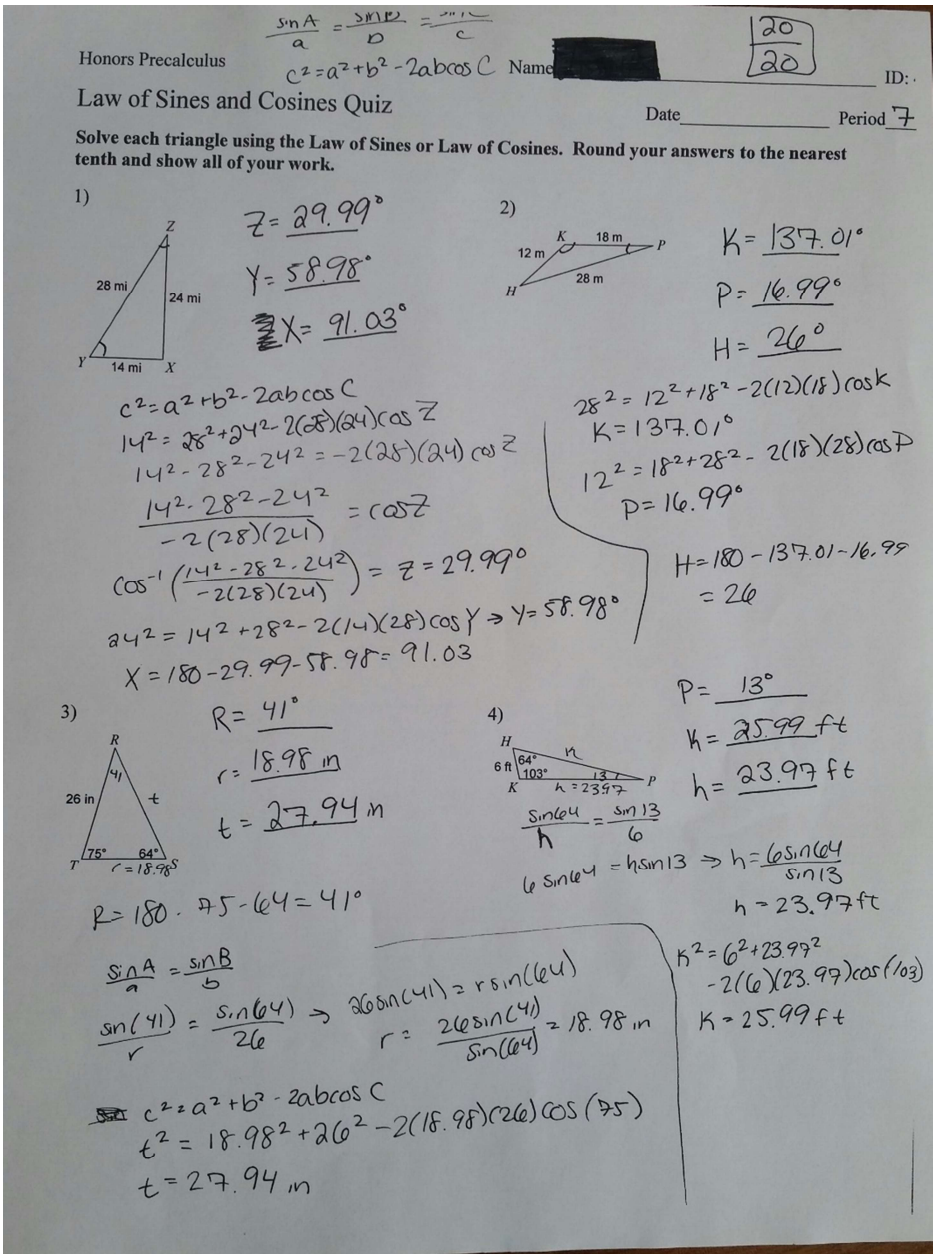
$\sin B = \frac{k}{c} \rightarrow k = a\sin B$

$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

1. Sketch an altitude from vertex B.
2. Label the altitude k.
3. The altitude creates two right triangles inside ΔABC. Notice that angle A is contained in one of the right triangles and angle C is contained in the other. Using right triangle trigonometry, write two equations, one involving sinA and the other involving sinC.
   sinA=_____ sinC=_____
4. Solve each equation for k and set equal to each other.
5. Regroup the equation from #4 so that sinA and a are together, as are sinC and c.
6. Consider the same triangle ΔABC again. Now draw an altitude from vertex C and label it k.
7. Write equations for sinA=_____ and sinB=_____
8. Solve equations in #7 for k and set equal.
9. Regroup the equation from #8 so that sinA and a are together and sinB and b are together.
10. Use the results from #5 and #9 to write one equation relating a, b, c, sinA, sinB, and sinC.

# APPENDIX F: SAMPLES OF STUDENT WORK

## Figure F.1: Results of Law of Sines and Cosine Quiz (One perfect score, one medium score, and one low score)



Honors Precalculus

$c^2 = a^2 + b^2 - 2ab\cos C$

Name [redacted] ID:

20/20

Law of Sines and Cosines Quiz

Date _____ Period 7

**Solve each triangle using the Law of Sines or Law of Cosines. Round your answers to the nearest tenth and show all of your work.**

1)




Z = 29.99°

Y = 58.98°

X = 91.03°

$c^2 = a^2 + b^2 - 2ab\cos C$

$14^2 = 28^2 + 24^2 - 2(28)(24)\cos Z$

$14^2 - 28^2 - 24^2 = -2(28)(24)\cos Z$

$\frac{14^2 - 28^2 - 24^2}{-2(28)(24)} = \cos Z$

$\cos^{-1}\left(\frac{14^2 - 28^2 - 24^2}{-2(28)(24)}\right) = Z = 29.99°$

$24^2 = 14^2 + 28^2 - 2(14)(28)\cos Y \rightarrow Y = 58.98°$

$X = 180 - 29.99 - 58.98 = 91.03$

2)




K = 137.01°

P = 16.99°

H = 26°

$28^2 = 12^2 + 18^2 - 2(12)(18)\cos K$

K = 137.01°

$12^2 = 18^2 + 28^2 - 2(18)(28)\cos P$

P = 16.99°

H = 180 − 137.01 − 16.99 = 26

3)




R = 41°

r = 18.98 in

t = 27.94 in

R = 180 − 75 − 64 = 41°

$\frac{\sin A}{a} = \frac{\sin B}{b}$

$\frac{\sin(41)}{r} = \frac{\sin(64)}{26} \rightarrow 26\sin(41) = r\sin(64)$

$r = \frac{26\sin(41)}{\sin(64)} = 18.98$ in

$c^2 = a^2 + b^2 - 2ab\cos C$

$t^2 = 18.98^2 + 26^2 - 2(18.98)(26)\cos(75)$

$t = 27.94$ in

4)




P = 13°

h = 25.99 ft

h = 23.97 ft

$\frac{\sin 64}{h} = \frac{\sin 13}{6}$

$6\sin 64 = h\sin 13 \Rightarrow h = \frac{6\sin 64}{\sin 13}$

h = 23.97 ft

$h^2 = 6^2 + 23.97^2 - 2(6)(23.97)\cos(103)$

K = 25.99 ft

Honors Precalculus

17/20

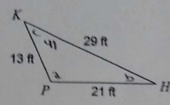
Name [redacted] ID:

Law of Sines and Cosines Quiz

Date 4/29/16 Period 6

**Solve each triangle using the Law of Sines or Law of Cosines. Round your answers to the nearest tenth and show all of your work.**

1)




K = 41°

P = 115°

H = 24°

$21^2 = 13^2 + 29^2 - 2(13)(29)\cos C$

$441 = 169 + 841 - 754\cos C$

$-569 = -754\cos C$

$.75 = \cos C$

$41 = C$

$29^2 = 13^2 + 21^2 - 2(13)(21)\cos P$

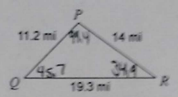
$841 = 169 + 441 - 546\cos P$

$231 = -546\cos P$

$115 = P$

$180 - 115 - 41 = 24$

2)




P = 99.4°

Q = 45.7°

R = 34.9°

$14^2 = 11.2^2 + 19.3^2 - 2(11.2)(19.3)\cos Q$

$196 = 125.44 + 372.49 - 432.32\cos Q$

$-301.93 = -432.32\cos Q$

$.69 = \cos Q$

$45.7 = Q$

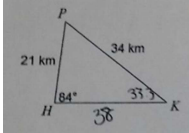
$11.2^2 = 14^2 + 19.3^2 - 2(14)(19.3)\cos R$

$125.44 = 196 + 372.49 - 540.4\cos R$

$.81 = \cos R$

$34.9 = R$

3)




P = 62.7° 58.1°

K = 33.3° 37.9°

p = 38 km 29 km

-3

$P^2 = 21^2 + 34^2 - 2(21)(34)\cos 84$

$P^2 = 441 + 1156 - 1428\cos 84$

$P^2 = 1597 - 1428\cos 84$

$P^2 = 1597 - 149.26$

$\sqrt{P^2} = \sqrt{1447.74}$

$P = 38$

$21^2 = 38^2 + 34^2 - 2(38)(34)\cos K$

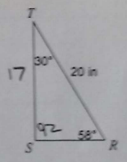
$441 = 1444 + 1156 - 2584\cos K$

$.8 = \cos K$

$33.3 = K$

$180 - 84 - 33.3 =$

4)




S = 92°

r = 17 in

t = 10 in

$\frac{\sin 92}{20} = \frac{\sin 58}{R}$

$.049R = \sin 58$

$\sin 92R = 20\sin 58$

$\frac{\sin 58}{17} = \frac{\sin 30}{T}$

$T\sin 58 = 17\sin 30$

$T = 10$

Honors Precalculus

12/20

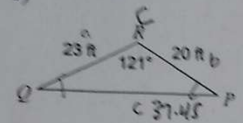
Name [redacted] ID:

# Law of Sines and Cosines Quiz

Date April 29th, 2016 Period 2

**Solve each triangle using the Law of Sines or Law of Cosines. Round your answers to the nearest tenth and show all of your work.**

1)




r = 37.45 ft

Q = 27.25°

P = 31.75°

-1.5

$c^2 = a^2 + b^2 - 2ab\cos C$

$c^2 = 23^2 + 20^2 - 2(23)(20)\cos 121$

$c = \sqrt{929 - 920\cos 121}$

$= 37.45$

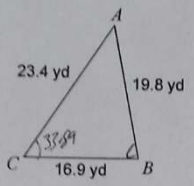
$\cos^{-1}\left(\frac{20^2 - 23^2 - 37.45^2}{-2(23)(37.45)}\right)$ P = 23°

Q = 27.25

P = 180 - 121 - 27.25

= 31.75

2)




A = 95.11°

B = 78.79°

C = 56.10°

-1.5

$\cos^{-1}\left(\frac{19.8^2 - 23.4^2 - 16.9^2}{-2(23.4)(16.9)}\right)$

C = 56.10

$\cos^{-1}\left(\frac{23.4^2 - 16.9^2 - 19.8^2}{-2(16.9)(19.8)}\right)$

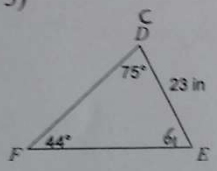
B = 78.79

A = 180 - C - B 180 - 78.79 - 56.10

= ~~180 - 56.10 - 78.79~~

= 134.89

3)



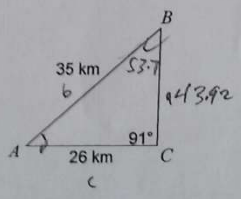

E = 61°

e = 29 -1

d = 32 -1

E = 180 - (44 + 75)

4)




a = 43.92 23 km

A = 52.71 41°

B = 36.29 48°

-3

$c^2 = a^2 + b^2 - 2ab\cos C$

$c^2 = 35^2 + 26^2 - 2(35)(26)\cos 91$

$c = \sqrt{1901 - 1610\cos 91}$

$= 43.92$

$A = \cos^{-1}\left(\frac{43.92^2 - 35^2 - 26^2}{-2(35)(26)}\right)$

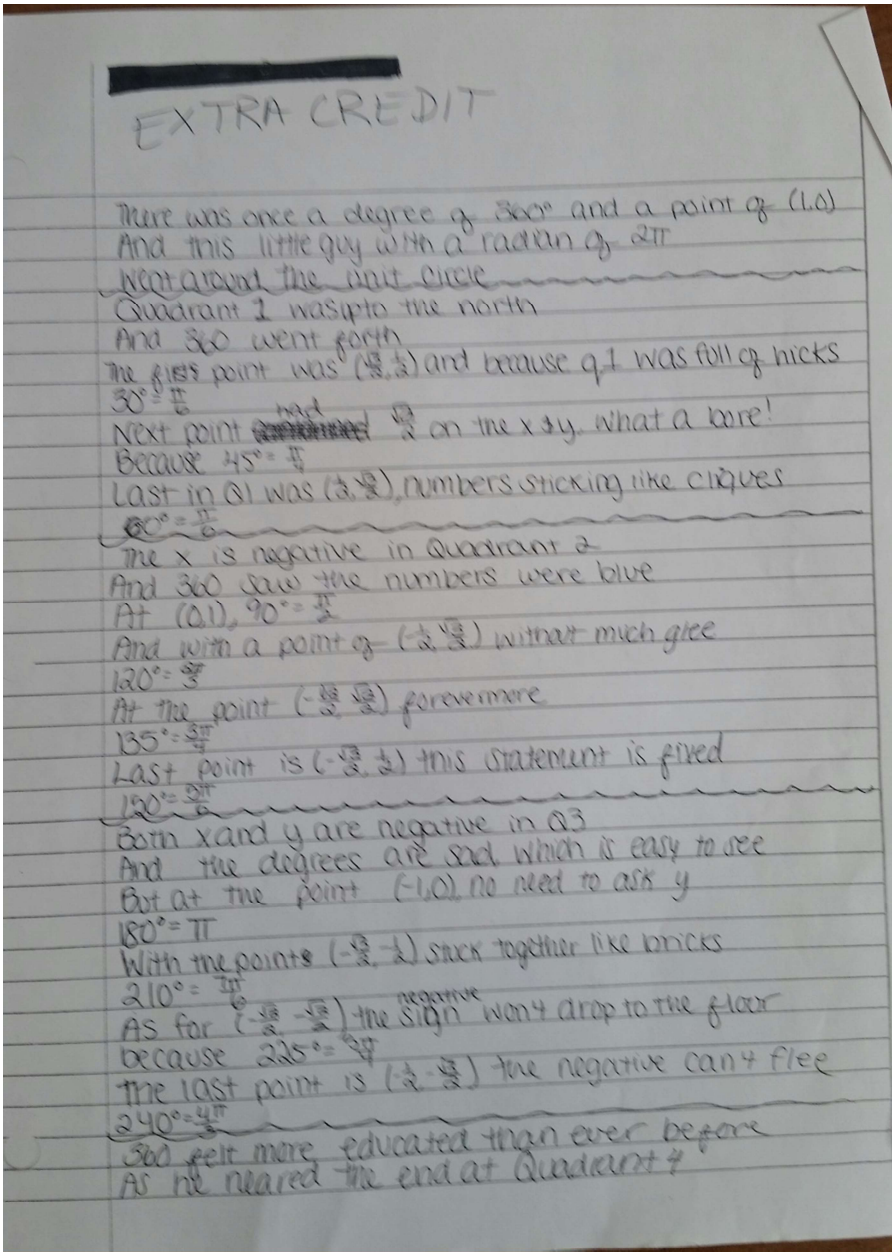
$B = \sin^{-1}\left(\frac{26^2 - 35^2 - 43.92^2}{-2(35)(43.92)}\right)$

$= 36.29$

A = 180 - 91 - 36.29

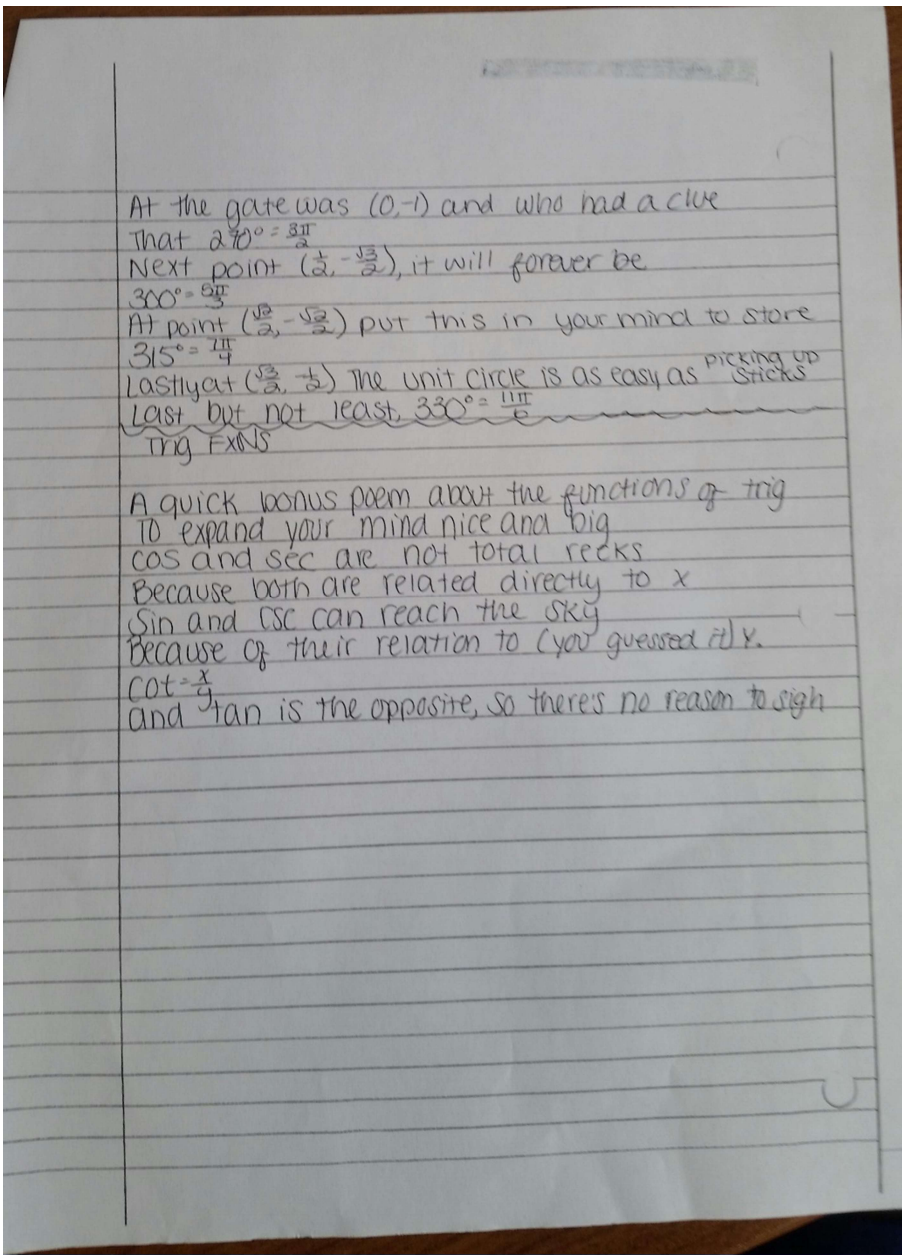
= 52.71

## Figure F.2: Unit Circle Extra Credit Assignment (poem)



EXTRA CREDIT

There was once a degree of 360° and a point of (1,0)
And this little guy with a radian of 2π
Went around the unit circle
Quadrant 1 was up to the north
And 360 went forth
The first point was $(\frac{\sqrt{3}}{2}, \frac{1}{2})$ and because q.1 was full of hicks
$30° = \frac{\pi}{6}$
Next point $\frac{\sqrt{2}}{2}$ on the x & y. What a bore!
Because $45° = \frac{\pi}{4}$
Last in Q1 was $(\frac{1}{2}, \frac{\sqrt{3}}{2})$, numbers sticking like cliques
$60° = \frac{\pi}{3}$
The x is negative in Quadrant 2
And 360 saw the numbers were blue
At (0,1), $90° = \frac{\pi}{2}$
And with a point of $(-\frac{1}{2}, \frac{\sqrt{3}}{2})$ without much glee
$120° = \frac{2\pi}{3}$
At the point $(-\frac{\sqrt{2}}{2}, \frac{\sqrt{2}}{2})$ forevermore
$135° = \frac{3\pi}{4}$
Last point is $(-\frac{\sqrt{3}}{2}, \frac{1}{2})$ this statement is fixed
$150° = \frac{5\pi}{6}$
Both x and y are negative in Q3
And the degrees are sad. Which is easy to see
But at the point (-1,0) no need to ask y
$180° = \pi$
With the points $(-\frac{\sqrt{3}}{2}, -\frac{1}{2})$ stuck together like bricks
$210° = \frac{7\pi}{6}$
As for $(-\frac{\sqrt{2}}{2}, -\frac{\sqrt{2}}{2})$ the negative sign won't drop to the floor
because $225° = \frac{5\pi}{4}$
The last point is $(\frac{1}{2}, -\frac{\sqrt{3}}{2})$ the negative can't flee
$240° = \frac{4\pi}{3}$
360 felt more educated than ever before
As he neared the end at Quadrant 4




## APPENDIX G: SAMPLE JOURNAL ENTRY

Name: _____Gabrielle Amarosa_____ Date: ___2/15/16_____

Highlights of my week: (anecdotes about my week, effective methods of discipline or teaching strategies, etc.)

I took over all four classes for the whole week and it was pretty successful. I was definitely pretty nervous the first day but feel like I adjusted quickly. After a week of having to be flexible based on how quickly students moved through material, I feel more confident about my ability to adjust my practice and lesson plans which is something I was nervous about.

Challenge of my week and what I learned about myself, learning or teaching through it: (personal concerns, pressures, ineffective methods of discipline or teaching strategies or teaching strategies, time management problems, frustrations, etc.)

My first lesson of my first day I was challenged by the difficulty my students had grasping the material. There were essentially three parts to the lesson. The first two parts were what I thought were the most difficult both conceptually and mechanically the students seemed to understand with no issue. The third piece was easier and was just a combination of the two pieces and I anticipated it would be the easiest part of the lessons, but the students were completely confused and unable to make the cognitive leap. I struggled to explain this piece when the students had questions because I didn't anticipate it would be an issue. However, I adjusted what I emphasized in the following lectures; the second lecture went slightly better and the third and fourth lectures were very successful.

One goal I have for the next week:

(For two weeks from now, since next week is February break). Become better at using the board—while I think I use the space well, sometimes I feel like I'm not "cheating out" enough when I'm writing longer expressions/definitions. While it doesn't seem to bother my students, it could be a problem in the future if I have a lot of ELLs. Also, if I can see my students more I will be able to gauge if anything I'm writing is confusing to them. I will possibly try to use technology more for drawings/definitions that take too long to write on the board.

Self-Evaluation: (record my growth, incorporation of new ideas, goals I met, etc.)

I think I grew a lot in my ability to dominate a classroom and think on my feet and adjust my practice accordingly.

Journal Question of the Week: <u>Describe processes that you will establish for reinforcing positive behavior and dealing with inappropriate behavior</u>

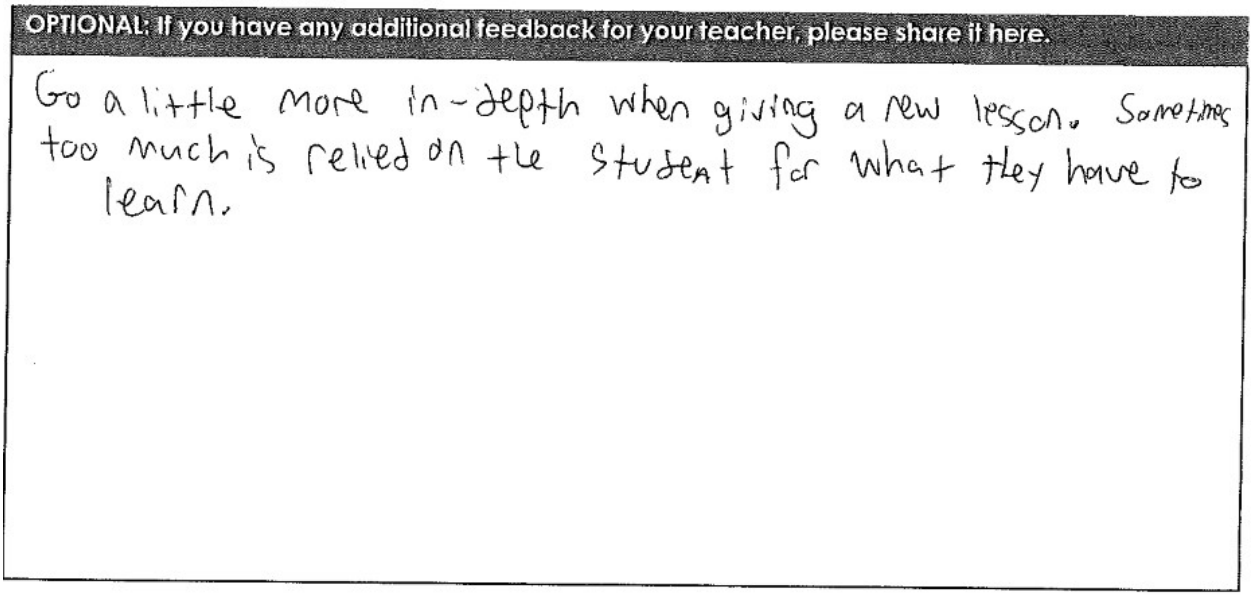
To reinforce good habits, I've largely been using discrete verbal praise such as "good work," "nice focus," "good process," etc. This has worked well so far because most of my students are eager to make a good impression and do good work. Also, students who are consistently polite, hardworking, and reliable gain the teacher's trust over time. For example, if a normally reliable student forgot their homework in their locker or at home, the teacher may give them the benefit of the doubt and allow them to bring it in the following day without penalty which will encourage them to be reliable because they can see the benefits. I also think that negative reinforcement is a good educational tool, such as

removing a homework assignment when students behave well or complete a challenging assignment successfully.

To deal with inappropriate behavior I think the teacher must think carefully about the specific situation and student(s). While certain behaviors (especially more serious ones) should be associated with specific, predetermined consequences, how the consequence is delivered (public vs. private, the tone of address) should be largely dependent on the students, the teacher's relationship with them, and what the rest of the class will learn from the consequence. For example, some students will resent being publically called out and it will make them less cooperative in the future, while other students (particularly those who crave attention) may benefit from feeling slightly embarrassed in front of their peers.

## APPENDIX H: STUDENT SURVEYS

I have chosen to include all of the handwritten responses that students included in their survey responses as I believe they are a more informative reflection of my teaching than the "strongly disagree"-"strongly agree" rankings.



**OPTIONAL: If you have any additional feedback for your teacher, please share it here.**

- for the answer I put disagree you really can't do them in math class.
- You did a very good job at teaching us, And made it very enjoyable.

---

**OPTIONAL: If you have any additional feedback for your teacher, please share it here.**

She is a great, caring individual that wants you to do well in school. She taught me many helpfull things I can use to further my education. She is also good at explaning the lesson well in class.

---

**OPTIONAL: If you have any additional feedback for your teacher, please share it here.**

She was very helpful and dedicated.

**OPTIONAL: If you have any additional feedback for your teacher, please share it here.**

Very helpful and helped us learn a lot in this class

**OPTIONAL: If you have any additional feedback for your teacher, please share it here.**

I loved the group work and the activities in class. The many ways she explained a topic for a better understanding. the Review of the material didn't feel like hard work but rather enjoyable.

**OPTIONAL: If you have any additional feedback for your teacher, please share it here.**

At first I was a little worried that my class is having a student teacher but it worked out Great! Ms. Amarosa was a Extremly good teacher and I couldn't ask for anything better.

OPTIONAL: If you have any additional feedback for your teacher, please share it here.

Ms. Amarosa is a great teacher in my opinion, When she teaches a lesson she does it in a way that makes it easier to understand. She also comes up with some activities that helped the class understand more of the lesson that she's trying to teach. Ms. Amarosa is very good with teaching and is a lot of fun as well.

OPTIONAL: If you have any additional feedback for your teacher, please share it here.

When teaching difficult material that most students did not understand Ms. Amarosa did not take enough time to reteach or explain the concepts students did not understand. She also did not do many examples However she did an amazing job keeping students entertained while still teaching. She played many games.

**OPTIONAL: If you have any additional feedback for your teacher, please share it here.**

- Felt like the class was taught at a faster pace (too fast) by Ms. Amarosa than Mrs. O'Leary.
- The mini unit circle quizzes helped/forced me to memorize the unit circle - I liked that
- The review game of where there would be different problems all around the class to do was helpful. Would've been more helpful if the answers were posted on engrade after the class to fix our mistakes and see where we went wrong, so that we wouldn't make the same mistakes on the SA

**OPTIONAL: If you have any additional feedback for your teacher, please share it here.**

Ms. Amarosa demonstrates strong characteristics and potential that makes her a proper teacher. She displays her efforts in the activities and aid that she provides to the students in high regards.

**OPTIONAL: If you have any additional feedback for your teacher, please share it here.**

Thank you for teaching our class. I would like to say that watching the Youtube videos you sent to us on engrade helped me understand the topics we learn in class. I also enjoyed all of the activities we did in class. Because it made me think math is fun.

**OPTIONAL: If you have any additional feedback for your teacher, please share it here.**

Ms. Amarosa was a good teacher. I preferred the way she taught, for I actually understood the mathematical concepts better than if my actual teacher taught them. Ms. Amarosa regularly made sure we all understood the material given to us, and helped us individually, if need be. Ms. Amarosa was understanding and supportive, and I enjoyed my time with her.

**OPTIONAL: If you have any additional feedback for your teacher, please share it here.**

I think you would be a very good teacher, I enjoyed you teaching me and helping me understand math. The ideas you had to help learn the material in a fun way were very good.

**OPTIONAL: If you have any additional feedback for your teacher, please share it here.**

MS. Amarosa was overall very nice, but never a push over. She always stayed on task. She also would always make a sincere effort to explain something I or other students did not understand.

**OPTIONAL: If you have any additional feedback for your teacher, please share it here.**

She has been a great teacher and knows how to modify lessons in order to help everyone understand. She is one of the best student teachers I've ever had.

**OPTIONAL: If you have any additional feedback for your teacher, please share it here.**

Though her teaching style didn't really suit me, she did pretty well dealing with such an uncompromising class. My only complaint is about the unecessary biorhythms project, it made us spend too much time on sin and cos graphing and allowed less time for other subjects.

**OPTIONAL: If you have any additional feedback for your teacher, please share it here.**

Some of the teaching methods presented to us were redundant, such as having us try difficult problems, only to get confused and need help. However, the multiple activities and "games" on to stay were interesting, fun, and different from other class work we have done, which I appreciate.

**OPTIONAL: If you have any additional feedback for your teacher, please share it here.**

It was great having Ms. Amarosa teach my class. It was a good experience.

**OPTIONAL: If you have any additional feedback for your teacher, please share it here.**

I have learned a lot from Ms. Amarosa, but some concepts did not get through well.

OPTIONAL: If you have any additional feedback for your teacher, please share it here.

Ms. Amarosa was an extremly great student teacher.
She did a great job explaining many things to the class.

OPTIONAL: If you have any additional feedback for your teacher, please share it here.

She's a great teacher.