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Common Core in Tennessee: an analysis of eighth grade mathematics standards

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Abstract

Since their introduction in 2010, the Common Core State Standards (CCSS) have been a highly controversial topic in educational reform. Though the standards are not a product of the federal government and are not federally mandated, they do represent a push towards national academic standards in America. For states such as Tennessee, educational policies of the past pushed them to lower their academic standards in order to create the illusion of success. Those states are now some of the places that have seen the most change with the adoption of the CCSS. It still remains somewhat unclear, however, which changes are a direct result of the CCSS and which are the result of other policy changes. In the future, Tennessee plans to replace the CCSS with new state standards, but the CCSS will continue to influence any future policy changes. Therefore, it is important for educators, as well as the general public, to be educated about the standards and to understand how the standards have helped reform education over the past six years. One of the main goals of this study is to present a cohesive summary of the CCSS's development process as well as its implementation in Tennessee. The report focuses specifically on the Common Core Grade 8 mathematics standards. A cross-walk document was created in order to directly compare the previously used Tennessee Grade Eight mathematics standards with the Common Core Grade 8 mathematics standards. The results show how well the two sets of standards are aligned and shed some light on the changes brought about by the CCSS.

Common Core in Tennessee: An Analysis of Eighth Grade Mathematics Standards

Introduction

Over the past few years, “Common Core” has become a buzzword of sorts in the political arena. Presidential candidates share their stances on Common Core in campaign speeches, state government officials speak out in favor of the standards or against them, and the general public is not shy of voicing their opinions on the standards either. Through social media posts, protests, and petitions against the standards, the Common Core State Standards (CCSS) have gained a lot of negative attention. Strongly conservative states in particular have been the most vocal in their disapproval of the standards. They see the CCSS as an attempt to take away state responsibility and individuality when it comes to education. Other states, however, have fully embraced the standards and see them as a way to unify and equalize education across the states. With all of this debate surrounding the CCSS, one might question if the varying opinions of the CCSS are simply politically based or if they are based on the standards themselves.

Tennessee, in particular, has had a tumultuous relationship with the CCSS. The state officially adopted the standards in 2010 and then changed the name to TNCore. Since the adoption of the standards, there has been a lot of backlash from parents, educators, and state government officials. Despite the amount of information that is available to the public, many people still have misconceptions about the standards. They see the standards as a way for the federal government to take away state power. They feel that Tennessee should have educational standards built specifically for Tennessee students. In subjects such as Social Studies that might be for the best, but in subjects such as English language arts and mathematics, where subject matter does not and should not vary much from state to state, this belief does not hold much ground. This study is meant to clarify some of those misconceptions by clearly outlining the

CCSS implementation process in Tennessee. After reading it, teachers, students, and parents might have a better grasp on what changes are a result of the CCSS alone, and which changes are the result of federal, state, and local governments' policies.

A large portion of this study features a cross-walk document, with a summarized analysis of the results. A cross-walk document is a tool that can be used to directly compare one set of educational standards to another set of educational standards. In this particular study, eighth grade mathematics was the chosen subject. Specifically, the Common Core Grade 8 standards and the Tennessee Grade Eight standards which were used prior to the adoption of the CCSS are compared with one another. Eighth grade was the chosen course level because it is the last mathematics course before high school but it still contains some advanced content. High school mathematics courses are not the same throughout the country and the Common Core high school standards are not divided the same way as the Tennessee standards which were previously used. So, eighth grade mathematics was the best option for this particular study.

Background Information

Education, a pressing concern of the 21st century, has not always been at the forefront of American politics at the national level. Up until the 1950's, educational policy was almost entirely a state-led effort. It was not until the beginning of the civil rights movement, after court cases such as Brown v. the Board of Education gained national attention, that the federal government got involved. Lyndon B. Johnson's Elementary and Secondary Education Act (ESEA) in 1965 was one of the first pieces of legislation with the purpose of reforming the American education system. Johnson's goal was to regulate education through reformation movements aimed at helping minority and low-income students (McGuinn, 2006). Under this act, the federal government provided the resources and funds necessary for schools to make changes. The focus was on providing opportunities and assistance rather than getting quick, concrete results.

Over the next couple of decades, opinions were divided about the level of federal involvement in education that was appropriate and necessary. In 1979, Jimmy Carter founded the U.S. Department of Education, a decision which obviously increased federal responsibilities in education. Ronald Reagan, on the other hand, tried to minimize the federal government's role in education throughout his two presidential terms in the 1980's (McGuinn, 2006). Then, in 1983, the National Commission on Excellence in Education published a report titled *A Nation at Risk: The Imperative for Educational Reform*, which brought national attention to the state of America's public schools and emphasized that "although education had long been primarily a state issue, the dire performance of American students had become a national problem" (McGuinn, 2006, p. 43). This sparked a resurgence of federal involvement in educational policy during George H. W. Bush's, Bill Clinton's, and George W. Bush's presidencies.

In 1989, the National Council of Teachers of Mathematics (NCTM) released the *Curriculum and Evaluation Standards for School Mathematics*. Though states had somewhat regulated curriculum before, it was always on a localized level and this report was one of the first instances of the creation of a set of specified standards for a particular subject. This report was very influential and inspired George H. W. Bush to push for the nation-wide creation of state educational standards. Throughout his time as president, from 1989-1993, Bush offered grants to states that developed standards in core subject areas such as math, English, and history (Rothman, 2013). The Clinton administration continued providing supplemental funds to states which developed standards when, in 1994, Congress reauthorized the ESEA and Clinton signed the Goals 2000 Act. The Goals 2000 Act, also known as the Educate America Act, was not mandatory, meaning it did not require states to develop their own standards and assessments. Instead, the Clinton administration continued providing resources to the participating states as an incentive to make those changes (McGuinn, 2006).

Then, in 2001, George W. Bush's No Child Left Behind Act (NCLB) went into effect. As opposed to the Goals 2000 Act, this policy mandated that all states develop standards and assessment programs. A huge emphasis was placed on the assessment requirements and testing became mandatory for grades 3-8. Schools, and even teachers themselves, became accountable for testing results. They were rewarded, often times with funds, for good results, but they also faced possible punitive actions if the results were not favorable (McGuinn, 2006). At its core, NCLB was intended to give individual states the power of determining what "proficiency" means for their students, along with the power of gauging student proficiency levels through standardized testing. Unfortunately, this policy resulted in some states creating less challenging sets of standards and assessments to create the illusion of success. Throughout the first decade of the 21st century, educational standards came to look drastically different from state to state. The National Assessment of Educational Progress (NAEP), a nationally distributed assessment, highlighted some of these differences. For example, in 2005, Tennessee had 87% proficiency on state tests in 4th grade math but only a 28% proficiency on the NAEP. Massachusetts, however, had a 40% proficiency on state tests and a 41% proficiency on the NAEP. This difference shows that Tennessee most likely had less difficult standards and assessments than Massachusetts in this area. NCLB became so results-driven that states began to lose sight of the ultimate goal of providing all students with the tools necessary to be successful after high school (Rothman, 2013).

Throughout all of these policy changes, the federal government became increasingly involved in educational reform efforts. One particular effort meant to reboot the American education system, however, did not begin at the federal level and has been an entirely state-led effort. In 2007, during the Council of Chief State School Officers' (CCSSO) Annual Policy Forum, state representatives discussed the idea of creating a set of uniform, national education standards. As a non-partisan nonprofit, the CCSSO helps provide nationwide assistance to the federal government and the public when it comes to education ("Forty-Nine States and Territories…," 2009). The next year, in December of 2008, the CCSSO joined with the National Governor's Association (NGA) and Achieve, a nonprofit organization focused on education reform, and released a report titled *Benchmarking for Success: Ensuring U.S. Students Receive a World-Class Education*. This report further encouraged the idea that states should join together to create a set of internationally benchmarked standards that would raise the bar for all students ("Benchmarking for Success…," 2008). With that, the Common Core State Standards Initiative became a reality.

Development of Common Core

The CCSSO and NGA took the lead on the project, partnering with Achieve, ACT, and the College Board, and in early 2009 the standards began to take shape. It was decided that the Common Core State Standards (CCSS) would consist of college- and career-ready standards included within K-12 standards for English language arts and mathematics. Throughout April and May of 2009, the first set of college- and career- ready standards was drafted and sent for review and by June of 2009, 50 states and territories made a commitment to the development of the K-12 standards. Over the next year, many different work groups drafted the standards and made changes based on the feedback received from designated committees and periods of open public discussion ("Development Process…," n.d.).

During the drafting and editing stages, there was a set of Standards-Setting Criteria that the writers of the CCSS followed. This set of criteria was created to ensure that the CCSS prepare all students for success after high school. The standards are meant to be "essential, rigorous, clear and specific, coherent, and internationally benchmarked" ("Common Core State Standards Initiative standards-setting criteria," n.d.). Essential standards ensure that students have the necessary knowledge and skills needed to be successful in college courses or training for the workforce. Rigorous standards require that students use problem-solving skills to apply known concepts to new situations. Clear and specific standards must be easily taught, and their learning measured. Coherent standards cover the main ideas of a discipline as a progression of age appropriate material. Internationally benchmarked standards compare to educational standards in high-performing countries. Ultimately these guidelines push for standards that are "fewer, clearer and higher" than the standards of the past ("Common Core State Standards Initiative standards-setting criteria," n.d.).

The workgroups for the K-12 mathematics standards consisted of 51 people: 16 of them worked for different states' Boards of Education, 22 worked in college settings, four worked in secondary education settings, one worked in an elementary education setting, two worked for testing companies, and six worked for other educationally focused groups ("Common Core State Standards Initiative K-12 standards development teams," n.d.). Of those 51 people, there were three men who wrote the majority of the math standards. Those men are: Phil Daro, a member of America's Choice and Strategic Education Research Partnerships; William McCallum, a professor and former Mathematics Department Head at the University of Arizona and a senior consultant at Achieve; and Jason Zimba, a former professor of math and physics at Bennington College as well as a member of Student Achievement Partners. Daro and McCallum both had previous experience developing state educational standards, which made them prime candidates for authoring the CCSS. Zimba helped found the Grow Network, a business that provides testing analysis reports for teachers and parents, and so he also had experience working with educational standards. Daro, McCallum, and Zimba began writing the standards in September of 2009 and continued working on them for the next nine months or so until the final draft was released in June of 2010 (Garland, 2014).

While developing the standards, Daro, McCallum, and Zimba looked closely at standards already in practice in states across America as well as in other high-performing countries. A common issue found in most states was that the standards for each subject were extremely dense but not effective. In other words, states had a large number of standards, but they were not necessarily of good quality or very challenging. According to Zimba, “the best of them were little more than test blueprints. They were not a blueprint for learning math” (Garland, 2014, p. 5). So, in order to rectify that problem, the developers of the CCSS conferred with state officials, teachers, and other experts to create better sets of educational standards. After each draft of the standards was completed, it was sent to increasingly larger feedback groups in order to make the most informed decisions possible (Garland, 2014).

There were a couple of periods, in the fall of 2009 and the spring of 2010, when the drafts were available for public comment. The public’s responses were then taken into consideration as different work groups made edits to the standards. From September 21 to October 21, 2009 a draft of the CCSS was available for public viewing, and the CCSSO and NGA analyzed the feedback. Altogether, 988 online surveys were completed, with each survey representing the opinions of one or more individuals. Educators, parents, students, school district staff members, and state education agency staff members were among some of the people who provided survey responses, and the general feedback was more along the lines of constructive criticism than complaints. The respondents felt that the standards would lead to a positive change in America's education system but had differing opinions about what content to include. College professors felt that the mathematics standards were lacking but high school teachers and those working in vocational fields felt that the standards covered too much material. For example, college professors suggested that the CCSS go more in depth with solving systems of equations but high school teachers suggested that they place less emphasis on that topic. Aside from some differing opinions on the structure of the standards, the overall public response seemed to be positive ("Summary of Public Feedback…," n.d.).

On March 10, 2010 the standards were made available for public comment for one last time. Over 10,000 surveys were completed, with responses coming from all fifty states, the District of Columbia, and every U.S. territory. As with the survey in 2009, the respondents were mainly educators and parents. The majority of the responses suggested that people felt comfortable with the standards as a whole but were concerned about some aspects of the structure, the implementation process, and the assessment methods. Around 75% of the responses for the mathematics standards were positive. The remaining 25% of respondents either felt that the standards were too strongly geared towards those students going into a university, particularly in science, technology, engineering, and math (STEM) fields, or that the standards were lacking for all students; along those lines, a majority of teachers felt that too much emphasis was being placed on teaching processes rather than conceptual understanding. They were concerned that this way of teaching would lead to more of the teaching-to-the-test mentality that was currently in place with different state standards. After careful analysis of the public's responses, the standards were sent to the validation committee, in May of 2010, for final approval ("Reactions to the March 2010 draft…," n.d.).

The Common Core State Standards Initiative Validation Committee consisted of professors, teachers, researchers, and other members of the educational community. The committee was responsible for providing independent validation of the process that was used to write the standards as well as ensure that the standards upheld the original goals and guidelines set forth by the CCSSO and NGA. Once the committee found the CCSS to be well-informed, well-developed, and rigorous enough to ensure that students would be college- and career-ready, they certified the standards, and in June of 2010 the official Common Core State Standards were released to the public ("Reaching higher," 2010). With that phase of the process complete, it was then time for the ongoing process of implementation throughout the states.

Over the past six years, the Obama administration has fully supported the creation of national standards, but their support does not mean that the federal government created the standards ("College- and career-ready standards," n.d). As said before, the CCSS were and still are a state-led effort. There were, however, federally granted incentives for those states that adopted new, rigorous, college- and career-ready standards. The CCSS were promoted more so than other sets of standards, but there was no specific requirement for states to adopt the CCSS. The Race to the Top program, an extension of NCLB which was authorized in 2009 under the American Recovery and Reinvestment Act (ARRA), supplied funding to groups of states that implemented new and improved standards ("Race to the Top assessment program," n.d.). There was originally a $4.35 billion budget for the program and, through an application process, states had the chance to compete for grant money. States that received grant money have since done a lot to ensure their schools provide an education that will prepare all students for success after graduation. Massachusetts, for example, trained over 1,000 high school teachers to teach AP classes and has since increased the number of students taking AP courses and exams; Tennessee used its funds to train 30,000 teachers in the CCSS, to give additional assistance to 167 “Focus Schools” which showed a significant achievement gap compared to the rest of the state, and to train new STEM teachers by partially funding two UTeach programs at state universities; Ohio used grant money to develop hundreds of curriculum resources in support of the new CCSS (“Setting the pace…,” 2014).

In December of 2015, President Obama signed the Every Student Succeeds Act (ESSA), a bi-partisan bill which re-authorized the ESEA and replaced the original NCLB. Under this new law, states are still required to adopt challenging college- and career- ready standards but, unlike before, the federal government is not permitted to promote any specific standards. Therefore, there is no longer a strong incentive for states to adopt the CCSS instead of other sets of standards. More responsibility has been given back to the states in terms of educational policy, and many of the restrictive limitations and requirements of the original NCLB have been modified (Klein, 2016). As with any new policy, there will be a necessary period of adjustment and change. Though it is unclear how states will respond to the changes, it is clear that the CCSS will continue to be a topic of controversy and a source of value to states and educators.

The CCSS in Tennessee

Initial Implementation Process

From the beginning, Tennessee has been involved in the development of the CCSS. In 2007, after Tennessee was criticized for its low levels of student proficiency on the NAEP, Governor Phil Bredesen began pushing for education reform. In that year, the state launched its

Diploma Project, part of the national program of the same name, in order to create new and improved sets of educational standards. These standards were meant to align better with college- and career-ready expectations. At this time, Governor Bredesen also served on the Board of Directors for Achieve. As mentioned above, Achieve was one of the main organizations that helped start the CCSS Initiative, so it was only natural that Tennessee would join the initiative as well. In 2009, Governor Bredesen and Education Commissioner Tim Webb officially joined the CCSS Initiative ("History and fact sheet…," n.d., p. 2-3).

Throughout the development process, content experts from the Tennessee Department of Education gave feedback on the standards. These experts participated in feedback groups where they evaluated the standards' structure and content, providing suggestions for improvement. Tennessee was also consistently represented during the periods of public feedback, as dozens of teachers and parents gave their input. Ultimately, on July 30, 2010, a bill implementing the CCSS in Tennessee passed *unanimously* in both the House and Senate of the Tennessee State Legislature. From there, Tennessee began the lengthy, and somewhat difficult, process of implementing the CCSS ("History and fact sheet…," n.d., p. 4-5).

Within Tennessee, the CCSS are referred to as TNCore, but this is only a name difference, as the standards themselves are identical. The reason for the name change is unclear, but it most likely has political underpinnings. Since educational policies have typically been a state-led effort, it is probable that the Tennessee Department of Education wished to differentiate Tennessee from other states. Perhaps, with the CCSS having a different name, the general public is less likely to recognize the standards as being part of a national effort, and is therefore less likely to fight back against the standards. The only real difference between the CCSS and TNCore, aside from their names, is how the standards are formatted. The order of the standards is the same, the wording is identical, but the designs are slightly different. For the purpose of this study, the current Tennessee standards will be referred to as the CCSS.

Over the past few years, the CCSS have been introduced into Tennessee classrooms progressively, through stages. During the 2011-2012 school year, the CCSS mathematics standards were introduced in all kindergarten through second grade classrooms. Then, during the 2012-2013 school year, the CCSS mathematics standards were partially introduced in third through eighth grade classrooms, with some, but not all, classrooms using the standards. Finally, during the 2013-2014 school year, kindergarten through twelfth grade classrooms, in all public schools, were using the CCSS mathematics standards. So, even though the CCSS were officially adopted by Tennessee in 2010, the standards were not fully implemented in all classrooms until three years later. By gradually phasing in the standards, teachers in upper grades were allowed more time to become familiar with the new expectations and guidelines ("The Common Core State Standards: Tennessee's transition plan," 2012).

Race to the Top

In January of 2010, Tennessee passed the First to the Top bill, signed by Governor Phil Bredesen. The First to the Top Act was passed with little opposition in either the House or the Senate of the Tennessee state legislature, and was part of Tennessee's plan to help its students become more college- and career-ready. Essentially, the First to the Top Act was Tennessee's Race to the Top application. As mentioned above, Race to the Top gave states the opportunity to receive federal funds for education reform, and thus provided a strong incentive for those states to adopt the CCSS. Though the CCSS were not finalized at the time of Tennessee's application, the state was already involved in the standards reform effort, with plans to adopt the CCSS upon their release ("History and fact sheet…," n.d., p. 7). Later that spring, in 2010, Tennessee won one of the first Race to the Top grants of a little over $500 million, one of only two grants awarded at that time (Hamilton, 2010).

During the 2010-2011 school year, Tennessee focused more on other areas of education reform than it did on the implementation of the CCSS. Starting in the 2011-2012 school year, Tennessee began using some of its Race to the Top funds for CCSS development and training programs. During this time, over 200 teachers and educational leaders were hired as Core Coaches and the CCSS Leadership Council was formed. The Core Coaches received extensive training from the University of Pittsburg's Institute for Learning and then used what they learned to train over 10,000 Tennessee educators. Aside from designated training sessions, the Core Coaches were recruited to continuously serve as mentors and resources throughout the entire CCSS implementation process. The CCSS Leadership Council, a thirteen-member team, helped guide the training programs and implementation of the CCSS throughout the 2011-2012 school year (Race to the Top Tennessee report year 2…," 2013, p. 10).

Throughout the 2012-2013 school year, Tennessee built on the progress it had made in the previous year. The CCSS Leadership Council provided additional support for Core Coaches, designed CCSS training programs for administrators, and provided instructional tools and updates for educators across the state. Also, more than 700 additional teachers were trained as Core Coaches, which allowed more teachers to receive support and guidance. In the summer of 2013, over 30,000 total teachers participated in training workshops. This nearly tripled the number of participants from the previous year. By the 2013-2014 school year, when Tennessee fully implemented the CCSS, many teachers had received specific training in relation the CCSS. Currently, the state offers instructional videos, online modules, and curriculum assistance for those teachers who want additional information on how to successfully implement the CCSS in their classrooms (Race to the Top Tennessee report year 3…," 2014, p. 13-14).

Common Core Assessments

Along with new sets of standards, new assessments were needed to replace Tennessee's old standardized tests. Nationwide, there are two main consortia of states that have developed Common Core-aligned assessments. Those assessments are the The Smarter Balanced Assessment and the Partnership for Assessment of Readiness for College and Careers (PARCC). Originally, Tennessee was a member of the PARCC consortium, with plans to introduce the new assessment during the 2014-2015 school year. In May of 2014, however, Tennessee introduced a new law that delayed implementing a new assessment. Lawmakers were concerned that they would not have the necessary resources for all students to take the high-tech PARCC assessment, and were worried that it might be too much of a change, too soon. The law required Tennessee to continue using the Tennessee Comprehensive Assessment Program (TCAP) during the following school year, and opened the door for new proposals to be sent in for assessments other than the PARCC (Gewertz, 2014).

Ultimately, Tennessee chose the TNReady assessment, from Measurement Inc., in place of the PARCC. The TNReady assessment, which is in alignment with the CCSS, was supposed to be administered in February of 2016. Students were supposed to take the test via computers, but, on the first day of testing, there was a network outage, and less than 20,000 students were able to successfully complete the test. For the rest of the students, the assessment had to be postponed, and paper tests were supposed to be sent out instead (Tatter, 2016). There was a delay in shipping, however, and so testing had to be postponed once again. Tennessee schools are now expected to administer the TNReady assessment in late March, as long as everything else goes as planned (Reeves, 2016). Currently, Tennessee plans to release the TNReady student results the fall of 2016, but, with all of the delays in testing, that release date might be postponed as well ("TNReady parent guide," n.d.).

Opinions of the CCSS

As there is with any major change, there has been some opposition to the CCSS in Tennessee. Facebook posts and entire blogs, such as the Momma Bears blog created by an ex-teacher in East Tennessee, are dedicated to fighting against the CCSS and have garnered some negative press for the standards. Amidst all the politically charged opinions, however, the voices of Tennessee teachers hold perhaps the most weight. They are the ones who actually teach the standards, work with students, and see the changes that the CCSS have had on their classrooms. Through surveys and studies, different organizations have tried to observe such changes in teachers' opinions of the CCSS since its initial adoption in 2010.

The Tennessee Consortium on Research, Evaluation, and Development at Vanderbilt, for one, has consistently conducted surveys over the past few years. These survey results have helped gauge teachers' opinions of the First to the Top Act, and, more specifically, their opinions of the CCSS. Over the years there has been an evident change in educators' attitudes towards the CCSS. In comparison to the 2013 survey results, the 2014 results showed an increase in teacher opposition to the CCSS. Interestingly, it was found that most teachers do not have much issue with the standards themselves, but rather the implementation process. Specifically, teachers feel that they are not receiving adequate support, that they are being unfairly evaluated, and that the new Common Core assessments are too advanced for their students. The Tennessee Consortium suggests that there might be some response bias, where unsatisfied teachers were more likely to respond to the survey, therefore causing the results to be skewed towards a more negative opinion. Even if this is the case, the results still provide some valuable insight. Overall, the results suggest that teachers think the CCSS were not implemented effectively, but that the standards themselves are not an issue ("Findings from the 2014 First to the Top Survey…," 2014).

Common Core-Aligned Textbooks- Eighth Grade Mathematics

One important aspect of implementing educational standards is textbook choice. Over the past few years, the Tennessee Department of Education reviewed new Common Core-aligned textbooks and developed lists of acceptable, grade-appropriate textbooks. From there, each district then had the choice of which textbooks they wanted to adopt starting in the 2015-2016 school year. Some of those options for grades 6-8 include the *Go Math!* textbooks from Houghton Mifflin Harcourt, the *Glencoe Math* textbooks from McGraw-Hill, and the *Ready TNCore* textbooks from Curriculum Associates ("Official list of textbooks…," 2015).

In the Chattanooga area, Hamilton County schools chose to adopt the *Ready TNCore 8* math textbook for their eighth grade math classes. This textbook is formatted like a workbook, with spaces for the students to write their answers and notes within the pages. The textbook is divided into five major units, aligned with the five Domains from the Common Core Grade 8 standards. Within the units, there are lessons, each one focused on a particular Common Core Grade 8 standard, or a small group of standards. These lessons fall under one of two types: an *understanding* lesson or an *application* lesson. This differentiation between students simply understanding content and then directly applying the same content to solve specific problems, comes directly from the Common Core Grade 8 standards themselves. The CCSS are written in a similar fashion, with each standard building upon the standards before it.

The *understanding* lessons are meant to help students relate familiar concepts to new concepts. Within these lessons, students have the opportunity to see proofs and explanations of major concepts, explore new ideas on their own, and try multiple methods of problem solving through guided examples. The *application* lessons focus more on how those major concepts can be used to solve problems. Each of these lessons begins with an Explore It section, where students are guided through a series of questions which help them discover key concepts on their own. After the Explore It section there are the Modeled Instruction, Guided Instruction, and Guided Practice sections. Within these sections, students are led through a series of examples, and then they are expected to work through other problems by themselves, with minimal guidance from the textbook or teacher. At the end of both the *understanding* lessons and *application* lessons, there are questions which can be used for assessment. Then, at the end of every unit, there is a cumulative Interim Assessment followed by a Performance Task. The Interim Assessment is a series of test-like questions and the Performance Task is an extended problem-based question, with an opportunity for student reflection.

The *Ready TNCore 8* textbook is atypical compared to the types of textbooks which were usually used in the past. While both the traditional textbooks of the past and the *Ready TNCore 8* textbook are divided into sections of related material, the *Ready TNCore 8* textbook approaches the material in a unique way. Older textbooks typically presented material in a very straight-forward manner, with only a few examples and then a lot of practice problems for students to try. The *Ready TNCore 8* textbook, however, encourages students to make discoveries on their own. Rather than just being told about mathematical ideas, students are pushed to come to the right conclusions through their own logical reasoning. In this aspect, the *Ready TNCore* is very much aligned with the goals of the CCSS. Also, since each lesson is specifically designed to fulfill one or more Common Core standards, all of the material included in the *Ready TNCore* textbook is relevant to the standards which need to be covered.

There are some potential problems related to the use of such a textbook, however. Tennessee is currently planning on adopting new mathematics standards in the 2017-2018 school year and even though the new standards are nearly identical to the CCSS, there are some differences. Since the *Ready TNCore* textbook is so specific to the CCSS, some of the new additions to the standards might not be adequately covered in the *Ready TNCore* textbook. Also, since the *Ready TNCore* textbooks are designed to be a workbook for students, there are some economic issues as well. If students write inside of the books, the books will need to be replaced on a yearly basis. Considering that Tennessee school districts just spent millions of dollars on new Common Core-aligned math textbooks, replacing the books every year would be extremely expensive. Even if the students do not write inside of the books, using their own paper instead, it will be at a cost for both parents and teachers. Since the *Ready TNCore* textbooks are not hardback, they are not very durable, and will therefore have to be frequently replaced. In some cases, students might not be given their own textbooks, leaving teachers to make copies of instructional material. This too, is a costly endeavor. No matter the situation, by replacing the old, hardback textbooks with new workbooks, schools are going to have to continue spending considerable amounts of money.

Despite these issues, it was and still is necessary for new Common Core-aligned textbooks to be adopted in Tennessee classrooms. If teachers are expected to teach the CCSS, then they should have appropriate materials. It is a shame, however, that these resources were not utilized until several years after the initial implementation of the CCSS in Tennessee, with only a couple of years left until new standards are implemented. Typically, new mathematics textbooks are adopted every six years or so. However, sources say that the state is prepared to adopt new textbooks earlier than the projected 2021 date, if need be (“Tennessee textbook adoption cycle,” 2015) (Armstrong, 2015).

Eighth Grade Mathematics Standards - Tennessee and the CCSS

Often times it is asked how different the CCSS are from the Tennessee mathematics standards which were previously in use. A cross-walk document can help shed some light on those differences. Though eighth grade mathematics standards were chosen as the focus of this particular study, other course standards can be compared in the same way. Anyone who wishes to compare two sets of educational standards can follow the methodology described below, with adjustments made for subject matter and course level, and come to his or her own conclusions.

Throughout this cross-walk document’s development process, there were some factors taken into consideration. Those factors helped determine how the cross-walk document was organized, what was included in the cross-walk document, and what was not included in the cross-walk document. Each factor embodies a different aspect of the development process, all of which were accounted for in the final product. A list of those determining factors can be found below; the old Tennessee Grade Eight mathematics standards can be found in Appendix A; the Common Core Grade 8 mathematics standards can be found in Appendix B; and the cross-walk document can be found in Appendix C.

Cross-walk Development Process

1. **Structure:** The Tennessee Grade Eight Mathematics standards and the Common Core Grade 8 Mathematics standards are not designed or organized in exactly the same manner. The Tennessee Grade Eight standards are divided into categories, called Standards, which divide the individual standards based on their content. The Common Core Grade 8 standards are also divided into

categories, called Domains, which serve a similar purpose. Within the Tennessee Grade Eight standards' Standards sections, there are Grade Level Expectations (GLEs), State Performance Indicators (SPIs), and Checks for Understanding (√s or CUs). The GLEs give a general overview of what students should know, the SPIs give more specific instructions for what material should be taught, and the CUs give detailed examples of what students should be able to do. In the Common Core Grade 8 standards, the Domains are divided into Clusters, each Cluster containing Standards. The Clusters are groups of related standards and the Standards describe what students should be capable of doing, some of them including specific examples of problems. The writers of the CCSS also developed eight Standards for Mathematical Process which are meant to be implemented in each course along with the specific course standards. For the purpose of this project, the Standards for Mathematical Practice were all treated as one single Domain, with each individual Practice serving as a Cluster and/or Standard. In order to account for the differences in structure and format, each of the Tennessee Grade Eight Standard sections was matched with a corresponding Common Core Grade 8 Domain(s). The cross-walk document was then divided into those related Standards and Domains. The Tennessee Grade Eight standards' GLEs, SPIs, and CUs all overlap with the Common Core Grade 8 Clusters and Standards, so there is no specific distinction amongst those relations within the cross-walk document.

2. **Quantity:** The Tennessee Grade Eight standards have a total of five Standards, twenty-six SPIs and forty-five CUs. The Common Core Grade 8 standards have five Domains, ten Clusters, and thirty-one Standards. Compared to each other, the Tennessee Grade Eight standards are far greater in quantity than the Common Core Grade 8 standards. Since there are not enough Common Core Grade 8 standards for there to be a one-to-one alignment, meaning each Tennessee Grade Eight standard matches with one specific Common Core Grade 8 standard,

many of the Common Core Grade 8 standards are used more than once throughout the cross-walk document. If a specific Common Core Grade 8 standard is used more than once, it appears, in full text, next to each of the Tennessee standards with which it aligns. In some instances, a Common Core Grade 8 standard is not aligned with any Tennessee Grade Eight standard. If that is the case, then the Common Core Grade 8 standard is not listed in full within the cross-walk document but is mentioned in the cross-walk analysis.

3. **Course-Level:** There is some material covered in the Tennessee Grade Eight mathematics standards that is not covered in the Common Core Grade 8 mathematics standards. Whenever there was a Tennessee standard with no corresponding Common Core Grade 8 standard, other Common Core standards, in different courses, were searched for similarities. If there was a similar standard found in another Common Core course, the course was denoted with an asterisk in the cross-walk document, but the standard was not given in full. Since the study is focused specifically on eighth grade standards, it was deemed unnecessary to fully provide other course standards as well. All Common Core standards can be found at the Common Core website, www.corestandards.org, or at the Tennessee Department of Education website, www.tncore.org.
4. **Content:** The cross-walk document goes through each of the Tennessee standards and the related Common Core State Standard(s) is provided alongside the Tennessee standard. Two standards were determined to be aligned with one another if they contain similar wording, content, or purpose. If a Common Core State Standard is not entirely aligned with one of the TN standards, but still has some overlap, it is listed as a related standard. In the cross-walk document, the parts of each standard which are in alignment with one another are underlined. The parts of each standard which are not underlined were found to be only somewhat related or were not found to be related at all.

5. **Design:** The design of this cross-walk document was influenced by the design and lay-out of other cross-walk documents. States such as Wyoming, Oregon, and New Hampshire created similar guides detailing their respective standards' alignment with the Common Core State Standards during their own implementation periods. Their organization methods and general formatting directly influenced the design of this cross-walk document. Tennessee's Department of Education also created its own cross-walk documents for every course, all of which can be found at the TN Curriculum website, www.tncurriculumcenter.org/mathematics. (CCSSM – TN standards crosswalk, 2012) During the development of this cross-walk document, Tennessee's cross-walk document for eighth grade mathematics was of some influence, but there are several differences between the two documents. For example, the Tennessee document begins with the Common Core State Standards and then lists those Tennessee standards which relate to each Common Core State Standard. This document, however, begins with the Tennessee standards and then lists the corresponding Common Core State Standard(s). Also, each alignment in the Tennessee document is assigned a numerical ranking which denotes how well the Tennessee standards and Common Core standards align with one another, along with a short summary of how the standards overlap. All of this information makes the Tennessee document somewhat dense and hard to follow. In order to make this cross-walk document more user-friendly and transparent, only the standards themselves are included in the document. As mentioned above, the places in each standard which are in alignment with each other are underlined; underlining allows for a clear comparison of the standards based solely on what material they have in common.

Analysis of Cross-walk Results

From the cross-walk document, certain conclusions can be made on how well the Tennessee Grade Eight mathematics standards compare to the Common Core Grade 8 mathematics standards. In some cases the two sets of standards show a lot of alignment, but in some cases they do not. These discrepancies are clearly seen in the cross-walk document and they give some insight into which set of standards is better than the other, if that is the case. Below is an analysis of the cross-walk document, broken down by subject matter into the Tennessee Grade Eight five main Standards: Mathematical Processes; Number & Operations; Algebra; Geometry; and Data Analysis, Statistics, & Probability.

Standard 1- Mathematical Processes

This section is most aligned with the Common Core Standards for Mathematical Practice. Each Grade Level Expectation, like the Common Core Standards for Mathematical Practice, describes what a good student of mathematics should be able to do, without delving into specific content. These Grade Level Expectations are not specific to eighth grade alone. They are identical to those found in the sixth and seventh grade standards and are similar to those found in the Algebra I standards. Since most of the Common Core Standards for Mathematical Practice were used more than once in the cross-walk document, this suggests that the Tennessee standards are unnecessarily repetitive. In particular, GLE 0806.1.2 and GLE 0806.1.8 both express the need for students to use appropriate problem-solving methods and tools. Also, GLE 0806.1.3 and GLE 0806.1.6 are similar in the fact that they both require students to use reasoning when solving problems and communicating their results. Like the Common Core Standards for Mathematical Practice, there are eight GLEs under the Mathematical Processes Standard. The fact that some of them were repetitive, however, suggests that they are not as clear and concise as the Common Core Standards for Mathematical Practice. In this instance, the CCSS seem to be more effective, since they are not repetitive and the same Standards for Mathematical Practice are used for every grade level.

In this section, content matter is featured in the SPI's and CU's and most of the SPI's and CU's under the Mathematical Processes Standard are not mentioned elsewhere in the Tennessee Grade Eight Mathematics standards, nor do they show much alignment with the Common Core Grade 8 Mathematics standards. √0806.1.3, √0806.1.4, *SPI 0806.1.1, and SPI 0806.1.3* are all never referred to again within the Tennessee Grade Eight standards and are not specifically mentioned in the Common Core Grade 8 standards either. *SPI 0806.1.1*, which refers to "rate/time/distance" problems, concerns a specific type of linear equations, which deals with proportional relationships. Though the Common Core Grade 8 standards mention linear equations, the Common Core Grade 6 standards specifically mention rate/time/distance problems. This means that under the CCSS, students in Tennessee are expected to be familiar with rate/distance/time problems a full two years before they were expected to learn this material under the previous Tennessee standards.

Overall, the Mathematical Processes Standard section of the Tennessee Eighth Grade standards shows decent overlap with the Common Core Grade 8 standards. The Grade Level Expectations align strongly with the Standards for Mathematical Practice, but the specific State Performance Indicators and Checks for Understanding seem out of place and do not align well with the Common Core Grade 8 standards. Both sets of standards do, however, set over-arching goals for all students of mathematics and neither set of standards necessarily expects more of students than the other. When it comes to content, however, the Tennessee Grade Eight standards appear to be less advanced than the Common Core Grade 8 standards. Therefore, it can be concluded that the Common Core Grade 8 standards are slightly more advanced and better organized than the Tennessee Grade Eight standards in the area of Mathematical Processes.

Standard 2- Number and Operations

This section is most aligned with the Number System and Expressions & Equations Domains from the Common Core Grade 8 standards. Both the Tennessee standards and the Common Core standards place a lot of emphasis on irrational numbers, scientific notation, and the laws of exponents. The Tennessee standards, however, explicitly state that students should be able to identify the subsets of the real number system, while the CCSS do not. With the CCSS, the students are supposed to gain a gradual understanding of the real number system without there ever being a specific standard dictating what they should know. Also, according to the Common Core Grade 8 standards, students should learn to assess the decimal expansion of a number and determine if the number is rational or irrational in the eighth grade. Under the old Tennessee standards, however, students were expected to know that rational numbers have terminating or repeating decimal expansions in the sixth grade.

Overall, the Number and Operations section of the Tennessee Grade Eight standards shows strong alignment with the Common Core Grade 8 standards. Though there is some disagreement in how the two sets of standards approach the real number system and irrational numbers in particular, there is almost total alignment between the scientific notation standards as well as the laws of exponents standards. As far as content level is concerned, even though the Tennessee standards require that students learn about the decimal expansion of rational numbers earlier than the CCSS, the two sets of standards are generally on par with each other in this area. Therefore, it cannot be concluded that one set of standards is better than the other in the area of Number and Operations.

Standard 3- Algebra

This section is most aligned with the Expressions & Equations and Functions Domains from the Common Core Grade 8 standards. Both sets of standards involve solving linear equations in one variable, solving systems of linear equations in two variables, evaluating multiple representations of linear functions, recognizing both linear and nonlinear functions, and determining rates of change. Comparing the way that the two sets of standards approach these concepts, however, reveals some key differences.

Tennessee's GLE 0806.3.1 concerns algebraic expressions. The only Common Core Grade 8 standard which shows any alignment with that particular Grade Level Expectation mentions expanding algebraic expressions as a means to solve a linear equation. There are no Common Core Grade 8 standards that deal exclusively with algebraic expressions because, under the CCSS, algebraic expressions are covered in the Grade 6 and Grade 7 courses. Tennessee's GLE 0806.3.2 concerns algebraic equations and inequalities of one and two variables. As said above, there is some overlap in this area since the Common Core Grade 8 standards do mention solving linear equations of one variable. However, while the Tennessee standards mention linear equations in two variables and inequalities in one and two variables, the Common Core Grade 8 standards do not. Under the CCSS, inequalities are taught in the Grade 6, Grade 7, and Algebra courses, with no mention of them in the Grade 8 course.

Both the Tennessee Grade Eight standards and the Common Core Grade 8 standards have a similar approach to solving systems of equations. They each emphasize that the solution to a system of linear equations in two variables is the intersection of their graphs, and, under both sets of standards, students are expected to solve such systems of linear equations. One small difference in this area is that the Common Core Grade 8 standards require students to start thinking of these concepts in real-world situations while the Tennessee standards do not require contextual understanding of systems of equations until Algebra. Another small difference is that the Tennessee Grade Eight standards require students to recognize if systems of linear equations relate two lines that intersect, are parallel, or are the same. In comparison, the Common Core Grade 8 standards only expect students to understand that the solution of systems of linear equations is where the two lines intersect, without specifically mentioning the cases where they do not intersect or where they are the same line. More emphasis is placed on systems of equations in the Common Core Algebra course standards.

Linear and nonlinear functions are covered in both the Tennessee Grade Eight standards and the Common Core Grade 8 standards. Under both sets of standards, students are expected to evaluate different representations of functions, identify the slopes of linear functions, and also graph functions. Within the CCSS, functions are first mentioned in the Common Core Grade 8 course, there is a clear and consistent distinction between functions and equations, and a lot of emphasis is placed on the graphs of functions. In comparison, the Tennessee standards do not consistently emphasize the difference between functions and equations. Unlike the CCSS, functions are first mentioned in Grade Seven of the Tennessee standards. Though the notion of a function is clearly defined in the Grade Seven standards, the Grade Eight standards do not include a review of the concept or a clear separation of functions from equations. Also, the Tennessee Grade Eight standards require students to distinguish particular types of nonlinear functions, specifically quadratic and exponential functions, as well as compare their rates of change to those of linear functions. While the Common Core Grade 8 standards do express a need for students to recognize if a function is nonlinear, there is no mention of quadratic or exponential functions within this course level. It is not until the Algebra course, and later high school level courses, where specific types of nonlinear functions are introduced in the Common Core standards.

Slope is also covered in both sets of standards and, for the most part, the Tennessee Grade Eight standards and the Common Core Grade 8 standards are aligned in this area. They both require students to determine rate of change, or slope, from different representations of data. They both mention proportional relationships and emphasize that the unit rate or constant of proportionality is the slope. One minor difference is that the Common Core Grade 8 standards place importance on students being able to compare different proportional relationships, but this is not explicitly stated in the Tennessee Grade Eight standards.

Overall, the Tennessee Grade Eight and Common Core Grade 8 standards in this section were found to be fairly aligned. Though there are some differences in the approaches taken by both sets of standards, the same basic concepts are still there. Where there are disagreements concerning when certain material should be taught, one set of standards is not consistently behind or ahead of the other. In some areas, the old Tennessee standards introduce material earlier than the CCSS and in other areas the CCSS introduce material earlier than the old Tennessee standards. Therefore, it cannot be concluded that one set of standards is more advanced than the other in terms of algebraic content. However, the Common Core Grade 8 standards consistently differentiate between equations and functions and the Tennessee Grade Eight standards do not. The difference between an equation and a function is a critical concept for any student of mathematics to learn; since they emphasize student understanding of those concepts, the Common Core Grade 8 standards are more effective than the Tennessee Grade Eight standards in the area of algebraic content.

Standard 4- Geometry

This section is most aligned with the Geometry Domain from the Common Core Grade 8 standards, and it also shows some alignment with the Standards for Mathematical Practice. Compared to the previous three sections, this area has far less overlap between the two sets of standards. Both sets of standards place emphasis on the Pythagorean Theorem, angles formed by parallel lines cut by a transversal, and general precision when taking measurements. Aside from those similarities, however, the two sets of standards have little in common.

One major difference is how they each approach the concept of angles. Under the Tennessee Grade Eight standards students are expected to fully understand all the relationships among angles formed from parallel lines and a transversal. Under the Common Core Grade 8 standards, however, this topic is only briefly mentioned and is later elaborated in the Algebra course standards. The Common Core Grade 8 standards give more attention to the angle relationships found in triangles, mentioning how they can be used to determine triangle similarity. Those concepts are not mentioned in the Tennessee Grade Eight standards but can be found in their Grade Six and Grade Seven standards.

The Tennessee Grade Eight standards also expect students to convert between metric and customary units of measurement, making both between-system and within-system conversions. The Common Core Grade 8 standards do not mention this as a grade appropriate expectation, but there are mentions of unit conversions in elementary grade standards. Grade 4 and Grade 5 standards require students to make within-system conversions. However, under the CCSS it is not specifically expected for students to make between-system conversions in any course.

Another area where the two sets of standards differ is the topic of geometric figures. The Tennessee Grade Eight standards express that students should be able to visualize and work with both 2- and 3-dimensional figures. There are no related Common Core Grade 8 standards since these concepts are not covered in the Grade 8 course. Instead, they are covered in the Common Core Geometry course.

The discrepancies between the two sets of standards are not only one-way, however; just as the Tennessee Grade Eight standards in this section contain a lot of material not mentioned in the Common Core Grade 8 standards, the Common Core Grade 8 standards also contain material not found in the Tennessee Grade Eight standards. For instance, the Common Core Grade 8 standards state that students should become familiar with translations of geometric figures. Translations, rotations, reflections, and symmetry are all covered in the Tennessee Grade 6 standards. Also, the Common Core Grade 8 standards mention that students should know the volume formulas for 3-dimensional figures. This too is covered in the Tennessee Grade 6 standards.

Overall, the Tennessee Grade Eight standards in this section show some alignment with the Common Core Grade 8 standards. They have some similar content and the differences in content can almost always be accounted for in another course's standards. As with the Algebra section, one set of standards is not consistently more advanced than the other. For example, most of the material covered solely in the Common Core Grade 8 standards can be found in previous grades' Tennessee standards and vice versa; they just take a different approach towards organizing geometric content throughout their respective courses.

Standard 5- Data Analysis, Statistics, & Probability

This section shows alignment with the Statistics & Probability Domain in the Common Core Grade 8 standards. There is mention of relative frequencies, scatterplots, and lines of best fit in both sets of standards, but there are still differences in how they each approach those topics.

For instance, the Tennessee Grade Eight standards focus on calculating probabilities while the Common Core Grade 8 standards expect students to use knowledge of frequencies and relative frequencies to evaluate data involving two variables. Probabilities of compound, independent, and dependent events are covered earlier in the Common Core Grade 7 standards and the Statistics course standards. Also, the Tennessee Grade Eight standards focus on students using different types of charts and graphs, comparing samples from a population, and evaluating the use of statistics in the media, all of which are covered in earlier Common Core courses or the Statistics course. In comparison to the Tennessee Grade Eight standards, the Common Core Grade 8 standards place more emphasis on students using relative frequencies and recognizing patterns in sets of data. The Tennessee Grade Eight standards do not cover this content in the same amount of detail but more attention is given to this material later in the Algebra course standards.

Overall, the Tennessee Grade Eight standards in this section show little alignment with the Common Core Grade 8 standards. When two standards in this section are related, it is typically just small pieces of each standard which overlap. In this section, the Common Core Grade 8 standards seem to be more advanced than the Tennessee Grade Eight standards. What material the two sets of standards do not have in common is typically covered in either an earlier Common Core course or a later Tennessee course.

Summary of Cross-walk Results

In conclusion, the Tennessee Grade Eight standards and the Common Core Grade 8 standards were found to be reasonably well-aligned. They show the most overlap in the area of Number and Operations and the least overlap in the area of Data Analysis, Statistics, & Probability. As explained in the subsections above, there are many standards which showed only partial alignment with one another. The Tennessee standards include material covered in different Common Core courses and vice versa. Though there is a fairly decent balance of each set of standards teaching material in earlier courses than the other, the Common Core Grade 8 standards were found to be somewhat more advanced than the Tennessee Grade Eight standards, particularly in the area of Data Analysis, Statistics, & Probability.

Also, as far as organization and quality of the standards is concerned, the Common Core Grade 8 standards have the upper hand. There are far more Tennessee standards than Common Core, resulting in a lot of repetition. A major strength of the Common Core State Standards is their conciseness. Rather than repeating ideas and concepts within one set of standards or over several courses, the Common Core standards are mostly specific to each course level with unifying organizational methods which span many grades. Also, the Tennessee Grade Eight standards do not clearly separate functions from equations. This leads to some confusion about what exactly students should know. The Common Core Grade 8 standards, on the other hand, have a clear distinction between functions and equations. Based on these observations, the Common Core Grade 8 standards were found to be differing in structure and superior to the Tennessee Grade Eight standards.

Conclusion

Ultimately, this cross-walk document shows that the Tennessee Grade Eight standards and the Common Core Grade 8 standards are in fact quite different. The way the standards are organized, the order in which certain content is taught, and the overall purpose of each set of standards are all areas where they differ; since there are differences in the eighth grade mathematics standards, it can be assumed that there are similar differences throughout all course levels.

As far as the standards themselves are concerned, the CCSS seem to be a positive change for eighth grade mathematics. The main difference between the two sets of standards is the conciseness of the CCSS. That difference is one of the CCSS's biggest assets. With the previous Tennessee standards, teachers had a long list of standards they were required to cover in each course. With the CCSS, those requirements are greatly reduced. In eighth grade mathematics, Tennessee previously had 71 total *SPIs* and CUs and the CCSS have 31 standards. By reducing the number of standards for each grade, the CCSS allow teachers to go more in depth with each general content area, without worrying about meeting every specific requirement.

One concern that some people have with the CCSS is that the standards are too advanced. Even though the Common Core Grade 8 standards were found to be somewhat more advanced than the Tennessee Grade Eight standards in the areas of Number & Operations and Data Analysis, Statistics, & Probability, the Common Core Grade 8 standards were not found to be more advanced than the Tennessee Grade Eight standards in the other three areas. In those areas there was a fairly even distribution of the Common Core Grade 8 standards introducing material earlier than the Tennessee Grade Eight standards and vice versa. Based solely on the standards themselves, it does not appear that eighth grade mathematics in Tennessee became *significantly* more difficult with the adoption of the CCSS.

It does appear that the Eighth grade mathematics standards in Tennessee became somewhat more focused with the adoption of the CCSS. The CCSS reordered content, making the standards more cohesive and less repetitive from course to course. Whereas the Tennessee Grade Eight mathematics standards featured a lot of the same content as the Tennessee Grade Six, Grade Seven, and Algebra course standards, the Common Core Grade 8 standards have far less overlap with other Common Core courses. These results were for the specific case of eighth grade mathematics, but it is reasonable to expect that there would be similar results for other course comparisons as well.

Despite the advantages of the CCSS, there are some disadvantages of the implementation process. Since the CCSS were implemented in all grade levels within a short period of three years, students in middle school and high school were not taught with the CCSS throughout their elementary school years. Therefore, they might have missed crucial steps in their early education which would have prepared them for later Common Core courses. Since the CCSS are so interdependent amongst course levels, a student’s entire education should be aligned with the standards in order for the standards to be most effective. Also, the CCSS are geared towards elementary and middle grades, rather than high school. After eighth grade, the CCSS are divided into high school level groups of standards related to Number and Quantity, Algebra, Functions, Modeling, Geometry, and Statistics & Probability. Since high school courses are not necessarily the same for every student in every state, and the CCSS are designed to be used at the national level, this method of dividing the standards makes sense. They are divided based on the type of content and it is then up to the states to decide which standards go with each course. Though this is probably the best method for having uniform high school standards throughout the country, it is somewhat of a disadvantage since the Common Core high school level groups of standards are not the same as the high school level courses offered in Tennessee.

With all of the varying opinions of CCSS in Tennessee, the state’s implementation of the CCSS has been inconsistent, at best. Initially Tennessee was fully on board with the creation of the CCSS, but as time went by, and different issues arose, the state took a less supportive stance. After only a few years of using the CCSS, Tennessee is ready to adopt new mathematics standards once again. Indiana, South Carolina, and Oklahoma all repealed the CCSS in 2014 and now Tennessee is following their lead. (Bidwell, 2015) Governor Bill Haslam first put the CCSS up for public review in November of 2014, the standards were revised in 2014, and then they were put up for public review once more in October of 2015. After that second period of public feedback, a Standards Recommendation Committee reviewed the final revisions and then sent the new standards to the State Board of Education for approval. The new standards will be approved in April of 2016 and implemented during the 2017-2018 school year. They are available to the public at www.tn.gov/sbe/article/math-and-english-language-arts ("Math and English Language Arts," n.d.).

When comparing the CCSS to the new Tennessee Mathematics standards, the new standards are practically the same as the CCSS. The main differences between the new Grade Eight standards and the Common Core Grade 8 standards are the addition of Literacy Skills for Mathematical Proficiency and the omission of several standards in the Geometry and Statistics & Probability Domains. The Literacy Skills for Mathematical Proficiency are the same for all grades, but are listed under each course's standards along with the Standards for Mathematical Practice. The Standards for Mathematical Practice are also the same for each grade and are identical to the CCSS's list. In the Geometry Domain the new standards changed the first Cluster to focus less on congruence and similarity. The Common Core Standards 8.G.2 and 8.G.4, which cover congruence and similarity of figures going through a series of translations, were removed completely from the new Grade Eight standards. In the Statistics Domain, standard 8.SP.4, which covers frequencies and relative frequencies, was removed completely as well. A new Cluster was added in its place, along with a new Standard which places emphasis on probability, particularly with compound events. Aside from these changes, the new Grade Eight mathematics standards are nearly identical to the Common Core Grade 8 mathematics standards.

Even with all of the similarities, there are some potential issues with adopting new standards so soon after the adoption of the CCSS. Though the CCSS were officially adopted in 2010, they were not used in all classrooms until the 2013-2014 school year. There is a necessary adjustment period when it comes to changes in any educational policy, one that is arguably longer than three years. Also, since Tennessee does not yet have results from their TNReady assessment, it is difficult to measure the effects that the CCSS has had on students. By constantly changing its approach to the CCSS, Tennessee has perhaps hindered its own success with the standards. However, even though Tennessee is implementing new mathematics standards in the fall of 2017, those standards are nearly identical to the CCSS and thus the CCSS will continue to be a part of Tennessee classrooms for quite some time. For that reason, it is necessary for educators, students, and parents alike to familiarize themselves with the changes brought about by the CCSS so that they are best prepared for the changes of the future.

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Appendix A:

Tennessee Grade Eight Mathematics Standards

(used prior to the adoption of the CCSS)

Standard – Processes or Content Strand
  GLE - Grade Level Expectation
    SPI – State Performance Indicator
      √- Check for Understanding

Standard 1 – Mathematical Processes
GLE 0806.1.1 Use mathematical language, symbols, and definitions while developing mathematical reasoning.

GLE 0806.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution.

√ **0806.1.8** Use a variety of methods to solve real-world problems involving multi-step linear equations (e.g. manipulatives, technology, pencil and paper).

GLE 0806.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.

GLE 0806.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.

GLE 0806.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.

SPI 0806.1.2 *Interpret a qualitative graph representing a contextual situation.*

√ **0806.1.1** Relate nonlinear functions to geometric contexts of length, area, an volume.

√ **0806.1.2** Draw qualitative graphs (trend graphs) of functions and describe their general shape/trend.

GLE 0806.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.

GLE 0806.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world.

√ **0806.1.3** Research the contributions Pythagoras to mathematics.

√ **0806.1.4** Relate data concepts to relevant concepts in the earth and space, life and physical sciences.

√ **0806.1.5** Use age-appropriate books, stories, and videos to convey ideas of mathematics.

GLE 0806.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

SPI 0806.1.1 Solve problems involving rate/time/distance *(i.e., $d = rt$).*

SPI 0806.1.3 *Calculates rates involving cost per unit to determine the best buy*

√ **0806.1.6** Use models (such as dynamic geometry software, patty paper and geo boards) to explore relationships among angles (complementary, supplementary, interior, exterior, vertical, and corresponding).

√ **0806.1.7** Use a graphing calculator or spreadsheet to create scatterplots of data and approximate lines of best fit.

√ **0806.1.8** Use a variety of methods to solve real-world problems involving multi step linear equations (e.g. manipulatives, technology, pencil and paper).

Standard 2 – Number & Operations

GLE 0806.2.1 Extend understanding of the real number system to include irrational numbers.

SPI 0806.2.1 *Order and compare rational and irrational numbers and locate on the number line.*

SPI 0806.2.2 *Identify numbers and square roots as rational or irrational.*

√ **0806.2.2** Square numbers and simplify square roots.

√ **0806.2.4** Use a Venn diagram to represent the subsets of the real number system.

√ **0806.2.5** Identify the subset(s) of the real number system to which a number belongs.

GLE 0806.2.2 Solve problems involving exponents and scientific notation using technology.

SPI 0806.2.3 *Use scientific notation to compute products and quotients.*

SPI 0806.2.4 *Solve real-world problems requiring scientific notation.*

√ **0806.2.1** Recognize and use exponential, scientific, and calculator notation.

√ **0806.2.7** Add, subtract, multiply, and divide numbers expressed in scientific notation.

GLE 0806.2.3 Solve real-world problems using rational and irrational numbers.

√ **0806.2.3** Solve contextual problems involving powers and roots.

GLE 0806.2.4 Understand and use the laws of exponents.

√ **0806.2.6** Simplify expressions using the laws of exponents.

Standard 3 - Algebra

GLE 0806.3.1 Recognize and generate equivalent forms for algebraic expressions.

√ **0806.3.1** Perform basic operations on algebraic expressions (including grouping, order of operations, exponents, square/cube roots, simplifying and expanding).

GLE 0806.3.2 Represent, analyze, and solve problems involving linear equations and inequalities in one and two variables

SPI 0806.3.2 *Solve the linear equation f(x) = g(x).*

SPI 0806.3.3 *Solve and graph linear inequalities in two variables.*

√ **0806.3.2** Represent algebraic relationships with equations and inequalities.

√ **0806.3.4** Understand the relationship between the graph of a linear inequality and its solutions.

√ **0806.3.5** Solve linear inequalities in two variables (including those whose solutions require multiplication or division by a negative number).

√ **0806.3.13** Represent situations and solve real-world problems using symbolic algebra.

GLE 0806.3.3 Solve systems of linear equations in two variables.

SPI 0806.3.1 *Find solutions to systems of two linear equations in two variables.*

√ **0806.3.3** Solve systems of linear equations in two variables and relate the systems to pairs of lines that intersect, are parallel, or are the same line.

GLE 0806.3.4 Translate among verbal, tabular, graphical and algebraic representations of linear functions.

SPI 0806.3.4 *Translate between various representations of a linear function.*

SPI 0806.3.6 *Analyze the graph of a linear function to find solutions and intercepts.*

√ **0806.3.6** Identify x- and y-intercepts and slope of linear equations from an equation, graph or table.

√ **0806.3.9** Given a function rule, create tables of values for x and y, plot graphs of nonlinear functions.

GLE 0806.3.5 Use slope to analyze situations and solve problems.

SPI 0806.3.5 *Determine the slope of a line from an equation, two given points, a table or a graph.*

√ **0806.3.7** Analyze situations and solve problems involving constant rate of change.

√ **0806.3.8** Recognize a proportion as a special case of a linear equation and understand that the constant of proportionality is the slope, and the resulting graph is a line through the origin.

GLE 0806.3.6 Compare and contrast linear and nonlinear functions.

SPI 0806.3.7 *Identify, compare and contrast functions as linear or nonlinear.*

√ **0806.3.10** Distinguish quadratic and exponential functions as nonlinear using a graph and/or a table of values.

√ **0806.3.11** Distinguish between the equations of linear, quadratic, and exponential functions (e.g., function families such as $y = x^2$, $y = 2^x$, and $y = 2x$).

√ **0806.3.12** Understand how rates of change of nonlinear functions contrast with constant rates of change of linear functions.

Standard 4 - Geometry
GLE 0806.4.1 Derive the Pythagorean Theorem and understand its applications.
SPI 0806.4.1 *Use the Pythagorean Theorem to solve contextual problems.*
SPI 0806.4.2 *Apply the Pythagorean Theorem to find distances between points in the coordinate plane to measure lengths and analyze polygons and polyhedra.*
√ **0806.4.1** Model the Pythagorean Theorem.
√ **0806.4.2** Use the converse of the Pythagorean Theorem to determine if a triangle is a right triangle.

GLE 0806.4.2 Understand the relationships among the angles formed by parallel lines cut by transversals.
SPI 0806.4.3 *Find measures of the angles formed by parallel lines cut by a transversal.*
√ **0806.4.2** Analyze the congruent and supplementary relationships of angles formed by parallel lines and transversals (such as alternate interior, alternate exterior, corresponding, and adjacent).

GLE 0806.4.3 Understand the necessary levels of accuracy and precision in measurement.
√ **0806.4.3** Select or use the appropriate measurement instruments to determine or create a given length, area, volume, angle, weight, or mass.
√ **0806.4.4** Understand how the precision of measurement influences accuracy of quantities derived from these measurements.

GLE 0806.4.4 Understand both metric and customary units of measurement.
SPI 0806.4.4 *Convert between and within the U.S. Customary System and the metric system.*
√ **0806.4.6** Make within-system and between-system conversions of derived quantities including distance, temperature, and money.

GLE 0806.4.5 Use visualization to describe or identify intersections, cross-sections, and various views of geometric figures.
SPI 0806.4.5 *Identify the intersection of two or more geometric figures in the plane.*
√ **0806.4.7** Visualize or describe the cross section resulting from the intersection of a plane with a 3-dimensional figure.
√ **0806.4.8** Build, draw, and work with 2- and 3-dimensional figures by means of orthogonal views, projective views, and/or nets.

Standard 5 – Data Analysis, Statistics, & Probability
GLE 0806.5.1 Explore probabilities for compound, independent and/or dependent events.
SPI 0806.5.1 *Calculate probabilities of events for simple experiments with equally probable outcomes.*
SPI 0806.5.2 *Use a variety of methods to compute probabilities for compound events (e.g., multiplication, organized lists, tree diagrams, area models).*
√ **0806.5.1** Solve simple problems involving probability and relative frequency.

√ **0806.5.2** Compare probabilities of two or more events and recognize when certain events are equally likely.

GLE 0806.5.2 Select, create, and use appropriate graphical representations of data (including scatterplots with lines of best fit) to make and test conjectures.

SPI 0806.5.3 *Generalize the relationship between two sets of data using scatterplots and lines of best fit.*

√ **0806.5.4** Explain the benefits and the limitations of various representations (i.e., bar graphs, line graphs, circle graphs, histograms, stem-and-leaf plots, box plots, scatterplots) of data.

√ **0806.5.5** Create and interpret box-and-whisker plots and scatterplots.

√ **0806.5.6** Use observations about differences between two or more samples to make conjectures about the populations from which the samples were taken.

√ **0806.5.7** Estimate lines of best fit to make and test conjectures.

GLE 0806.5.3 Evaluate the use of statistics in media reports.

SPI 0806.5.4 *Recognize misrepresentations of published data in the media.*

√ **0806.5.3** Recognize common misconceptions associated with dependent and independent events.

√ **0806.5.8** Consider the source, design, analysis, and display of data to evaluate statistics reported in the media.

Appendix B:

Common Core Standards for Mathematical Practice and Grade 8 Mathematics Standards

Mathematics | Standards for Mathematical Practice

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.
These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. The first of these are the NCTM process standards of problem solving, reasoning and proof, communication, representation, and connections. The second are the strands of mathematical proficiency specified in the National Research Council's report *Adding It Up*: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy).

1 Make sense of problems and persevere in solving them.

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

2 Reason abstractly and quantitatively.

Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to *decontextualize*—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to *contextualize*, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

3 Construct viable arguments and critique the reasoning of others.

Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

4 Model with mathematics.

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

5 Use appropriate tools strategically.

Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

6 Attend to precision.

Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

7 Look for and make use of structure.

Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7×8 equals the

well remembered $7 \times 5 + 7 \times 3$, in preparation for learning about the distributive property. In the expression $x^2+9x + 14$, older students can see the 14 as 2×7 and the 9 as $2 + 7$. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 - 3(x - y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.

8 Look for and express regularity in repeated reasoning.

Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with slope 3, middle school students might abstract the equation $(y – 2)/(x – 1) = 3$. Noticing the regularity in the way terms cancel when expanding $(x–1)(x+1)$,$(x–1)(x^2+x+1)$,and$(x–1)(x^3+x^2+x+1)$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

Mathematics | Grade 8

In Grade 8, instructional time should focus on three critical areas: (1) formulating and reasoning about expressions and equations, including modeling an association in bivariate data with a linear equation, and solving linear equations and systems of linear equations; (2) grasping the concept of a function and using functions
to describe quantitative relationships; (3) analyzing two- and three-dimensional space and figures using distance, angle, similarity, and congruence, and understanding and applying the Pythagorean Theorem.

(1) Students use linear equations and systems of linear equations to represent, analyze, and solve a variety of problems. Students recognize equations for proportions ($y/x = m$ or $y = mx$) as special linear equations ($y = mx + b$), understanding that the constant of proportionality (m) is the slope, and the graphs are lines through the origin. They understand that the slope (m) of a line is a constant rate of change, so that if the input or x-coordinate changes by an amount A, the output or y-coordinate changes by the amount $m·A$. Students also use a linear equation to describe the association between two quantities in bivariate data (such as arm span vs. height for students in a classroom). At this grade, fitting the model, and assessing its fit to the data are done informally. Interpreting the model in the context of the data requires students to express a relationship between the two quantities in question and to interpret components of the relationship (such as slope and y-intercept) in terms of the situation.

Students strategically choose and efficiently implement procedures to solve linear equations in one variable, understanding that when they use the properties of equality and the concept of logical equivalence, they maintain the solutions of the original equation. Students solve systems of two linear equations in two variables and relate the systems to pairs of lines in the plane; these intersect, are parallel, or are the same line. Students use linear equations, systems of linear equations, linear functions, and their understanding of slope of a line to analyze situations and solve problems.

(2) Students grasp the concept of a function as a rule that assigns to each input exactly one output. They understand that functions describe situations where one quantity determines another. They can translate among representations and partial representations of functions

(noting that tabular and graphical representations may be partial representations), and they describe how aspects of the function are reflected in the different representations.

(3) Students use ideas about distance and angles, how they behave under translations, rotations, reflections, and dilations, and ideas about congruence and similarity to describe and analyze two-dimensional figures and to solve problems. Students show that the sum of the angles in a triangle is the angle formed by a straight line, and that various configurations of lines give rise to similar triangles because of the angles created when a transversal cuts parallel lines. Students understand the statement of the Pythagorean Theorem and its converse, and can explain why the Pythagorean Theorem holds, for example, by decomposing a square in two different ways. They apply the Pythagorean Theorem to find distances between points on the coordinate plane, to find lengths, and to analyze polygons. Students complete their work on volume by solving problems involving cones, cylinders, and spheres.

Grade 8 Overview

The Number System

- Know that there are numbers that are not rational, and approximate them by rational numbers.

Expressions and Equations

- Work with radicals and integer exponents.
- Understand the connections between proportional relationships, lines, and linear equations.
- Analyze and solve linear equations and pairs of simultaneous linear equations.

Functions

- Define, evaluate, and compare functions.
- Use functions to model relationships between quantities.

Geometry

- Understand congruence and similarity using physical models, transparencies, or geometry software.
- Understand and apply the Pythagorean theorem.
- Solve real-world and mathematical problems involving volume of cylinders, cones and spheres.

Statistics and Probability

- Investigate patterns of association in bivariate data.

Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.

5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

<u>The Number System | 8.NS</u>

Know that there are numbers that are not rational, and approximate them by rational numbers.

1. Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.
2. Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^2). *For example, by truncating the decimal expansion of* $\sqrt{2}$*, show that* $\sqrt{2}$ *is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.*

<u>Expressions and Equations | 8.EE</u>

Work with radicals and integer exponents.

1. Know and apply the properties of integer exponents to generate equivalent numerical expressions. *For example,* $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.
2. Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.
3. Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. *For example, estimate the population of the United States as* 3×10^8 *and the population of the world as* 7×10^9*, and determine that the world population is more than 20 times larger*.
4. Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.

Understand the connections between proportional relationships, lines, and linear equations.

5. Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. *For*

example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.

6. Use similar triangles to explain why the slope *m* is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at *b*.

Analyze and solve linear equations and pairs of simultaneous linear equations.

7. Solve linear equations in one variable.

   a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which
   of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a$, $a = a$, or $a = b$ results (where *a* and *b* are different numbers).
   b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

8. Analyze and solve pairs of simultaneous linear equations.

   a. Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.
   b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *For example,* $3x + 2y = 5$ *and* $3x + 2y = 6$ *have no solution because* $3x + 2y$ *cannot simultaneously be 5 and 6.*
   c. Solve real-world and mathematical problems leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.*

<u>Functions | 8.F</u>

Define, evaluate, and compare functions.

1. Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output[1].

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[1] Function notation is not required in Grade 8

2. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.*
3. Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. *For example, the function* $A = s^2$ *giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.*

Use functions to model relationships between quantities.

4. Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.
5. Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

<u>Geometry | 8.G</u>

Understand congruence and similarity using physical models, transparencies, or geometry software.

1. Verify experimentally the properties of rotations, reflections, and translations:
   a. Lines are taken to lines, and line segments to line segments of the same length.
   b. Angles are taken to angles of the same measure.
   c. Parallel lines are taken to parallel lines.
2. Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.
3. Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.
4. Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two- dimensional figures, describe a sequence that exhibits the similarity between them.
5. Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. *For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.*

Understand and apply the Pythagorean Theorem.

6. Explain a proof of the Pythagorean Theorem and its converse.
7. Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.
8. Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.

9. Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.

Statistics and Probability | 8.SP

Investigate patterns of association in bivariate data.

1. Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.
2. Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.
3. Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.*
4. Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. *For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?*

Appendix C
Cross-walk Document
Tennessee Grade Eight Mathematics and Common Core Grade 8 Mathematics

Each Tennessee Grade Eight standard is listed in the left-hand column with the related Common Core Grade 8 standard(s) in the right hand column next to it. The standards are divided into the five Tennessee Standards: Mathematical Processes, Number & Operations, Algebra, Geometry, and Data Analysis, Statistics, & Probability. All of the Common Core Grade 8 Domains which relate to those Standards are listed next to the Common Core column. The related parts of each standard are underlined. If a Tennessee Grade Eight standard is not related to any Common Core Grade 8 standards, but is related to standards found in other Common Core courses, those Common Core courses are denoted with an asterisk.

	Tennessee Standard Grade Eight Mathematics		Common Core State Standard Mathematics- Grade 8
Standard 1- Mathematical Processes	**GLE 0806.1.1** <u>Use</u> mathematical language, <u>symbols</u>, and <u>definitions</u> while developing <u>mathematical reasoning</u>.	**Domain: Functions, Expressions and Equations, Statistics and Probability, Geometry Standards for Mathematical Practice**	**Standards for Mathematical Practice** **SFMP 2** <u>Reason</u> abstractly and quantitatively. ("…abstract a given situation and <u>represent it symbolically</u> and manipulate the representing <u>symbols</u>…") **SFMP 3** Construct viable arguments and critique the reasoning of others. ("<u>Mathematically proficient students understand and use</u>… <u>definitions</u>…") ***Mathematical language is emphasized periodically throughout different courses.***

	GLE 0806.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including estimation, and reasonableness of the solution. √ **0806.1.8** Use a variety of methods to solve real-world problems involving multi-step linear equations (e.g. manipulatives, technology, pencil and paper).		**Standards for Mathematical Practice** **SFMP 8** Look for and express regularity in repeated reasoning. ("… evaluate the reasonableness of their intermediate results.") **SFMP 1** Make sense of problems and persevere in solving them. ("… plan a solution pathway…") **SFMP 5** Use appropriate tools strategically. ("… strategically using estimation…")
	GLE 0806.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.		**Standards for Mathematical Practice** **SFMP 3** Construct viable arguments and critique the reasoning of others. ("…They justify their conclusions, communicate them to others…")
	GLE 0806.1.4 Move flexibly between concrete and abstract representations of mathematical ideas in order to solve problems, model mathematical ideas, and communicate solution strategies.		**Standards for Mathematical Practice** **SFMP 2** Reason abstractly and quantitatively. **SFMP 3** Construct viable arguments and critique the reasoning of others. ("...They justify their conclusions, communicate them to others…") **SFMP 4** Model with mathematics.
	GLE 0806.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions. ***SPI 0806.1.2*** *Interpret a qualitative graph representing a contextual situation.* √ **0806.1.1** Relate nonlinear functions		**Standards for Mathematical Practice** **SFMP 7** Look for and make use of structure. ("… discern a pattern or structure…") **SFMP 8** Look for and express regularity in repeated reasoning **SFMP 4** Model with Mathematics. ("…They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense…")

	to geometric contexts of length, area, and volume. √ **0806.1.2** Draw qualitative graphs (trend graphs) of functions and describe their general shape/trend.		**SFMP 1** Make sense of problems and persevere in solving them. **Functions- Define, evaluate, and compare functions.** **8.F.3** Interpret the equation y =mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. *For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.* **8.F.5** Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g. where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.
	GLE 0806.1.6 Read and interpret the language of mathematics and use written/oral communication to express mathematical ideas precisely.		**Standards for Mathematical Practice** **SFMP 1** Make sense of problems and persevere in solving them. ("…start by explaining to themselves the meaning of a problem and looking for entry points to its solution…") **SFMP 6** Attend to precision. ("…students try to communicate precisely to others…")

	GLE 0806.1.7 Recognize the historical development of mathematics, mathematics in context, and the connections between mathematics and the real world. √ **0806.1.3** Research the contributions of Pythagoras to mathematics. √ **0806.1.4** Relate data concepts to relevant concepts in the earth and space, life and physical sciences. √ **0806.1.5** Use age-appropriate books, stories, and videos to convey ideas of mathematics.		**Standards for Mathematical Practice** **SFMP 4** Model with mathematics. ("…solve problems arising in everyday life, society, and the workplace….") **SFMP 5** Use appropriate tools strategically. **Geometry- Understand and apply the Pythagorean Theorem.** **8.G.6** Explain a proof of the Pythagorean Theorem and its converse.
	GLE 0806.1.8 Use technologies/ manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts. ***SPI 0806.1.1*** Solve problems involving rate/time/distance *(i.e., d = rt).* ***SPI 0806.1.3*** *Calculates rates involving cost per unit to determine the best buy* √ **0806.1.6** Use models (such as dynamic geometry software, patty paper and geo boards) to explore relationships among angles (complementary, supplementary, interior, exterior, vertical, and		**Standards for Mathematical Practice** **SFMP 5** Use appropriate tools strategically. **SFMP 4** Model with mathematics. **Functions- Use functions to model relationships between quantities.** **8.F.4** Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x,y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. **Functions- Define, evaluate and compare functions.**

	corresponding). √ **0806.1.7** Use a graphing calculator or spreadsheet to create scatterplots of data and approximate lines of best fit. √ **0806.1.8** Use a variety of methods to solve real-world problems involving multi-step linear equations (e.g. manipulatives, technology, pencil and paper).		**8.F.2** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by an algebraic expression, determine which function has the greater rate of change*. **Geometry- Understand congruence and similarity using physical models, transparencies, or geometry software.** **8.G.5** Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. *For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.* **Statistics and Probability- Investigate patterns of association in bivariate data.** **8.SP.1** Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association. **8.SP.2** Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.

			Expressions and Equations- Analyze and solve linear equations and pairs of simultaneous linear equations. **8.EE.7** Solve linear equations in one variable. ****See Common Core Grade 6 standards for more detail on distance/rate/time problems.***
Standard 2- Number & Operations	**GLE 0806.2.1** Extend understanding of the real number system to include irrational numbers. ***SPI 0806.2.1*** *Order and compare rational and irrational numbers and locate on the number line.* ***SPI 0806.2.2*** *Identify numbers and square roots as rational or irrational.* √ **0806.2.2** Square numbers and simplify square roots. √ **0806.2.4** Use a Venn diagram to represent the subsets of the real number system. √ **0806.2.5** Identify the subset(s) of the real number system to which a number belongs.	**Domain: The Number System, Expressions and Equations**	**The Number System- Know that there are numbers that are not rational, and approximate them by rational numbers.** **8.NS.1** Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number. **8.NS.2** Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g. π^2). *For example, by truncating the decimal expansion of* $\sqrt{2}$, *show that* $\sqrt{2}$ *is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.*
	GLE 0806.2.2 Solve problems involving exponents and scientific notation using technology. ***SPI 0806.2.3*** *Use scientific notation to compute products and quotients.* ***SPI 0806.2.4*** *Solve real-world problems*		**Expressions and Equations- Work with radicals and integer exponents.** **8.EE.3** Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. *For example, estimate the population*

	requiring scientific notation. √ **0806.2.1** Recognize and use exponential, scientific, and calculator notation. √ **0806.2.7** Add, subtract, multiply, and divide numbers expressed in scientific notation.		*of the United States as 3 x 10^8 and the population of the world as 7 x 10^9, and determine that the world population is more than 20 times larger.* **8.EE.4** Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific and choose units of appropriate size for measurements of a very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.
	GLE 0806.2.3 Solve real-world problems using rational and irrational numbers. √ **0806.2.3** Solve contextual problems involving powers and roots.		**Expressions and Equations- Work with radicals and integer exponents.** **8.EE.2** Use square roots and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.
	GLE 0806.2.4 Understand and use the laws of exponents. √ **0806.2.6** Simplify expressions using the laws of exponents.		**Expressions and Equations- Work with radicals and integer exponents.** **8.EE.1** Know and apply the properties of integer exponents to generate equivalent numerical expressions. *For example,* $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.

<table>
<tr>
<td rowspan="2">Standard 3- Algebra</td>
<td>GLE 0806.3.1 Recognize and generate equivalent forms for algebraic expressions.
√ 0806.3.1 Perform basic operations on algebraic expressions (including grouping, order of operations, exponents, square/cube roots, simplifying and expanding).</td>
<td rowspan="2">Domain: Expressions and Equations, Functions</td>
<td>Expressions and Equations- Analyze and solve linear equations and pairs of simultaneous linear equations.
8.EE.7b Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

*See Common Core Grade 6 and Grade 7 standards for more information on manipulating algebraic expressions.</td>
</tr>
<tr>
<td>GLE 0806.3.2 Represent, analyze, and solve problems involving linear equations and inequalities in one and two variables
SPI 0806.3.2 Solve the linear equation f(x) = g(x).
SPI 0806.3.3 Solve and graph linear inequalities in two variables.
√ 0806.3.2 Represent algebraic relationships with equations and inequalities.
√ 0806.3.4 Understand the relationship between the graph of a linear inequality and its solutions.
√ 0806.3.5 Solve linear inequalities in two variables (including those whose solutions require multiplication or division by a negative number).
√ 0806.3.13 Represent situations and solve real-world problems using symbolic algebra.</td>
<td>Expressions and Equations- Analyze and solve linear equations and pairs of simultaneous linear equations.
8.EE.7a Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form x = a, a = a, or a = b results (where a and b are different numbers).
8.EE.7b Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.
8.EE.8a Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.

*See Common Core Grade 7 and Algebra standards for more information on equations in two variables and inequalities in one and two variables.</td>
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	GLE 0806.3.3 Solve systems of linear equations in two variables. ***SPI 0806.3.1*** *Find solutions to systems of two linear equations in two variables*. √ **0806.3.3** Solve systems of linear equations in two variables and relate the systems to pairs of lines that intersect, are parallel, or are the same line.		**Expressions and Equations- Analyze and solve linear equations and pairs of simultaneous linear equations.** **8.EE.8a** Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously. **8.EE.8b** Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *For example, 3x + 2y cannot simultaneously be 5 and 6.* **8.EE.8c** Solve real-world and mathematical problems leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.* ****See Common Core Algebra standards for more information on systems of equations.***
	GLE 0806.3.4 Translate among verbal, tabular, graphical and algebraic representations of linear functions. ***SPI 0806.3.4*** *Translate between various representations of a linear function*. ***SPI 0806.3.6*** *Analyze the graph of a linear function to find solutions and intercepts.* √ **0806.3.6** Identify x- and y-intercepts and slope of linear equations from an		**Functions- Define evaluate, and compare functions.** **8.F.1** Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output. **8.F.2** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.*

	equation, graph or table. √ **0806.3.9** Given a function rule, create tables of values for x and y, and plot graphs of nonlinear functions.		**Functions- Use functions to model relationships between quantities.** **8.F.4** Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x,y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. **8.F.5** Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally. ****See Common Core Functions standards for more information on finding solutions and intercepts.***
	GLE 0806.3.5 Use slope to analyze situations and solve problems. ***SPI 0806.3.5*** *Determine the slope of a line from an equation, two given points, a table or a graph.* √ **0806.3.7** Analyze situations and solve problems involving constant rate of change. √ **0806.3.8** Recognize a proportion as a special case of a linear equation and understand that the constant of		**Expressions and Equations- Understand the connections between proportional relationships, lines, and linear equations.** **8.EE.5** Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. *For example, compare a distance-time graph to a distance-time equation to determine which of the two moving objects has greater speed.*

	proportionality is the slope, and the resulting graph is a line through the origin.		**Functions- Use functions to model relationships between quantities.** **8.F.4** Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x,y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.
	GLE 0806.3.6 Compare and contrast linear and nonlinear functions. ***SPI 0806.3.7*** *Identify, compare and contrast functions as linear or nonlinear*. √ **0806.3.10** Distinguish quadratic and exponential functions as nonlinear using a graph and/or a table of values. √ **0806.3.11** Distinguish between the equations of linear, quadratic, and exponential functions (e.g., function families such as $y = x^2$, $y = 2^x$, and $y = 2x$). √ **0806.3.12** Understand how rates of change of nonlinear functions contrast with constant rates of change of linear functions.		**Functions- Define, evaluate, and compare functions.** **8.F.3** Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. *For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4), and (3,9), which are not on a straight line.* **Functions- Use functions to model relationships between quantities.** **8.F.5** Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally. ****See Common Core Algebra standards for more information on nonlinear functions.***

Standard 4- Geometry		Domain: Geometry Standards for Mathematical Practice	
	GLE 0806.4.1 Derive the Pythagorean Theorem and understand its applications. ***SPI 0806.4.1*** *Use the Pythagorean Theorem to solve contextual problems*. ***SPI 0806.4.2*** *Apply the Pythagorean Theorem to find distances between points in the coordinate plane to measure lengths and analyze polygons and polyhedra*. √ **0806.4.1** Model the Pythagorean Theorem. √ **0806.4.2** Use the converse of the Pythagorean Theorem to determine if a triangle is a right triangle.		**Geometry- Understand and apply the Pythagorean Theorem.** **8.G.6** Explain a proof of the Pythagorean Theorem and its converse. **8.G.7** Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. **8.G.8** Apply the Pythagorean Theorem to find the distance between two points in a coordinate system. ****See Common Core Geometry standards for more information on the Pythagorean Theorem.***
	GLE 0806.4.2 Understand the relationships among the angles formed by parallel lines cut by transversals. ***SPI 0806.4.3*** *Find measures of the angles formed by parallel lines cut by a transversal*. √ **0806.4.2** Analyze the congruent and supplementary relationships of angles formed by parallel lines and transversals (such as alternate interior, alternate exterior, corresponding, and adjacent).		**Geometry- Understand congruence and similarity using physical models, transparencies, or geometry software.** **8.G.5** Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. *For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.* ****See Common Core Geometry standards for more information on angles.***

	GLE 0806.4.3 Understand the necessary levels of accuracy and precision in measurement. √ **0806.4.3** Select or use the appropriate measurement instruments to determine or create a given length, area, volume, angle, weight, or mass. √ **0806.4.4** Understand how the precision of measurement influences accuracy of quantities derived from these measurements.		**Standards for Mathematical Practice** **SFMP 5** Use appropriate tools strategically. **SFMP 6** Attend to precision. ("…They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context…")
	GLE 0806.4.4 Understand both metric and customary units of measurement. ***SPI 0806.4.4*** *Convert between and within the U.S. Customary System and the metric system.* √ **0806.4.6** Make within-system and between-system conversions of derived quantities including distance, temperature, and money.		**No related Grade 8 standard** ****See Common Core Grade 4 and Grade 5 standards for more information on conversions.***

	GLE 0806.4.5 Use visualization to describe or identify intersections, cross-sections, and various views of geometric figures. ***SPI 0806.4.5*** *Identify the intersection of two or more geometric figures in the plane.* √ **0806.4.7** Visualize or describe the cross section resulting from the intersection of a plane with a 3-dimensional figure. √ **0806.4.8** Build, draw, and work with 2- and 3-dimensional figures by means of orthogonal views, projective views, and/or nets.		**No related Grade 8 standard** ***See Common Core Geometry standards for more information on 3-D figures.***
Standard 5- Data Analysis, Statistics, & Probability	**GLE 0806.5.1** Explore probabilities for compound, independent and/or dependent events. ***SPI 0806.5.1*** *Calculate probabilities of events for simple experiments with equally probable outcomes.* ***SPI 0806.5.2*** *Use a variety of methods to compute probabilities for compound events (e.g., multiplication, organized lists, tree diagrams, area models).* √ **0806.5.1** Solve simple problems involving probability and relative frequency. √ **0806.5.2** Compare probabilities of two or more events and recognize	**Domain: Statistics and Probability**	**Statistics and Probability- Investigate patterns of association in bivariate data.** **8.SP.4** Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. *For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?*

	when certain events are equally likely.		***See Common Core Grade 7 and Statistics standards for more information on probability.***
	GLE 0806.5.2 Select, create, and use appropriate graphical representations of data (including scatterplots with lines of best fit) to make and test conjectures. ***SPI 0806.5.3*** *Generalize the relationship between two sets of data using scatterplots and lines of best fit*. √ **0806.5.4** Explain the benefits and the limitations of various representations (i.e., bar graphs, line graphs, circle graphs, histograms, stem-and-leaf plots, box plots, scatterplots) of data. √ **0806.5.5** Create and interpret box-and whisper plots and scatterplots. √ **0806.5.6** Use observations about differences between two or more		**Statistics and Probability- Investigate patterns of association in bivariate data.** **8.SP.1** Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive, or negative association, linear association, and nonlinear association. **8.SP.2** Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line. ***See Common Core Grade 6 and earlier elementary grades' standards for more information on types of graphs and plots.***

	samples to make conjectures about the populations from which the samples were taken. √ **0806.5.7** Estimate lines of best fit to make and test conjectures.		***See Common Core Statistics standards for more information on sample populations.**
	GLE 0806.5.3 Evaluate the use of statistics in media reports. ***SPI 0806.5.4** Recognize misrepresentations of published data in the media.* √ **0806.5.3** Recognize common misconceptions associated with dependent and independent events. √ **0806.5.8** Consider the source, design, analysis, and display of data to evaluate statistics reported in the media.		**No related Grade 8 standard** ***See Common Core Statistics standards for more information on statistics in the media.**