

May 2019

# A Teaching Practicum at Worcester Technical High School

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# A TEACHING PRACTICUM AT WORCESTER TECHNICAL HIGH SCHOOL

Interactive Qualifying Project  
C and D Terms 2018-2019

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## **Abstract**

This paper summarizes a semester long Interactive Qualifying Project of student teaching at Worcester Technical High School. Connecting the theory of education to the classroom, this paper is sectioned to analyze the ways in which I have exhibited proficiency in the six Candidate Assessment of Performance (CAP) essential elements: well-structured lessons, meeting diverse needs, adjustments to practice, safe learning environment, high expectations, and reflective practice. Each section comes with supporting evidence in the form of lesson plans, handouts, student work, exams and quizzes, and student feedback surveys. Further, this paper evaluates the impact my education at WPI has had on my experience in the classroom. This paper concludes with a final reflection on the experience as well as goals to be taken further in years to come as an educator.

## **Dedication**

This paper is dedicated to someone who has inspired me with the passion for both mathematics and education, my mother. Growing up under her guidance, she has taught me so much about the importance of forming connections with the people I met. Time after time, my mother would find herself running into past students who are overjoyed to catch up with her again. The excitement and enthusiasm these students would display shows just how impactful and life changing a passionate and caring teacher can be. This sort of impact that my mother makes on her students influenced me to embark on this journey of the Teacher Preparation Program, hoping to establish similar relationships.

# Chapter 1: Background

## Massachusetts Education Reform Act of 1993

Much of the overwhelming success of the Massachusetts public school system can be attributed to the Massachusetts Education Reform Act, often referred to as MERA or merely the Act, of 1993. During the early 1990s, the Massachusetts Business Alliance for Education (MBAE) spent two years in creating the *Every Child is a Winner* report, which further established the framework for the Act. Although the implementation of the Education Reform Act brought initial controversy, it continues to prove itself as being a driver for improved public education despite changes in leadership both in politics and education.

The Act required the Massachusetts public school system to withhold a set of standards that each student would be required to meet; a statewide assessment system and an accountability system would further be implemented to hold schools and districts responsible in making progress towards these standards. For public school systems of all economic backgrounds to be able to implement these systems, the Act also established a new school finance system. This system made it possible for districts limited by funding to have access to the necessary resources to meet these standards. Meanwhile, the Act also led to major increases in the amount of state aid for public schools.

Through these efforts, the Act created a foundation for teachers and administrators to develop their skills and to be evaluated for proficiency so that the district continued improving its reputation in education. Meanwhile, the Act also led to the emergence of many vocational and charter schools to accompany the diverse needs and talents of students in Massachusetts. With the advances made through the Massachusetts Reform Education Act, Massachusetts has made great progress in becoming one of the leading states in education.

## Massachusetts Performance Relative to the International Community

To compare these advances on an international scale, eighth graders from Massachusetts along with eight other U.S. states participated in the Trends in International Mathematics and Science Study (TIMSS). As of 2011, Massachusetts scored above both the TIMSS scale and the U.S. national averages. Shown in Table 1, Massachusetts scored 61 points higher than the TIMSS scale average while scoring 52 points higher than the U.S. average. This table also breaks down the results from this study into average TIMSS scores across different genders, races and ethnicities, and economic statuses; generally speaking, Massachusetts eighth grade students across all groups scored higher than the TIMSS scale average.

<b>Mathematics</b>	
<b>Reporting groups</b>	<b>Grade 8</b>
<b>TIMSS scale average</b>	<b>500</b>
<b>U.S. average</b>	<b>509 *</b>
<b>Massachusetts average</b>	<b>561 *</b>
<b>Sex</b>	
Female	558 *
Male	563 *
<b>Race/ethnicity</b>	
White	572 *
Black	516
Hispanic	507
Asian	599 *
Multiracial	567 *
<b>Percentage of public school students eligible for free or reduced-price lunch</b>	
Less than 10 percent	584 *
10 to 24.9 percent	576 *
25 to 49.9 percent	542 *
50 to 74.9 percent	559 *
75 percent or more	491

\* $p < .05$ . Difference between score and TIMSS scale average is significant.  
 NOTE: Black includes African American and Hispanic includes Latino. Racial categories exclude Hispanic origin. Not all race/ethnicity categories are shown, but they are all included in the U.S. and state totals shown throughout the report. The standard errors of the estimates are shown in table E-19 available at <http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2013009>  
 SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS), 2011.

Table 1: Average mathematics scores in grade 8 for selected student groups in public schools in Massachusetts: 2011

Now looking at these scores analyzed against other participating education systems across the world, only the scores of Korea, Singapore, Chinese Taipei, and Hong Kong were higher than those of Massachusetts according to Table 2. It is important to note that out of all the education systems, both national and international, only these four education systems scored higher, which is pretty remarkable. In Table 2, the ranks of the other education systems in comparison to Massachusetts can be found.

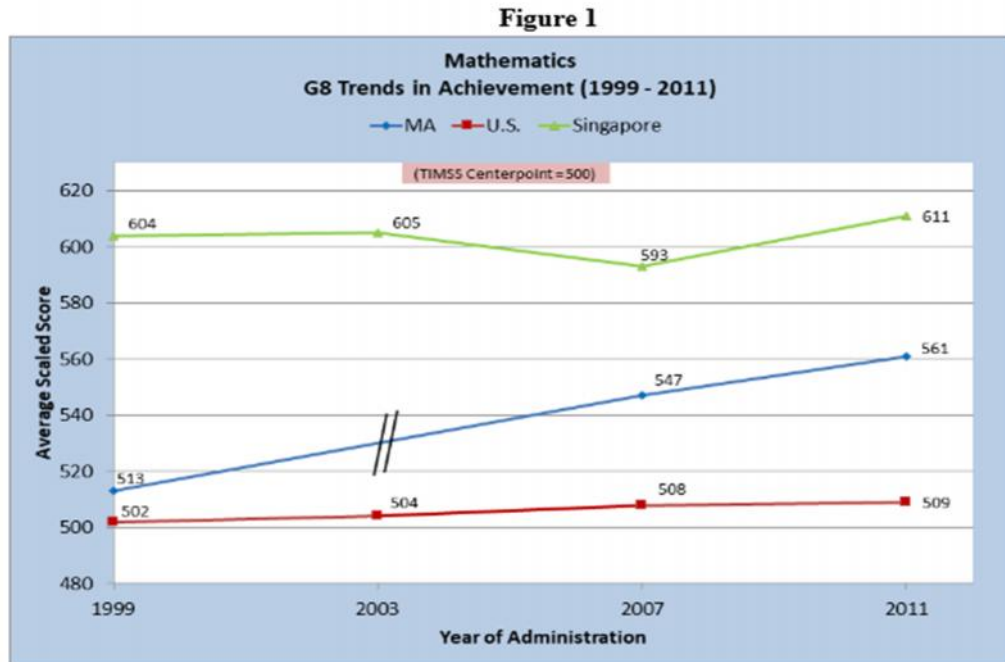
Grade 8	
<b>Education systems higher than Massachusetts</b>	
Korea, Rep. of	<i>Chinese Taipei-CHN</i>
Singapore	<i>Hong Kong-CHN</i>
<b>Education systems not measurably different from Massachusetts</b>	
Japan	
<b>Education systems lower from Massachusetts</b>	
<i>Minnesota-USA</i>	Norway
Russian Federation	Armenia
<i>North Carolina-USA</i>	<i>Alabama-USA</i>
<i>Quebec-CAN</i>	Romania
<i>Indiana-USA</i>	United Arab Emirates
<i>Colorado-USA</i>	Turkey
<i>Connecticut-USA</i>	Lebanon
Israel	<i>Abu Dhabi-UAE</i>
Finland	Malaysia
<i>Florida-USA</i>	Georgia
<i>Ontario-CAN</i>	Thailand
United States	Macedonia, Rep. of
<i>England-GBR</i>	Tunisia
<i>Alberta-CAN</i>	Chile
Hungary	Iran, Islamic Rep. of
Australia	Qatar
Slovenia	Bahrain
Lithuania	Jordan
Italy	<i>Palestinian Nat'l Auth.</i>
<i>California-USA</i>	Saudi Arabia
New Zealand	Indonesia
Kazakhstan	Syrian Arab Republic
Sweden	Morocco
Ukraine	Oman
<i>Dubai-UAE</i>	Ghana

NOTE: Italics indicate participants identified and counted in this report as an education system and not as a separate country.  
 SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS), 2011.

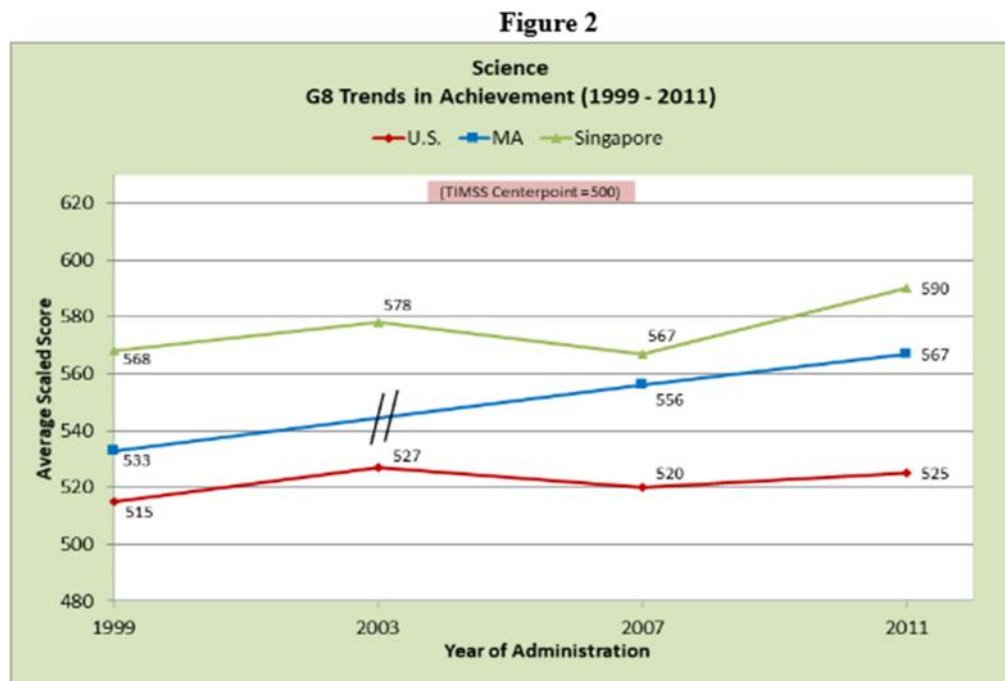
Table 2: Average mathematics scores of 8<sup>th</sup> grade students in Massachusetts public schools compared with other participating education systems: 2011



Although these sets of data all positively reflect the Massachusetts education system, the data shown in Figure 1 and Figure 2 showcase the impact that the Act had on the state itself.



Note: Massachusetts did not participate in the 2003 TIMSS.



Note: Massachusetts did not participate in the 2003 TIMSS.

As shown in these figures, Massachusetts students scored 48 points higher and 34 points higher in Mathematics and Science respectively from 1999 to 2011. While these gains in scores were both substantial, the increase in the score for Mathematics was the highest of any participating country or benchmarking entity for this time period. With reference to the data and the idea that other states across the country began to adapt parts of the Massachusetts Education Reform Act, it can be said that the Act will continue to make a positive impact in years to come.

### **Worcester Public Schools**

Under the successful school system of Massachusetts, the Worcester public school district emphasizes high achievement for each student through implementing rigorous activities, social emotional learning, and access to advanced opportunities to educate the student as a whole. In other words, Worcester schools strive to meet the needs of all students through taking a personalized approach when it comes to instruction and content delivery in the classroom. This ideology is administered by teachers across 44 schools: 34 elementary schools, four middle schools, and six high schools. With a student/teacher ratio of 14.2:1, these teachers are able to reach almost 25,500 students who collectively speak 74 languages. The qualifications of these teachers in combination with the resources provided by Worcester schools, one example being that 100% of classrooms are on the internet, help contribute to a 94% attendance rate. With an average attendance rate of about 96.3% as of 2017, Worcester Technical High School (WTHS) is an established vocational-technical high school located on Skyline Drive in Worcester that contributes to these advances.

## Worcester Technical High School

With around 1,400 students enrolled, Worcester Technical High School provides students with a choice from 23 different trades from which they will learn valuable skills that can take them right into the workforce. In fact, WTHS's value to students helps maintain the remarkably low dropout rate of 0% as of the 2017-2018 academic year. For the same academic year, Table 3 outlines the post-graduation plans for the 97% of WTHS students who graduate in four years.

Plan	% of School	% of District	% of State
4-Year Private College	26	16	29
4-Year Public College	26	25	31
2-Year Private College	1	1	1
2-Year Public College	32	38	19
Other Post-Secondary	1	2	2
Apprenticeship	0	0	0
Work	10	12	9
Military	3	2	2
Other	0	0	2
Unknown	2	5	5

Table 3: Plans of Worcester Technical High School Graduates (2017-18)

As for the demographics of WTHS, the diversity of the school is comparable to the diversity of Worcester public schools as a whole. This fact is further demonstrated in Table 4. Meanwhile, when compared to the demographics of Massachusetts public schools, it is apparent that the Hispanic population in both WTHS and in Worcester public schools is almost double that of the public schools of the state. It is also important to remember that with 74 languages being spoken across Worcester public schools, 46.6% of WTHS is composed of students whose first language is not English. In a breakdown of the other selected populations that make up WTHS, Table 5 outlines the percentage of students whose first language is not English across the district and state.

<b>Enrollment by Race/Ethnicity (2018-19)</b>			
<b>Race</b>	<b>% of School</b>	<b>% of District</b>	<b>% of State</b>
African American	16.3	16.3	9.2
Asian	7.1	6.7	7.0
Hispanic	36.0	42.9	20.8
Native American	0.1	0.2	0.2
White	36.8	29.6	59.0
Native Hawaiian, Pacific Islander	0.1	0.0	0.1
Multi-Race, Non-Hispanic	3.5	4.3	3.8

Table 4: Enrollment Data by Race/Ethnicity (2018-19)

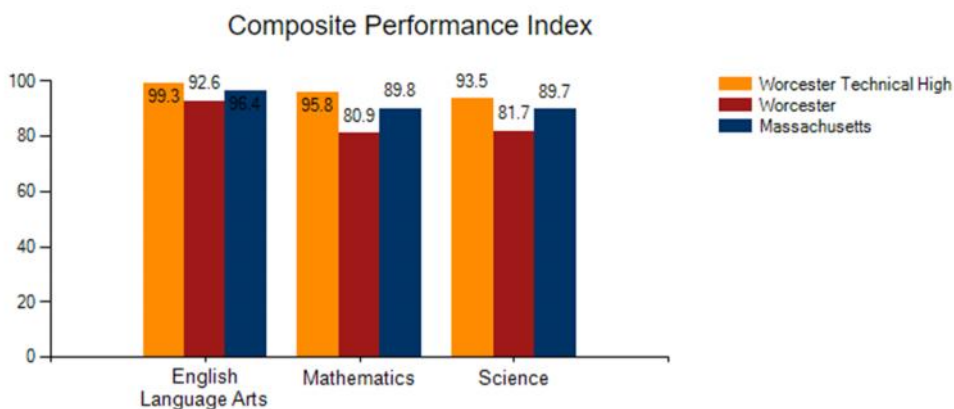
<b>Title</b>	<b>% of School</b>	<b>% of District</b>	<b>% of State</b>
First Language not English	46.6	57.5	21.9
English Language Learner	7.4	32.8	10.5
Students With Disabilities	11.4	19.4	18.1
High Needs	60.4	79.4	47.6
Economically Disadvantaged	44.1	57.9	31.2

Table 5: Selected Populations Data (2018-19)

Personally coming from a high school district where there was little diversity in both race and selected populations, I knew that teaching at a school with such a different dynamic would require me to make an adjustment; the barriers presented by race and these selected populations challenge many educators with the goal of meeting the diverse needs of the classroom.

In terms of performance, Worcester Technical High School typically scores well on the MCAS tests, producing higher scores than the average scores of both the district and the state. A Composite Performance Index (CPI) for English Language Arts, Mathematics, and Science is given to measure the performance of students on the MCAS for the subjects; the CPI is “a number from 1-100 that represents the extent to which students have attained or are progressing

toward proficiency in a given subject” (Massachusetts School and District Profiles). Following is a breakdown of WTHS’s performance using this index in the school year of 2017-2018.



	English Language Arts (CPI)	Mathematics (CPI)	Science (CPI)
Worcester Technical High	99.3	95.8	93.5
Worcester	92.6	80.9	81.7
Massachusetts	96.4	89.8	89.7

Notes: Enrollment data are reported for the 2018–2019 school year. Accountability and assessment data are reported for the 2017–2018 school year.

Figures 3 and 4: WTHS MCAS CPI report for the school year of 2017-2018

From the data outlined above, WTHS consistently has outperformed nearby high schools in Worcester and in Massachusetts as a whole. However, the faculty at WTHS continue to set high standards for their students to score well on these tests for years to come.

Given that Worcester Technical High School is a vocational school, their unique schedule allows their upperclassmen to dedicate one week to their academics, which has been coined the phrase, “academic week”, and another week to working on their trade, also known as “shop week” as a reference to the many shops offered at WTHS. These two weeks are further categorized as A and Z weeks. As for the lowerclassmen, these students have half of their day dedicated to academics, and their other half is dedicated to working in their shops for each week.

The class levels at Worcester Technical High School typically follow those at any other high schools. In order of level of advancement, WTHS offers Resource College Level, Inclusion College Level, College Level, Honors, and Advanced Placement (AP). In my case, I was responsible for teaching and lesson planning for two sections of freshmen Inclusion Algebra I class each day, a double period of one section of a junior Honors Algebra II class, and occasionally I also have filled in to teach a class of Algebraic Reasoning with seniors.

For the majority of my Algebra I students, they were on Individualized Educational Plans (IEPs) where I would need to adjust my teaching to meet the diverse needs of the classroom. Thankfully, interacting with the six Essential Elements of CAP (Candidate's Assessment of Performance) for the fifteen weeks of the teaching practicum has helped shape and prepare me to be the teacher my students needed me to be. With all that being said, my initial reactions to the six Essential Elements led me to be slightly intimidated due to the unknown terminology and the standards I was required to meet by the end of the program. In addition, I had to find a way to integrate my Worcester Polytechnic Institute (WPI) project-based learning into my teaching. Although a challenge, I managed to do this by incorporating a diverse set of activities that brought real world-applications into the classroom.

## **Chapter 2: 1.A.4, Well – Structured Lessons**

The first essential element of CAP is Well – Structured Lessons, which falls under the first standard of Curriculum, Planning, and Assessment. To satisfy the objectives of this element, a teacher must be able to develop well-structured lessons with challenging, measurable objectives while implementing appropriate student engagement strategies, pacing, sequence, activities, materials, resources, technologies, and grouping. For a teacher who is able to achieve this standard of work, they would have reached proficiency in this area according to the DESE

CAP rubric. This would imply that this teacher would be knowledgeable in the subject matter and is able to articulate that information in a way that is understandable by the students.

Furthermore, the teacher is able to accomplish these tasks through designing effective lessons (Trends in International Mathematics and Science Study, 2011).

To be a well-respected, organized, and influential teacher, lesson plans are a crucial component in making a substantial impact on a student's understanding and outlook on the classroom. Lesson plans are the map teachers use to help guide each of their students to reaching their potential as a learner. With that being said, effective lesson plans are not suitable for all students as each student comes from a different educational background with prior knowledge not every student may have. Even the experiences a student has had with certain material can greatly impact a student's ability to perform well in a given activity or at a particular assessment. Therefore, I have learned throughout this practicum that in order to create effective, meaningful lessons, I truly needed to understand the needs of my students. Meanwhile, I had to carefully construct my lesson plans around the restriction of a 40-minute class period. This definitely challenged me as I began to realize that with announcements, students arriving late in the morning, assemblies, and fire drills, that little time I had to work with was slowly eaten away. Therefore, to be a good teacher, one must not only have a plan coming into class, but one should also be prepared to think on their feet for students to meet the objectives of that lesson in a shorter period of time.

At the beginning of the practicum, it was hard for me to make that initial connection with my students, especially given the fact that they have spent half a school year already adjusting to a particular teaching style and lesson structure; they were slow to open up to me, answer questions, and voice any comments and concerns to help me understand their grasp of the

material. With that being said, I focused on reflecting back to what the students seemed to respond well to when I was observing them.

For my Algebra I students, I came to the conclusion that many of them needed more help grasping basic arithmetic skills and breaking down multi-step problems into a concrete process they could utilize. While writing my lessons plans for my freshmen students, I made sure to take my time with more challenging units, such as when I started teaching them how to perform operations with polynomials and factoring. Specifically, for factoring, I planned to incorporate a day for students to build up their number sense through having students practice their divisibility rules and find factors of one number that added up to another; these two skills are the foundation of factoring, and I knew that if my students could get used to the idea of doing this that factoring would not be so intimidating as it may be to most students. I also made sure to provide graphic organizers (Appendix A, pg. 59), tables, concrete steps to factoring more complicated quadratics (Appendix A, pg. 48), and much encouragement to my students as I consistently stressed the importance and relevance of factoring in upper level math courses. For multi-step problems, I made sure to outline each step to help make multi-step problems appear to just be multiple one-step problems. As a new student teacher teaching a complicated unit, all of what I was doing was still new to me, but after one of my classes, a student came up to me and said, “Wow this makes so much sense now. My teacher last year tried teaching us polynomials, but it did not make much sense at the time. She just rushed through it, but you are actually taking your time with it”. This comment helped me gain the confidence I needed to have in myself as a student teacher.

As for my junior Algebra II students, I was more concerned with the idea of picking up that class given the potential resistance they may have had against me for creating a change deep into the year. Therefore, it was a priority for me to not only gain their trust, but also to slowly



integrate myself and my teaching style into their classroom. As a possible solution, I decided to keep the classroom structure they have gotten used to for so long the same as they tried to get used to me being their instructor. From what I observed, a majority of their classes revolved around closely following material from the textbook. In fact, this model and structure was used so often that these students were in the habit of learning in this environment. Therefore, I initially used the textbook as a guide for my lesson plans, and I kept the breakdown of the classroom very much the same; one period was dedicated to a lesson, and the second period allowed students to work on problems to build up mastery of the material (Appendix A, pg. 56). This format worked pretty well for my juniors as a majority of them were independent learners who enjoyed an organized class structure. This format also allowed me to walk around the room to check in with students who were struggling with the topic, and it helped me evaluate whether or not I needed to re-explain a topic I went over earlier in the class. After a few weeks of this format, I was able to move away from the textbook. I began personalizing the lessons through finding supplemental graphic organizers and handouts to enhance the content to which my students responded well.

While covering the content addressed in the curriculum standards, I also wanted to take the initiative to develop lessons that focused around using technology, specifically the graphing calculator. In my experience, many students of all ages struggle with how to use a graphing calculator and all of its useful tools, like its ability to find the zeroes, maximum, and minimum of a function. Knowing these skills make it super helpful in more advanced math and science classes, and it gives students another way to check their work and validate their answer when doing the math by hand. When I introduced the unit on quadratics to my Algebra I class, I introduced the value of technology by giving them a tutorial on how to use a graphing calculator

throughout the unit; I gave them a cheat sheet about how using methods like factoring to find the zeroes of a quadratic can be validated through using a graphing calculator (Appendix A, pg. 60).

Although I had gotten proficient at writing well-thought out and appropriate lesson plans for my students, one main component of this essential element that I struggled with was pacing. I understood from feedback that pacing is something that improves and becomes more natural with experience as it is a hard skill to teach. The main piece of advice my program supervisor gave me was to be mindful of the clock and to adhere to the time guidelines I had written in my lesson plans. However, it is equally important to be able to adjust those time frames in scenarios where students may need a topic to be more fleshed out than originally planned. In those cases, I would try to prioritize my instruction, making sure I made those connections of the material to the activities they were doing. Sometimes this meant that I would have to shorten activities like Problems of the Day (PODs) or give less problems for my students to work on, especially when introducing a new topic. This allowed both my students and I to prioritize quality work over the quantity of work that was being done. Although this still remains to be a challenge for me, I believe that I have grown in this area throughout my practicum.

### **Chapter 3: 1.B.2, Adjustments to Practice**

The second essential element of CAP is Adjustments to Practice, which also falls under the first standard of Curriculum, Planning, and Assessment. To be proficient in this element, one must be able to organize and analyze results from a variety of assessments to determine progress toward intended outcomes. The most critical component of being able to achieve this standard is for the teacher to take those results and use them to adjust their practice through appropriately differentiating interventions and enhancements for students. Some indicators of successfully achieving proficiency in this element would be being able to use a variety of informal and formal

methods of assessment to measure student learning and understanding for improved future instruction (Trends in International Mathematics and Science Study, 2011).

Although teachers have the main responsibility to relay information to their students for the purpose of helping them learn, a great teacher also needs to be open to becoming a student themselves; impactful, effective teachers are lifelong learners who continuously want to improve their craft in the best interest of their students. This act of making adjustments to their practice can happen either before, during, or after a lesson. For instance, a teacher may have their lesson plan ready for the following day, but after grading either a formal or informal assessment, the instructor may notice that students are having trouble grasping a certain topic or skillset. To adjust to their practice, that teacher should take the responsibility to address this common mistake, whether that be after handing back the assessment, incorporating that topic in a Problem of the Day (POD), or by adding in another day to practice and go over that concept students were having trouble on. During a lesson, a teacher may also have to make adjustments when lessons do not go as planned, whether that be that students are having trouble doing an activity or are not engaged, challenged, or are too confused about the content. Therefore, it is crucial for teachers to be able to think on their feet all the time, always having a back-up plan in mind. As for after a lesson, reflective practice allows for a teacher to make adjustments to their practice as they evaluate the progress made by students towards mastering the content.

At the beginning of the teaching practicum, I was a little worried about being able to become proficient in this essential element. For the most part, I felt comfortable about the idea of giving formal and informal assessments to judge where my students were in grasping the content. I learned this technique from both my ID 3100: Teaching Methods course and during weekly seminar. In both of these WPI courses, the instructors stressed that incorporating formal

and informal assessments are great ways to measure student understanding and growth. I loved when my students would be vocal about whether or not they understood my instruction. In fact, this made teaching a lot easier for me when students would ask questions, so I always tried to encourage questions and comments to help me help them reach their potential as learners.

Some ways of how I became proficient in this essential element were through incorporating many informal check-ins with my students for evaluating my students' understanding of the material both during and after class; the purpose of this strategy was mainly to help me prepare better for the following day through assigning appropriate activities to build up the weaker points students were not understanding. Throughout the first week of teaching my Algebra II class, it initially was a challenge for me to see where my students were in ability. This struggle was enhanced as I transitioned from only teaching an Inclusion Algebra I class with freshmen to also teaching an Honors Algebra II class with juniors. However, once the students became more comfortable with me, I started to understand what prior math knowledge they had. Generally, they were pretty prepared, but a handful of my students still struggled with Algebra I concepts and with identifying the properties of graphs. Therefore, I made sure to fully go over what the terms domain, range, and end behavior meant, so my students could apply that knowledge to more than just one type of function. I noticed their other area of weakness when one of my students came in for test corrections. I realized that the main reason for many of her mistakes stemmed from having a poor Algebra I experience. At that point, I realized how important it was never to assume the prior knowledge of students. Rather than telling her that this was information she should already know, I wanted to work with her to make sure that that gap of being able to understand new material would decrease. She really appreciated my help, and her test scores on the following unit significantly improved. Although I felt like I grew in

this element throughout my teaching practicum, this area is one I hope to continue to improve upon throughout my teaching career.

## **Chapter 4: 2.A.3, Meeting Diverse Needs**

As a part of the second standard of Teaching All Students, the third CAP essential element is Meeting Diverse Needs. This element requires that teachers use appropriate practices to accommodate differences in learning styles, needs, interests, and levels of readiness, whether that be for students who follow IEPs or are English language learners (ELLs). In other words, a teacher to be proficient in this element is able to engage and tailor a lesson to students coming from a variety of backgrounds and abilities. Ways for a successful teacher to engage and connect with all students would be to use appropriate language during instruction in order to create a safe, comfortable, and supportive learning environment (Trends in International Mathematics and Science Study, 2011).

Being able to successfully meet the diverse needs of the classroom is a goal for many teachers. To be proficient in this skill while effectively reaching each student with new information makes a teacher accomplished in their craft, and it is something many educators strive to implement in their classroom. It is extremely important for an instructor to find a way to reach out and accommodate for the varying levels of ability within a classroom, whether that be academic abilities, physical abilities, language barriers, or cultural differences. With that being said, acquiring this skill is extremely challenging as there are an infinite number of factors and differences between students. Ideally, a teacher should try and understand each student individually and the class collectively to appropriately tailor their lesson plans to their classroom environment. In my case, I strongly emphasized the importance of building those relationships and connections with as many of my students as possible. By doing so, I am not only

simultaneously creating a safe-learning environment, but I am also focused on trying to understand the way my students' minds work, what questions they could ask, and what content areas they would struggle with the most. Although I followed my instincts in carrying out this technique, this idea was reinforced throughout seminar and ID 3100, especially after observing numerous experienced teachers who also wanted to make connections with their own students.

Given the broad range of diverse needs students may have in a classroom, I knew that fulfilling this element would be hard for me. As described previously, I had an idea for how to approach fulfilling this element, but nevertheless, I knew seamlessly being able to meet all the needs of the classroom would be difficult. In ID 3100, the instructor of the course suggested the idea of using multiple worksheets to accommodate for different academic abilities without watering down any of the content. This idea has a strong impact allowing each student to work at their own pace. However, I was unsure about where to start and how to go about following through with this suggestion. I was worried about signaling out students and the work required to create multiple assignments for my classes. With that, being able to keep track of all of these versions of an assignment posed to be a challenge to me.

For ways I was able to grow in this area, I took what I learned from ID 3100 and applied it to my experience in the classroom. I was taught different techniques such as using multiple colored markers to differentiate instruction, both verbally repeating directions while presenting them on the board, creating different versions of exams, and giving students options for homework. In my Algebra I class, I implemented many of these techniques, especially given the fact that I had many students on IEPs. Particularly, one of my students, Student T, had dyslexia and typically needed a teacher to read aloud problems and instructions. Because he would have a hard time not mixing up his terms in an equation, I also made sure to both color code like terms

and provide highlighters to my students to model my instruction. I simultaneously would use different shapes to denote each type of term for those students who preferred that over color coding to keep their work organized. I was proud to see that my student with dyslexia modeled my instruction well while taking notes, and his table partner, Student E, would even model the same behavior (Appendix B, pg. 69, 70); they worked really well together, and I believe that the two of them really helped carry each other throughout the class.

Along with the way I differentiated my instruction, I also tried to incorporate different styles of activities throughout the practicum. For instance, I created a Pi Day activity with stations for students to discover the relationship of the circumference and diameter of a circle (Appendix A, pg. 62). I also created an activity for my Algebra I students called “The Coin Fountain” (Appendix B, pg. 66). The purpose of this activity was for my Algebra I students to practice their knowledge of quadratic functions; they were responsible for knowing how to find the vertex, axis of symmetry, x-intercepts, and even having to solve for the “a” value in the equation,  $y = ax^2 + bx + c$ . Unlike a traditional classroom, the students were not given a function, but they instead got to create the function. After modeling the activity with my own numbers, students were able to create an equation to model a water arc of a coin fountain they designed for downtown Worcester. This activity practiced culturally responsive teaching as it gave students the ability to be creative with how they wanted their fountain to look. By also starting with the graph, students were able to have a visual representation when figuring out its equation. Therefore, it helped them make the connection between their graph and the equation, the meaning behind the “a” value, the x-intercepts, the axis of symmetry, and the vertex.

I also included a POD where students repeatedly cut pieces of string in half to demonstrate the exponential behavior of the number of pieces of string and their lengths

(Appendix B, pg. 68). This activity benefited my visual and hands-on learners through being able to physically engage with the material. To honor the general diversity within the class, I also tried to incorporate their names into word problems, especially if that word problem related to one of their interests or their technical shop; I got this information from my mentor who gave students a “Get to Know Me” paper at the beginning of the school year where students included their hobbies, ways they learned the best, and their interests.

To allow students a choice in the way in which they wanted to be graded, one week I gave them the option between two different factoring worksheets to turn in for a grade. One worksheet was more formulaic, walking the student through each step of a problem (Appendix B, pg. 70), while the other was a Pizzazz worksheet where students had both the answers and problems in front of them (Appendix A, pg. 64). I was happy to see the mix of worksheets I received from my students, and they seemed to like having the option to turn in the one they felt more comfortable doing. Along the same lines, I also made sure when writing my assessments to include a variety of problems, different versions of tests where one suited those with more advanced arithmetic skills, and bonuses to give students the opportunity to try a harder problem without being penalized (Appendix C, pg. 74,76). Although this still remains to be a challenge for me, I am inspired to grow further in my ability to be creative with the ways in which I differentiate my teaching.

## **Chapter 5: 2.B.1: Safe Learning Environment**

The fourth CAP essential element, Safe Learning Environment, also falls under the second standard of Teaching All Students. To create a safe learning environment, teachers should incorporate rituals, routines, and use appropriate responses for students to feel comfortable taking academic risks, challenging themselves, and claiming ownership of their



learning (Trends in International Mathematics and Science Study, 2011). Meanwhile, a successful instructor will play an active role in both respecting each student's diverse backgrounds and abilities while preventing behaviors that interfere with learning.

As someone who has always been an anxious person, especially in an academic setting, creating a safe learning environment is extremely important to me. I do not want my students to feel unsafe, worried, or upset in any of my classes since I know that these feelings can severely impact one's ability to retain information. To validate the significance of a safe learning environment, I learned from many of my psychology courses at WPI that adolescence embarks a challenging time of self-discovery for students. With that comes many obstacles students would face such as the struggle to find their identity, the need to compare themselves to others, and the hardship that comes with enduring issues that arise in their personal lives. In a perfect world, a teacher knowing the background of all of their students to this degree would be extremely helpful to create this safe environment. However, it is not an easy task for a teacher to connect with that many students on such a personal level. This uncertainty of not knowing all the thoughts, feelings, and struggles each student is dealing with makes creating a safe learning environment in the classroom even more crucial.

When I first started teaching each of my classes, I wanted to slowly integrate myself into their classroom. I did this by partially taking over each of my Algebra I periods, walking around to help students while my supervising practitioner taught, and starting conversations with the students I knew I would later be teaching to help them feel comfortable with me. I did notice that many of my students were shy with me for at least the first few weeks I started teaching. However, putting in the effort to establish those connections helped create a foundation for a safe learning environment.

On the habitual side of things, creating a safe learning environment comes with creating a routine in the classroom. For both my Algebra I and Algebra II classes, I would always start my classes with PODs as students got situated in my classroom. Creating an environment where students knew what to expect when walking into the classroom helped eliminate the fear of the unknown. Further, I typically outlined a majority of my classes, especially for my Algebra II students, with a POD, going over the homework to uncover any questions about the previous lesson, teaching a new lesson, and then giving my students time to work on problems in pairs. The familiarity in this format helped my students feel comfortable, and having them work on problems gave them the opportunity to ask questions while I was there.

While teaching, I also made sure early on to encourage questions, feedback regarding my pace with my instruction, and verbal responses to my questions to check their understanding. Over time, more of my students became comfortable, and they became less fearful when voicing how they did not understand something. For instance, after my Algebra II students learned about graphing radical functions, they were not afraid to tell me that they were very confused and needed me to re-explain the properties of these functions. Although this delayed my lesson for that day, I was happy to go over the material again, and by having them drive the lesson, I gave them control over their learning. Despite the delay, we still managed to stay on track with completing the original lesson for that day, and I am glad I took the time to build up their understanding.

As I focused on creating a safe learning environment every day, I started to see positive changes in my students, two students in particular. One of these students who will be addressed as Student A for confidentiality was known for struggling with many mathematical concepts. On top of that, she was a little shy when it came to speaking up in class. To both my supervisor's

and my surprise, one class she rose her hand to answer a question, and in another class, she volunteered to go up to the board to do a problem. To encourage this behavior, I made sure to call on her in both instances and supported her as she did the problem on the board. For my other student, Student J, he tended to get frustrated with himself easily when he did not perform well on an exam or was not understanding the material. It turned out that one of the reasons for his low self-confidence in the classroom stemmed from an experience he had in middle school where one of his teachers called him “stupid”. After knowing that, I tried to focus more of my attention to work with him to really help him understand the material, which at the time was when I was teaching factoring. Typically, this is a challenging unit for many students, but with the extra attention and support I gave Student J, he was doing really well with the concepts. He even volunteered to do a factoring problem on the board, and said, “Wow, I actually feel smart. I am getting this”. This moment reminded me how rewarding it is to be given the opportunity to positively change someone’s perspective.

Although there were many high moments during my journey to become proficient in this element, there was one moment that really put everything into perspective for me. Again for confidentiality, the name of the student in which this story revolves around will be classified, so I will be referring to her as Student D. Over the course of my time as a student teacher, Student D and I grew pretty comfortable with each other. I usually found myself talking to her and her friend, Student AD, before class. However, there were still many things that I was unaware of. One full school week went by, and Student D was not in class. I could also tell that Student AD was less energetic as her partner in crime was not sitting next to her. One student pointed out her absence and I asked whether or not she was sick. Student AD made a comment that implied that something major was the reason for her absence. I picked up on that it was something serious, so

I brushed off the topic and redirected the class quickly back to the lesson. Later that day, I learned that Student D was absent because she was in the hospital. On the last day she was in school, Student D said she wanted to kill herself. I felt devastated when I heard the news, especially given that she did not have much support from her family at home about her feelings. All I wanted to do for her was help her and make sure she felt comfortable in my classroom, whether that be catching her up on material she missed one-on-one or by just being a friendly face.

This moment really hit home for me, and it gave me this whole new perspective about how all these students have their own battles and stories, from being homeless, to experiencing drama within their friend group, or to struggling with their own inner demons. I knew that creating a safe learning environment was important, but this experience helped me realize how crucial it is to try and be the best teacher, the best person, and the best supporter that these students could have; striving to achieve proficiency in this element has helped me become more aware of both myself and my surroundings as actions have such a strong impact on someone else's life.

## **Chapter 6: 2.D.2: High Expectations**

The fifth essential of element of CAP that is the last element a part of the second standard of Teaching All Students is High Expectations. Teacher candidates can proficiently model this CAP element through effectively modeling and reinforcing ways that students can master challenging material through effective effort, rather than having to depend on innate ability (Trends in International Mathematics and Science Study, 2011). One indicator of being able to achieve this standard would be by being able to use instructional practices to reflect the importance of high quality effort and work. When doing so, it is equally important for the

instructor to create a learning environment where students can effectively access the knowledge to achieve these expectations.

Through instilling high expectations into a classroom of students, teachers can help students reach their potential. It is encouraged that students should not feel ashamed of being unable to perform to the same level as a neighboring student, but rather they should realize the value in demonstrating effort and working hard. In addition, a teacher should have the mindset that it is equally important for students to learn what their potential is as it is to learn the content. After all, students being encouraged to push past the boundaries they set themselves can greatly drive them to do whatever they set their minds to. Sometimes that is what being a strong educator is all about. Not only should these students be learning the curriculum standards, but they should also be learning useful life skills to become lifelong learners. It is important to get each student to feel responsible for their own education as it is the driving force for the way they will continue to carry themselves.

Given the greatness of this task, I definitely struggled figuring out ways to implement the characteristics of this essential element into my teaching. Naturally, I was comfortable verbalizing my high expectations to the class often, whether that be through phrases of encouragement or of redirection. For other ways to practice this element, I thought back to my WPI courses, and I remembered that giving students the opportunity to do test corrections or to redo certain pieces of an assignment can help instill the importance of perseverance, especially when it comes to solving math problems.

When it came to test taking, I often gave my students extra time and extensions in order for them to feel like they had the time to put in the effort to perform well. These methods

typically were given to the class as a whole to keep everything fair between my students. Specifically, most of the tests and quizzes given to my Algebra I class spanned over two days as one class period was just forty minutes. If students were able to finish earlier when most of the class was still working, I would review over their test. I mainly looked for whether or not the student had made careless mistakes that under proper revision, could easily be fixed. There was one exceptionally bright student, Student AR, who was able to finish her test in one class period. After reviewing her test over before the following day, I noticed that she made some common arithmetic mistakes that I knew she would be able to find and correct. Therefore, I gave her test back to her, and I told her that there were a few small errors in her work, but I did not specify where they were. At the end of the period, she came back to me with her test and identified her mistakes, and she was able to get a better grade.

Another thing I looked for when reviewing completed tests was whether or not the student gave up before finishing it. There was one instance where a student, Student M, gave me her test at the end of the first period. I was about to grade it until I noticed that the backside of her test was almost blank, and Student M seemed to guess on the ones she did answer. The following day, I told her that I was going to give her another day to work on it, especially since I took some time before the start of that class to do some general review of the material as a POD. She was able to complete more of her test after the second day. Although there were still errors, my policy of giving partial credit still allowed her to get a better grade than what she would have gotten originally.

On a similar note, I also had the experience to do test corrections with a student from my Algebra II class, Student S. Student S was disappointed with her grade and was determined to bring it up. I gave her the opportunity to redo the problems she got wrong. After the completion

of each problem, she showed me her work and we walked through each problem together to help solidify a stronger understanding of the material she missed initially. Along with the other moments of where I demonstrated proficiency in this essential element, Student S coming in for test corrections allowed me to demonstrate that putting in the extra effort is worth the payoff.

## **Chapter 7: 4.A.1 Reflective Practice**

The sixth and final CAP essential element is Reflective Practice which is a part of the fourth standard, Professional Culture. To be proficient in this element, one must regularly reflect on the effectiveness of lessons, units, and interactions with students. Further, this should lead the teacher candidate to use the insight gained from this reflective practice to improve upon both instruction and student learning. A successful candidate would gather information, analyze data, examine issues, and set meaningful goals regularly in order to develop new approaches to improve upon own practice (Trends in International Mathematics and Science Study, 2011).

As teachers continue to improve upon their practice, a crucial component to this process is to regularly reflect on what areas have room for improvement. This is what truly distinguishes good teachers from great ones. Over the years, much research has been done on the various teaching styles and their impact on a group of students. With that being said, no amount of extensive research can help prepare a teacher year to year or even day to day in a classroom setting. No groups of students are comparable in their learning styles, personalities, and overall class dynamic. No individual student can even be compared to an assumingly similar student. All students are different types of learners, and what may work for one student or class of students may not work for another. Therefore, it is essential that teachers are mindful about their

instruction and are able to make adjustments to effectively teach for the diversity of the classroom.

As a part of the teaching practicum at WPI, each week during seminar, student teachers are given the opportunity to reflect on their performance throughout the week both individually and collectively. Additionally, I always found myself reflecting after each class and each day even from the beginning of the practicum. This came naturally to me as I tend to be a pensive person in general. However, no matter how much I reflected in order to better myself as a teacher, I consistently questioned whether or not I was teaching my students well. Once it came time to the announced and unannounced observations, the feedback I receive from my program supervisor helped shape me as a teacher. The feedback was at my best interest, and it both helped me find areas to improve upon while boosting my confidence as an educator.

After my first observation, I overall received pretty good feedback, but I held myself to high standards and still wanted to learn on what I could do better. Luckily over the course of my practicum, I was given advice and feedback for some things I could do better. Looking at the feedback of all of my observations collectively, the main areas of improvement included pacing, walking around the classroom, getting the students working, and not keeping my back turned towards the class.

I can say that I have gotten better at more frequently making eye contact with my students while I am writing on the board, whether that meant having to awkwardly write from the side. As for walking around the classroom and getting my students working, this was something I struggled with at the beginning given that my students were shy around me, and I was not completely comfortable with them yet either. Once my students and I had a dynamic



relationship, it felt more natural for me to walk around the class to talk and check in with all of my students. Also considering I then understood the abilities of my students better, I felt more comfortable letting them do more problems on their own; the lack of communication between me and my students initially was the main issue, but my growing familiarity with my students helped me see when more of my instruction was needed before having them do problems on their own. Meanwhile, pacing remains to be a hardship for me since I am very considerate of my less advanced students; I have a hard time moving on to the next activity when there are still a few students who are not comfortable with a concept from the previous activity. However, I learned that getting the class as a whole working on the next task tended to allow me to help those individual students as the rest of the class was preoccupied. I have also noticed that I became more mindful of the clock while teaching in order to prioritize the main components of my lesson. Both of these actions have helped me improve my pacing in the classroom.

Other opportunities I had for reflective practice include student feedback surveys and a pre-test and post-test that will both be analyzed further in a later chapter of this paper. Both of these moments allowed me to be reflective and see the areas of where I could improve and focus on. Considering that being reflective is the main factor for the way I teach each of my classes, I have faith that this is an essential element I will continue to incorporate for the rest of my teaching career.

## **Chapter 8: My WPI Education and Experience**

As a junior who is currently studying actuarial mathematics at WPI, I attribute much of my passion, understanding of the subject matter, and awareness of its relevance to the real world to my WPI experience. The passion I have for mathematics stemmed from when I was a little kid as I grew up with a father who is a mechanical engineer and a mother who is a high school math

teacher herself. Each night, I remember doing timed addition, subtraction, multiplication, and division problems after dinner for practice, and regularly, I would hear the excitement from my mother talking about math or while tutoring a student in our kitchen. I always knew that math was what I wanted to study because I loved it, and I wanted to bring that same enthusiasm my mother had to my classroom. Therefore, I made sure each day to bring positivity and a dynamic environment, even if I personally was not in a great mood. I knew that it would not be fair to my students to deflect my emotions onto them, impacting their ability to feel safe and have a positive experience with math in my classroom.

For the classes I have taken at WPI, they can generally be broken up into two categories: my mathematics courses for my major and the courses I took as a part of the Teacher Preparation Program (TPP) at WPI. As expected, my mathematics courses definitely prepared me in having a deep understanding of the subject matter I was teaching. It gave me a unique understanding of what specific topics were crucial for students to understand given their relevance to more advanced math courses. For instance, when it came time for me to teach factoring to my Algebra I students, I made it very clear to them that this was a topic that is crucial to their mathematics education at Worcester Technical High School. In other words, it was a topic that would not just be relevant for this Algebra I course. I also made sure to tell them that factoring is used very often when solving more complicated math problems, and as an actuarial math student, I still find myself factoring. As for my Algebra II class, I had the opportunity to teach my students logarithms, another crucial unit in mathematics. I knew ahead of time that this was a topic many students struggled with given their unfamiliarity with the concept. While making sure I was coaching and supporting my students through the lesson, I also regularly would check in with their understanding of the material. I often used the phrase, “Logarithms are exponents”, and I

even had my students write this same phrase in large font on the first day of taking notes. I wanted to take something seemingly complicated and put it into simple terms for them. That way, they would be less frustrated with the material as frustration would only lead to more confusion. Again, I made sure to tell my students how logarithms were used everywhere, especially in calculus and even in my field of study, to put them into context.

Although I have learned much throughout all of the courses apart of the TPP, WPI's Sheltered English Immersion course (ID 3200) really opened up my eyes to the diversity within a classroom. Coming from a high school where there was little to no diversity in socio-economic status and ethnicity, I knew I had much to learn from this course before I began teaching in a public school district like Worcester's. This course not only taught me to be more aware of the cultural differences of my students, but it also taught me some ways I could be culturally responsible. Some methods included using names from a variety of students of various cultural backgrounds in problems, connecting the content in a way that was relevant to their culture, and making sure students of all economic backgrounds and language abilities had equal opportunity to access the content. One example of making sure to include all economic backgrounds was through giving printed homework that could be done without the need of an expensive graphing calculator at home. Although some of these methods posed to be a challenge for me, it helped me be more aware of the language I used in the classroom and to be more understanding when certain students were struggling more than others.

As I finished my student teaching at WTHS, I wanted my students to understand that although some students may dislike the subject, math is used everywhere, especially in their technical shops. Shops like carpentry, auto-tech, culinary arts, finance and marketing, programming and web development, allied health, and etc. all either require concrete

mathematical calculations or mathematical thinking. Within society, math is further used daily when calculating budgets, taking out loans, shopping, and paying taxes, all routines that each student would have to experience at some point in their lives. Further, there will be a time where each student will be faced with a problem, mathematical or not, that they would have to solve, and studying mathematics helps train students to become better problem solvers. Although I unfortunately cannot force any student to have the same love I do for math, I hope that I helped students realize the importance mathematics and problem solving has in the real world.

## **Chapter 9: My Classes at Worcester Technical High School**

Throughout my teaching practicum, I have taught two periods of Algebra I, one double-period of Algebra II, and one double period of Algebraic Reasoning. During the A Weeks at WTHS, I would teach both periods of Algebra I, and if there needed to be a substitute teacher for the Algebraic Reasoning class, I would teach them as well. As for the Z Weeks, I would still have my two periods of Algebra I students, but I would also be teaching the class of Algebra II juniors right after, making it four periods of teaching in a row. Each of these classes exhibited a unique dynamic that has allowed me to execute different teaching styles to suit the environment of that class. In this chapter, I will be going into depth about each of my classes and the differences between their environments, personalities, and my experiences.

### **Inclusion Algebra I: Freshmen, Periods 1-10**

Out of my two Algebra I periods, this class of students overall carried a stronger skillset for mathematic understanding. This period was a class of 17 students, 12 of which were special education students and 4 of which were also ELL students. The ELL students in this class, and also similarly to those in my other classes, had a strong working knowledge of the English

language. There would occasionally be times where I would have to give synonyms to academic vocabulary, give definitions of words in word problems, and re-explain certain pieces of information. This though not only helped the ELL students in my classes, but it also helped my other students be exposed to the material more times to grasp a better understanding.

Within this class, many of the students were very comfortable with each other as many of them shared similar academic schedules or were in the same shop with one another. This tended to lead to a fun dynamic as these students were both able to work well with another, encourage each other, and still lighten up the atmosphere of the class. These students were not afraid to speak up when they did not understand something, and they were eager to learn and understand the material. In fact, creating seating charts for this class was relatively easy; many of these students could benefit from any other person in that class as many generally wanted to work together. Another key characteristic about this class was that they were pretty well-organized. Much of the student work I decided to use as pieces of evidence for the CAP elements came from this class of students; they demonstrated clear, well-written notes that very much modeled the way I instructed my class. With that being said, my classroom management of this class tended to be less involved as many of these students were naturally well-behaved and engaged. If I needed to use classroom management techniques to control the classroom behavior on more hectic days, other students would model the behavior I asked for and would encourage their classmates to do the same. Some of my classroom management techniques for this class included using phrases to help bring their attention to the front of the room, waiting for the students to settle down in combination with saying, "I am not going to teach if you guys are talking", and most importantly, making sure that I never yelled. For one thing, it is not my teaching style, but many teachers have told me that once a teacher raises their voice, they are going to have to raise

their voice for the rest of the year; I did not want to have to do that. With all that being said, I was very fortunate to be teaching this class of students due to their work ethic, dynamic personality, and respect.

### **Inclusion Algebra I: Freshmen, Periods 2-9**

When I first started teaching this class of Algebra I, I knew I had a long road ahead of me. All of these students were of course great students who I have grown to really care for, but this class tended to both get off task with their chattiness while not having a solid mathematics and arithmetic foundation. Within this class, there were 19 students, 11 of which were special education, 1 of which was an ELL student, and 3 of which were ELL and special education students. Therefore, I knew that classroom management would be crucial for these students to be successful when many of them needed individual attention and redirection. I used many of the same classroom management techniques as for my first period, but I made sure to do so more frequently to create habits within my students. In addition to this information, I had students coming from different economic backgrounds and home lives. For instance, one student who typically came in exhausted was homeless and was living out of his car. With him, I had to make sure to frequently check in to see how much material he was retaining and to work with him to get where he needed to be. On the other hand, I had students who came from more economically stable families, so it was important as a teacher to adjust my word choice and lesson plans to accommodate for these differences.

Out of all of the classes I taught, the most challenging students I had to work with were also in this class. There were two students in particular who tested me the most as an educator: Student C and Student A, whom I have mentioned earlier in this paper. These two students brought me two different challenges. On one hand, Student C had so much potential to be

successful in math as he seemed to have a natural grasp of many concepts, demonstrated in his test and quiz scores. However, Student C lacked little self-motivation when it came to do work in class, and he would regularly speak out in class about how he was tired, did not want to do the assignment, or about something completely off topic. Because I knew that this student was capable of performing well in this class, my main strategy was to regularly check on him as I circled the room. Each time I made my way over to him, I would redirect him to work on the next problem in front of him while quickly asking him a question to put him in the correct state of mind for that next problem. By the time I made my way over again, I would check his work for that problem, and because he would not want to start working on the next problem, I would then keep repeating this process. This seemed to be the best tactic to make sure he was working, and it allowed him to get in the practice he needed to keep performing well on exams.

On the other hand, Student A did not have a strong foundation when it came to performing arithmetic and algebra. Along with not having the skill set, she had a hard time staying on task, worsening her focus to work on her technical skills. She could not afford any distraction from learning the material she needed to reach her potential. My strategy with making sure Student A could succeed was to keep her in the front of the classroom, incorporate regular check-ins, and to make sure I made her feel comfortable working with me. By keeping her in front of the classroom, this would help me hold her accountable to paying attention to my lesson while giving her more accessibility to ask for help. Even when she was too shy to ask for help, she was close enough to the front of the room for me to see her progress on an assignment, allowing me to step in when necessary. Although her skills in math remain to be a weakness of hers, she began to feel comfortable enough to take risks like going up to the board and answering questions in class.

## **Honors Algebra II: Juniors, Z Week Periods 3-4**

Before I picked up my class of Algebra II juniors, I was pretty intimidated to teach the class. I felt that because we were closer in age that they would not be able to take me seriously. I also knew that I needed to adjust my teaching style from an inclusion classroom to an honors classroom as these students were generally more independent. The first week of teaching them, the only real information I knew about the class was that there were 3 special education students and 3 ELL students out of a class of 21 students. They were pretty reserved the first week, and it made it hard for me to understand what they understood. However, I had a feeling that their foundation in algebra was not as strong as it could be, and that became more prevalent as I continued to teach and interact with them. Therefore, I made sure they felt comfortable speaking up in my class when they did not understand something, and after a few weeks, they did just that and there was a real dynamic. In combination with that, I never assumed that they were familiar with specific material, and I would ask whether or not I needed to go over background information that supported the remainder of the lesson. They really appreciated this teaching style, and they told me that they did not appreciate it when a teacher would assume they already knew the material.

As for classroom management, this group of juniors was very well-behaved and respected me as their teacher. I could tell that they trusted me as their teacher as they would give me their full attention during each lesson. Towards the end of my time with them, many students opened up to me saying how I helped them understand math and that they appreciated how I always made an effort to help everyone. Considering my initial fears with this class, all this feedback was so relieving to hear, and it helped me feel confident continuing to take control of the classroom.



## **Algebraic Reasoning: Seniors, A Week Periods 6-7**

Over the course of my teaching practicum, I only taught this group of seniors a few times when a substitute was needed. However, they taught me a lot about working with others and reminded me why I love teaching. In this particular class, there were many students I became pretty comfortable with despite my limited time with them. One student, Student JU, and I bonded over the stress high school probability would cause both of us given how hard it was to validate answers. Another student, Student JA, and I had a very similar sense of humor, and to be honest, the energy he brought to the classroom was contagious; it helped me get through the long days of teaching. A friend of Student JA whom I am going to refer to as Student N had a similar impact on the classroom. I not only admired this student for his dedication to his studies, his enthusiasm, and his respect for everyone around him, but also for the attitude he had despite his personal situation. I never would imagine that this student was dealing with so much, so I was shocked to learn that when he was younger, he had witnessed his father kill his mother, and now he and his brother live with their aunt given that the father was sent to prison. With the effervescent attitude that Student N displayed countlessly, he inspired me to see the good in every day and to always bring light to any situation. I am lucky to have gotten to both observe, teach, and connect with these students as they have taught me so much about being a better version of myself.

## **Reflection of Classroom Experience**

Throughout my experience with all of my classes, I gained much knowledge with mainly working with special education students to help prepare them for their assessments. This experience stemmed from my Inclusion Algebra I classes, and the ways in which I worked with these students were fairly similar. After reviewing the IEPs of my students, I noticed common

themes throughout their accommodations: graphic organizers, Cornell notes, concrete steps, and multi-sensory approach. These accommodations I wanted to incorporate into each of my lesson plans, and this was particularly done well when I began teaching the “AC Method” for factoring (Appendix A, pg. 48). I made sure to give students Cornell notes with concrete steps on how to factor, and after covering all units of factoring, they received a graphic organizer that summarized the different methods they learned (Appendix A, pg. 59). In addition, I also made sure to consistently use verbal and written instruction to accommodate a diverse set of learning styles.

About halfway through my practicum, I gave a student feedback survey to my Inclusion Algebra I classes to make sure my instruction was benefiting their diverse needs (Appendix D, pg. 82). To analyze my results, I gave each answer a numerical value: 4 for “Strongly Agree”, 3 for “Agree”, 2 for “Disagree” and 1 for “Strongly Disagree”. I took the average of my student responses for each question, and modeled the data with the following graph:

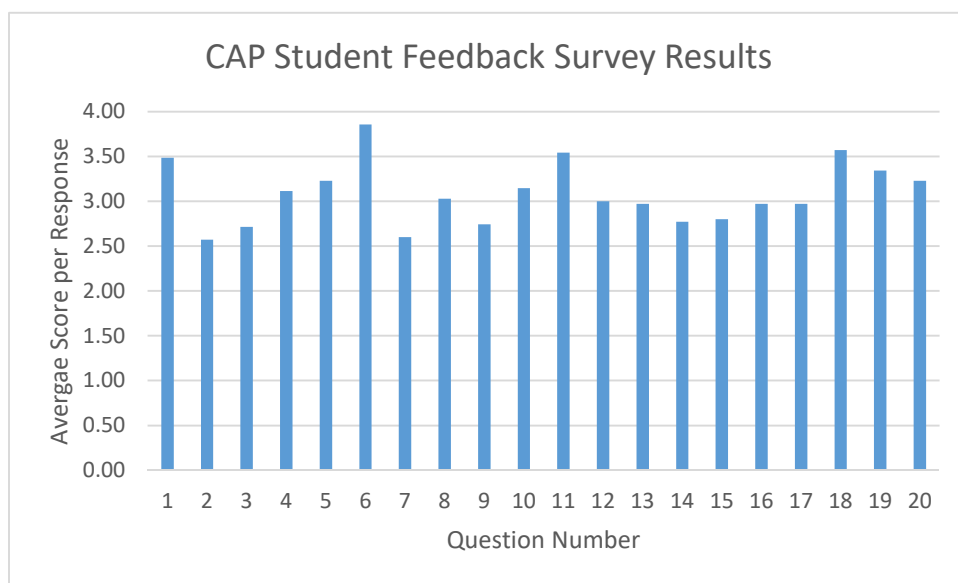


Figure 5: CAP Student Feedback Survey Results

My areas of strength were based off of the results from questions 1, 6, 11, and 18. The results inferred that I was able to demonstrate that mistakes were a part of learning, use a positive tone, teach material clearly, and adjust my practice when students were not understanding the material. Meanwhile, my main areas of growth came from questions 2,3,7, 9, 14, and 15. These responses were not surprising as I knew I struggled with remembering to have my students summarize the lesson, incorporating more group work and peer review, and flushing out more of my students' interests within the content. As a future educator, I plan to use a survey at the beginning of the year to understand my students and their interests, incorporate more "Think Pair Shares" and "Exit Tickets" for in-class reflection, and to be more clear when allowing students to work in groups on problems. With that being said, many of the written responses were positive in which students enjoyed having me as their teacher (Appendix D, pg. 83), and I appreciate the feedback they had to give me.

Another method of reflection I administered during this practicum was the use of a pre-test and post-test to measure student growth and the impact my instruction had on their performance and understanding of polynomials. The students received the same exam for their pre-test and post-test, and the questions of this exam covered material from adding and subtracting polynomials, factoring, and multiplying polynomials (Appendix C, pg. 78, 80). After collecting the data from the pre-test, I compiled the data into a graph to show a comparison between the number of correct and incorrect answers per question.

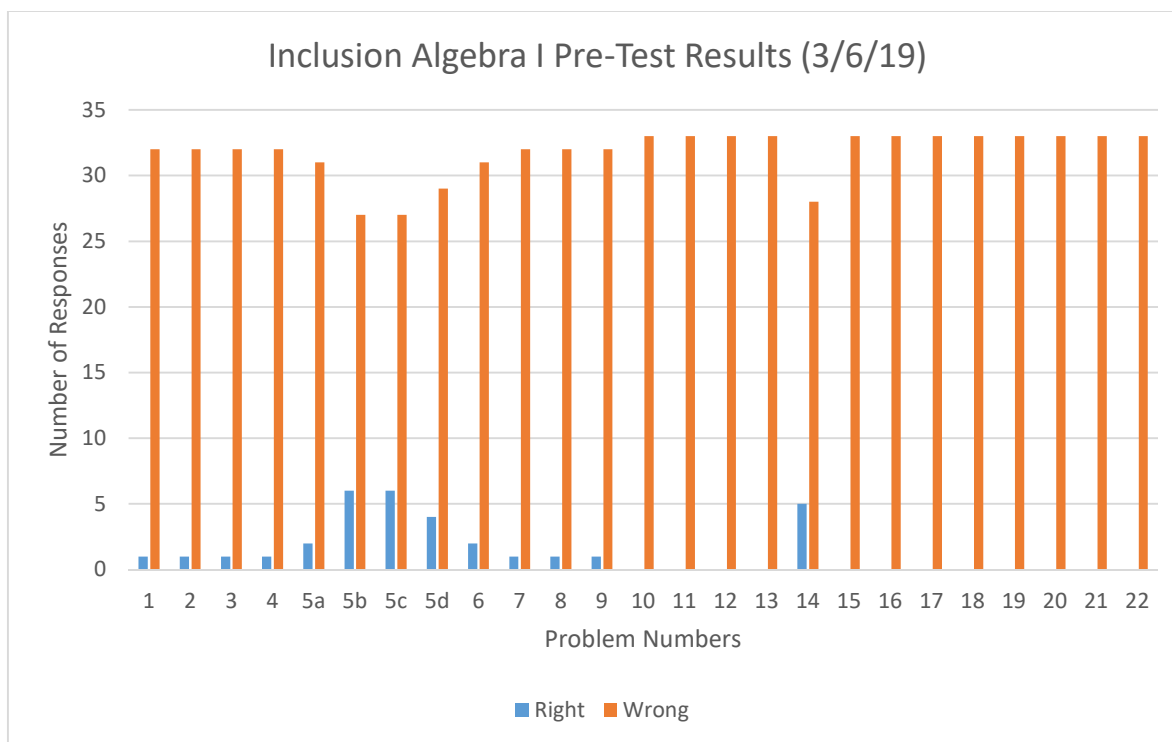


Figure 6: Inclusion Algebra I Pre-Test Results

With the 33 responses between both Algebra I periods, there were an overwhelming number of incorrect answers for each question. Therefore, I knew not to assume that all of these students had any prior exposure to anything with polynomials. Other concrete data that came back from this pre-test included an average of around 15.08% between both classes. When it came time to administer the post-test, the following results were acquired:

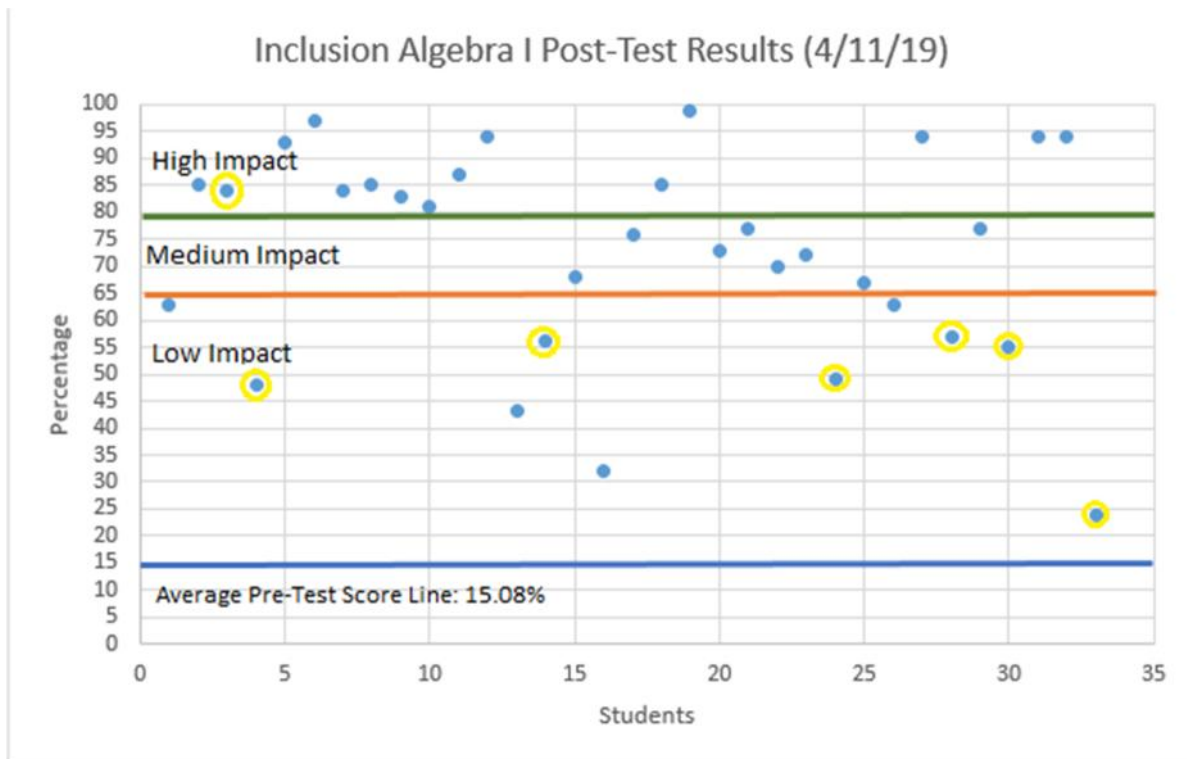


Figure 7: Inclusion Algebra I Post-Test Results

Before analyzing the data, it is important to note that there were scores from students who did not finish, indicated by being circled in yellow. Since students can come in to finish their test at a later date, these scores can only go up. However, given the time constraint of this practicum, the data analysis of these scores was done before students came in to finish their tests for a higher grade.

The average score on this exam at the time was a 78.45%. With the raw scores shown in the graph, 47.23% of students were highly impacted with a score greater than an 80%, 22.78% of students were mediumly impacted with a passing grade between a 65% and an 80%, and 30% of students were lowly impacted with a score below a 65%. However, considering that a majority of the highlighted points are in the low impact range, this number of 30% can only decrease, leading to an increase in either the high impact or medium impact ranges. Regardless, I predicted

that 30% of my students would be in the high impact range, 40% would be in the medium impact range, and 30% would be in the low impact range. Therefore, I managed to impact more of my students to reach a score of at least 80%, and even though fewer students managed to reach the medium impact range, I know that the students who were unable to finish have the potential to at least reach that range.

During this experience, I was also fortunate to experience a parent interaction and a department meeting. The parent interaction was towards the beginning of my practicum, and it was over the phone with a mother of one of my students to discuss his failure warning and how he could do better in the class. The main pieces of advice that both myself and my mentor gave her was to make sure he stayed organized given that his notebook grade tended to be on the lower end. In addition, we both suggested that she checked to make sure that he was keeping up with his homework as homework would be collected for a grade. There was a positive tone used on both ends, and I learned from this interaction that it is crucial for a teacher to be willing to work with the parent in the best interest of the student. It also goes a long way to positively talk about ways the student could improve and for the parent to feel supported by the teacher. I hope to have more parent interactions of my own when I have my own classroom considering that it is an important step in helping the student reach their potential.

As for the department meeting, this meeting was held back in January, and it discussed the logistics for eighth grade tours, evaluation timelines, substitutes, library times, and the duty schedule. The principal of the school mainly stressed duties to monitor students in the hallways and in the bathroom due to issues with vandalism. Now teachers would have a duty signing students into and out of the bathroom so that groups of students would not congregate in the bathroom. Teachers were also stressed to make sure students had a visible ID and pass when

walking in the hallways during class periods. With all that being said, the main purpose of this department meeting and others similarly was to keep faculty and staff on the same page for the school to run smoothly.

## **Conclusion**

When I first started my teaching practicum, I was nervous about many things: whether or not I would do a good job as a teacher, if my students would respect and be comfortable with me, the time commitment, and if I were even capable of going through this whole process successfully. Although it took me weeks to finally be comfortable, I have seen so much growth in myself as both a teacher and a person. This program put many things in perspective for me, and the challenges I faced throughout has helped me become mentally stronger.

During the first half of the semester, I had the intimidating task of not only taking on the Teacher Preparation Program, but also balancing that with my WPI classes, being a member of a sorority on campus, being an interim for the position of president of the Panhellenic Council, and making sure I practiced self-care. In all honesty, that was the hardest term of my career at WPI, and it became one of the hardest periods of my life. I was dealing with a lot personally, and with all my other responsibilities I prioritized, I often neglected taking care of myself. Although there were many days where I felt beaten down, exhausted, and stressed, I held myself to the standard of making sure I separated my own emotions from teaching. In the profession of being an educator, it is crucial that each teacher leaves their stress and hardships behind when they walk into the classroom. No instructor should ever take out their own personal frustrations on the students sitting in front of them when they too are also dealing with so much. For many students, school could be their safe haven, and for others, it could also be a very stressful environment. Making sure each student feels comfortable in the classroom takes away that stressful barrier

from being able to be fully engaged in the lesson. This not only allowed me to be more aware of the thoughts and feelings of the people around me, but it also helped me be in tune with myself about what I needed to do to make it through the practicum.

Looking back at this experience, although challenging, I am glad that I persevered and chose to take up this opportunity to student teach. I knew that teaching was such a vital profession for molding the minds of the next generation of educators, engineers, businessmen, entrepreneurs, doctors, politicians, and so forth. However, by having the time to work in a high school, I never realized just how much impact teachers have on the outside community. If I were to have my own classroom, one of my professional goals would be to integrate the outside community as much as possible into my classroom. Family and community involvement is essential for students to take ownership of their education. When teachers are able to work closely with the important people in a student's life, they can come up with a plan to help that student reach their greatest potential as both a learner and as a person. In addition, I would like to incorporate weekly emails to send to the families of my students to inform them of what is happening in the classroom. With that being said, I hope to gain more personal connections with my students' families to better meet their diverse needs, understand their cultural differences, and to build positive relationships.

Overall, this experience has provided me with many lessons and skillsets that I can apply as an educator and to my life as a whole. I have learned to become more comfortable speaking in front of people, communicating with others, being more mindful, and not being afraid to push myself to reach my potential. Most importantly, I have learned throughout this practicum that teachers can best impact a student's success from being someone they can confide in. A great teacher should be one who acts as a mentor for the students, and someone these students feel



comfortable working with to feel supported, encouraged, and safe. If there is mutual respect between the teacher and the student, the motivation to do each other proud will be prevalent. My mother, someone I look up to as both a role model and as an educator, told me a piece of valuable advice that really resonates with this key takeaway. She told me that, “Students will not care what you know until they know that you care”, and this practicum has proven to me that this is true.

## Appendix A: Lesson Plans and Handouts

### I. Inclusion Algebra I 9.6 AC Method Factoring Lesson Plan

#### 9.6 Factoring $ax^2 + bx + c$

**Teacher's Name:** Danielle Angelini.

**Subject/Course:** Algebra I

**Unit:** Polynomials and Factoring

**Grade Level:** 9

#### Overview of and Motivation for Lesson:

Students will be learning how to factor a trinomial of the form  $ax^2 + bx + c$

Motivation: Students can use factoring to figure out the time it takes for an item in trajectory motion to hit the ground given its starting height and its initial velocity.

Stage 1-Desired Results
<p><b>Standard(s):</b></p> <ul style="list-style-type: none"> <li>• A-SSE 2</li> <li>• A-SSE 3.a</li> </ul>
<p><b>Aim/Essential Question:</b></p> <ul style="list-style-type: none"> <li>• What are the steps that need to be taken to factor a trinomial when the leading coefficient is not 1?</li> <li>• What determines the signs of p and q when factoring a trinomial?</li> <li>• What determines the values of p and q when factoring a trinomial?</li> </ul>
<p><b>Understanding(s):</b> <i>Students will understand that...</i></p> <ul style="list-style-type: none"> <li>• Students will understand how to find factors of a number, c, that add up to another number b.</li> <li>• Students will understand how to use the "ac Method" to factor a trinomial of the form <math>ax^2 + bx + c</math></li> <li>• Students will understand that checking problems involved with factoring can be done with using the FOIL method.</li> </ul>
<p><b>Content Objectives:</b> <i>Students will be able to...</i></p> <ul style="list-style-type: none"> <li>• Find factors of a number c, that add up to another number b.</li> <li>• Factor trinomials completely</li> <li>• Find the greatest common factor of a trinomial</li> <li>• Use the "ac Method" to factor trinomials in the format, <math>ax^2 + bx + c</math></li> </ul>
<p><b>Key Vocabulary</b></p> <ul style="list-style-type: none"> <li>• Trinomial</li> <li>• "ac Method"</li> <li>• Greatest common factor</li> <li>• Factor</li> <li>• Grouping</li> </ul>
Stage 2-Assessment Evidence

<p><b>Performance Task or Key Evidence</b></p> <ul style="list-style-type: none"> <li>• Day 2: HW from the night before will be collected</li> <li>• Day 2: Pizzazz worksheet with work will be collected at the end of class</li> </ul>
<p><b>Key Criteria to measure Performance Task or Key Evidence</b></p> <ul style="list-style-type: none"> <li>• Completeness, accuracy, effort</li> </ul>
<p style="text-align: center;"><b>Stage 3- Learning Plan</b></p>
<p><b>Learning Activities:</b></p> <p><b>Day 1: Factoring <math>ax^2 + bx + c</math></b>  Do Now/Bell Ringer/Opener: (10 minutes)  Factor the following expressions:</p> <ol style="list-style-type: none"> <li>1. <math>x^2 + 3x - 18</math></li> <li>2. <math>a^2 + 2a - 24</math></li> <li>3. <math>x^2 + 2x - 15</math></li> <li>4. <math>y^2 - 6y + 8</math></li> </ol> <p>While students are completing POD, the teacher will be taking attendance, getting worksheets ready to hand out, and walking around to check in with students. If a common question arises while going over problems, teacher will address question as a whole to students.</p> <p>Teacher will have students come to the board to solve problems through volunteering. Teacher will go through problems to check while checking in with class for agreement or disagreement.</p> <p><b>Learning Activity 1: (20 minutes)</b>  Teacher will hand out "Trinomial Method Notes". Teacher will display these notes on the board.  Notes are <a href="#">here</a> (pg 8)  Teacher will tell students that sometimes, one would have to factor trinomials where the leading coefficient is not 1. When this happens, we approach it using the "ac Method". Teacher will have students title their notes with "ac Method".</p> <p>Teacher will walk through notes with students on the board.</p> <ol style="list-style-type: none"> <li>1. Find the GCF</li> <li>2. Multiply <math>a</math> and <math>c</math> (ex. <math>3 \cdot 8 = 24</math>)</li> <li>3. Write down the factors for <math>ac</math> that add up to <math>b</math> (ex. <math>-6</math> and <math>-4</math> to add up to <math>-10</math>)</li> <li>4. Turn into a Quad! <ol style="list-style-type: none"> <li>a. Write out the <math>b</math> term as a sum of the two factors from step 3</li> <li>b. <math>3x^2 - 6x - 4x + 8</math></li> </ol> </li> </ol>

5. Factor by grouping
  - a.  $(3x^2 - 6x) + (-4x + 8)$
  - b. Teacher will note to students that nothing about the expression is actually changing
6. Find the GCF of each group
  - a.  $3x(x - 2) - 4(x - 2)$
7. Factor the "twin" out
  - a.  $(3x - 4)(x - 2)$

Teacher will write the following problem on the board for demonstration.

1.  $4x^2 + 8x + 3$

Teacher will write  $ax^2 + bx + c$  next to this expression for reference to students.

Teacher will walk students through the following steps and write them out on the board:

8. Find the GCF
9. Multiply  $a$  and  $c$  (ex.  $4 \cdot 3 = 12$ )
10. Write down the factors for  $ac$  that add up to  $b$  (ex. 6 and 2 to add up to 8)
11. Turn into a Quad!
  - a. Write out the  $b$  term as a sum of the two factors from step 3
  - b.  $4x^2 + 6x + 2x + 3$
12. Factor by grouping
  - a.  $(4x^2 + 6x) + (2x + 3)$
  - b. Teacher will note to students that nothing about the expression is actually changing
13. Find the GCF of each group
  - a.  $2x(2x + 3) + 1(2x + 3)$
14. Factor the "twin" out
  - a.  $(2x + 3)(2x + 1)$

Teacher will ask if students have any questions to check for understanding.

Teacher will go through another example with students.

1.  $6x^2 - 3x - 9$

Teacher will note to students that there is a GFC other than 1 for this expression.

$$3(2x^2 - x - 3)$$

$$3(2x^2 - 3x + 2x - 3)$$

$$3((2x^2 - 3x) + (2x - 3))$$

$$3(x(2x - 3) + 1(2x - 3))$$

$$3(2x - 3)(x + 1)$$

#### Learning Activity 2: (10 minutes)

Teacher will hand out practice problems with factoring with expressions in this format. Teacher will have students work on problems until the end of class individually or with a partner. Teacher will go around to check in with individual students to check for understanding and answer questions.

Worksheet [here](#)

### Application

Students will finish worksheet given in class for homework.

### Summary/Closing

Teacher will do a final check in at the end of class through asking for a thumbs up or down for understanding. After each problem finished, each student can come up to the teacher to check answer on problem for understanding.

### **Day 2: Practicing Factoring**

#### **Do Now/Bell Ringer/Opener: (5 minutes)**

Teacher will assign each student with a problem if possible (For instance, teacher will assign more difficult problems to stronger students) or will use numbered pieces of paper for students to choose from that go with each problem. Students will be asked to do problems out on the board for teacher to go over them with the class.

While students are completing POD, the teacher will be taking attendance, getting worksheets ready to hand out, and walking around to check in with students. If a common question arises while going over problems, teacher will address question as a whole to students.

#### **Learning Activity 1: Going over the HW problems (15 minutes)**

Teacher will use this time to explain and go over problems from the homework from the night before. Teacher will highlight common mistakes and explain them so that students can avoid making the same mistake again in the future. Teacher will check for understanding after each problem to know to move on to the next problem.

#### **Learning Activity 2: Pizzazz Worksheets (20 minutes)**

Students for the remainder of class will work on a Pizzazz worksheet. Students are allowed to work in pairs and ask questions. Students will turn in Pizzazz worksheet at the end of class for a classwork grade. All work must be shown for credit.

### Application

Students will be told that getting good at factoring will help when it comes to solving for x-intercepts when graphing functions called quadratics. Students will also be expected to solve word problems using factoring.

### Summary/Closing

Teacher will do a final check in at the end of class through asking for a thumbs up or down for understanding. Teacher will give students another worksheet with factoring for homework especially if students still need more practice.

### **Multiple Intelligences Addressed:**

<input type="checkbox"/> Linguistic	<input checked="" type="checkbox"/> Logical-Mathematical	<input type="checkbox"/> Musical	<input type="checkbox"/> Bodily-kinesthetic
<input type="checkbox"/> Spatial	<input type="checkbox"/> Interpersonal	<input type="checkbox"/> Intrapersonal	<input type="checkbox"/> Naturalistic
<b>Student Grouping</b>			
<input checked="" type="checkbox"/> Whole Class	<input type="checkbox"/> Small Group	<input checked="" type="checkbox"/> Pairs	<input checked="" type="checkbox"/> Individual
<b>Instructional Delivery Methods</b>			
<input checked="" type="checkbox"/> Teacher Modeling/Demonstration	<input checked="" type="checkbox"/> Lecture	<input type="checkbox"/> Discussion	
<input checked="" type="checkbox"/> Cooperative Learning	<input type="checkbox"/> Centers	<input checked="" type="checkbox"/> Problem Solving	
<input type="checkbox"/> Independent Projects			
<b>Accommodations</b>			
Students with accommodations will receive a printout of the steps of the “ac Method” and the example problem showing the steps ahead of time. Steps to the “ac Method” will be displayed on the board as well.			
<b>Homework/Extension Activities:</b>			
Day 1: “ac Method” Worksheet			
Day 2: Factoring Binomials Worksheet			
<b>Materials and Equipment Needed:</b>			
<ul style="list-style-type: none"> <li>• Notebooks, dry erase markers, whiteboard, pencils</li> </ul>			

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

## Factoring: Trinomial Method - NOTES

Lesson 9.6

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

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

The trinomial method is used to factor a trinomial where the coefficient of the squared term is not "1".

This method is similar to the simple trinomial method when "a" was always "1".

$$ax^2 + bx + c$$

\*\*\* YOUR BIG CHALLENGE !!!! \*\*\*

\*\* Find two numbers that multiply to  $ac$  and add to  $b$ .

Example  $3x^2 - 10x + 8$

Step 1: multiply "a" times "c"

$$ac = (3)(8) = 24$$

The factors of 24 are:

1 and 24      -1 and -24

2 and 12      -2 and -12

3 and 8      -3 and -8

4 and 6      -4 and -6

Step 2: Look for factors that add to "b"

-4 and -6 add up to -10 so they are the right numbers

Step 3: Break up the middle term

$$\text{ie. } -10x = -4x - 6x$$

$$3x^2 - 4x - 6x + 8$$

Step 4: Group the first two terms and factor.

Group the last two terms and factor.

$$x(3x - 4) - 2(3x - 4)$$

Step 5: Note that  $(3x - 4)$  is common to both

terms, so you can factor it out. Put that term in the first parenthesis.

Now put what you factored out in the

second parenthesis.

$$(3x - 4)(x - 2) \quad \text{your factors !!!!!}$$

Check your answer using FOIL.

First =  $3x^2$

Outside =  $-6x$

Inside =  $-4x$

Last =  $8$

**Factoring: Simple Trinomial Method**

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

Lesson 9.6 (page 1)

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

**Factoring: Trinomial Method  $ax^2 + bx + c$** 

Trinomial	Step 1 Multiply ac	Step 2 and Add to b...	Step 3 Break up the ac	Step 4 Group the first two terms Group the last two terms	Step 5 Factored Form
1. $3x^2 + 7x + 2$	6	7	6 1 times 6 and $7x = 1x + 6x$	$3x^2 + 1x + 6x + 2$ $x(3x + 1) + 2(3x + 1)$	$(3x + 1)(x + 2)$
2. $2x^2 + 5x + 3$					(    ) (    ) Check it F = O = I = L = =
3. $3x^2 - 16x + 5$					(    ) (    ) Check it F = O = I = L = =
4. $7x^2 - 9x + 2$					(    ) (    ) Check it F = O = I = L = =
5. $6x^2 + 5x + 1$					(    ) (    ) Check it F = O = I = L = =
6. $8x^2 - 9x + 1$					(    ) (    ) Check it F = O = I = L = =
7. $10x^2 + 17x + 3$					(    ) (    ) Check it F = O = I = L = =



**Factoring: Simple Trinomial Method**

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

Lesson 4.4 (page 2)

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

**Factoring: Trinomial Method  $ax^2 + bx + c$** 

Trinomial	Step 1 Multiply ac	Step 2 and Add to b...	Step 3 Break up the ac	Step 4 Group the first two terms Group the last two terms	Step 5 Factored Form
1. $3x^2 + 7x + 2$	6	7	6 1 times 6 and $7x = 1x + 6x$	$3x^2 + 1x + 6x + 2$ $x(3x + 1) + 2(3x + 1)$	$(3x + 1)(x + 2)$
2a. $2x^2 + 13x + 18$					(    ) (    ) Check it F = O = I = L = =
2b. $3b^2 - 23b + 14$					(    ) (    ) Check it F = O = I = L = =
2c. $5a^2 - 28a + 32$					(    ) (    ) Check it F = O = I = L = =
2d. $4c^2 + 17c + 15$					(    ) (    ) Check it F = O = I = L = =
2e. $2d^2 + 22d + 56$					(    ) (    ) Check it F = O = I = L = =
2f. $3g^2 + 20g - 63$					(    ) (    ) Check it F = O = I = L = =

## II. Honors Algebra II 5.1 Lesson Plan

### 5.1 Operations with Functions

**Teacher's Name:** Danielle Angelini.

**Subject/Course:** Algebra II

**Unit:** Inverses and Radical Functions

**Grade Level:** 11

#### Overview of and Motivation for Lesson:

Students will learn the content required to perform operations with functions and their applications

Stage 1-Desired Results
<p><b>Standard(s):</b></p> <ul style="list-style-type: none"> <li>• F-BF 1.b</li> </ul>
<p><b>Aim/Essential Question:</b></p> <ul style="list-style-type: none"> <li>• How does one perform arithmetic operations with functions?</li> <li>• How does one apply arithmetic operations with functions?</li> </ul>
<p><b>Understanding(s):</b> <i>Students will understand that...</i></p> <ul style="list-style-type: none"> <li>• Students will understand how to perform arithmetic operations (addition, subtraction, multiplication, and division) with functions</li> <li>• Students will understand how to apply operations with functions</li> </ul>
<p><b>Content Objectives:</b> <i>Students will be able to...</i></p> <ul style="list-style-type: none"> <li>• Students will be able to perform arithmetic operations with functions</li> </ul>
<p><b>Key Vocabulary</b></p> <ul style="list-style-type: none"> <li>• Arithmetic operations</li> <li>• Functions</li> <li>• Polynomials</li> </ul>
Stage 2-Assessment Evidence
<p><b>Performance Task or Key Evidence</b></p> <ul style="list-style-type: none"> <li>• pg 318 Check Your Understanding #1 and #2</li> <li>• HW: pg 318 #4-10 EVENS</li> </ul>
<p><b>Key Criteria to measure Performance Task or Key Evidence</b></p> <ul style="list-style-type: none"> <li>• Completeness, performing correct operation, accuracy</li> </ul>
Stage 3- Learning Plan
<p><b>Learning Activities:</b></p>

**Do Now/Bell Ringer/Opener: (20 minutes)**

Teacher will display pg 317 on the board to do Robotics problem.

Teacher will write down underneath or beside, "If the team has 15 members, how much does each paying team member contribute to the cost of the T-shirts"?

Teacher will go over same problem with using operations with functions, and will go through parts a, b, c and d

**Learning Activity 1: (40 minutes)**

Teacher will have students follow along on pg 315-316 and write down notes for:

- How to add & subtract functions (Examples 315, students do 1A and 1B)
- How to multiply & divide functions on pg 316 (Example 316, students do 2A and 2B)

Teacher will do a CYU with students on pg. 318 for 1,2

**Learning Activity 2: (20 minutes)**

Students will work on HW pg. 318 #4-10 EVENS

**Application**

Students can represent different problems and scenarios with functions (Robotics problem, coupons and discounts)

**Summary/Closing**

Teacher will remind students to complete HW for the next day

**Multiple Intelligences Addressed:**

- |                                     |  |  |   |
|-------------------------------------|--|--|---|
| <input type="checkbox"/> Linguistic | <input checked="" type="checkbox"/> Logical-Mathematical | <input type="checkbox"/> Musical       | <input type="checkbox"/> Bodily-kinesthetic |
| <input type="checkbox"/> Spatial    | <input type="checkbox"/> Interpersonal                   | <input type="checkbox"/> Intrapersonal | <input type="checkbox"/> Naturalistic       |

**Student Grouping**

- |   |                                      |   |  |
|---|--------------------------------------|---|--|
| <input checked="" type="checkbox"/> Whole Class | <input type="checkbox"/> Small Group | <input checked="" type="checkbox"/> Pairs | <input checked="" type="checkbox"/> Individual |
|---|--------------------------------------|---|--|

**Instructional Delivery Methods**

- |  |   |   |
|--|---|---|
| <input checked="" type="checkbox"/> Teacher Modeling/Demonstration | <input checked="" type="checkbox"/> Lecture | <input type="checkbox"/> Discussion                 |
| <input checked="" type="checkbox"/> Cooperative Learning           | <input type="checkbox"/> Centers            | <input checked="" type="checkbox"/> Problem Solving |
| <input type="checkbox"/> Independent Projects                      |   |   |

**Accommodations**

Students will have access to the textbook to follow along with what is displayed on the board

**Homework/Extension Activities:**

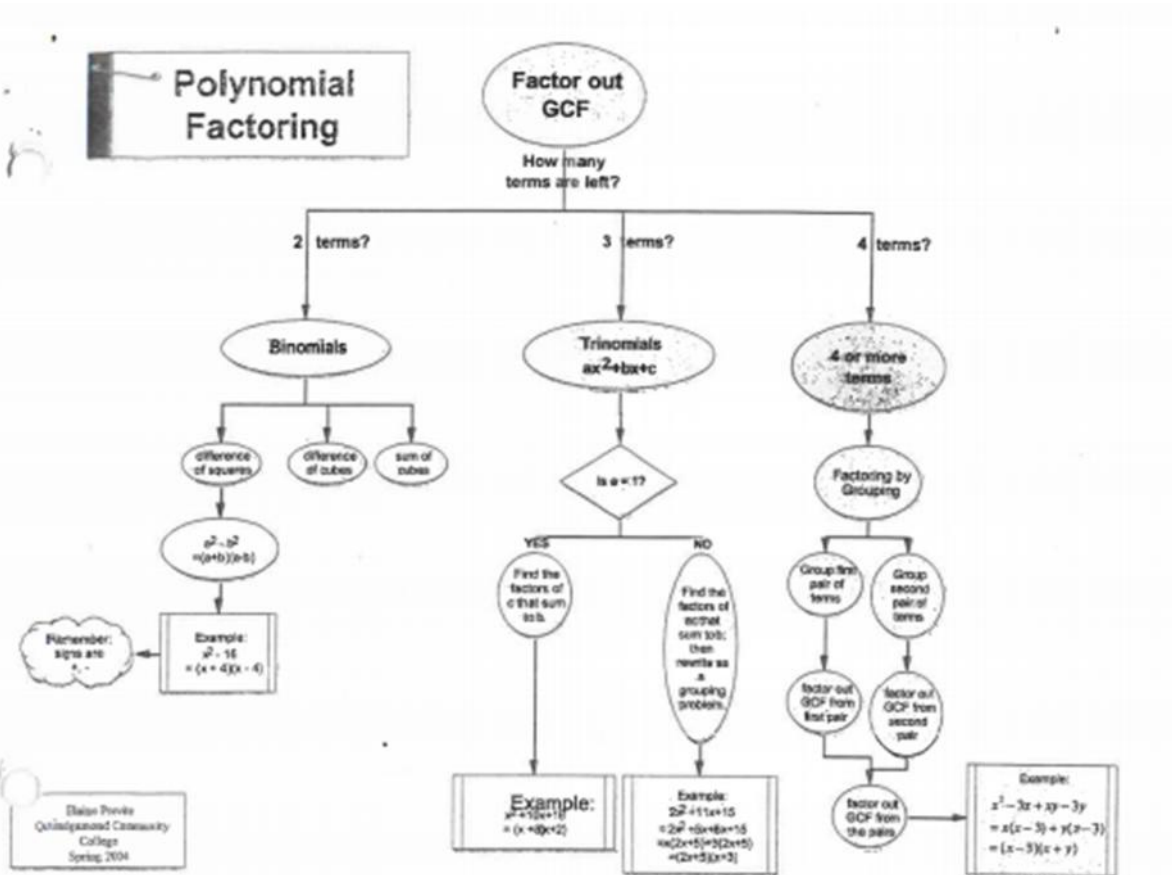
HW pg. 318 #4-10 EVENS

**Materials and Equipment Needed:**

- Textbooks, PDF of textbook, projector

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

### III. Factoring Graphic Organizer



Blaine Preble  
Oklahoma Community  
College  
Spring 2004

Methods to Factor Polynomials	
Any Polynomial—Look for the greatest common factor.	
$ab - ac = a(b - c)$	$6x^2y + 10xy^2 = 2xy(3x + 5y)$
Binomials—Look for a difference of two squares.	
$a^2 - b^2 = (a + b)(a - b)$	$x^2 - 9y^2 = (x + 3y)(x - 3y)$
Trinomials—Look for perfect-square trinomials and other factorable trinomials.	
$a^2 + 2ab + b^2 = (a + b)^2$	$x^2 + 4x + 4 = (x + 2)^2$
$a^2 - 2ab + b^2 = (a - b)^2$	$x^2 - 2x + 1 = (x - 1)^2$
$x^2 + bx + c = (x + \quad)(x + \quad)$	$x^2 + 3x + 2 = (x + 1)(x + 2)$
$ax^2 + bx + c = (\quad x + \quad)(\quad x + \quad)$	$6x^2 + 7x + 2 = (2x + 1)(3x + 2)$
Polynomials of Four or More Terms—Factor by grouping.	
$ax + bx + ay + by = x(a + b) + y(a + b)$	$2x^3 + 4x^2 + x + 2 = (2x^3 + 4x^2) + (x + 2)$
$= (x + y)(a + b)$	$= 2x^2(x + 2) + 1(x + 2)$
	$= (x + 2)(2x^2 + 1)$

## IV. Graphing Calculator Cheat Sheet

### Finding the Minimum or Maximum of a Curve

To find the min or max of  $y = x^2 - 4x - 9$

1. Press  $\boxed{Y=}$
2. Next to  $\boxed{Y_1=}$  type in  $x^2 - 4x - 9$
3. Press  $\boxed{\text{Graph}}$
4. Notice the parabola opens up so we will find the minimum
5. Press  $\boxed{2^{\text{nd}}}$   $\boxed{\text{Trace}}$  (Calc)
6. Arrow down to **minimum**
7. Press  $\boxed{\text{Enter}}$
8. **Left Bound?** appears on the screen
  - a. Look at the parabola and choose the x value next to the left side of the curve - and type it, - 2
9. Press  $\boxed{\text{Enter}}$
10. **Right Bound?** appears on the screen
  - a. Look at the parabola and choose the x value next to the right side of the curve - and type it, 6
11. Press  $\boxed{\text{Enter}}$
12. **Guess?** appears on the screen
13. Press  $\boxed{\text{Enter}}$
14. The value is displayed on the bottom of the screen

**Minimum**  
X=2.0000021    Y=-13

The vertex is (2, -13) and -13 is the minimum value of the quadratic

To find the min or max of  $y = -2x^2 - 10x + 15$

1. Press  $\boxed{Y=}$
2. Next to  $\boxed{Y_1=}$  type in  $-2x^2 - 10x + 15$
3. Press  $\boxed{\text{Graph}}$
4. Notice the parabola opens down so we will find the maximum
5. Press  $\boxed{2^{\text{nd}}}$   $\boxed{\text{Trace}}$  (Calc)
6. Arrow down to **maximum**
7. Press  $\boxed{\text{Enter}}$
8. **Left Bound?** appears on the screen
  - a. Look at the parabola and choose the x value next to the left side of the curve - and type it, - 7
9. Press  $\boxed{\text{Enter}}$
10. **Right Bound?** appears on the screen
  - a. Look at the parabola and choose the x value next to the right side of the curve - and type it, 2
11. Press  $\boxed{\text{Enter}}$
12. **Guess?** appears on the screen
13. Press  $\boxed{\text{Enter}}$
14. The value is displayed on the bottom of the screen

**Maximum**  
X=-2.499998    Y=27.5

The vertex is (-2.5, 27.5) and 27.5 is the minimum value of the quadratic

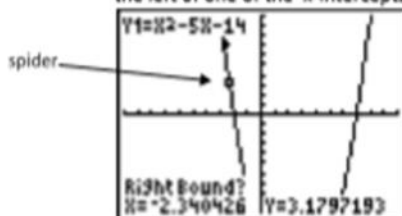
### Finding the Zeros of an Equation

Zeros of an equation are where the equation crosses the x-axis. They are the solutions to the variable in the equation when the equation is set equal to zero.

To find the zeros of  $y = x^2 - 5x - 14$

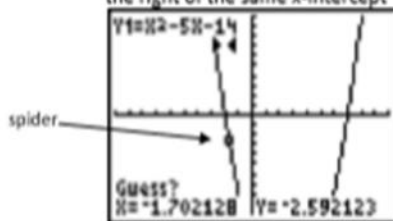
1. Press  $\boxed{Y=}$
2. Next to  $\boxed{Y_1=}$  type in  $x^2 - 5x - 14$
3. Press  $\boxed{\text{Graph}}$
4. Press  $\boxed{2^{nd}} \boxed{\text{Trace}}$  (Calc)
5. Arrow down to zero
6. Press  $\boxed{\text{Enter}}$
7. **Left Bound?** appears on the screen

- a. You can choose the left bound by using the left or right arrow buttons to move the spider on the line to the left of one of the x-intercepts



- b. Or you can type in the left bound value – look for the value on the x-axis to the left of the intercept point and type it, -3

8. Press  $\boxed{\text{Enter}}$
9. **Right Bound?** appears on the screen
- a. You can choose the right bound by using the left or right arrow buttons to move the spider on the line to the right of the same x-intercept



- b. Or you can type in the right bound value – look for the value on the x-axis to the right of the same intercept point and type it, -1

10. Press  $\boxed{\text{Enter}}$
11. **Guess?** appears on the screen
12. Press  $\boxed{\text{Enter}}$

13. The spider is on the zero, the x-intercept, and the value is displayed on the bottom of the screen

Zero  
X=-2      Y=0

You repeat #4-13 to find another zero if the graph intersects the x-axis in a second location.

14. Press  $\boxed{2^{nd}} \boxed{\text{Trace}}$  (Calc)
15. Arrow down to zero
16. Press  $\boxed{\text{Enter}}$
17. **Left Bound?** appears on the screen
- c. You can choose the left bound by using the left or right arrow buttons to move the spider on the line to the left of one of the x-intercepts
- d. Or you can type in the left bound value – look for the value on the x-axis to the left of the intercept point and type it, 6

18. Press  $\boxed{\text{Enter}}$
19. **Right Bound?** appears on the screen
- e. You can choose the right bound by using the left or right arrow buttons to move the spider on the line to the right of the same x-intercept
- f. Or you can type in the right bound value – look for the value on the x-axis to the right of the same intercept point and type it, 8

20. Press  $\boxed{\text{Enter}}$
21. **Guess?** appears on the screen
22. Press  $\boxed{\text{Enter}}$
23. The spider is on the zero, the x-intercept, and the value is displayed on the bottom of the screen

Zero  
X=7      Y=0

24. Press  $\boxed{\text{Enter}}$  to clear the Zero value

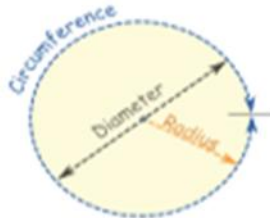
The two zeros, or solutions for x, of the equation  $y = x^2 - 5x - 14$  are  $x = -2$  and  $x = 7$

## V. Pi Day Activity

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: www # \_\_\_\_\_

### Finding Pi with Household Items

What is pi, also known as  $\pi$ ?



The ratio of a circle's circumference to its diameter

In other words: all the way around a circle divided by all the way across it.

The symbol is  $\pi$

No matter how large or small the circle, its circumference is always  $\pi$  times its diameter.

$$\frac{\text{Circumference}}{\text{Diameter}} = \pi = 3.14159\dots$$

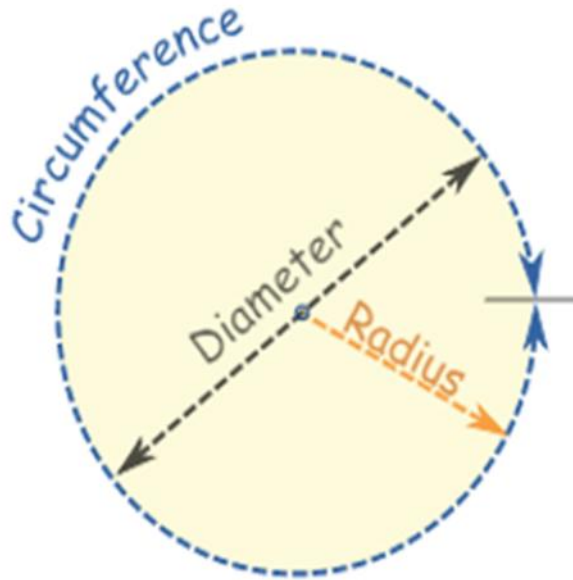
$\pi = 3.14159265358979323846\dots$  (the digits go on forever without repeating)

#### Directions:

1. There are 5 stations set up around the room each with commonly found household items. Using these items, measure the circumference and the diameter of your circle below.

To find circumference: Count the number of items it takes to go around the circumference of the circle.

To find the diameter: Count the number of items it takes to go across the diameter of the circle.





2. At each station, fill in the table:

Station Number	Household Item	How many items lined up around the circumference? <b>C</b>	How many items lined up on the diameter? <b>d</b>	Divide Circumference / diameter <b>C / d</b>	Answer (if decimal, round to 4 decimal places Ex. 3.141592 = 3.1416)
1	eraser caps				
2	paper clips				
3	beans				
4	pennies				
5	sequins				

3. Did we find  $\pi$ ?

$$\pi = \frac{\text{Circumference}}{\text{diameter}} = \frac{C}{d} = 3.14159265358979 \dots$$

Compare the answers you found from the table to the value of  $\pi$ . What items gave you the closest results?

What items did not give you the closest results? Why do you think so?

VI. Pizzazz Worksheet

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Group: \_\_\_\_\_ Assignment #: \_\_\_\_\_

# A DRASTIC WAY TO DIET

AN EXTREME BUT EFFECTIVE WAY TO DIET IS HIDDEN IN THE LETTERS BELOW.  
TO FIND IT:

Factor each trinomial below. Find the factored form in the set of answers under the exercise and cross out the letter above it. When you finish, the diet will remain. You might call it the "Algebra diet."



- ①  $m^2 + 8m + 7$
- ②  $m^2 + 5m + 6$
- ③  $m^2 + 10m + 9$
- ④  $m^2 - 6m + 8$
- ⑤  $m^2 - 8m + 12$
- ⑥  $m^2 + 11m + 24$

- ⑦  $d^2 - 8d + 15$
- ⑧  $d^2 - 12d + 20$
- ⑨  $d^2 + 14d + 13$
- ⑩  $d^2 - 13d + 36$
- ⑪  $d^2 + 17d + 30$
- ⑫  $d^2 + 9d + 18$

- ⑬  $x^2 + 5xy + 4y^2$
- ⑭  $x^2 - 18xy + 32y^2$
- ⑮  $x^2 - 13xy + 40y^2$
- ⑯  $x^2 + 7xy + 12y^2$
- ⑰  $x^2 - 27xy + 28y^2$
- ⑱  $x^2 + 19xy + 60y^2$

G	E	B	A	S	U	T	O	Y	F	N	U	L	E	O	M	A	T	O	R	E	G	I	A	N	L	T
$(m - 2)(m - 4)$	$(m + 9)(m + 1)$	$(m + 8)(m + 1)$	$(m - 2)(m - 6)$	$(m + 7)(m + 1)$	$(m + 3)(m + 4)$	$(m + 2)(m + 3)$	$(m + 8)(m + 3)$	$(m - 2)(m - 8)$	$(d + 1)(d + 13)$	$(d + 2)(d + 15)$	$(d - 5)(d - 3)$	$(d - 10)(d - 2)$	$(d - 2)(d - 18)$	$(d - 5)(d - 4)$	$(d - 4)(d - 9)$	$(d + 6)(d + 3)$	$(x - 16y)(x - 2y)$	$(x + 4y)(x + 15y)$	$(x + 2y)(x + 4y)$	$(x + y)(x + 4y)$	$(x + 4y)(x + 3y)$	$(x + 20y)(x + 3y)$	$(x - 5y)(x - 8y)$	$(x - 2y)(x - 13y)$	$(x - 26y)(x - y)$	

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Group: \_\_\_\_\_ Assignment #: \_\_\_\_\_

# Did You Hear About...

$(t + 3)(t - 2)$	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
STARTED				
$(t + 6)(t - 1)$	<b>E</b>	<b>F</b>	<b>G</b>	<b>H</b>
WHO				
$(t + 6)(t - 2)$				
RED				
$(t + 5)(t - 2)$	<b>I</b>	<b>J</b>	<b>K</b>	<b>L</b>
THE				
$(t - 9)(t + 8)$	<b>M</b>	<b>N</b>	<b>O</b>	<b>P</b>
BECAUSE				
$(t - 4)(t + 2)$				<b>?</b>
JOINED				
$(t - 4)(t + 5)$				
ARMY				
$(t - 10)(t + 2)$				
CROSS				
$(t + 7)(t - 3)$				
CAT				
$(t + 4)(t - 3)$				
AFTER				
$(t - 11)(t + 1)$				
THE				

$(x - 18)(x + 1)$	<b>Q</b>	<b>R</b>	<b>S</b>	<b>T</b>
WANTED				
$(x + 9y)(x - 4y)$	<b>U</b>	<b>V</b>	<b>W</b>	<b>X</b>
KIT				
$(x - 18y)(x + 2y)$	<b>Y</b>	<b>Z</b>	<b>AA</b>	<b>AB</b>
BAND				
$(x - 12y)(x + 3y)$	<b>AC</b>	<b>AD</b>	<b>AE</b>	<b>AF</b>
AID				
$(x + 5y)(x - 3y)$	<b>AG</b>	<b>AH</b>	<b>AI</b>	<b>AJ</b>
A				
$(x + 8)(x - 3)$	<b>AK</b>	<b>AL</b>	<b>AM</b>	<b>AN</b>
TO				
$(x + 6)(x - 4)$	<b>AO</b>	<b>AP</b>	<b>AQ</b>	<b>AR</b>
HELP				
$(x + 6)(x - 3)$	<b>AS</b>	<b>AT</b>	<b>AU</b>	<b>AV</b>
IT				
$(x - 25y)(x + 2y)$	<b>AW</b>	<b>AX</b>	<b>AY</b>	<b>AZ</b>
LION				
$(x - 12)(x + 2)$	<b>BA</b>	<b>BB</b>	<b>BC</b>	<b>BD</b>
BE				
$(x - 10y)(x + 5y)$	<b>BE</b>	<b>BF</b>	<b>BG</b>	<b>BH</b>
FIRST				

Factor each trinomial below. Find the factored form in the answer column nearest the exercise, and notice the word beneath it. Write this word in the box containing the letter of that exercise. Keep working and you will hear about a kitty cat.

- (A)  $t^2 + 3t - 10$
- (B)  $t^2 + 4t - 21$
- (C)  $t^2 + 5t - 6$
- (D)  $t^2 - 2t - 8$
- (E)  $t^2 - 10t - 11$
- (F)  $t^2 + 4t - 12$
- (G)  $t^2 - 8t - 20$
- (H)  $t^2 - t - 72$

- (I)  $x^2 + 3x - 18$
- (J)  $x^2 - 17x - 18$
- (K)  $x^2 + 5x - 24$
- (L)  $x^2 - 10x - 24$
- (M)  $x^2 + 2xy - 15y^2$
- (N)  $x^2 - 5xy - 50y^2$
- (O)  $x^2 - 9xy - 36y^2$
- (P)  $x^2 + 5xy - 36y^2$

# Appendix B: Student Work

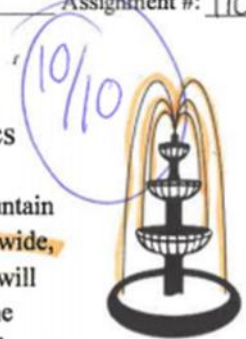
## I. The Coin Fountain

Name: [REDACTED] Date: 4-26-19 Period: 1-10 Assignment #: 110

### THE COIN FOUNTAIN

The study of parabolic curves through the design of water arcs

You have been hired by the Worcester community to design a new coin fountain for downtown Worcester. The pool of the fountain is planned to be 20 feet wide, and the water arc is to be greater than 6 feet tall, but less than 50 feet. You will need to determine the locations of the launch point and landing point and the maximum height of the water arc of the fountain. Also, you will need to write an equation that describes the water arc in terms of its height in relation to the horizontal distance along the pool.



- Place the side view of your fountain in a first quadrant graph. Have the surface of the pool correspond to the x-axis with the left side at the origin. Show the coordinates of the roots and vertex, and include all pertinent data points from the following questions.

$$y = a(x-4)(x-16)$$

- Using the equation  $y = a(x - x_1)(x - x_2)$  where  $(x_1, 0)$  &  $(x_2, 0)$  are the roots of the parabola, choose a value for "a" that will produce a reasonable arc. Then convert your equation to the form:  $y = ax^2 + bx + c$ .

$$y = a(x-4)(x-16)$$

$$42 = a(10-4)(10-16)$$

$$42 = a(6)(-6)$$

$$42 = a(-36)$$

$$a = \frac{42}{-36} = -5/3$$

x	-4
x <sup>2</sup>	-4x
-16x	64

$$y = -5/3(x-4)(x-16)$$

$$y = -5/3(x^2 - 20x + 64)$$

- State your launch and landing points and the height of your water arc.  
Launch (4, 0)      Landing (16, 0)      Height 42

$$y = -\frac{5}{3}x^2 + 33.3x - 106.6$$

- After one foot of horizontal distance (from your launch point) how high will the water arc be?

$$y = -\frac{5}{3}x^2 + 33.3x - 106.6$$

$$= 18.23$$

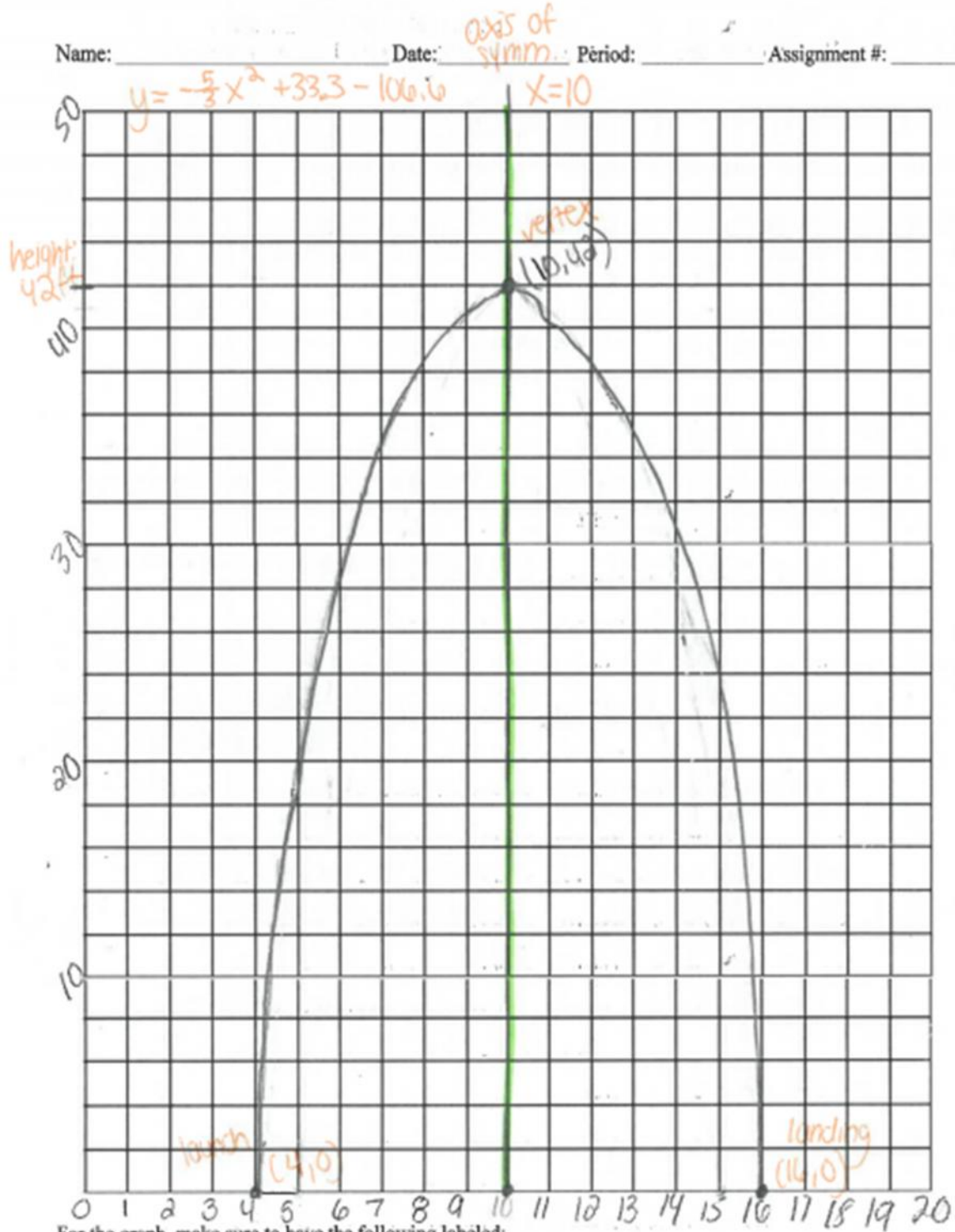
$$y = -\frac{5}{3}(5)^2 + 33.3(5) - 106.6$$

- Find the vertex and the equation for the axis of symmetry.

Vertex (10, 42)

Axis of symmetry:  $x = 10$

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Period: \_\_\_\_\_ Assignment #: \_\_\_\_\_



For the graph, make sure to have the following labeled:  
vertex, axis of symmetry, height of fountain, launch/landing points, and the equation for the function itself.

Ki

## II. Exponential Growth and Decay Problem of the Day

### Lesson 8.6 Exponential Decay Functions

# 78

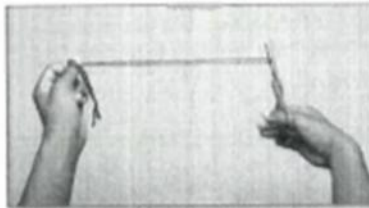
## 8.6 Exponential Models

**MATERIALS** • yarn • scissors

**QUESTION** How can you model a situation using an exponential function?

**EXPLORE** Collect data so that you can write exponential models

**STEP 1** *Fold and cut* Take about 1 yard of yarn and consider it to be 1 unit long. Fold it in half and cut, as shown. You are left with two pieces of yarn, each half the length of the original piece of yarn.



**STEP 2** *Copy and complete* Copy the table. Notice that the row for stage 1 has the data from Step 1. For each successive stage, fold *all* the pieces of yarn in half and cut. Then record the number of new pieces and the length of each new piece until the table is complete.

exp. growth      exp. decay

Stage	Number of pieces	Length of each new piece
1	2	$\frac{1}{2}$
2	? 4	? $\frac{1}{4}$
3	? 8	? $\frac{1}{8}$
4	? 16	? $\frac{1}{16}$
5	? 32	? $\frac{1}{32}$

*Handwritten notes: Arrows indicate doubling the number of pieces (x2) and halving the length (1/2) for each successive stage.*

**DRAW CONCLUSIONS** Use your observations to complete these exercises

- Use the data in the first and second columns of the table.
  - Do the data represent an exponential function? *Explain how you know.*
  - Write a function that models the number of pieces of yarn at stage  $x$ .
  - Use the function to find the number of pieces of yarn at stage 10.
- Use the data in the first and third columns of the table.
  - Do the data represent an exponential function? *Explain how you know.*
  - Write a function that models the length of each new piece of yarn at stage  $x$ .
  - Use the function to find the length of each new piece of yarn at stage 10.

$y = 1 \left(\frac{1}{2}\right)^{10}$   
 $y = 1 \left(\frac{1}{2}\right)^{10}$

$y = a(1+r)^t$   
 $a = 1$   
 $(1+r) = 2$   
 $t = t$   
 $y = 1(2)^t$

### III. Inclusion Algebra I 9.1 Polynomials Notes

Name \_\_\_\_\_ Date \_\_\_\_\_

Student T

Assignment 82

**LESSON 9.1**  
**Study Guide**  
 For use with pages 554-560

**GOAL** Add and subtract polynomials.

**Vocabulary**

A **monomial** is a number, a variable, or the product of a number and one or more variables with whole number exponents.  $4b$

The **degree** of a monomial is the sum of the exponents of the variables in the monomial.

A **polynomial** is a monomial or a sum of monomials, each called a **term** of the polynomial.

The **degree** of a polynomial is the greatest degree of its terms.

When a polynomial is written so that the exponents of a variable decrease from left to right, the coefficient of the first term is called the **leading coefficient**.

A polynomial with two terms is called a **binomial**.  $14a - 5$

A polynomial with three terms is called a **trinomial**.  $2x^2 + 4x - 1$

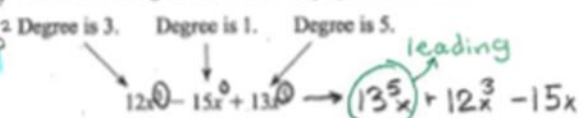
LESSON 9.1

**EXAMPLE 1** Rewrite a polynomial

Write  $12x^3 - 15x + 13x^5$  so that the exponents decrease from left to right. Identify the degree and the leading coefficient of the polynomial.

$$\begin{array}{r} (3a + 4p + 2b) \\ + (6a + 5b + 3p^2) \\ \hline 9a + 4p + 7b + 3p^2 \end{array}$$

**Solution**  
 Consider the degree of each of the polynomial's terms.



The polynomial can be rewritten as  $13x^5 + 12x^3 - 15x$ . The greatest degree is 5, so the degree of the polynomial is 5, and the leading coefficient is 13.

**Exercises for Example 1**

Write the polynomial so that the exponents decrease from left to right. Identify the degree and the leading coefficient of the polynomial.

1.  $9 - 2x^2$
2.  $16 + 3y^3 + 2y$
3.  $6x^2 + 7x^2 - 3x^3$

Terms - in a expression are separated by plus or minus signs.

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IV. Inclusion Algebra I 9.5 Factoring Trinomials Notes

Factoring: Simple Trinomial Method

Mr. Fitzpatrick

Assignment 90

Student T

Name: [REDACTED]

Date: 3/15/19

Factoring: Trinomial Method

Lesson 9.5

$$\begin{array}{r} 9 \\ 2 \overline{) 18} \\ \underline{4} \\ 14 \end{array} = 6$$

	Trinomial	Two Numbers that Multiply to ...	and Add to ...	The numbers are ...	Factored
1	$x^2 + 5x + 4$	4	5	1 and 4	$(x+1)(x+4)$
2	$x^2 + 9x + 8$	8	9	1 and 8	$(x+1)(x+8)$
3	$x^2 - 10x + 16$	16	-10	-2 and -8	$(x-2)(x-8)$
4	$x^2 - 14x + 13$	13	-14	-1 and -13	$(x-1)(x-13)$
5	$x^2 + 10x + 21$	21	10	7 and 3	$(x+7)(x+3)$
6	$x^2 - 13x + 40$	40	-13	-5 and 8	$(x-5)(x-8)$
7	$x^2 + 16x + 39$	39	16	3 and 13	$(x+3)(x+13)$
8	$x^2 - 22x + 72$	72	-22	-4 and -18	$(x-4)(x-18)$
9	$x^2 - 20x + 64$	64	-20		(   x   )
10	$x^2 + 27x + 75$	75	27		(   x   )
11	$x^2 + 5x - 6$	-6	5	-1 and 6	$(x+6)(x-1)$
12	$x^2 + 28x + 75$	75	28	3 and 25	$(x+3)(x+25)$
13	$x^2 + 2x - 8$	-8	2	-2 and 4	$(x-2)(x+4)$
14	$x^2 - 10x - 9$	-9	-10	-1 and 9	$(x+9)(x-1)$
15	$x^2 - x - 72$	-72	-1	-1 and 72	$(x+72)(x-1)$

Note: Two of the trinomials cannot be factored. They are "prime".



Helpful Guide for Factoring:

Trinomial  $x^2 + bx + c$   $\xrightarrow{\text{multiply}}$  Binomial  $(x + 1)(x + 2)$

*add*  $\underline{+}$   $\underline{+}$   $\underline{+}$

Factoring when b and c are positive

example:  $x^2 + 3x + 2$   
 $(x + 1)(x + 2)$   $\begin{matrix} 1 \\ + \\ 2 = 3 \end{matrix}$

Trinomial  $x^2 - bx + c$   $\xrightarrow{\text{multiply}}$  Binomial  $(x - ) (x - )$

Factoring when b is Negative and c is Positive

example:  $x^2 - 5x + 6$   
 $(x - 2)(x - 3)$   $\begin{matrix} -1 & 6 \\ -2 & -3 = -5 \end{matrix}$

Trinomial  $x^2 - bx - c$   $\xrightarrow{\text{multiply}}$  Binomial  $(x + ) (x - )$

*bigger negative*

Factoring when b and c are Negative *The "high" number will be negative.*  
 high number example:  $x^2 - 2x - 8$   
 $(x + 2)(x - 4)$

Trinomial  $x^2 + bx - c$   $\xrightarrow{\text{multiply}}$  Binomial  $(x + 9)(x - 2)$

Factoring when b is Positive and c is Negative *The "high" number will be positive.*

example:  $x^2 + 7x - 18$   
 $(x + 9)(x - 2)$   $\begin{matrix} -1 & -18 \\ -2 & 9 = 7 \end{matrix}$

## Factoring: Simple Trinomial Method

Mr. Fitzpatrick

Assignment 90

Student E

Name: [REDACTED]

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

## Factoring: Trinomial Method

Lesson 95

	Trinomial	Two Numbers that Multiply to ...	and Add to ...	The numbers are ...	Factored
1	$x^2 + 5x + 4$	4	5	1 and 4	$(x+1)(x+4)$
2	$x^2 + 9x + 8$	8	9	1 and 8	$(x+1)(x+8)$
3	$x^2 - 10x + 16$	16	-10	-2 and -8	$(x-2)(x-8)$
4	$x^2 - 14x + 13$	13	-14	-1 and -13	$(x-1)(x-13)$
5	$x^2 + 10x + 21$	21	10	3 and 7	$(x+3)(x+7)$
6	$x^2 - 13x + 40$	40	-13	-5 and -8	$(x-5)(x-8)$
7	$x^2 + 16x + 39$	39	16	3 and 13	$(x+3)(x+13)$
8	$x^2 - 22x + 72$	72	-22	-4 and -18	$(x-4)(x-18)$
9	$x^2 - 20x + 64$	64	-20	-4 and -16	$(x-4)(x-16)$
10	$x^2 + 27x + 75$	75	27		( ... )
11	$x^2 + 8x + 6$	-6	5	-1 and 6	$(x-1)(x+6)$
12	$x^2 + 28x + 25$	75	28	3 and 25	$(x+3)(x+25)$
13	$x^2 + 2x + 8$	-8	2	-2 and 4	$(x-2)(x+4)$
14	$x^2 - 10x - 9$	-9	-10	-1 and -9	$(x-1)(x-9)$
15	$x^2 - 36$	-72	-1		( ... )

Note: Two of the trinomials cannot be factored. They are "prime".

Helpful Guide for Factoring:

Trinomial  $x^2 + \underline{bx} + \underline{c}$   $\xrightarrow{\text{multiply}}$  Binomial  $(x + \quad)(x + \quad)$

Factoring when b and c are positive  
 example:  $x^2 + 3x + 2$   
 $(x + 1)(x + 2)$   $1 + 2 = 3$

Trinomial  $x^2 - \underline{bx} + \underline{c}$   $\xrightarrow{\text{multiply}}$  Binomial  $(x - \quad)(x - \quad)$

Factoring when b is Negative and c is Positive  
 example:  $x^2 - 5x + 6$   
 $(x - 2)(x - 3)$   $-1 - 2 = -3$   $1 \cdot 2 = 2$

Trinomial  $x^2 - \underline{bx} - \underline{c}$   $\xrightarrow{\text{multiply}}$  Binomial  $(x + \quad)(x - \quad)$  *higher factor*

high number  $\xrightarrow{\text{multiply}}$   $(x + \quad)(x - \quad)$  *higher factor*

Factoring when b and c are Negative *The "high" number will be negative.*  
 example:  $x^2 - 2x - 8$   
 $(x + 2)(x - 4)$

Trinomial  $x^2 + \underline{bx} - \underline{c}$   $\xrightarrow{\text{multiply}}$  Binomial  $(x + \quad)(x - \quad)$  *higher factor*

positive  $\xrightarrow{\text{multiply}}$   $(x + \quad)(x - \quad)$  *higher factor*

Factoring when b is Positive and c is Negative *The "high" number will be positive.*  
 example:  $x^2 + 7x - 18$   
 $(x + 9)(x - 2)$

~~Accuracy~~

## Appendix C: Exams and Quizzes

### I. Polynomial Quiz A

Name: \_\_\_\_\_ Group: \_\_\_\_\_ Date: \_\_\_\_\_

*The tongue weighs practically nothing, but few can hold it.....*

Given the Following Trinomials. Fill in the **signs (+ or -)** for the Factored trinomials... *read carefully!*

1.  $Ax^2 + Bx + C \rightarrow (x \#)(x \#)$

2.  $Ax^2 - Bx + C \rightarrow (x \#)(x \#)$

3.  $Ax^2 - Bx - C \rightarrow (x \text{ bigger}\#)(x \#)$

4.  $Ax^2 + Bx - C \rightarrow (x \text{ bigger}\#)(x \#)$

Quiz problem number 5:  $8x^2 - 5x - 3$

5 (step1) what is 8 times -3 = \_\_\_\_\_. List ALL of the factors of -24, build a factor tree or factor horseshoe.

5. (step 2) which set of factors add to -5? \_\_\_\_\_ (put the bigger "raw" number first)

5. (step 3) break up -5x = \_\_\_x + \_\_\_x

REWRITE your original problem  $8x^2 \quad - 3$

5. (step 4) factor  $8x^2 + -8x$ . What is the GCF (greatest common factor)? How many x's can you remove? \_\_\_( \_\_\_ - \_\_\_) check it, does  $8x(x - 1)$  bring you back to  $8x^2 - 8x$ ? Yes?

5. (step 4) factor  $3x - 3$ . What is the GCF (greatest common factor)? How many x's can you remove? \_\_\_( \_\_\_ - \_\_\_) check it, does  $3(x - 1)$  bring you back to  $3x - 3$ ? Yes?

5. (step 5) What is in both of these parenthesis? This is the **twin**. Put that in the parenthesis on the left below. What is in front of each of the parenthesis above? Put that in the parenthesis on the right below.

( - )( + )

Hopefully you have

$(x - 1)(8x + 3)$

5. (check) FOIL or use the Box Method  $(x - 1)(8x + 3)$  does it come back to  $8x^2 - 5x - 3$ ?

What are the solution for  $(x - 1)(8x + 3) = 0$ ?

$x - 1 = 0$  and  $8x + 3 = 0$

$x =$  and  $x =$

**SHOW ALL WORK OR NO CREDIT (including FOIL-ing back out)**

**Factoring: Trinomial Method  $ax^2 + bx + c$**

Trinomial	Step 1 Multiply ac	Step 2 and Add to b...	Step 3 Break up the middle term	Step 4 and 5 (4)Group the first two terms (4)Group the last two terms (5) Factor out common term	FOIL/ use Box method back out to...
6. $5x^2 - 9x - 2$				(   X   )	
7. $9x^2 + 15x + 4$				(   X   )	

Give me the **SOLUTIONS** to Problems 6 and 7.

8.  $5x^2 - 9x - 2 = 0$

\_\_\_\_\_

9.  $9x^2 + 15x + 4 = 0$

\_\_\_\_\_

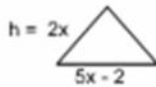
Factor and solve the equation

10.  $9x^3 - 4x = 0$

\_\_\_\_\_

Bonus: The Area of the triangle = 115 Find the value of x.

\_\_\_\_\_



## II. Polynomial Quiz B

Name: \_\_\_\_\_ Group: \_\_\_\_\_ Date: \_\_\_\_\_  
*The tongue weighs practically nothing, but few can hold it.....*

Given the Following Trinomials. Fill in the **signs (+ or -)** for the Factored trinomials... *read carefully!*

1.  $Ax^2 + Bx + C \rightarrow (x \#)(x \#)$

2.  $Ax^2 - Bx + C \rightarrow (x \#)(x \#)$

3.  $Ax^2 - Bx - C \rightarrow (x \text{ bigger}\#)(x \#)$

4.  $Ax^2 + Bx - C \rightarrow (x \text{ bigger}\#)(x \#)$

Quiz problem number 5:  $8x^2 - 5x - 3$

5 (step 1) what is 8 times -3 = \_\_\_\_\_. List ALL of the factors of -24, build a factor tree or factor horseshoe.

5. (step 2) which set of factors add to -5? \_\_\_\_\_ (put the bigger "raw" number first)

5. (step 3) break up -5x = \_\_\_x + \_\_\_x

REWRITE your original problem  $8x^2 \quad \quad \quad - 3$

5. (step 4) factor  $8x^2 + -8x$ . What is the GCF (greatest common factor)? How many x's can you remove? \_\_\_( \_\_\_ - \_\_\_) check it, does  $8x(x-1)$  bring you back to  $8x^2 - 8x$ ? Yes?

5. (step 4) factor  $3x - 3$ . What is the GCF (greatest common factor)? How many x's can you remove? \_\_\_( \_\_\_ - \_\_\_) check it, does  $3(x-1)$  bring you back to  $3x - 3$ ? Yes?

5. (step 5) What is in both of these parenthesis? This is the **twin**. Put that in the parenthesis on the left below. What is in front of each of the parenthesis above? Put that in the parenthesis on the right below.

( - )( + )

Hopefully you have

$(x-1)(8x+3)$

5. (check) FOIL or use the Box Method  $(x-1)(8x+3)$  does it come back to  $8x^2 - 5x - 3$ ?

What are the solution for  $(x-1)(8x+3) = 0$ ?

$x-1 = 0$

and  $8x+3 = 0$

$x =$  and  $x =$

**SHOW ALL WORK OR NO CREDIT (including FOIL-ing back out)**

## Factoring: Trinomial Method $ax^2 + bx + c$

Trinomial	Step 1 Multiply ac	Step 2 and <b>Add</b> to b...	Step 3 Break up the middle term	Step 4 and 5 (4) Group the first two terms (4) Group the last two terms (5) Factor out common term	FOIL use Box Method back out to...
6. $3x^2 - x - 30$				(    X    )	
7. $15x^2 + 19x + 6$				(    X    )	

Give me the SOLUTIONS to Problems 6 and 7.

8.  $3x^2 - x - 30 = 0$

\_\_\_\_\_

9.  $15x^2 + 19x + 6 = 0$

\_\_\_\_\_

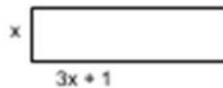
Factor and solve the equation

10.  $2x^3 - 5x^2 + 3x = 0$

\_\_\_\_\_

Bonus: The Area of the rectangle = 30 Find the value of x.

\_\_\_\_\_



III. Unit 9 Polynomials Pre-Test

**PRE-TEST** Show Your Work --- No Work --- No Credit Chapter 9 Quadratic Test A A

Student AR

Name [REDACTED] Date 8/1 Class 2-9 F-R

*If you mess up, it's not your parents' fault, it's not your teachers' fault, so don't whine about your mistakes, learn from them.*

Add the Polynomials. Assume all variable exponents represent whole numbers (4 pts each)

1.  $(7x^4 + 4x^3 + 5x^2) + (6x^4 + 5x^3 + 2x^2)$      2.  $(8x^4 + 9x + 3x^2) + (x^2 + 5x^4 + 8)$

$(16x^4) + (13x^3)$       $20x^7 + 13x^7 - 8$

$29x^{18}$       $33x^{14}$

Subtract the Polynomials. Assume all variable exponents represent whole numbers

3.  $(4x^6 + 3x^3 + 8x) - (4x^6 - 7x^3 + 2x)$      4.  $(6x^2 - 7x + 2x^4) - (x^4 - 3x^2 - 12)$

$15x^{10} - 5x^2$       $4x^2 - 9x^5$

$10x^5$       $3x^3 - 9x$       $-6x^2$

Match the correct Trinomial with the correct factorization (Binomials). (4 pts each)

5a.  $x^2 - 3x - 54$      W.  $(x - 6)(x - 9)$      5a. W

5b.  $x^2 - 15x + 54$      X.  $(x - 6)(x + 9)$      5b. X

5c.  $x^2 + 15x + 54$      Y.  $(x - 9)(x + 6)$      5c. Y

5d.  $x^2 + 3x - 54$      Z.  $(x + 9)(x + 6)$      5d. Z

**Factor each trinomial** (4 points each)

6.  $x^2 - 4x - 32$      7.  $x^2 + 8x - 20$      6.  $x^2 - 36$

$x^2 - 36$      7. IDK

8.  $x^2 - 15x + 50$      9.  $x^2 + 9x + 14$      8. IDK

9. IDK

**Find all possible solutions** for questions 6 - 9 (4 points each)

10.  $x^2 - 4x - 32 = 0$      11.  $x^2 + 8x - 20 = 0$      10. IDK

11. IDK

12.  $x^2 - 15x + 50 = 0$      13.  $x^2 + 9x + 14 = 0$      12. IDK

13. IDK / -42



Show Your Work --- No Work - No Credit Chapter 9 Quadratic Test A

14. List Four Perfect Square numbers. 1 D E K

$\sqrt{8}$

Find the product.

15.  $(x - 5)^2$

16.  $(x - 9)(x + 9)$

15.  $x^2 - 25$

16. IDK

Factor each completely

17.  $9x^2 - 24x + 16$

18.  $64x^2 - 121$

17. IDK

18. IDK

Factor completely (5 points each)

19.  $3x^2 + 15x + 18$

20.  $2x^2 + 19x + 24$

19. IDK

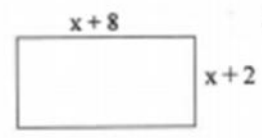
20. IDK

21.  $5x^2 - 20x - 8x + 32$

21. IDK

22. (10 points) Find the value of x using a Quadratic Equation. The area of the rectangle = 72

Area = Length \* Width  
 $\frac{72}{\quad} = (x+8)(x+2)$



-8

What is the only possible solution for x? x =         

What are the dimensions?          \*         

Check Your Answer          \*          =         

(Bonus 5 pts) A mathematically correct answer that does not make sense in the context of the problem is called an extraneous answer.

~~-46~~

IV. Unit 9 Polynomials Post-Test

Student AR Show Your Work --- No Work - No Credit Chapter 9 Quadratic Test A

99  
nice!

Name \_\_\_\_\_ Date 4/11 Class F-R 2-9

If you mess up, it's not your parents' fault, it's not your teachers' fault, so don't whine about your mistakes, learn from them.

Add the Polynomials. Assume all variable exponents represent whole numbers (4 pts each)

1.  $(7x^4 + 4x^3 + 5x^2) + (6x^4 + 5x^3 + 2x^2)$       2.  $(8x^4 + 9x + 3x^2) + (x^2 + 5x^4 + 8)$       1.  $13x^4 + 9x^3 + 7x^2$   
 $13x^4 + 9x^3 + 7x^2$        $18x^4 + 4x^2 + 9x + 8$       2.  $13x^4 + 4x^2 + 9x + 8$

Subtract the Polynomials. Assume all variable exponents represent whole numbers

3.  $(4x^3 + 3x^2 + 8x) + (4x^3 + 7x^2 + 2x)$       4.  $(6x^2 - 7x + 2x^4) + (x^4 + 3x^2 - 12)$       3.  $10x^3 + 6x$   
 $10x^3 + 6x$        $x^4 + 9x^2 - 7x + 12$       4.  $x^4 + 9x^2 - 7x + 12$

Match the correct Trinomial with the correct factorization (Binomials). (4 pts each)

- 5a.  $x^2 - 3x - 54$       ~~W.~~  $(x-6)(x-9)$       5a. 4  
 5b.  $x^2 - 15x + 54$       ~~X.~~  $(x-6)(x+9)$       5b. W  
 5c.  $x^2 + 15x + 54$       ~~X.~~  $(x-9)(x+6)$       5c. Z  
 5d.  $x^2 + 3x - 54$       ~~/.~~  $(x+9)(x+6)$       5d. X

Factor each trinomial! (4 points each)

6.  $x^2 - 4x - 32$       7.  $x^2 + 8x - 20$       6.  $(x+4)(x-8)$   
 $(x+4)(x-8)$        $(x-2)(x+10)$       7.  $(x-2)(x+10)$   
 8.  $x^2 - 15x + 50$       9.  $x^2 + 9x + 14$       8.  $(x-5)(x-10)$   
 $(x-5)(x-10)$        $(x+2)(x+7)$       9.  $(x+2)(x+7)$

Find all possible solutions for questions 6-9 (4 points each)

10.  $x^2 - 4x - 32 = 0$       11.  $x^2 + 8x - 20 = 0$       10.  $x = -4$     $x = 8$   
 $(x+4)(x-8) = 0$        $(x-2)(x+10) = 0$   
 $-4+4=0$        $8-8=0$        $2-2=0$        $-10+10=0$   
 $x = -4$        $x = 8$        $x = 2$        $x = -10$   
 12.  $x^2 - 15x + 50 = 0$       13.  $x^2 + 9x + 14 = 0$       12.  $x = 5$     $x = 10$   
 $(x-5)(x-10) = 0$        $(x+2)(x+7) = 0$   
 $5-5=0$        $10-10=0$        $-2+2=0$        $-7+7=0$   
 $x = 5$        $x = 10$        $x = -2$        $x = -7$



Show Your Work --- No Work - No Credit Chapter 9 Quadratic Test A

14. List Four Perfect Square numbers. 4 16 25 36

Find the product.  $x^2 - 10x + 25$

15.  $(x-5)^2 - 5$

x	-5
-5	25

16.  $(x-9)(x+9)$

x	-9
9	-81

$x^2 - 81$

15.  $x^2 - 10x + 25$

16.  $x^2 - 81$

Factor each completely

17.  $9x^2 - 24x + 16$

$(3x-4)(3x-4)$

18.  $64x^2 - 121$

$(8x-11)(8x+11)$

17.  $(3x-4)(3x-4)$

18.  $(8x-11)(8x+11)$

Factor completely (5 points each)

19.  $3x^2 + 15x + 18$

$3(x+3)(x+2)$

20.  $2x^2 + 19x + 24$

$(2x+16)(x+3)$

19.  $3(x+3)(x+2)$

20.  $(x+8)(2x+3)$

21.  $5x^2 - 20x + 15$

$5(x-4)(x-3)$

$2x(x+5) + 3(x+8)$

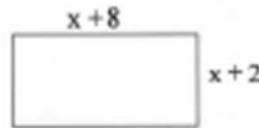
$(x+5)(2x+3)$

21.  $(x-4)(5x-8)$

22. (10 points) Find the value of x using a Quadratic Equation. The area of the rectangle = 72



Area = Length \* Width  
 $72 = (x+2)(x+8)$



x	2
x	2x
8	16

$x^2 + 10x + 16 = 72$

$x^2 + 10x - 56 = 0$

$x = -4 \quad x = 14$

$-1 \quad -56 \quad 56$

$-2 \quad 28$

$4 \quad -14 = -10$

What is the only possible solution for x?  $x = 4$

$4+8 = 12$

$4+2 = 6$

What are the dimensions?  $12 \cdot 6$

$12$

$6$

$72$

Check Your Answer  $12 \cdot 6 = 72$

(Bonus 5 pts) A mathematically correct answer that does not make sense in the context of the problem is called an extraneous answer.

1

# Appendix D: Student Feedback Surveys

## I. CAP Student Feedback Surveys and Comments



### CAP Student Feedback Survey Grades 6-12: Short Form

Name of teacher: Ms. Angelini Date: 4/12/19

Directions: Read each statement and then choose **one** answer choice that you think fits best. There are no right or wrong answers. Your teacher will use your class's responses to better understand what it's like to be a student in this class. Your teacher will not see your individual answers.

		Strongly Agree	Agree	Disagree	Strongly Disagree
1.	My teacher demonstrates that mistakes are a part of learning.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.	My teacher asks us to summarize what we have learned in a lesson.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.	Students push each other to do better work in this class.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
4.	I am able to connect what we learn in this class to what we learn in other subjects.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
5.	My teacher uses open-ended questions that enable me to think of multiple possible answers.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6.	In discussing my work, my teacher uses a positive tone even if my work needs improvement.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7.	In this class, students review each other's work and provide each other with helpful advice on how to improve.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8.	When asked, I can explain what I am learning and why.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9.	In this class, other students take the time to listen to my ideas.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
10.	The level of my work in this class goes beyond what I thought I was able to do.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
11.	The material in this class is clearly taught.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12.	If I finish my work early in class, my teacher has me do more challenging work.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
13.	My teacher asks me to rate my understanding of what we have learned in class.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14.	To help me understand, my teacher uses my interests to explain difficult ideas to me.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>





**CAP Student Feedback Survey**  
**Grades 6-12: Short Form**

		Strongly Agree	Agree	Disagree	Strongly Disagree
15.	In this class, students work together to help each other learn difficult content.	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
16.	In this class, students are asked to teach (or model) to other classmates a part or whole lesson.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17.	Our class stays on task and does not waste time.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
18.	During a lesson, my teacher is quick to change how he or she teaches if the class does not understand (e.g., switch from using written explanations to using diagrams).	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19.	My teacher encourages us to accept different points of view when they are expressed in class.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20.	I can show my learning in many ways (e.g., writing, graphs, pictures) in this class.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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

Ms. Angelini is a great teacher she teaches things clearly and when we don't understand she breaks it down to where it's more simple and understandable. She shows us multiple ways to answer questions. She's chill and makes things fun.

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

She is a great teacher and she has a good attitude and she should already be a professional teacher.

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

Great teacher I understand what is happening in class and if I don't it can be explained in a different way. No shame in getting something wrong.

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

She is an amazing teacher that gives clear and clarifying information that helps me with difficult situations.

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

When we are loud she can make sure to quiet us with out having to yell or complain.

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