A Member of the Texas Tech University System

Course Syllabus: Teaching Math in Middle School/High School

West College of Education
EDUC 4076-X10
COURSE SYLLABUS: Fall 2023

Contact Information

Instructor: Mrs. Angie Bullard **Office**: Bridwell 210 **Office Phone**: 940-397-4136 **E-mail**: angela.bullard@msutexas.edu	**Office hours**: Tuesday 9:00am-10:00am Wednesday 9:30-12:30am Thursday 9:00am-10:00am *Other times available by request

Instructor Response Policy

We will communicate constantly throughout the semester. Email is good for contacting me, however you will also be a part of class Group Text App. This will provide more flexibility in communication. I will try my best to answer all emails and texts within 24 hours, however you will definitely get a response within 48 hours (2 business days). Any emails or texts received during weekends will not receive a response till the following Monday.

Textbook & Instructional Materials

- Dillon, F. L., Perry, A. D., Cheng, A. N., & Outz, J. (2022). *Answers to your biggest questions about teaching secondary math*. Corwin, a SAGE Company.
- Handouts and copied materials as required throughout the semester.

Course Description

This field-based, 3-credit course focuses on middle and secondary school math pedagogy with emphasis on instructional strategies and models, the use of technology in the learning/teaching process, effective practices, professionalism, curriculum, and lesson design. Different teaching strategies include appropriate use of creative approaches to the learning/teaching process, cooperative learning, direct instruction, inquiry, concept attainment, etc. An important component of this field-based block of classes is the course time spent in active participation in field (classroom) experiences

Prerequisite(s): EDUC 3163, EDUC 3183, EPSY 3153, and SPED 3613 & Admission to the teacher education program.

Co-requisite(s): Concurrent enrollment in ETEC 4003.

Course Objectives

- Learners will be able to understand, describe and implement learning and thinking in mathematics in middle/high school level.
- Learners will be able to develop curriculum and use effective instructional planning skills.
- Learners will be able to develop appropriate assessment tools to assess students' learning and use the assessment data to design appropriate learning activities.
- Learners will be able to develop lesson plans that involve students in an active learning environment, including flexible instructional strategies and differentiation.
- Learners will be able to develop lesson plans/unit plans that incorporate national standards and state standards in mathematics.
- Learners will be able to develop technology integrated instructional and assessment strategies and activities.
- Learners will be able to develop and implement effective teaching strategies including learner-centered instruction, integrating effective modeling, questioning and self-reflection strategies.
- Learner will be able to effectively implement discipline management procedures and communicate clear expectations for achievement and behavior for their students.
- Learners will be able to develop and implement learning environments (positive, equitable, engaging) that utilize various teaching/learning strategies, integrating critical thinking, inquiry, and problem solving.
- Learner will be able to assume various roles in the instructional process (facilitator, instructor, audience, …)
- Learner will be able to provide quality and timely feedback to students.
- Learner will be able to differentiate instruction to meet the academic needs and behavioral needs of students with disabilities and LEP-ELL and to provide appropriate ways of the students to demonstrate their learning.
- Learner will be able to collaborate with professionals in meeting the needs of students with disabilities.
- Learner will be able to understand and adhere to federal and state laws and district and campus policies regarding Students with disabilities and LEP-ELL students and implement IEP decisions and assessments related with IEP goals and objectives.
- Learner will be able to model and teach the forms and functions of academic English in content areas.
- Learner will be able to build and maintain positive rapport with students and their families.

See Appendix A for a complete list of standards, competencies, and other expectations.

Grading/Assessment

Table 1: Points allocated to each assignment.

Assignments	**Grade Points**
Technology Assignments	150 points
Lesson Plan	250 points
Classroom Observation	75 points
Written Assignments	100 points
Quizzes	100 points
Attendance	100 points
Disposition & Class Participation	25 points
Final Exam (Unit Plan)	200 points
TOTAL	**1000 points**

Table 2: Total points for final grade.

Grade	Points
A	90% - 100%
B	80% - 89%
C	70% - 79%
D	60% - 69%
F	Below 59%

Quizzes

There are several quizzes with varying grade points in this course that align with the book chapters. Quizzes will consist of multiple choice and open-ended questions. Quiz details as well as a rubric for open-ended questions will be provided.

Assignments

There **will be written assignments and technology assignments in this course that will** build your understanding of thinking about how **students** assimilate mathematics and also prepare you to become aware of research-based practices in teaching mathematics especially understanding equity in a math classroom. Details for each **assignment w**ill be provided in class and also available on D2L. Integration of technology needs to be purposeful and intentional in teaching of mathematics. During the semester, you will be exposed to numerous technologies and also have opportunities to demonstrate your understanding of integrating technology. The assignments will provide variety and space to express your understanding in different ways. Details about the assignment along with rubrics will be shared in class.

Expectations for written work:

Correct grammar, punctuation, and spelling are expected on all written assignments (web discussions are not held to the high standard of a research project or other written assignment).

Written assignments should be:

- Done in Microsoft Word and turned in as an attachment in dropbox on D2L or
- Converted to a PDF and turned in as an attachment in dropbox on D2L.
- Discussions (if applicable) should be completed within the D2L discussion space and NOT uploaded as an attachment.

Presentation/Mini-Teaching

Students will be required to give presentations during the course to provide you with a space to practice teaching as week as receive peer and instructor feedback. These may vary from individual presentations to group presentations. These opportunities will provide students with different pedagogies in teaching. Details about the expectations, rubric, and implementation will be provided in class and also available on D2L.

Lesson Planning (WCOE Template)

Teacher candidates must demonstrate the ability to plan, assess, and implement instruction. This begins in the Foundational block where the teacher candidates create and write lessons for effective teaching. Teacher candidates are required to develop lesson plans. The specific format can be adapted, but should always include the objectives (TEKS), procedures, materials/resources, and assessment. Student engagement is a key element in a good lesson with a goal of student learning/success is the ultimate goal.

Candidates must form an assessment strategy to determine the extent to which students are able to master learning of objectives. Candidates also describe the instructional delivery method addressing the following step-by-step procedures:

1. Questions and concerns listed in the directions given to you by your instructor
2. Setting purposes ("Today we will be…I want you to…because you will…")
3. Method(s) for engaging students in the lesson
4. Any questions asked during the lesson should be in bold
5. Higher order thinking reflected in questions
6. Instructional Strategies: Modeling, Discussion, "Hands-on", Inquiry, etc.
7. Grouping: when and how
8. Instruction that addresses learners' needs (ELLs, Special Education, 504, Gifted, Struggling Learner)
9. Closure

After teaching the lesson, candidates are then required to reflect on and explain:

- the lesson delivery and appropriateness of instructional strategies,
- the impact for future planning using evidence from gathered data and
- collaboration opportunities with the mentor teacher.

The skills acquired during lesson planning provide the foundation and are also built upon for unit planning and other key assessments.

Unit Planning

Unit Plan is a WCOE key assessment. Teacher candidate's ability to demonstrate the ability to plan, assess, and implement instruction continues in the professional block with the Unit plan assessment. The unit plan assessment is a modified form of Midwestern Impact on Student Learning (MISL) that requires teacher candidates to plan a unit of teaching. Candidates are required to determine a set of multiple learning objectives aligned to state content standards Texas Essential Knowledge and Skills (TEKS) appropriate to the lesson(s) the candidate is preparing.

As you complete the assignments for this class, you will demonstrate skills from the following five categories and will be assessed based on them:

Domain I: Planning and Preparation - demonstrate knowledge of content and pedagogy; demonstrate knowledge of students; select instructional goals; demonstrate knowledge of resources; design coherent instruction; assess student learning.

- Plan *minds-on* lessons in a unit around *powerful ideas* that have students actively involved in the learning process.
- Use the TEKS and district assigned standards for mathematics instruction.
- Curriculum and NCTM standards, to develop and present the lessons.
- Content understanding and learning goals are assessed.
- Data collection and analysis.

Domain II: Classroom Environment - establish a culture for learning.

- Field experience observation: Teach three math lessons in your field experience placement.
- Submit Lesson Plan at least *five school days in advance*.
- Lesson cannot be taught until approved by both of us and must be observed by me.

Domain III: Instruction - communicate clearly and accurately; use questioning and discussion techniques; engage students in learning; provide feedback to students; demonstrate flexibility and responsiveness.

- Field experience observation.
- Peer instruction and reviews.
- Classroom activities
- Problem-solving

Domain IV: Professionalism - Reflect on teaching; show professionalism; contribute to the school and/or district.

- Reflection required after Math lesson taught.
- Being *present* in class in a prompt manner.
- Classroom Participation.

Domain V: Technology Integration - demonstrate the use of technology in the learning/teaching process.

- Integrate technology by being aware of various resources and its effectiveness and application to the curriculum.
- Integrate technology and correlate it to the Math TEKS by critically analyzing technology for teaching mathematics.
- Assignments accurately posted through D2L and TK20.

Extra Credit

Extra Credit opportunities may be given and will depend on the flow and needs of the class.

Late Work

25% off per day per assignment (including Saturday and Sunday). So, if the assignment is worth 100 points, the maximum score is 75 for submission one day late, 50 for submission two days, 25 for submission three days late, and zero on the 4th late day. *There is NO late work on discussion boards or quizzes*! If there is an issue, contact me **BEFORE** the assignment is due (at least 24 to 48 hours before the assignment is due). Time shown on D2L, or email will be used.

Please note: *Even though this is a face-to-face class, this class requires you to have access to a computer (with Internet access) to check for class news updates, materials, instructions, resources and upload your assignments in D2L.* Extensive use of the MSU D2L program is a part of this course. Each student is expected to be familiar with D2L as it provides a primary source of communication regarding assignments, examination materials, and general course information. You can log into D2L through the MSU Homepage. If you experience difficulties, please contact the technicians listed for the program or contact your instructor. *It is your responsibility to have (or have access to) a working computer in this class.* ***Assignments are due by the due date, and personal computer technical difficulties will not be considered reason for the instructor to allow students extra time for submission.***

Make Up Work/Tests

There will be no make-up or resubmissions allowed on assignments, quizzes, discussion boards, or any other activity in class.

Important Dates

Last day for term schedule changes**:** 8/31/2023
Deadline to file for graduation: December graduation 9/25/2023
Last Day to drop with a grade of "W:" 10/30/23 by 4 PM
Refer to: Drops, Withdrawals & Void
Refer to the academic calendar for more details.

Desire-to-Learn (D2L)

Extensive use of the MSU D2L program and Pearson MyLab is a part of this course. Each student is expected to be familiar with D2L as it provides a primary source of communication regarding assignments, examination materials, and general course information. You can log into D2L through the MSU Homepage. *Again, if you experience difficulties, please contact the technicians listed for the program or contact your instructor.* ***Do not wait till the last minute to submit the assignment. Delays or sending through email will be counted late!***

Computers are available on campus in various areas of the buildings as well as the Academic Success Center. ***Again, your computer being down is not an excuse for missing a deadline!!*** There are many places to access your class! If you have technical difficulties in the course, there

is also a student helpdesk available to you. The college cannot work directly on student computers due to both liability and resource limitations however they are able to help you get connected to our online services. For help, log into D2L.

Attendance

Absence Policy - Professional teachers are dependable, reliable, and responsible. Therefore, candidates are expected to be on time and in attendance at **every** class, and to stay for the **entire** class. Tardiness, leaving early, and excessive absences (3) are considered evidence of lack of dependability, and are taken seriously. *Candidates will receive a grade of F on the third absence. If a candidate is taking 'block' courses that are taught at a Professional Development School, requiring field experience, the candidate will be dropped with an F from those classes as well.*

After an absence from the course, it is imperative that a student schedule an appointment with the course instructor to discuss attendance. Failure to schedule and attend a conference will result in the loss of classroom participation and disposition points and also in the overall grade being lowered by one letter. It is the candidate's responsibility to make up any missed work. It is also expected that you will complete all course field experience hours in a professional manner.

Professional conduct is expected when observing or participating in school settings (e.g., dressing appropriately, arriving on time, remaining for the entire pre-arranged time, not canceling, and demonstrating respect in all interactions with young people, parents, teachers, and staff).

If you must miss your field experience for any reason, you are expected to contact the school and the teacher you are working with **before** school begins for the day. You must also contact the course instructor by e-mail or text to let me know you will not be present and arrange a time with me when we can discuss the most appropriate way to make up that absence. Excessive tardiness can be defined as an absence and subject to the absentee policy.
Three instances of tardy arrival will be counted as one absence.

In the event that a class member is absent, for whatever reason, that individual assumes responsibility for contacting the instructor to account for missed work and to turn in work. **It is impossible to provide a summary of all that takes place during any given class via email.** If a student is going to be absent, they have the responsibility to contact the instructor to turn in assignments and obtain copies of any handouts from the missed class. Tentative assignment due dates are listed on the course schedule. While the actual due dates may vary due to the flow of the class, all assignment due dates will be finalized and announced in class well in advance of the specific date. Late work, unless arrangements are made by the student and approved **in advance** by the instructor, **will not be accepted for full credit**.

Class Participation
Students should participate in all the activities of this course. It is important that students meet all the deadlines as posted. In the case of any emergency situation (like death or illness in family, etc.) it is important that the student should report the same to the professor in a timely manner. It is your course, and the primary intention should be to reach the goals and acquire proficiency in

the topics discussed in the course. Generally, students are graded on intellectual effort and performance rather than attendance, absences may lower the student's grade where class attendance and class participation are deemed essential.

Excessive tardiness or absence (as determined by the professor), disruptive attitude, or failure to consistently meet class requirements might result in instructor-drop, if required. Being repeatedly late for class will also result in a grade reduction regardless of other marks. Tardiness will result in loss of classroom disposition points and three instances of tardy arrival will be counted as one absence.

Each student brings a unique perspective and life experience to the learning environment and is expected to participate actively and thoughtfully by making pertinent contributions. All students are expected to read assignments and be prepared to discuss them. Note that you are provided with focus questions that are designed to structure your reading of the assigned texts. Moreover, the course instructor may assign additional readings. *Participating in class discussions and following expectations is a part of your grade*. Please come to class with questions or issues from the reading that you found central or worthy of further exploration. Students may also be asked to do activities and exercises related to the assigned readings or to lead discussions on a topic or reading. You will have many opportunities to participate in class and on D2L. These opportunities are a very important part of this course.

Instructor Classroom Policies

Students are expected to assist in maintaining a classroom environment which is conducive to learning. In order to assure that all students have the opportunity to gain from time spent in class, unless otherwise approved by the instructor, students are prohibited from engaging in any form of distraction—this includes but is not limited to pagers and cell phones. In the classroom or during virtual meetings, cell phones need to be put away so that they do not disrupt the learning environment for you and others. Inappropriate behavior in the classroom shall result, minimally, in a request to leave class and a Professional Fitness Form will be filed for review with the college. If the instructor must file a Fitness Alert Form for any reason, including failure to demonstrate appropriate teaching dispositions, the student may receive an instructor drop with an "F" for the course.

Any student who misses class (for any reason) remains responsible for contacting other students to obtain class materials. In the event that a class member is absent, for whatever reason, that individual assumes responsibility for contacting the instructor to account for missed work and to turn in work. It is impossible to provide a summary of all that takes place during any given class via email. If a student is going to be absent, they have the responsibility to contact the instructor to turn in assignments and obtain copies of any handouts from the missed class. Tentative assignment due dates are listed on the course schedule. While the actual due dates may vary due to the flow of the class, all assignment due dates will be finalized and announced in class well in advance of the specific date. ***Late work, unless arrangements are made by the student and approved in advance by the instructor, will not be accepted for full credit.***

As previously mentioned, cheating, collusion, and plagiarism (the act of using source material of other persons, either published or unpublished, without following the accepted techniques of

crediting, or the submission for credit of work not the individuals to whom credit is given) will not be considered. I use Turnitin for the written assignments and D2L directly syncs with it (you do not have to do anything). You will be able to see the plagiarism percentage and are welcome to make changes and resubmit **BEFORE** the due date. Any plagiarism of 30% and above is too much and the assignment will not be graded, given a zero, and no make-up allowed!!!

MSU Texas Policies and Procedures:

Student Handbook

Refer to: 2023-2024 Student Handbook

Academic Misconduct Policy & Procedures

Academic Dishonesty: Cheating, collusion, and plagiarism (the act of using source material of other persons, either published or unpublished, without following the accepted techniques of crediting, or the submission for credit of work not the individuals to whom credit is given). Additional guidelines on procedures in these matters may be found in the Office of Student Conduct. **Refer to**: Office of Student Conduct

Study Hours and Tutoring Assistance

The TASP offers a schedule of selected subjects tutoring assistance. Please contact the TASP, (940)397-4684, or visit the TLC homepage for more information. Tutoring & Academics Supports Programs

Instructor Drop

As per the College policies, an instructor may drop a student any time during the semester for excessive absences, for consistently failing to meet class assignments, for an indifferent attitude, or for disruptive conduct. Instructor will give the student a verbal or written warning prior to dropping the student from the class. The instructor-drop takes precedence over the student-initiated course drop of a later date. The instructor will assign a grade of either WF or F through the first 8 weeks of this semester. After this period, the grade will be an F. The date the instructor drop form is received in the Office of the Registrar is the official drop date.

Change of Schedule

A student dropping a course (but not withdrawing from the University) within the first 12 class days of a regular semester or the first four class days of a summer semester is eligible for a 100% refund of applicable tuition and fees. Dates are published in the Schedule of Classes each semester.

Refund and Repayment Policy

A student who withdraws or is administratively withdrawn from Midwestern State University (MSU) may be eligible to receive a refund for all or a portion of the tuition, fees and room/board charges that were paid to MSU for the semester. HOWEVER, if the student received financial aid (federal/state/institutional grants, loans and/or scholarships), all or a portion of the refund may be returned to the financial aid programs. As described below, two formulas (federal and

state) exist in determining the amount of the refund. (Examples of each refund calculation will be made available upon request).

Online Computer Requirements

As mentioned above, it is your responsibility to have (or have access to) a working computer in this class. *Assignments are due by the due date, and personal computer technical difficulties will not be considered a reason for the instructor to allow students extra time to submit assignments, tests, or discussion postings*.
Computers are available on campus in various areas of the buildings as well as the Academic Success Center. Your computer being down is not an excuse for missing a deadline!

Services for Students with Disabilities

In accordance with Section 504 of the Federal Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990, Midwestern State University endeavors to make reasonable accommodations to ensure equal opportunity for qualified persons with disabilities to participate in all educational, social, and recreational programs and activities. After notification of acceptance, students requiring accommodations should make application for such assistance through Disability Support Services, located in the Clark Student Center, Room 168, (940) 397-4140. Current documentation of a disability will be required in order to provide appropriate services, and each request will be individually reviewed. For more details, please go to Disability Support Services.

Students with Disabilities:

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make necessary arrangements. Students must present appropriate verification from the University's Disability Support Services (DSS) Office during the instructor's office hours. Please note that instructors are not allowed to provide classroom accommodation(s) to a student until appropriate verification from DSS has been provided.

Campus Carry Rules/Policies

Effective August 1, 2016, the Campus Carry law (Senate Bill 11) allows those licensed individuals to carry a concealed handgun in buildings on public university campuses, except in locations the University establishes has prohibited. The new Constitutional Carry law does not change this process. Concealed carry still requires a License to Carry permit, and openly carrying handguns is not allowed on college campuses.
For more information, visit Campus Carry Rules and Policies.

Smoking/Tobacco Policy

College policy strictly prohibits the use of tobacco products in any building owned or operated by WATC. Adult students may smoke only in the outside designated-smoking areas at each location.

Alcohol and Drug Policy
To comply with the Drug Free Schools and Communities Act of 1989 and subsequent amendments, students and employees of Midwestern State are informed that strictly enforced policies are in place which prohibits the unlawful possession, use or distribution of any illicit drugs, including alcohol, on university property or as part of any university-sponsored activity. Students and employees are also subject to all applicable legal sanctions under local, state, and federal law for any offenses involving illicit drugs on University property or at University-sponsored activities.

Active Shooter
The safety and security of our campus is the responsibility of everyone in our community. Each of us has an obligation to be prepared to appropriately respond to threats to our campus, such as an active aggressor. Please review the information provided by MSU Police Department regarding the options and strategies we can all use to stay safe during difficult situations. For more information, visit Safety / Emergency Procedures. Students are encouraged to watch the video entitled "*Run. Hide. Fight.*" which may be electronically accessed via the University police department's webpage: *"Run. Hide. Fight."*

COVID
Scientific data shows that being fully vaccinated is the most effective way to prevent and slow the spread of COVID-19 and has the greatest probability of avoiding serious illness if infected in all age groups. Although MSU Texas is not mandating vaccinations in compliance with Governor Abbott's executive orders, we highly encourage eligible members of our community to get a vaccination. If you have questions or concerns about the vaccine, please contact your primary care physician or health care professional. Given the recent rise in cases, individuals are also strongly encouraged to wear facial coverings when indoors among groups of people, regardless of vaccination status. Although MSU Texas is not currently requiring facial coverings, they have been an effective strategy in slowing the spread.

Grade Appeal Process
Students who wish to appeal a grade should consult the Midwestern State University
Refer to: MSU Catalog

Notice
Changes in the course syllabus, procedure, assignments, and schedule may be made at the discretion of the instructor.

Course Schedule
Disclaimer Notice: Changes in the course syllabus, procedure, assignments, and schedule may be made at the discretion of the instructor to meet the needs of the class appropriately.
All assignments are due on Monday by 11:59pm.
All math certification candidates should get a minimum of 36 field hours in their mathematics methods course.

Other Expectations

As a part of your preparation for becoming a teacher, you are expected to begin acting in a professional manner – starting today. This includes, but is not limited to:

Internship Experience – Throughout your internship experience, ask your mentor teacher to provide you with constructive feedback regarding your classroom presence, interactions with students and lessons that you present to the students. Use this information to make necessary improvements during the time that remains in the schedule. Always conduct yourself in a professional manner.

Participation – It is not enough to just "show up." In other words, you cannot just sit there and breathe. You need to be prepared to discuss the readings that are assigned, contribute appropriately, and encourage the participation of your peers.

Preparation – Complete all assignments on time. Written assignments (whether submitted online or in class) will be discounted by 25% for each late day. Complete readings assigned prior to class in order to be able to participate in class discussions and activities.

Classroom Observation - The student must achieve a Developing or Above on all criteria-failure to achieve a Developing or above will result in teaching a mini-lesson that specifically addresses the deficit(s).

Attitude – Demonstrate the following dispositions that are essential for learning:

- Curiosity (ask questions, look for additional answers, probe, reflect)
- Flexibility (take alternate points of view, be open-minded)
- Organization (plan ahead – literally, GET A PLANNER!)
- Patience (take time to reason, be persistent in efforts)
- Risk-taking (try things beyond your current repertoire)
- Passion (invest in ideas, processes, products, and most of all – other people)

Be aware that your attitude is conveyed to others by body language, conversation, neatness, completeness of work, willingness to assist and contribute and many other ways. A sense of humor and the ability to be flexible are crucial – not just in this class but from now on – that is the nature of the classroom.

Respect – Be considerate of others. Do not talk while others are talking; do not use foul language; behave in an ethical manner. This is particularly important considering our classroom location - we are guests in the Wichita Falls school district and should behave as such.

Professional Development – Remember that teaching requires a commitment to continual learning. You will be asked to complete several "chores" as the semester rolls along and the points earned for dispositions are affected by those "chores." Timely completion of tasks (or "chores") is an indication of your "fitness" to this profession.

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Appendix A: Standards/Competencies/Course Objectives

WCOE Standards

The outcomes for graduates of professional programs are based upon knowledge, skills, and dispositions in the following elements:

1. Learner Development - understand how learners grow and develop, recognizing that patterns of learning and development vary individually within and across the cognitive, linguistic, social, emotional, and physical areas, and design and implement developmentally appropriate and challenging learning experiences.
2. Learning Differences - understand individual differences and diverse cultures and communities to ensure inclusive learning environments that enable each learner to meet high standards.
3. Learning Environment - work with others to create environments that support individual and collaborative learning, and that encourage positive social interaction, active engagement in learning, and self-motivation.
4. Content Knowledge - understand the central concepts, tools of inquiry, and structures of the discipline(s) he or she teaches and creates learning experiences that make the discipline accessible and meaningful for learners to assure mastery of the content.
5. Application of Content - understand how to connect concepts and use differing perspectives to engage learners in critical thinking, creativity, and collaborative problem solving related to authentic local and global issues.
6. Assessment - understand and use multiple methods of assessment to engage learners in their own growth, to monitor learner progress, and to guide the teacher's and learner's decision making.
7. Planning for Instruction - plan instruction that supports every student in meeting rigorous learning goals by drawing upon knowledge of content areas, curriculum, cross-disciplinary skills, and pedagogy, as well as knowledge of learners and the community context.
8. Instructional Strategies - understand and use a variety of instructional strategies to encourage

learners to develop deep understanding of content areas and their connections, and to build skills to apply knowledge in meaningful ways.
9. Professional Learning and Ethical Practice - engage in ongoing professional learning and use evidence to continually evaluate his or her practice, particularly the effects of his or her choices and actions on others (learners, families, other professionals, and the community), and adapts practice to meet the needs of each learner.
10. Leadership and Collaboration - seek appropriate leadership roles and opportunities to take responsibility for student learning, to collaborate with learners, families, colleagues, other school professionals, and community members to ensure learner growth, and to advance the profession.

Course Objectives

1. Learners will be able to understand, describe and implement learning and thinking in mathematics in middle/high school level.
2. Learners will be able to develop curriculum and use effective instructional planning skills.
3. Learners will be able to develop appropriate assessment tools to assess students' learning and use the assessment data to design appropriate learning activities.
4. Learners will be able to develop lesson plans that involve students in an active learning environment, including flexible instructional strategies and differentiation.
5. Learners will be able to develop lesson plans/unit plans that incorporate national standards and state standards in mathematics.
6. Learners will be able to develop technology integrated instructional and assessment strategies and activities.
7. Learners will be able to develop and implement effective teaching strategies including learner-centered instruction, integrating effective modeling, questioning and self-reflection strategies.
8. Learner will be able to effectively implement discipline management procedures and communicate clear expectations for achievement and behavior for their students.
9. Learners will be able to develop and implement learning environments (positive, equitable, engaging) that utilize various teaching/learning strategies, integrating critical thinking, inquiry, and problem solving.
10. Learner will be able to assume various roles in the instructional process (facilitator, instructor, audience, …)
11. Learner will be able to provide quality and timely feedback to students.
12. Learner will be able to differentiate instruction to meet the academic needs and behavioral needs of students with disabilities and LEP-ELL and to provide appropriate ways of the students to demonstrate their learning.
13. Learner will be able to collaborate with professionals in meeting the needs of students with disabilities.
14. Learner will be able to understand and adhere to federal and state laws and district and campus policies regarding Students with disabilities and LEP-ELL students and implement IEP decisions and assessments related with IEP goals and objectives.
15. Learner will be able to model and teach the forms and functions of academic English in content areas.
16. Learner will be able to build and maintain positive rapport with students and their families.

Competencies for Math Instruction
Mathematics Standards Grade 4-8 and Mathematics Standards EC-12

Standard I. Number Concepts: The mathematics teacher understands and uses numbers, number systems and their structure, operations and algorithms, quantitative reasoning, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.

Teacher Knowledge: What Teachers Know

Teachers of Students in Grades 4–8 and Teachers of Students in Grades EC–12

The beginning teacher of mathematics knows and understands: 1.1k the structure of number systems, the development of a sense of quantity, and the relationship between quantity and symbolic representation; 1.2k the connections of operations, algorithms, and relations with their associated concrete and visual representations; 1.3k the relationship among number concepts, operations and algorithms, and the properties of numbers, including ideas of number theory; 1.4k how to model, construct, and solve problems within and outside of mathematics; and 1.5k how number concepts, operations, and algorithms are developmental and connected across grade levels.

Application: What Teachers Can Do

Teachers of Students in Grades 4–8

The beginning teacher of mathematics is able to: 1.13s apply all skills specified for teachers in grades EC–4, using content and contexts appropriate for grades 4–8; 1.14s demonstrate a sense of equivalency among different representations of rational numbers; 1.15s select appropriate representations of real numbers (e.g., fractions, decimals, percents, roots, exponents, scientific notation) for particular situations and justify that selection; 1.16s analyze, explain, and model the four basic operations involving integers and real numbers; 1.17s analyze and describe relationships between number properties, operations, and algorithms for the four basic operations involving integers, rational numbers, and real numbers; 1.18s work with complex numbers and demonstrate, explain, and model how some situations that have no solution in the integer, rational, or real number systems have solutions in the complex number system; 1.19s explain and justify the traditional algorithms for the four basic operations with integers, rational numbers, and real numbers and analyze common error patterns that may occur in their application; 1.20s use integers, rational numbers, and real numbers to describe and quantify phenomena such as money, length, area, volume, and density; 1.21s extend and generalize the operations on rationals and integers to include exponents, their operations, their properties, and their applications to the real numbers.

Application: What Teachers Can Do

Teachers of Students in Grades 7–12

The beginning teacher of mathematics is able to: 1.22s apply all skills specified for teachers in grades EC–8, using content and contexts appropriate for grades 7–12; 1.23s demonstrate an understanding of the real and complex number systems as algebraic fields; 1.24s describe and analyze properties of subsets of the real numbers (e.g., rational, irrational, algebraic, transcendental) and the complex numbers (e.g., real numbers, imaginary numbers); 1.25s select appropriate representations of complex numbers (e.g., vector, ordered pair, polar, exponential) for particular situations and justify that selection; 1.26s describe real and complex number operations and their interrelationships using geometric

and symbolic representations; 1.27s apply properties of the real and complex numbers to explain and justify algebraic algorithms; and 1.28s investigate and apply fundamental number theory concepts and principles (e.g., divisibility, Euclidean algorithm, congruence classes, modular arithmetic, the fundamental theorem of arithmetic) in a variety of situations.

Standard II. Patterns and Algebra: The mathematics teacher understands and uses patterns, relations, functions, algebraic reasoning, analysis, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.

Teacher Knowledge: What Teachers Know

Teachers of Students in Grades 4–8 and Teachers of Students in Grades EC–12

The beginning teacher of mathematics knows and understands: 2.1k how to use algebraic concepts and reasoning to investigate patterns, make generalizations, formulate mathematical models, make predictions, and validate results; 2.2k how to use properties, graphs, and applications of relations and functions to analyze, model, and solve problems; 2.3k the concept of and relationships among variables, expressions, equations, inequalities, and systems in order to analyze, model, and solve problems; 2.4k the connections among geometric, graphic, numeric, and symbolic representations of functions and relations; 2.5k that patterns are sometimes misleading; 2.6k that in many situations, a pattern is only a trend and is accompanied by random variation from the trend; and 2.7k how patterns, relations, functions, algebraic reasoning, and analysis are developmental and connected across grade levels.

Application: What Teachers Can Do

Teachers of Students in Grades 4–8

The beginning teacher of mathematics is able to: 2.8s apply all skills specified for teachers in grades EC–4, using content and contexts appropriate for grades 4–8; 2.9s make, test, validate, and use conjectures about patterns and relationships in data presented in tables, sequences, or graphs; 2.10s use linear and nonlinear functions and relations, including polynomial, absolute value, trigonometric, rational, radical, exponential, logarithmic, and piecewise functions, to model problems; 2.11s use a variety of representations and methods (e.g., numerical methods, tables, graphs, algebraic techniques) to solve linear and nonlinear equations, inequalities, and systems; 2.12s use transformations to illustrate properties of functions and relations and to solve problems; 2.13s give appropriate justification of the manipulation of algebraic expressions, equations, and inequalities; 2.14s relate the concept of limit as a conceptual foundation of calculus to middle school mathematics; 2.15s relate the rate of change as a conceptual foundation of calculus to middle school mathematics; 2.16s relate the area under a curve as a conceptual foundation of calculus to middle school mathematics; and 2.17s work with patterns with random variations.

Application: What Teachers Can Do

Teachers of Students in Grades 7–12

The beginning teacher of mathematics is able to: 2.18s apply all skills specified for teachers in grades EC–8, using content and contexts appropriate for grades 7–12; 2.19s use methods of recursion and iteration to model and solve problems; 2.20s analyze the properties of sequences and series and use them to solve problems involving finite and infinite

processes; including problems related to simple, compound, and continuous interest rates, as well as annuities; 2.21s use the method of mathematical induction to prove theorems; 2.22s use deductive reasoning to simplify and justify algebraic processes; 2.23s analyze attributes of functions and relations (e.g., domain, range, one-to-one functions, composite functions, inverse functions, odd and even functions, continuous functions) and their graphs; 2.24s describe linear, quadratic, and other polynomial functions, analyze their algebraic and graphical properties, and use these to model and solve problems using a variety of methods, including technology; 2.25s describe exponential, logarithmic, and logistic functions algebraically and graphically, analyze their algebraic and graphical properties, and use these to model and solve problems using a variety of methods, including technology; 2.26s describe trigonometric and circular functions algebraically and graphically, analyze their algebraic and graphical properties, and use these to model and solve problems using a variety of methods, including technology; 2.27s describe rational, radical, absolute value, and piecewise functions algebraically and graphically, analyze their algebraic and graphical properties, and use these to model and solve problems using a variety of methods, including technology; 2.28s investigate and solve problems using techniques of differential and integral calculus along with a variety of other methods, including technology; 2.29s represent and solve problems using techniques of linear and matrix algebra; 2.30s apply the properties of vectors and vector algebra to solve pure and applied problems; 2.31s demonstrate an understanding of algebraic structures (e.g., groups, rings, fields, vector spaces) and their relationship to secondary mathematics; and 2.32s demonstrate an understanding of analysis (e.g., analytic geometry and calculus) and its relationship to secondary mathematics.

Standard III. Geometry and Measurement: The mathematics teacher understands and uses geometry, spatial reasoning, measurement concepts and principles, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.

Teacher Knowledge: What Teachers Know

Teachers of Students in Grades 4–8 and Teachers of Students in Grades EC–12

The beginning teacher of mathematics knows and understands: 3.1k how to use spatial reasoning to investigate concepts such as direction, orientation, perspective, shape, and structure; 3.2k the use of mathematical reasoning to develop, generalize, justify, and prove geometric relationships; 3.3k connections among geometric ideas and number concepts, measurement, probability and statistics, algebra, and analysis; 3.4k measurement as a process; 3.5k methods of approximation and estimation and the effects of error on measurement; 3.6k how to use measurement to collect data, to recognize relationships, and to develop generalizations, including formulas; 3.7k how to locate, develop, and solve real-world problems using measurement and geometry concepts; 3.8k how to explore geometry from synthetic, coordinate, and transformational approaches; 3.9k logical reasoning, justification, and proof in relation to the axiomatic structure of geometry; and 3.10k how geometry, spatial reasoning, and measurement concepts and principles are developmental and connected across grade levels.

Application: What Teachers Can Do

Teachers of Students in Grades 4–8

The beginning teacher of mathematics is able to: 3.7s apply all skills specified for teachers in grades EC–4, using content and contexts appropriate for grades 4–8; 3.8s develop, justify, and perform geometric constructions using compass, straight-edge, and reflection devices and other appropriate technology; 3.9s investigate and prove geometric relationships within the axiomatic structure of Euclidean geometry; 3.10s analyze and solve problems involving one-, two-, and three-dimensional objects such as lines, angles, circles, triangles, polygons, cylinders, prisms, and spheres; 3.11s analyze the relationship among three-dimensional figures and related two dimensional representations (e.g., projections, cross-sections, nets) and use these representations to solve problems; 3.12s apply measurement concepts and dimensional analysis to derive units and formulas for a variety of situations, including rates of change of one variable with respect to another; 3.13s use symmetry to describe tessellations and show how they can be used to illustrate concepts, properties, and relationships; 3.14s relate geometry to algebra and trigonometry by using the Cartesian coordinate system and use this relationship to solve problems; and 3.15s use calculus concepts to answer questions about rates of change, areas, volumes, and properties of functions and their graphs.

Application: What Teachers Can Do

Teachers of Students in Grades 7–12

The beginning teacher of mathematics is able to: 3.16s apply all skills specified for teachers in grades EC–8, using content and contexts appropriate for grades 7–12; 3.17s illustrate axiomatic systems and their components, such as undefined terms, defined terms, theorems, examples, and counter-examples, and in particular, describe and analyze axioms for Euclidean geometry; 3.18s demonstrate an understanding of the methods, uses, and results of Euclidean geometry; 3.19s discuss finite geometries, non–Euclidean geometries, fractal geometry, and networks and graphs; 3.20s show how differential calculus is used to answer questions about rates of change and optimization; 3.21s use integral calculus to compute various measurements associated with curves and regions in the plane, and measurements associated with curves, surfaces, and regions in three-space; 3.22s illustrate geometry from several perspectives, including the use of coordinate systems, transformations, and vectors; 3.23s investigate and explore geometric concepts and properties using technology; and 3.24s relate geometry to algebra by representing transformations as matrices and use this relationship to solve problems.

Standard IV. Probability and Statistics: The mathematics teacher understands and uses probability and statistics, their applications, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.

Teacher Knowledge: What Teachers Know

Teachers of Students in Grades 4–8 and Teachers of Students in Grades EC–12

The beginning teacher of mathematics knows and understands: 4.1k how to use graphical and numerical techniques to explore data, characterize patterns, and describe departures from patterns; 4.2k how to design experiments and surveys to answer questions and solve problems; 4.3k the theory of probability and its relationship to sampling and statistical inference; 4.4k statistical inference and how it is used in making and evaluating

predictions; and 4.5k how probability and statistics are developmental and connected across grade levels.

Application: What Teachers Can Do

Teachers of Students in Grades 4–8

The beginning teacher of mathematics is able to: 4.9s apply all skills specified for teachers in grades EC–4, using content and contexts appropriate for grades 4–8; 4.10s investigate real-world problems by designing, conducting, analyzing, and interpreting statistical experiments; 4.11s develop and justify concepts and measures of central tendency (e.g., mean, median, mode) and dispersion (e.g., range, interquartile range, variance, standard deviation) and use those measures to describe a set of data; 4.12s calculate and interpret percentiles and quartiles; 4.13s explore, describe, and analyze bivariate data using techniques such as scatter plots, regression lines, correlation coefficients, and residual analysis; 4.14s explain and use precise probability language to make observations and draw conclusions from single variable data and to describe the level of confidence in the conclusion; 4.15s determine probability by constructing sample spaces to model situations; and 4.16s make inferences about a population using the binomial and geometric distributions.

Application: What Teachers Can Do

Teachers of Students in Grades 7–12

The beginning teacher of mathematics is able to: 4.17s apply all skills specified for teachers in grades EC–8, using content and contexts appropriate for grades 7–12; 4.18s identify and understand the selection of a measurement scale (i.e., nominal, ordinal, interval, ratio) used to answer research questions and analyze data; 4.19s organize, display, and interpret data in a variety of formats, (e.g., tables, frequency tallies, box plots, stem-and-leaf plots, histograms) and discuss the advantages or disadvantages of a given format; 4.20s apply linear transformations (translating, stretching, shrinking) to convert data and describe the effect of linear transformations on measures of central tendency and dispersion; 4.21s calculate probabilities using the axioms of probability and related theorems and concepts such as the addition rule, multiplication rule, conditional probability, and independence; 4.22s apply concepts and properties of discrete and continuous random variables to model and solve a variety of problems involving probability and probability distributions; 4.23s describe and analyze bivariate data using various techniques (e.g., scatterplots, regression lines, outliers, residual analysis and correlation coefficients); 4.24s transform nonlinear data into a linear form in order to apply linear regression techniques to develop exponential, logarithmic, and power regression models; 4.25s describe and apply the characteristics of a well-designed and well-conducted survey or experiment; 4.26s analyze and interpret statistical information from the media, such as the results of polls and surveys, and recognize valid and misleading uses of statistics; 4.27s use the law of large numbers and the central limit theorem to describe the role of probability theory in the process of statistical sampling and inference; and 4.28s use confidence interval arguments to formulate and test hypotheses

Standard V. Mathematical Processes: The mathematics teacher understands and uses mathematical processes to reason mathematically, to solve mathematical problems, to

make mathematical connections within and outside of mathematics, and to communicate mathematically.

Teacher Knowledge: What Teachers Know

Teachers of Students in Grades 4–8 and Teachers of Students in Grades EC–12

The beginning teacher of mathematics knows and understands: 5.1k logical reasoning, justification, and proof in relation to the structure of and relationships within an axiomatic system; 5.2k the role of logical reasoning in mathematics and age-appropriate methods and uses of informal and formal reasoning; 5.3k the process of identifying, posing, exploring, and solving mathematical problems in age-appropriate ways; 5.4k connections among mathematical concepts, procedures, and equivalent representations; 5.5k connections between mathematics, daily living, and other disciplines; 5.6k how to communicate mathematical ideas and concepts in age-appropriate oral, written, and visual forms; and 5.7k how to use age-appropriate mathematical manipulatives and drawings and a wide range of technological tools to develop and explore mathematical concepts and ideas.

Application: What Teachers Can Do

Teachers of Students in Grades 4–8 Logical Reasoning

The beginning teacher of mathematics is able to: 5.1s apply correct mathematical reasoning to derive valid conclusions from a set of premises; 5.2s apply principles of inductive reasoning to make conjectures and use deductive methods to evaluate the validity of conjectures; 5.3s use formal and informal reasoning to explore, investigate, and justify mathematical ideas; 5.4s recognize examples of fallacious reasoning; 5.5s evaluate mathematical arguments and proofs; and 5.6s provide convincing arguments or proofs for mathematical theorems. 5.7s recognize that a mathematical problem can be solved in a variety of ways, evaluate the appropriateness of various strategies, and select an appropriate strategy for a given problem; 5.8s evaluate the reasonableness of a solution to a given problem; 5.9s use physical and numerical models to represent a given problem or mathematical procedure; 5.10s recognize that assumptions are made when solving problems and identify and evaluate those assumptions; 5.11s investigate and explore problems that have multiple solutions; 5.12s apply content knowledge to develop a mathematical model of a real-world situation and analyze and evaluate how well the model represents the situation; 5.13s develop and use simulations as a tool to model and solve problems; and 5.14s develop and use iteration and recursion to model and solve problems. 5.15s explore problems using verbal, graphical, numerical, physical, and algebraic representations; 5.16s recognize and use multiple representations of a mathematical concept (e.g., a point and its coordinates, the area of a circle as a quadratic function in r, probability as a ratio of two areas); 5.17s apply mathematical methods to analyze practical situations; and 5.18s use mathematics to model and solve problems in other disciplines, such as art, music, science, social science, and business. 5.19s facilitate discourse between the teacher and students and among students to explore, build, and refine mathematical ideas; 5.20s use questioning strategies to identify, support, monitor, and challenge students' mathematical thinking; 5.21s translate mathematical statements among developmentally appropriate language, standard English, mathematical language, and symbolic mathematics; 5.22s provide students with opportunities to demonstrate their understanding of mathematics in a variety of ways using a variety of tools; 5.23s use visual media such as graphs, tables, diagrams, and animations to communicate

mathematical information; and 5.24s use the language of mathematics as a precise means of expressing mathematical ideas.

Application: What Teachers Can Do

Teachers of Students in Grades EC–12 Logical Reasoning

The beginning teacher of mathematics is able to: 5.1s apply correct mathematical reasoning to derive valid conclusions from a set of premises; 5.2s apply principles of inductive reasoning to make conjectures and use deductive methods to evaluate the validity of conjectures; 5.3s use formal and informal reasoning to explore, investigate, and justify mathematical ideas; 5.4s recognize examples of fallacious reasoning; 5.5s evaluate mathematical arguments and proofs; and 5.6s provide convincing arguments or proofs for mathematical theorems. Problem Solving The beginning teacher of mathematics is able to: 5.7s recognize that a mathematical problem can be solved in a variety of ways, evaluate the appropriateness of various strategies, and select an appropriate strategy for a given problem; 5.8s evaluate the reasonableness of a solution to a given problem; 5.9s use physical and numerical models to represent a given problem or mathematical procedure; 5.10s recognize that assumptions are made when solving problems and identify and evaluate those assumptions; 5.11s investigate and explore problems that have multiple solutions; 5.12s apply content knowledge to develop a mathematical model of a real-world situation and analyze and evaluate how well the model represents the situation; 5.13s develop and use simulations as a tool to model and solve problems; and 5.14s develop and use iteration and recursion to model and solve problems. Connections The beginning teacher of mathematics is able to: 5.15s explore problems using verbal, graphical, numerical, physical, and algebraic representations; 5.16s recognize and use multiple representations of a mathematical concept (e.g., a point and its coordinates, the area of a circle as a quadratic function in r, probability as a ratio of two areas); 5.17s apply mathematical methods to analyze practical situations; and 5.18s use mathematics to model and solve problems in other disciplines, such as art, music, science, social science, and business. Communication The beginning teacher of mathematics is able to: 5.19s facilitate discourse between the teacher and students and among students to explore, build, and refine mathematical ideas; 5.20s use questioning strategies to identify, support, monitor, and challenge students' mathematical thinking; 5.21s translate mathematical statements among developmentally appropriate language, standard English, mathematical language, and symbolic mathematics; 5.22s provide students with opportunities to demonstrate their understanding of mathematics in a variety of ways using a variety of tools; 5.23s use visual media such as graphs, tables, diagrams, and animations to communicate mathematical information; and 5.24s use the language of mathematics as a precise means of expressing mathematical ideas.

Standard VI. Mathematical Perspectives: The mathematics teacher understands the historical development of mathematical ideas, the interrelationship between society and mathematics, the structure of mathematics, and the evolving nature of mathematics and mathematical knowledge.

Teacher Knowledge: What Teachers Know

Teachers of Students in Grades 4–8 and Teachers of Students in Grades EC–12

The beginning teacher of mathematics knows and understands: 6.1k the history and evolution of mathematical concepts, procedures, and ideas; 6.2k the contributions that different

cultures have made to the field of mathematics and the impact mathematics has on society and culture; 6.3k the role society plays in shaping personal views and perspectives of mathematics; 6.4k the impact of technological advances on mathematical knowledge and skills and of mathematics on technology; 6.5k how mathematics is used in a variety of careers and professions; 6.6k the structural properties common to the mathematical disciplines; and 6.7k the implications of current trends and research in mathematics and mathematics education.

Application: What Teachers Can Do

Teachers of Students in Grades 4–8

The beginning teacher of mathematics is able to: 6.1s use key events and knowledge of specific individuals throughout the history of mathematics to illustrate age-appropriate mathematical concepts; 6.2s design age-appropriate activities that emphasize mathematical contributions from various cultures; 6.3s use the historical developments of mathematical ideas to illustrate how mathematics progresses from concrete applications to abstract generalizations; 6.4s use historic mathematical problems as a tool for assessing the mathematical knowledge of a particular period or culture; 6.5s select age-appropriate activities that relate to the linguistic, cultural, and socioeconomic background of students; 6.6s plan age-appropriate instruction that emphasizes the role of mathematics in the workplace and demonstrate how mathematics is used in a variety of careers; and 6.7s analyze the structure of mathematical systems and use the structural properties of mathematical systems to make age-appropriate connections among mathematical concepts.

Application: What Teachers Can Do

Teachers of Students in Grades EC–12

The beginning teacher of mathematics is able to: 6.1s use key events and knowledge of specific individuals throughout the history of mathematics to illustrate age-appropriate mathematical concepts; 6.2s design age-appropriate activities that emphasize mathematical contributions from various cultures; 6.3s use the historical developments of mathematical ideas to illustrate how mathematics progresses from concrete applications to abstract generalizations; 6.4s use historic mathematical problems as a tool for assessing the mathematical knowledge of a particular period or culture; 6.5s select age-appropriate activities that relate to the linguistic, cultural, and socioeconomic background of students; 6.6s plan age-appropriate instruction that emphasizes the role of mathematics in the workplace and demonstrate how mathematics is used in a variety of careers; and 6.7s analyze the structure of mathematical systems and use the structural properties of mathematical systems to make age-appropriate connections among mathematical concepts.

Standard VII. Mathematical Learning and Instruction: The mathematics teacher understands how children learn and develop mathematical skills, procedures, and concepts, knows typical errors students make, and uses this knowledge to plan, organize, and implement instruction; to meet curriculum goals; and to teach all students to understand and use mathematics.

Teacher Knowledge: What Teachers Know

Teachers of Students in Grades 4–8 and Teachers of Students in Grades EC–12

The beginning teacher of mathematics knows and understands: 7.1k current theories, research, and practice on how students learn mathematics; 7.2k how students differ in their approaches to learning with regards to linguistic, cultural, socioeconomic, and developmental diversity; 7.3k strategies, techniques, and procedures for helping students understand mathematics; 7.4k how students' prior knowledge of and attitudes towards mathematics may affect their learning; 7.5k the process by which students construct mathematical knowledge; 7.6k common mathematical misconceptions and errors; 7.7k how learning may be assisted through the use of mathematics manipulatives, drawings, and technological tools; 7.8k how individual and group instruction can promote learning and create a learning environment that actively engages students in learning and encourages self-motivation; 7.9k a variety of instructional methods, tools, and tasks that promote students' confidence, curiosity, and inventiveness while using mathematics described in the TEKS; 7.10k planning strategies for developing mathematical instruction as a discipline of interconnected concepts and procedures; 7.11k procedures for selecting, developing, and implementing worthwhile mathematical tasks that meet the diverse needs of the student population and require students to reason, make connections, solve problems, and communicate mathematically; 7.12k procedures for developing instruction that connects concrete, symbolic, and abstract representations of mathematical knowledge; 7.13k methods for locating, selecting, developing, and evaluating learning opportunities that emphasize the connections between mathematics and real world phenomena; 7.14k how technological tools and manipulatives can be used appropriately to assist students in developing, comprehending, and applying mathematical concepts and skills; 7.15k procedures for creating a variety of mathematical exploratory activities; 7.16k how to relate mathematics to students' lives and daily living; 7.17k strategies that students with diverse strengths and needs can use to determine word meaning in content-related texts; 7.18k strategies that students with diverse strengths and needs can use to develop content-area vocabulary; and 7.19k strategies that students with diverse strengths and needs can use to facilitate comprehension before, during, and after reading content-related texts.

Application: What Teachers Can Do

Teachers of Students in Grades 4–8

The beginning teacher of mathematics is able to: 7.1s apply theories and principles of learning mathematics to plan appropriate instructional activities for all students; 7.2s use students' prior mathematical knowledge to build conceptual links to new knowledge; 7.3s employ instructional strategies that build on the linguistic, cultural, and socioeconomic diversity of students; 7.4s develop a variety of instructional activities to guide students in constructing mathematical knowledge; 7.5s teach students to recognize and correct common mathematical misconceptions and errors; 7.6s engage students in tasks that require students to communicate their mathematical reasoning; 7.7s motivate students and actively engage them in the learning process by using a variety of interesting, challenging, and worthwhile mathematical tasks in individual, small-, and large-group settings; 7.8s use a variety of tools, including, but not limited to, rulers, protractors, scales, stopwatches, measuring containers, money, calculators, and software, to strengthen comprehension and understanding; 7.9s provide instruction along a continuum from concrete to abstract and plan instruction that builds on strengths and addresses needs; 7.10s model appropriate mathematical problem-solving techniques, reasoning,

discourse, and enthusiasm for mathematics as an example to help students develop positive attitudes towards mathematics; 7.11s develop clear learning goals to plan, deliver, assess, and reevaluate instruction based upon the TEKS; 7.12s select and create worthwhile mathematical tasks based on the TEKS that actively engage students in the learning process; 7.13s provide students with opportunities to develop and improve mathematical skills and procedures; 7.14s use a variety of instructional delivery methods, such as individual, structured, small-group, and large-group formats; 7.15s use a variety of questioning strategies to encourage mathematical discourse and to help students analyze and evaluate their mathematical thinking; 7.16s create strategies for integrating writing as appropriate in the mathematics class; 7.17s use challenging tasks that make connections between mathematics, the real world, and other disciplines to motivate learning; 7.18s use mathematics labs, simulations, open-ended investigations, research projects, and other activities when appropriate to guide students' learning; 7.19s apply appropriate technology to promote mathematical learning; 7.20s use appropriate mathematical manipulatives to promote abstract understanding; 7.21s select and use mathematical activities that relate to students' lives and communities; 7.22s use a variety of instructional strategies to ensure all students' reading comprehension of content-related texts, including helping students link the content of texts to their lives and connect related ideas across different texts; 7.23s teach students how to locate, retrieve, and retain content-related information from a range of texts and technologies; and 7.24s teach students how to locate the meanings and pronunciations of unfamiliar content-related words using appropriate sources, such as dictionaries, thesauruses, and glossaries.

Application: What Teachers Can Do

Teachers of Students in Grades EC–12

The beginning teacher of mathematics is able to: 7.1s apply theories and principles of learning mathematics to plan appropriate instructional activities for all students; 7.2s use students' prior mathematical knowledge to build conceptual links to new knowledge; 7.3s employ instructional strategies that build on the linguistic, cultural, and socioeconomic diversity of students; 7.4s develop a variety of instructional activities to guide students in constructing mathematical knowledge; 7.5s teach students to recognize and correct common mathematical misconceptions and errors; 7.6s engage students in tasks that require students to communicate their mathematical reasoning; 7.7s motivate students and actively engage them in the learning process by using a variety of interesting, challenging, and worthwhile mathematical tasks in individual, small-, and large-group settings; 7.8s use a variety of tools, including, but not limited to, rulers, protractors, scales, stopwatches, measuring containers, money, calculators, and software, to strengthen comprehension and understanding; 7.9s provide instruction along a continuum from concrete to abstract and plan instruction that builds on strengths and addresses needs; 7.10s model appropriate mathematical problem-solving techniques, reasoning, discourse, and enthusiasm for mathematics as an example to help students develop positive attitudes towards mathematics; 7.11s develop clear learning goals to plan, deliver, assess, and reevaluate instruction based upon the TEKS; 7.12s select and create worthwhile mathematical tasks based on the TEKS that actively engage students in the learning process; 7.13s provide students with opportunities to develop and improve mathematical skills and procedures; 7.14s use a variety of instructional delivery methods, such as individual, structured, small-group, and large-group formats; 7.15s use a variety

of questioning strategies to encourage mathematical discourse and to help students analyze and evaluate their mathematical thinking; 7.16s create strategies for integrating writing as appropriate in the mathematics class; 7.17s use challenging tasks that make connections between mathematics, the real world, and other disciplines to motivate learning; 7.18s use mathematics labs, simulations, open-ended investigations, research projects, and other activities when appropriate to guide students' learning; 7.19s apply appropriate technology to promote mathematical learning; 7.20s use appropriate mathematical manipulatives to promote abstract understanding; 7.21s select and use mathematical activities that relate to students' lives and communities; 7.22s use a variety of instructional strategies to ensure all students' reading comprehension of content-related texts, including helping students link the content of texts to their lives and connect related ideas across different texts; 7.23s teach students how to locate, retrieve, and retain content-related information from a range of texts and technologies; and 7.24s teach students how to locate the meanings and pronunciations of unfamiliar content-related words using appropriate sources, such as dictionaries, thesauruses, and glossaries.

Standard VIII. Mathematical Assessment: The mathematics teacher understands assessment and uses a variety of formal and informal assessment techniques appropriate to the learner on an ongoing basis to monitor and guide instruction and to evaluate and report student progress.

Teacher Knowledge: What Teachers Know

Teachers of Students in Grades 4–8 and Teachers of Students in Grades EC–12

The beginning teacher of mathematics knows and understands: 8.1k the purpose, characteristics, and uses of various assessments in mathematics, including formative and summative assessments; 8.2k the importance of carefully selecting or designing formative and summative assessments for the specific decisions they are intended to inform; 8.3k how to select and administer appropriate assessment instruments that evaluate students' knowledge of and ability to use mathematics; 8.4k appropriate procedures for sharing assessment information with students, parents, and school personnel; 8.5k how to select and develop assessment methods that are consistent with what is taught and how it is taught; 8.6k how to evaluate a variety of assessment methods and materials for reliability, validity, absence of bias, clarity of language, and appropriateness of mathematical level; 8.7k the reciprocal nature of assessment and instruction and how to evaluate assessment results to design, monitor, and modify instruction to improve mathematical learning; and 8.8k how to diagnose and correct common mathematical misconceptions and errors.

Application: What Teachers Can Do

Teachers of Students in Grades 4–8

The beginning teacher of mathematics is able to: 8.1s select or design and administer a variety of appropriate assessment instruments and/or methods (e.g., formal/informal, formative/summative) to monitor student understanding of mathematics and progress over time; 8.2s develop a variety of formal and informal assessments and scoring procedures that consist of worthwhile tasks that assess mathematical understanding, common misconceptions, and error patterns; 8.3s align assessment methods with what is taught and how it is taught; 8.4s interpret the results of formal and informal assessments and use results to evaluate and modify instructional approaches; 8.5s establish criteria consistent with ethical and legal principles regarding the sharing of assessment results

with students, parents, and appropriate school personnel; 8.6s develop a valid student grading system based on the results of students' assessments; and 8.7s communicate assessment results to students' parents/caregivers and other appropriate personnel.

Application: What Teachers Can Do

Teachers of Students in Grades EC–12

The beginning teacher of mathematics is able to: 8.1s select or design and administer a variety of appropriate assessment instruments and/or methods (e.g., formal/informal, formative/summative) to monitor student understanding of mathematics and progress over time; 8.2s develop a variety of formal and informal assessments and scoring procedures that consist of worthwhile tasks that assess mathematical understanding, common misconceptions, and error patterns; 8.3s align assessment methods with what is taught and how it is taught; 8.4s interpret the results of formal and informal assessments and use results to evaluate and modify instructional approaches; 8.5s establish criteria consistent with ethical and legal principles regarding the sharing of assessment results with students, parents, and appropriate school personnel; 8.6s develop a valid student grading system based on the results of students' assessments; and 8.7s communicate assessment results to students' parents/caregivers and other appropriate personnel.

Standard IX. Professional Development: The mathematics teacher understands mathematics teaching as a profession, knows the value and rewards of being a reflective practitioner, and realizes the importance of making a lifelong commitment to professional growth and development.

Teacher Knowledge: What Teachers Know

Teachers of Students in Grades 4–8 and Teachers of Students in Grades EC–12

The beginning teacher of mathematics knows and understands: 9.1k the importance of establishing collegial relationships with other teachers and professional staff; 9.2k the advantages of participating in workshops, courses, conferences, and other professional activities that address topics related to the teaching of mathematics, including the use of technology; 9.3k the value of joining and actively participating in the professional community of mathematics educators; 9.4k the advantages of discussing with colleagues current ideas, trends, and directions in mathematics and mathematics education through local organizations, professional publications, and electronic communities; 9.5k the importance of participating in school, community, and political efforts to effect positive change in mathematics education; 9.6k national and statewide curriculum in mathematics curriculum development, instruction, and assessment; and 9.7k the availability of state resources to support teachers of mathematics.

Application: What Teachers Can Do

Teachers of Students in Grades 4–8

The beginning teacher of mathematics is able to: 9.1s communicate with colleagues to create professional interactions across all disciplines at the building and district level; 9.2s exchange information with mathematics teachers at lower and higher grade levels to ensure continuity in students' mathematics education; 9.3s use professional relationships to gather information for creating links between the mathematics curriculum and other disciplines; 9.4s use workshops and professional development activities as an opportunity to keep up with current technology, obtain new instructional materials and ideas, discover new approaches for delivering mathematical lessons, and continue to learn new

mathematics; 9.5s select materials from appropriate publications produced by professional mathematics organizations to develop lesson plans, instructional activities, and assessments; 9.6s use local organizations and electronic communities as a forum for exchanging, discussing, and evaluating ideas regarding mathematics and mathematical instruction, and as an opportunity for professional self-assessment; and 9.7s organize and participate in a variety of methods (e.g., newsletters, Web pages, fundraisers, math nights, volunteer programs, field trips) to promote communication among parents, students, and the community.

Application: What Teachers Can Do

Teachers of Students in Grades EC–12

The beginning teacher of mathematics is able to: 9.1s communicate with colleagues to create professional interactions across all disciplines at the building and district level; 9.2s exchange information with mathematics teachers at lower and higher grade levels to ensure continuity in students' mathematics education; 9.3s use professional relationships to gather information for creating links between the mathematics curriculum and other disciplines; 9.4s use workshops and professional development activities as an opportunity to keep up with current technology, obtain new instructional materials and ideas, discover new approaches for delivering mathematical lessons, and continue to learn new mathematics; 9.5s select materials from appropriate publications produced by professional mathematics organizations to develop lesson plans, instructional activities, and assessments; 9.6s use local organizations and electronic communities as a forum for exchanging, discussing, and evaluating ideas regarding mathematics and mathematical instruction, and as an opportunity for professional self-assessment; and 9.7s organize and participate in a variety of methods (e.g., newsletters, Web pages, fundraisers, math nights, volunteer programs, field trips) to promote communication among parents, students, and the community.

Texas Teaching Standards (TAC 19.2. Chapter 149.AA. Rule §149.1001)

(a) Purpose. The standards identified in this section are performance standards to be used to inform the training, appraisal, and professional development of teachers.

(b) Standards.

(1) Standard 1--Instructional Planning and Delivery. Teachers demonstrate their understanding of instructional planning and delivery by providing standards-based, data-driven, differentiated instruction that engages students, makes appropriate use of technology, and makes learning relevant for today's learners.

(A) Teachers design clear, well organized, sequential lessons that build on students' prior knowledge.

(i) Teachers develop lessons that build coherently toward objectives based on course content, curriculum scope and sequence, and expected student outcomes.

(ii) Teachers effectively communicate goals, expectations, and objectives to help all students reach high levels of achievement.

(iii) Teachers connect students' prior understanding and real-world experiences to new content and contexts, maximizing learning opportunities.

(B) Teachers design developmentally appropriate, standards-driven lessons that reflect evidence-based best practices.

(i) Teachers plan instruction that is developmentally appropriate, is standards driven, and motivates students to learn.
(ii) Teachers use a range of instructional strategies, appropriate to the content area, to make subject matter accessible to all students.
(iii) Teachers use and adapt resources, technologies, and standards-aligned instructional materials to promote student success in meeting learning goals.
(C) Teachers design lessons to meet the needs of diverse learners, adapting methods when appropriate.
(i) Teachers differentiate instruction, aligning methods and techniques to diverse student needs, including acceleration, remediation, and implementation of individual education plans.
(ii) Teachers plan student groupings, including pairings and individualized and small-group instruction, to facilitate student learning.
(iii) Teachers integrate the use of oral, written, graphic, kinesthetic, and/or tactile methods to teach key concepts.
(D) Teachers communicate clearly and accurately and engage students in a manner that encourages students' persistence and best efforts.
(i) Teachers ensure that the learning environment features a high degree of student engagement by facilitating discussion and student-centered activities as well as leading direct instruction.
(ii) Teachers validate each student's comments and questions, utilizing them to advance learning for all students.
(iii) Teachers encourage all students to overcome obstacles and remain persistent in the face of challenges, providing them with support in achieving their goals.
(E) Teachers promote complex, higher-order thinking, leading class discussions and activities that provide opportunities for deeper learning.
(i) Teachers set high expectations and create challenging learning experiences for students, encouraging them to apply disciplinary and cross-disciplinary knowledge to real-world problems.
(ii) Teachers provide opportunities for students to engage in individual and collaborative critical thinking and problem solving.
(iii) Teachers incorporate technology that allows students to interact with the curriculum in more significant and effective ways, helping them reach mastery.
(F) Teachers consistently check for understanding, give immediate feedback, and make lesson adjustments as necessary.
(i) Teachers monitor and assess student progress to ensure that their lessons meet students' needs.
(ii) Teachers provide immediate feedback to students in order to reinforce their learning and ensure that they understand key concepts.
(iii) Teachers adjust content delivery in response to student progress through the use of developmentally appropriate strategies that maximize student engagement.
(2) Standard 2--Knowledge of Students and Student Learning. Teachers work to ensure high levels of learning, social-emotional development, and achievement outcomes for all students, taking into consideration each student's educational and developmental backgrounds and focusing on each student's needs.
(A) Teachers demonstrate the belief that all students have the potential to achieve at high levels and support all students in their pursuit of social-emotional learning and academic success.
(i) Teachers purposefully utilize learners' individual strengths as a basis for academic and social-emotional growth.

(ii) Teachers create a community of learners in an inclusive environment that views differences in learning and background as educational assets.
(iii) Teachers accept responsibility for the growth of all of their students, persisting in their efforts to ensure high levels of growth on the part of each learner.
(B) Teachers acquire, analyze, and use background information (familial, cultural, educational, linguistic, and developmental characteristics) to engage students in learning.
(i) Teachers connect learning, content, and expectations to students' prior knowledge, life experiences, and interests in meaningful contexts.
(ii) Teachers understand the unique qualities of students with exceptional needs, including disabilities and giftedness, and know how to effectively address these needs through instructional strategies and resources.
(iii) Teachers understand the role of language and culture in learning and know how to modify their practices to support language acquisition so that language is comprehensible and instruction is fully accessible.
(C) Teachers facilitate each student's learning by employing evidence-based practices and concepts related to learning and social-emotional development.
(i) Teachers understand how learning occurs and how learners develop, construct meaning, and acquire knowledge and skills.
(ii) Teachers identify readiness for learning and understand how development in one area may affect students' performance in other areas.
(iii) Teachers apply evidence-based strategies to address individual student learning needs and differences, adjust their instruction, and support the learning needs of each student.
(3) Standard 3--Content Knowledge and Expertise. Teachers exhibit a comprehensive understanding of their content, discipline, and related pedagogy as demonstrated through the quality of the design and execution of lessons and their ability to match objectives and activities to relevant state standards.
(A) Teachers understand the major concepts, key themes, multiple perspectives, assumptions, processes of inquiry, structure, and real-world applications of their grade-level and subject-area content.
(i) Teachers have expertise in how their content vertically and horizontally aligns with the grade-level/subject-area continuum, leading to an integrated curriculum across grade levels and content areas.
(ii) Teachers identify gaps in students' knowledge of subject matter and communicate with their leaders and colleagues to ensure that these gaps are adequately addressed across grade levels and subject areas.
(iii) Teachers keep current with developments, new content, new approaches, and changing methods of instructional delivery within their discipline.
(B) Teachers design and execute quality lessons that are consistent with the concepts of their specific discipline, are aligned to state standards, and demonstrate their content expertise.
(i) Teachers organize curriculum to facilitate student understanding of the subject matter.
(ii) Teachers understand, actively anticipate, and adapt instruction to address common misunderstandings and preconceptions.
(iii) Teachers promote literacy and the academic language within the discipline and make discipline-specific language accessible to all learners.
(C) Teachers demonstrate content-specific pedagogy that meets the needs of diverse learners, utilizing engaging instructional materials to connect prior content knowledge to new learning.

(i) Teachers teach both the key content knowledge and the key skills of the discipline.
(ii) Teachers make appropriate and authentic connections across disciplines, subjects, and students' real-world experiences.
(4) Standard 4--Learning Environment. Teachers interact with students in respectful ways at all times, maintaining a physically and emotionally safe, supportive learning environment that is characterized by efficient and effective routines, clear expectations for student behavior, and organization that maximizes student learning.
(A) Teachers create a mutually respectful, collaborative, and safe community of learners by using knowledge of students' development and backgrounds.
(i) Teachers embrace students' backgrounds and experiences as an asset in their learning environment.
(ii) Teachers maintain and facilitate respectful, supportive, positive, and productive interactions with and among students.
(iii) Teachers establish and sustain learning environments that are developmentally appropriate and respond to students' needs, strengths, and personal experiences.
(B) Teachers organize their classrooms in a safe and accessible manner that maximizes learning.
(i) Teachers arrange the physical environment to maximize student learning and to ensure that all students have access to resources.
(ii) Teachers create a physical classroom set-up that is flexible and accommodates the different learning needs of students.
(C) Teachers establish, implement, and communicate consistent routines for effective classroom management, including clear expectations for student behavior.
(i) Teachers implement behavior management systems to maintain an environment where all students can learn effectively.
(ii) Teachers maintain a strong culture of individual and group accountability for class expectations.
(iii) Teachers cultivate student ownership in developing classroom culture and norms.
(D) Teachers lead and maintain classrooms where students are actively engaged in learning as indicated by their level of motivation and on-task behavior.
(i) Teachers maintain a culture that is based on high expectations for student performance and encourages students to be self-motivated, taking responsibility for their own learning.
(ii) Teachers maximize instructional time, including managing transitions.
(iii) Teachers manage and facilitate groupings in order to maximize student collaboration, participation, and achievement.
(iv) Teachers communicate regularly, clearly, and appropriately with parents and families about student progress, providing detailed and constructive feedback and partnering with families in furthering their students' achievement goals.
(5) Standard 5--Data-Driven Practice. Teachers use formal and informal methods to assess student growth aligned to instructional goals and course objectives and regularly review and analyze multiple sources of data to measure student progress and adjust instructional strategies and content delivery as needed.
(A) Teachers implement both formal and informal methods of measuring student progress.
(i) Teachers gauge student progress and ensure student mastery of content knowledge and skills by providing assessments aligned to instructional objectives and outcomes that are accurate measures of student learning.

(ii) Teachers vary methods of assessing learning to accommodate students' learning needs, linguistic differences, and/or varying levels of background knowledge.
(B) Teachers set individual and group learning goals for students by using preliminary data and communicate these goals with students and families to ensure mutual understanding of expectations.
(i) Teachers develop learning plans and set academic as well as social-emotional learning goals for each student in response to previous outcomes from formal and informal assessments.
(ii) Teachers involve all students in self-assessment, goal setting, and monitoring progress.
(iii) Teachers communicate with students and families regularly about the importance of collecting data and monitoring progress of student outcomes, sharing timely and comprehensible feedback so they understand students' goals and progress.
(C) Teachers regularly collect, review, and analyze data to monitor student progress.
(i) Teachers analyze and review data in a timely, thorough, accurate, and appropriate manner, both individually and with colleagues, to monitor student learning.
(ii) Teachers combine results from different measures to develop a holistic picture of students' strengths and learning needs.
(D) Teachers utilize the data they collect and analyze to inform their instructional strategies and adjust short- and long-term plans accordingly.
(i) Teachers design instruction, change strategies, and differentiate their teaching practices to improve student learning based on assessment outcomes.
(ii) Teachers regularly compare their curriculum scope and sequence with student data to ensure they are on track and make adjustments as needed.
(6) Standard 6--Professional Practices and Responsibilities. Teachers consistently hold themselves to a high standard for individual development, pursue leadership opportunities, collaborate with other educational professionals, communicate regularly with stakeholders, maintain professional relationships, comply with all campus and school district policies, and conduct themselves ethically and with integrity.
(A) Teachers reflect on their teaching practice to improve their instructional effectiveness and engage in continuous professional learning to gain knowledge and skills and refine professional judgment.
(i) Teachers reflect on their own strengths and professional learning needs, using this information to develop action plans for improvement.
(ii) Teachers establish and strive to achieve professional goals to strengthen their instructional effectiveness and better meet students' needs.
(iii) Teachers engage in relevant, targeted professional learning opportunities that align with their professional growth goals and their students' academic and social-emotional needs.
(B) Teachers collaborate with their colleagues, are self-aware in their interpersonal interactions, and are open to constructive feedback from peers and administrators.
(i) Teachers seek out feedback from supervisors, coaches, and peers and take advantage of opportunities for job-embedded professional development.
(ii) Teachers actively participate in professional learning communities organized to improve instructional practices and student learning.
(C) Teachers seek out opportunities to lead students, other educators, and community members within and beyond their classrooms.
(i) Teachers clearly communicate the mission, vision, and goals of the school to students, colleagues, parents and families, and other community members.

(ii) Teachers seek to lead other adults on campus through professional learning communities, grade- or subject-level team leadership, committee membership, or other opportunities.
(D) Teachers model ethical and respectful behavior and demonstrate integrity in all situations.
(i) Teachers adhere to the educators' code of ethics in §247.2 of this title (relating to Code of Ethics and Standard Practices for Texas Educators), including following policies and procedures at their specific school placement(s).
(ii) Teachers communicate consistently, clearly, and respectfully with all members of the campus community, including students, parents and families, colleagues, administrators, and staff.
(iii) Teachers serve as advocates for their students, focusing attention on students' needs and concerns and maintaining thorough and accurate student records.
Statutory Authority: The provisions of this §149.1001 issued under the Texas Education Code, §21.351.
Source: The provisions of this §149.1001 adopted to be effective June 30, 2014, 39 TexReg 4955.

Technology Standards

In this course, we will focus on Standards I – VII of Technology Standards from the Texas State Board for Educator Certification, 2016.
Standard I. All teachers use and promote creative thinking and innovative processes to construct knowledge, generate new ideas, and create products.
Standard II. All teachers collaborate and communicate both locally and globally using digital tools and resources to reinforce and promote learning.
Standard III. All teachers acquire, analyze, and manage content from digital resources.
Standard IV. All teachers make informed decisions by applying critical-thinking and problem-solving skills.
Standard V. All teachers practice and promote safe, responsible, legal, and ethical behavior while using technology tools and resources.
Standard VI. All teachers demonstrate a thorough understanding of technology concepts, systems, and operations.
Standard VII. All teachers know how to plan, organize, deliver, and evaluate instruction for all students that incorporates the effective use of current technology for teaching and integrating the Technology Applications Texas Essential Knowledge and Skills (TEKS) into the curriculum.
Standard X. The digital art/animation teacher has the knowledge and skills needed to teach the creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts strands of the Technology Applications Texas Essential Knowledge and Skills (TEKS) in digital art/animation, in addition to the content described in Technology Applications Standards I–VII.
Standard XII. The digital communications teacher has the knowledge and skills needed to teach the creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts strands of the Technology Applications Texas Essential Knowledge and Skills (TEKS) in digital communications, in addition to the content described in Technology Applications Standards I–VII.
Standard XIII. The Web design teacher has the knowledge and skills needed to teach the creativity and innovation; communication and collaboration; research and information fluency;

critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts strands of the Technology Applications Texas Essential Knowledge and Skills (TEKS) in Web design, in addition to the content described in Technology Applications Standards I–VII

Technology Standards Complete List

Garde 4

(1) Technology includes data communication, data processing, and the devices used for these tasks locally and across networks. Learning to apply these technologies motivates students to develop critical-thinking skills, higher-order thinking, and innovative problem solving. Technology applications incorporates the study of digital tools, devices, communication, and programming to empower students to apply current and emerging technologies in their careers, their education, and beyond.

(2) The technology applications Texas Essential Knowledge and Skills (TEKS) consist of five strands that prepare students to be literate in technology applications by Grade 8: computational thinking; creativity and innovation; data literacy, management, and representation; digital citizenship; and practical technology concepts. Communication and collaboration skills are embedded across the strands.

(A) Computational thinking. Students break down the problem-solving process into four steps: decomposition, pattern recognition, abstraction, and algorithms.

(B) Creativity and innovation. Students use innovative design processes to develop solutions to problems. Students plan a solution, create the solution, test the solution, iterate, and debug the solution as needed, and implement a completely new and innovative product.

(C) Data literacy, management, and representation. Students collect, organize, manage, analyze, and publish various types of data for an audience.

(D) Digital citizenship. Students practice the ethical and effective application of technology and develop an understanding of cybersecurity and the impact of a digital footprint to become safe, productive, and respectful digital citizens.

(E) Practical technology concepts. Students build their knowledge of software applications and hardware focusing on keyboarding and use of applications and tools. Students also build their knowledge and use of technology systems, including integrating the use of multiple applications.

(3) The technology applications TEKS can be integrated into all content areas and can support stand-alone courses. Districts have the flexibility of offering technology applications in a variety of settings, including through a stand-alone course or by integrating the technology applications standards in the essential knowledge and skills for one or more courses or subject areas.

(4) Statements containing the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Computational thinking--foundations. The student explores the core concepts of computational thinking, a set of problem-solving processes that involve decomposition, pattern recognition, abstraction, and algorithms. The student is expected to:

(A) decompose story problems into smaller, manageable subproblems and discuss and document various solutions to the problems;

(B) identify patterns in story problems and make predictions based on the pattern;

(C) communicate design plans and solutions using a variety of options; and

(D) debug algorithms (set of procedures) by identifying and removing errors.

(2) Computational thinking--applications. The student applies the fundamentals of computer science. The student is expected to:

(A) use variables within a program to modify data; and

(B) use a design process to create programs that include sequences, loops, and conditionals to express ideas or address a problem.

(3) Creativity and innovation--innovative design process. The student takes an active role in learning by using a design process to solve authentic problems for a local or global audience, using a variety of technologies. The student is expected to:

(A) explain the importance of and demonstrate personal skills and behaviors, including problem solving and questioning, effective communication, following directions, mental agility, and metacognition, that are needed to implement a design process successfully; and

(B) apply an appropriate design process that includes components to improve processes and refine original products for authentic problems.

(4) Creativity and innovation--emerging technologies. The student demonstrates an understanding that technology is dynamic and impacts different communities. The student is expected to identify examples of emerging technologies.

(5) Data literacy, management, and representation--collect data. The student uses digital strategies to collect and identify data. The student is expected to:

(A) classify numerical and non-numerical data; and

(B) identify and collect data by using various search strategies, including two or more keywords within specific parameters.

(6) Data literacy, management, and representation--organize, manage, and analyze data. The student uses data to answer questions. The student is expected to use digital tools to transform and make inferences about data to answer a question.

(7) Data literacy, management, and representation--communicate and publish results. The student communicates data through the use of digital tools to inform an audience. The student is expected to use digital tools to communicate results of an inquiry to inform an intended audience.

(8) Digital citizenship--social interactions. The student understands different styles of digital communication and that a student's actions online can have a long-term impact. The student is expected to:

(A) describe how information retained online creates a permanent digital footprint;

(B) describe appropriate digital etiquette for various forms of digital communication such as text, email, and online chat; and

(C) demonstrate appropriate digital etiquette for various forms of digital collaboration such as shared documents, video conferencing, and other platforms.

(9) Digital citizenship--ethics and laws. The student recognizes and practices responsible, legal, and ethical behavior while using digital tools and resources. The student is expected to:

(A) demonstrate adherence to local acceptable use policy (AUP) and explain the importance of responsible and ethical technology use;

(B) describe the rights and responsibilities of a creator, define copyright law, and explain how copyright law applies to creative work; and

(C) create citations for digital forms of media with assistance.

(10) Digital citizenship--privacy, safety, and security. The student practices safe, legal, and ethical digital behaviors to become a socially responsible digital citizen. The student is expected to:

(A) demonstrate account safety, including creating a strong password and logging off devices, and explain the importance of these practices;

(B) identify and discuss types of data collection tools such as cookies, pop-ups, smart devices, and unsecured networks and explain why it is important to maintain digital privacy; and

(C) discuss and explain how to respond to cyberbullying, including advocating for self and others.

(11) Practical technology concepts--processes. The student engages with technology systems, concepts, and operations. The student is expected to:

(A) evaluate and choose applications for relevance to an assigned task; and

(B) perform software application functions such as outline options, bulleting, and numbering lists, and perform editing functions such as finding and replacing.

(12) Practical technology concepts--skills and tools. The student selects appropriate methods or techniques for an assigned task and identifies and solves simple hardware and software problems using common troubleshooting strategies. The student is expected to:

(A) communicate an understanding of terminology related to virtual systems such as video conferencing, augmented reality, and virtual reality environments;

(B) evaluate where and how to save, including the use of appropriate naming conventions and effective file management strategies and folder structures;

(C) demonstrate proper touch keyboarding techniques with speed and accuracy and ergonomic strategies such as correct hand and body positions;

(D) identify and practice using cross-curricular symbols or other input device shortcuts on a keyboard; and

(E) use troubleshooting strategies to solve minor technical problems with hardware and software such as restarting software or rebooting hardware.

Grade 5

(1) Technology includes data communication, data processing, and the devices used for these tasks locally and across networks. Learning to apply these technologies motivates students to develop critical-thinking skills, higher-order thinking, and innovative problem solving. Technology applications incorporates the study of digital tools, devices, communication, and programming to empower students to apply current and emerging technologies in their careers, their education, and beyond.

(2) The technology applications Texas Essential Knowledge and Skills (TEKS) consist of five strands that prepare students to be literate in technology applications by Grade 8: computational thinking; creativity and innovation; data literacy, management, and representation; digital citizenship; and practical technology concepts. Communication and collaboration skills are embedded across the strands.

(A) Computational thinking. Students break down the problem-solving process into four steps: decomposition, pattern recognition, abstraction, and algorithms.

(B) Creativity and innovation. Students use innovative design processes to develop solutions to problems. Students plan a solution, create the solution, test the solution, iterate, and debug the solution as needed, and implement a completely new and innovative product.

(C) Data literacy, management, and representation. Students collect, organize, manage, analyze, and publish various types of data for an audience.

(D) Digital citizenship. Students practice the ethical and effective application of technology and develop an understanding of cybersecurity and the impact of a digital footprint to become safe, productive, and respectful digital citizens.

(E) Practical technology concepts. Students build their knowledge of software applications and hardware focusing on keyboarding and use of applications and tools. Students also build their knowledge and use of technology systems, including integrating the use of multiple applications.

(3) The technology applications TEKS can be integrated into all content areas and can support stand-alone courses. Districts have the flexibility of offering technology applications in a variety of settings, including through a stand-alone course or by integrating the technology applications standards in the essential knowledge and skills for one or more courses or subject areas.

(4) Statements containing the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills

(1) Computational thinking--foundations. The student explores the core concepts of computational thinking, a set of problem-solving processes that involve decomposition, pattern recognition, abstraction, and algorithms. The student is expected to:

(A) decompose a real-world problem into smaller, manageable subproblems using graphic organizers such as learning maps, concept maps, or other representations of data;

(B) identify patterns in real-world problems and make predictions based on the pattern;

(C) design and create an outline collaboratively that documents a problem, possible solutions, and an expected timeline for the development of a coded solution; and

(D) compare multiple algorithms for the same task and determine which algorithm is the most appropriate for that task.

(2) Computational thinking--applications. The student applies the fundamentals of computer science. The student is expected to:

(A) use variables within a program to store and modify data;

(B) use a design process to create block-based programs that include sequences, loops, conditionals, and events to solve an everyday problem; and

(C) analyze a code and how the code may be reused to develop new or improved programs.

(3) Creativity and innovation--innovative design process. The student takes an active role in learning by using a design process to solve authentic problems for a local or global audience, using a variety of technologies. The student is expected to:

(A) explain the importance of and demonstrate personal skills and behaviors, including persistence, effective communication, following directions, mental agility, metacognition, problem solving and questioning, that are needed to implement a design process successfully; and

(B) apply an appropriate design process that includes components to generate multiple solutions for an authentic problem and develop original products.

(4) Creativity and innovation--emerging technologies. The student demonstrates an understanding that technology is dynamic and impacts different communities. The student is expected to predict how emerging technologies may impact different communities.

(5) Data literacy, management, and representation--collect data. The student uses digital strategies to collect and identify data. The student is expected to:

(A) identify and collect quantitative and qualitative data with digital tools; and

(B) identify keyword(s), Boolean operators, and limiters within provided search strategies.

(6) Data literacy, management, and representation--organize, manage, and analyze data. The student uses data to answer questions. The student is expected to use digital tools to analyze and transform data and make inferences to answer questions.

(7) Data literacy, management, and representation--communicate and publish results. The student communicates data through the use of digital tools to inform an audience. The student is expected to use digital tools to communicate and display data using appropriate visualization to inform an intended audience.

(8) Digital citizenship--social interactions. The student understands different styles of digital communication and that a student's actions online can have a long-term impact. The student is expected to:

(A) identify the components of a digital footprint such as online activity, game use, or social media platforms;

(B) describe appropriate digital etiquette for addressing different audiences such as peers, teachers, and other adults; and

(C) apply appropriate digital etiquette for collaborating with different audiences such as peers, teachers, and other adults.

(9) Digital citizenship--ethics and laws. The student recognizes and practices responsible, legal, and ethical behavior while using digital tools and resources. The student is expected to:

(A) demonstrate adherence to local acceptable use policy (AUP) and explain the importance of responsible and ethical technology use;

(B) describe the purpose of copyright law and the possible consequences for inappropriate use of digital content; and

(C) create citations for digital forms of media with assistance.

(10) Digital citizenship--privacy, safety, and security. The student practices safe, legal, and ethical digital behaviors to become a socially responsible digital citizen. The student is expected to:

(A) discuss cybersecurity strategies such as using a secured internet connection to protect digital information;

(B) discuss how data collection technology is used to track online navigation and identify strategies to maintain digital privacy and security; and

(C) discuss and identify how interactions can escalate online and explain ways to stand up to cyberbullying, including advocating for self and others.

(11) Practical technology concepts--processes. The student engages with technology systems, concepts, and operations. The student is expected to:

(A) identify file types for text, graphics, and multimedia files; and

(B) perform software application functions, including inserting or deleting text and images and formatting tools or options.

(12) Practical technology concepts--skills and tools. The student selects appropriate methods or techniques for an assigned task and identifies and solves simple hardware and software problems using common troubleshooting strategies. The student is expected to:

(A) describe and evaluate operating systems, learning management systems, virtual systems, and network systems such as internet, intranet, wireless network, and short-range wireless technology;

(B) organize files using appropriate naming conventions and folder structures;

(C) demonstrate proper touch keyboarding techniques with increasing speed and accuracy and ergonomic strategies such as correct hand and body positions;

(D) demonstrate keyboard or other input device shortcuts with fluency; and

(E) use help sources to research application features and solve software issues

Grade 6

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Through the study of technology applications, students make informed decisions by understanding current and emerging technologies, including technology systems, appropriate digital tools, and personal learning networks. As competent researchers and responsible digital citizens, students use creative and computational thinking to solve problems while developing career and college readiness skills.

(3) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Creativity and innovation. The student uses creative thinking and innovative processes to construct knowledge, generate new ideas, and create products. The student is expected to:

(A) identify, create, and use files in various formats such as text, raster and vector graphics, video, and audio files;

(B) create original works as a means of personal or group expression;

(C) explore complex systems or issues using models, simulations, and new technologies to make predictions, modify input, and review results; and

(D) discuss trends and possible outcomes.

(2) Communication and collaboration. The student collaborates and communicates both locally and globally to reinforce and promote learning. The student is expected to:

(A) participate in personal learning networks to collaborate with peers, experts, or others using digital tools such as blogs, wikis, audio/video communication, or other emerging technologies;

(B) communicate effectively with multiple audiences using a variety of media and formats; and

(C) read and discuss examples of technical writing.

(3) Research and information fluency. The student acquires, analyzes, and manages content from digital resources. The student is expected to:

(A) create a research plan to guide inquiry;

(B) discuss and use various search strategies, including keyword(s) and Boolean operators;

(C) select and evaluate various types of digital resources for accuracy and validity; and

(D) process data and communicate results.

(4) Critical thinking, problem solving, and decision making. The student makes informed decisions by applying critical-thinking and problem-solving skills. The student is expected to:

(A) identify and define relevant problems and significant questions for investigation;

(B) plan and manage activities to develop a solution, design a computer program, or complete a project;

(C) collect and analyze data to identify solutions and make informed decisions;

(D) use multiple processes and diverse perspectives to explore alternative solutions;
(E) make informed decisions and support reasoning; and
(F) transfer current knowledge to the learning of newly encountered technologies.
(5) Digital citizenship. The student practices safe, responsible, legal, and ethical behavior while using technology tools and resources. The student is expected to:
(A) understand copyright principles, including current laws, fair use guidelines, creative commons, open source, and public domain;
(B) practice ethical acquisition of information and standard methods for citing sources;
(C) practice safe and appropriate online behavior, personal security guidelines, digital identity, digital etiquette, and acceptable use of technology; and
(D) understand the negative impact of inappropriate technology use, including online bullying and harassment, hacking, intentional virus setting, invasion of privacy, and piracy such as software, music, video, and other media.
(6) Technology operations and concepts. The student demonstrates a thorough understanding of technology concepts, systems, and operations. The student is expected to:
(A) (A) define and use current technology terminology appropriately
(B) select technology tools based on licensing, application, and support;
(C) identify, understand, and use operating systems;
(D) understand and use software applications, including selecting and using software for a defined task;
(E) identify, understand, and use hardware systems;
(F) understand troubleshooting techniques such as restarting systems, checking power issues, resolving software compatibility, verifying network connectivity, connecting to remote resources, and modifying display properties;
(G) demonstrate effective file management strategies such as file naming conventions, location, backup, hierarchy, folder structure, file conversion, tags, labels, and emerging digital organizational strategies;
(H) discuss how changes in technology throughout history have impacted various areas of study;
(I) discuss the relevance of technology as it applies to college and career readiness, life-long learning, and daily living;
(J) use a variety of local and remote input sources;
(K) use keyboarding techniques and ergonomic strategies while building speed and accuracy;
(L) create and edit files with productivity tools, including:
(i) a word processing document using digital typography standards such as page layout, font formatting, paragraph formatting, and list attributes;
(ii) a spreadsheet workbook using basic computational and graphic components such as basic formulas and functions, data types, and chart generation;
(iii) a database by manipulating components such as entering and searching for relevant data; and
(iv) a digital publication using relevant publication standards;
(M) plan and create non-linear media projects using graphic design principles; and
(A) (N) integrate two or more technology tools to create a new digital product

Grade 7

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Through the study of technology applications, students make informed decisions by understanding current and emerging technologies, including technology systems, appropriate digital tools, and personal learning networks. As competent researchers and responsible digital citizens, students use creative and computational thinking to solve problems while developing career and college readiness skills.

(3) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

1) Creativity and innovation. The student uses creative thinking and innovative processes to construct knowledge, generate new ideas, and create products. The student is expected to:

(A) identify, create, and use files in various formats such as text, raster and vector graphics, video, and audio files;

(B) create and present original works as a means of personal or group expression;

(C) explore complex systems or issues using models, simulations, and new technologies to make predictions, modify input, and review results; and

(D) discuss trends and make predictions.

(2) Communication and collaboration. The student collaborates and communicates both locally and globally to reinforce and promote learning. The student is expected to:

(A) create personal learning networks to collaborate and publish with peers, experts, or others using digital tools such as blogs, wikis, audio/video communication, or other emerging technologies;

(B) communicate effectively with multiple audiences using a variety of media and formats; and

(C) create products using technical writing strategies.

(3) Research and information fluency. The student acquires, analyzes, and manages content from digital resources. The student is expected to:

(A) create a research plan to guide inquiry;

(B) use and evaluate various search strategies, including keyword(s) and Boolean operators;

(C) select and evaluate various types of digital resources for accuracy and validity; and

(D) process data and communicate results.

(4) Critical thinking, problem solving, and decision making. The student makes informed decisions by applying critical-thinking and problem-solving skills. The student is expected to:

(A) identify and define relevant problems and significant questions for investigation;

(B) plan and manage activities to develop a solution, design a computer program, or complete a project;

(C) collect and analyze data to identify solutions and make informed decisions;

(D) use multiple processes and diverse perspectives to explore alternative solutions;

(E) make informed decisions and support reasoning; and

(F) transfer current knowledge to the learning of newly encountered technologies

(5) Digital citizenship. The student practices safe, responsible, legal, and ethical behavior while using technology tools and resources. The student is expected to:

(A) understand and practice copyright principles, including current laws, fair use guidelines, creative commons, open source, and public domain;

(B) practice ethical acquisition of information and standard methods for citing sources;

(C) practice and explain safe and appropriate online behavior, personal security guidelines, digital identity, digital etiquette, and acceptable use of technology; and

(D) understand the negative impact of inappropriate technology use, including online bullying and harassment, hacking, intentional virus setting, invasion of privacy, and piracy such as software, music, video, and other media.

(6) Technology operations and concepts. The student demonstrates a thorough understanding of technology concepts, systems, and operations. The student is expected to:

(A) define and use current technology terminology appropriately;

(B) select and apply technology tools based on licensing, application, and support;

(C) identify, understand, and use operating systems;

(D) understand and use software applications, including selecting and using software for a defined task;

(E) identify, understand, and use hardware systems;

(F) understand troubleshooting techniques such as restarting systems, checking power issues, resolving software compatibility, verifying network connectivity, connecting to remote resources, and modifying display properties;

(G) implement effective file management strategies such as file naming conventions, location, backup, hierarchy, folder structure, file conversion, tags, labels, and emerging digital organizational strategies;

(H) explain how changes in technology throughout history have impacted various areas of study;

(I) explain the relevance of technology as it applies to college and career readiness, life-long learning, and daily living;

(J) use a variety of local and remote input sources;

(K) use keyboarding techniques and ergonomic strategies while building speed and accuracy;

(L) create and edit files with productivity tools, including:

(i) a word processing document using digital typography standards such as page layout, font formatting, paragraph formatting, and list attributes;

(ii) a spreadsheet workbook using advanced computational and graphic components such as complex formulas, basic functions, data types, and chart generation;

(iii) a database by manipulating components such as defining fields, entering data, and designing layouts appropriate for reporting; and

(iv) a digital publication using relevant publication standards;

(M) plan and create non-linear media projects using graphic design principles; and

(N) integrate two or more technology tools to create a new digital product.

Grade 8

(1) The technology applications curriculum has six strands based on the National Educational Technology Standards for Students (NETS•S) and performance indicators developed by the International Society for Technology in Education (ISTE): creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.

(2) Through the study of technology applications, students make informed decisions by understanding current and emerging technologies, including technology systems, appropriate digital tools, and personal learning networks. As competent researchers and responsible digital citizens, students use creative and computational thinking to solve problems while developing career and college readiness skills.

(3) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) Creativity and innovation. The student uses creative thinking and innovative processes to construct knowledge, generate new ideas, and create products. The student is expected to:

(A) identify, create, and use files in various formats, including text, raster and vector graphics, video, and audio files;

(B) create, present, and publish original works as a means of personal or group expression;

(C) explore complex systems or issues using models, simulations, and new technologies to develop hypotheses, modify input, and analyze results; and

(D) analyze trends and forecast possibilities.

(2) Communication and collaboration. The student collaborates and communicates both locally and globally to reinforce and promote learning. The student is expected to:

(A) create and manage personal learning networks to collaborate and publish with peers, experts, or others using digital tools such as blogs, wikis, audio/video communication, or other emerging technologies;

(B) communicate effectively with multiple audiences using a variety of media and formats; and

(C) create and publish products using technical writing strategies.

(3) Research and information fluency. The student acquires, analyzes, and manages content from digital resources. The student is expected to:

(A) create a research plan to guide inquiry;

(B) plan, use, and evaluate various search strategies, including keyword(s) and Boolean operators;

(C) select and evaluate various types of digital resources for accuracy and validity; and

(D) process data and communicate results.

(4) Critical thinking, problem solving, and decision making. The student makes informed decisions by applying critical-thinking and problem-solving skills. The student is expected to:

A) identify and define relevant problems and significant questions for investigation;

(B) plan and manage activities to develop a solution, design a computer program, or complete a project;

(C) collect and analyze data to identify solutions and make informed decisions;

(D) use multiple processes and diverse perspectives to explore alternative solutions;

(E) make informed decisions and support reasoning; and

(F) transfer current knowledge to the learning of newly encountered technologies.

(5) Digital citizenship. The student practices safe, responsible, legal, and ethical behavior while using technology tools and resources. The student is expected to:

(A) understand, explain, and practice copyright principles, including current laws, fair use guidelines, creative commons, open source, and public domain;

(B) practice and explain ethical acquisition of information and standard methods for citing sources;

(C) practice and explain safe and appropriate online behavior, personal security guidelines, digital identity, digital etiquette, and acceptable use of technology; and

(D) understand and explain the negative impact of inappropriate technology use, including online bullying and harassment, hacking, intentional virus setting, invasion of privacy, and piracy such as software, music, video, and other media.

(6) Technology operations and concepts. The student demonstrates a thorough understanding of technology concepts, systems, and operations. The student is expected to:

(A) define and use current technology terminology appropriately;

(B) evaluate and select technology tools based on licensing, application, and support;

(C) identify, understand, and use operating systems;

(D) understand and use software applications, including selecting and using software for a defined task;

(E) identify, understand, and use hardware systems;

(F) apply troubleshooting techniques, including restarting systems, checking power issues, resolving software compatibility, verifying network connectivity, connecting to remote resources, and modifying display properties;

(G) implement effective file management strategies such as file naming conventions, location, backup, hierarchy, folder structure, file conversion, tags, labels, and emerging digital organizational strategies;

(H) evaluate how changes in technology throughout history have impacted various areas of study;

(I) evaluate the relevance of technology as it applies to college and career readiness, life-long learning, and daily living;

(J) use a variety of local and remote input sources;

(K) use keyboarding techniques and ergonomic strategies while building speed and accuracy;

(L) create and edit files with productivity tools, including:

(i) a word processing document using digital typography standards such as page layout, font formatting, paragraph formatting, mail merge, and list attributes;

(ii) a spreadsheet workbook using advanced computational and graphic components such as complex formulas, advanced functions, data types, and chart generation;

(iii) a database by manipulating components, including defining fields, entering data, and designing layouts appropriate for reporting; and

(iv) a digital publication using relevant publication standards and graphic design principles;

(M) plan and create non-linear media projects using graphic design principles; and

(N) integrate two or more technology tools to create a new digital product.

Pedagogy and Professional Responsibilities Standards, Grades 4-8

(a) Grades 4-8 pedagogy and professional responsibilities (PPR) standards. The PPR standards identified in this section are targeted for classroom teachers of students in Grades 4-8. The standards address the discipline that deals with the theory and practice of teaching to inform skill-based training and development. The standards inform proper teaching techniques, strategies, teacher actions, teacher judgements, and decisions by taking into consideration theories of learning, understandings of students and their needs, and the backgrounds and interests of individual students. The standards are also aligned with the Commissioner's Teacher

Standards in 19 TAC Chapter 149 of this title (relating to Commissioner's Rules Concerning Educator Standards).
(b) Instructional Planning and Delivery. Grades 4-8 classroom teachers demonstrate understanding of instructional planning and delivery by providing standards-based, data-driven, differentiated instruction that engages students and makes learning relevant for today's learners. Grades 4-8 classroom teachers must:
(1) develop lessons that build coherently toward objectives based on course content, curriculum scope and sequence, and expected student outcomes;
(2) effectively communicate goals, expectations, and objectives to help all students reach high levels of achievement;
(3) connect students' prior understanding and real-world experiences to new content and contexts, maximizing learning opportunities;
(4) plan instruction that is developmentally appropriate, is standards driven, and motivates students to learn;
(5) use a range of instructional strategies, appropriate to the content area, to make subject matter accessible to all students;
(6) differentiate instruction, aligning methods and techniques to diverse student needs, including acceleration, remediation, and implementation of individual education plans;
(7) ensure that the learning environment features a high degree of student engagement by facilitating discussion and student-centered activities as well as leading direct instruction;
(8) set high expectations and create challenging learning experiences for students, encouraging them to apply disciplinary and cross-disciplinary knowledge to real-world problems;
(9) provide opportunities for students to engage in individual and collaborative critical thinking and problem solving;
(10) monitor and assess students' progress to ensure that their lessons meet students' needs;
(11) provide immediate feedback to students in order to reinforce their learning and ensure that they understand key concepts; and
(12) adjust content delivery in response to student progress through the use of developmentally appropriate strategies that maximize student engagement.
(c) Knowledge of Student and Student Learning. Grades 4-8 classroom teachers work to ensure high levels of learning and achievement outcomes for all students, taking into consideration each student's educational and developmental backgrounds and focusing on each student's needs. Grades 4-8 classroom teachers must:
(1) create a community of learners in an inclusive environment that views differences in learning and background as educational assets;
(2) connect learning, content, and expectations to students' prior knowledge, life experiences, and interests in meaningful contexts;
(3) understand the unique qualities of students with exceptional needs, including disabilities and giftedness, and know how to effectively address these needs through instructional strategies and resources;
(4) understand the role of language and culture in learning and know how to modify their practice to support language acquisition so that language is comprehensible and instruction is fully accessible; and
(5) understand how learning occurs and how learners develop, construct meaning, and acquire knowledge and skills.

(d) Content Knowledge and Expertise. Grades 4-8 classroom teachers exhibit an understanding of content and related pedagogy as demonstrated through the quality of the design and execution of lessons and the ability to match objectives and activities to relevant state standards. Grades 4-8 classroom teachers must:

(1) keep current with developments, new content, new approaches, and changing methods of instructional delivery within their discipline;

(2) organize curriculum to facilitate student understanding of the subject matter;

(3) understand, actively anticipate, and adapt instruction to address common misunderstandings and preconceptions;

(4) promote literacy and the academic language within the discipline and make discipline-specific language accessible to all learners; and

(5) teach both the key content knowledge and the key skills of the discipline.

(e) Learning Environment. Grades 4-8 classroom teachers interact with students in respectful ways at all times, maintaining a physically and emotionally safe, supportive learning environment that is characterized by efficient and effective routines, clear expectations for student behavior, and organization that maximizes student learning. Grades 4-8 classroom teachers must:

(1) embrace students' backgrounds and experiences as an asset in their learning;

(2) maintain and facilitate respectful, supportive, positive, and productive interactions with and among students;

(3) implement behavior management systems to maintain an environment where all students can learn effectively;

(4) maintain a culture that is based on high expectations for student performance and encourages students to be self-motivated, taking responsibility for their own learning;

(5) maximize instructional time, including managing transitions; and

(6) communicate regularly, clearly, and appropriately with parents and families about student progress, providing detailed and constructive feedback and partnering with families in furthering their students' achievement goals.

(f) Data-Driven Practices. Grades 4-8 classroom teachers use formal and informal methods to assess student growth aligned to instructional goals and course objectives and regularly review and analyze multiple sources of data to measure student progress and adjust instructional strategies and content delivery as needed. Grades 4-8 classroom teachers must:

(1) gauge student progress and ensure mastery of content knowledge and skills by providing assessments aligned to instructional objectives and outcomes that are accurate measures of student learning;

(2) analyze and review data in a timely, thorough, accurate, and appropriate manner, both individually and with colleagues, to monitor student learning; and

(3) design instruction, change strategies, and differentiate their teaching practices to improve student learning based on assessment outcomes.

(g) Professional Practices and Responsibilities. Grades 4-8 classroom teachers consistently hold themselves to a high standard for individual development, collaborate with other educational professionals, communicate regularly with stakeholders, maintain professional relationships, comply with all campus and school district policies, and conduct themselves ethically and with integrity. Grades 4-8 classroom teachers must:

(1) reflect on their own strengths and professional learning needs, using this information to develop action plans for improvement;

(2) seek out feedback from supervisor, coaches, and peers and take advantage of opportunities for job-embedded professional development;
(3) adhere to the educators' code of ethics in §247.2 of this title (relating to Code of Ethics and Standard Practices for Texas Educators), including following policies and procedures at their specific school placement(s); and
(4) communicate consistently, clearly, and respectfully with all members of the campus community, administrators, and staff.

Pedagogy and Professional Responsibilities Standards, Grades 7-12

(a) Grades 7-12 pedagogy and professional responsibilities (PPR) standards. The PPR standards identified in this section are targeted for classroom teachers of students in Grades 7-12. The standards address the discipline that deals with the theory and practice of teaching to inform skill-based training and development. The standards inform proper teaching techniques, strategies, teacher actions, teacher judgements, and decisions by taking into consideration theories of learning, understandings of students and their needs, and the backgrounds and interests of individual students. The standards are also aligned with the Commissioner's Teacher Standards in 19 TAC Chapter 149 of this title (relating to Commissioner's Rules Concerning Educator Standards).
(b) Instructional Planning and Delivery. Grades 7-12 classroom teachers demonstrate understanding of instructional planning and delivery by providing standards-based, data-driven, differentiated instruction that engages students and makes learning relevant for today's learners. Grades 7-12 classroom teachers must:
(1) develop lessons that build coherently toward objectives based on course content, curriculum scope and sequence, and expected student outcomes;
(2) effectively communicate goals, expectations, and objectives to help all students reach high levels of achievement;
(3) connect students' prior understanding and real-world experiences to new content and contexts, maximizing learning opportunities;
(4) plan instruction that is developmentally appropriate, is standards driven, and motivates students to learn;
(5) use a range of instructional strategies, appropriate to the content area, to make subject matter accessible to all students;
(6) differentiate instruction, aligning methods and techniques to diverse student needs, including acceleration, remediation, and implementation of individual education plans;
(7) ensure that the learning environment features a high degree of student engagement by facilitating discussion and student-centered activities as well as leading direct instruction;
(8) set high expectations and create challenging learning experiences for students, encouraging them to apply disciplinary and cross-disciplinary knowledge to real-world problems;
(9) provide opportunities for students to engage in individual and collaborative critical thinking and problem solving;
(10) monitor and assess students' progress to ensure that their lessons meet students' needs;
(11) provide immediate feedback to students in order to reinforce their learning and ensure that they understand key concepts; and
(12) adjust content delivery in response to student progress through the use of developmentally appropriate strategies that maximize student engagement.

(c) Knowledge of Student and Student Learning. Grades 7-12 classroom teachers work to ensure high levels of learning and achievement outcomes for all students, taking into consideration each student's educational and developmental backgrounds and focusing on each student's needs. Grades 7-12 classroom teachers must:

(1) create a community of learners in an inclusive environment that views differences in learning and background as educational assets;

(2) accept responsibility for the growth of all of their students, persisting in their efforts to ensure high levels of growth on the part of each learner;

(3) connect learning, content, and expectations to students' prior knowledge, life experiences, and interests in meaningful contexts;

(4) understand the unique qualities of students with exceptional needs, including disabilities and giftedness, and know how to effectively address these needs through instructional strategies and resources;

(5) understand the role of language and culture in learning and know how to modify their practice to support language acquisition so that language is comprehensible and instruction is fully accessible; and

(6) understand how learning occurs and how learners develop, construct meaning, and acquire knowledge and skills.

(d) Content Knowledge and Expertise. Grades 7-12 classroom teachers exhibit an understanding of content and related pedagogy as demonstrated through the quality of the design and execution of lessons and the ability to match objectives and activities to relevant state standards. Grades 7-12 classroom teachers must:

(1) keep current with developments, new content, new approaches, and changing methods of instructional delivery within their discipline;

(2) organize curriculum to facilitate student understanding of the subject matter;

(3) understand, actively anticipate, and adapt instruction to address common misunderstandings and preconceptions;

(4) promote literacy and the academic language within the discipline and make discipline-specific language accessible to all learners; and

(5) teach both the key content knowledge and the key skills of the discipline.

(e) Learning Environment. Grades 7-12 classroom teachers interact with students in respectful ways at all times, maintaining a physically and emotionally safe, supportive learning environment that is characterized by efficient and effective routines, clear expectations for student behavior, and organization that maximizes student learning. Grades 7-12 classroom teachers must:

(1) embrace students' backgrounds and experiences as an asset in their learning;

(2) maintain and facilitate respectful, supportive, positive, and productive interactions with and among students;

(3) implement behavior management systems to maintain an environment where all students can learn effectively;

(4) maintain a culture that is based on high expectations for student performance and encourages students to be self-motivated, taking responsibility for their own learning;

(5) maximize instructional time, including managing transitions; and

(6) communicate regularly, clearly, and appropriately with parents and families about student progress, providing detailed and constructive feedback and partnering with families in furthering their students' achievement goals.

(f) Data-Driven Practices. Grades 7-12 classroom teachers use formal and informal methods to assess student growth aligned to instructional goals and course objectives and regularly review and analyze multiple sources of data to measure student progress and adjust instructional strategies and content delivery as needed. Grades 7-12 classroom teachers must:

(1) gauge student progress and ensure mastery of content knowledge and skills by providing assessments aligned to instructional objectives and outcomes that are accurate measures of student learning;

(2) analyze and review data in a timely, thorough, accurate, and appropriate manner, both individually and with colleagues, to monitor student learning; and

(3) design instruction, change strategies, and differentiate their teaching practices to improve student learning based on assessment outcomes.

(g) Professional Practices and Responsibilities. Grades 7-12 classroom teachers consistently hold themselves to a high standard for individual development, collaborate with other educational professionals, communicate regularly with stakeholders, maintain professional relationships, comply with all campus and school district policies, and conduct themselves ethically and with integrity. Grades 7-12 classroom teachers must:

(1) reflect on their own strengths and professional learning needs, using this information to develop action plans for improvement;

(2) seek out feedback from supervisor, coaches, and peers and take advantage of opportunities for job-embedded professional development;

(3) adhere to the educators' code of ethics in §247.2 of this title (relating to Code of Ethics and Standard Practices for Texas Educators), including following policies and procedures at their specific school placement(s);

(4) communicate consistently, clearly, and respectfully with all members of the campus community, administrators, and staff; and

(5) serve as advocates for their students, focusing attention on students' needs and concerns and maintaining thorough and accurate student records.

TEXAS ESSENTIAL KNOWLEDGE AND SKILLS FOR MATHEMATICS

Grade 4

(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace;

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(E) create and use representations to organize, record, and communicate mathematical ideas;

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(2) Number and operations. The student applies mathematical process standards to represent, compare, and order whole numbers and decimals and understand relationships related to place value. The student is expected to:

(A) interpret the value of each place-value position as 10 times the position to the right and as one-tenth of the value of the place to its left;

(B) represent the value of the digit in whole numbers through 1,000,000,000 and decimals to the hundredths using expanded notation and numerals;

(C) compare and order whole numbers to 1,000,000,000 and represent comparisons using the symbols >, <, or =;

(D) round whole numbers to a given place value through the hundred thousands place;

(E) represent decimals, including tenths and hundredths, using concrete and visual models and money;

(F) compare and order decimals using concrete and visual models to the hundredths;

(G) relate decimals to fractions that name tenths and hundredths; and

(H) determine the corresponding decimal to the tenths or hundredths place of a specified point on a number line.

(3) Number and operations. The student applies mathematical process standards to represent and generate fractions to solve problems. The student is expected to:

(A) represent a fraction *a/b* as a sum of fractions 1/*b,* where *a* and *b* are whole numbers and $b > 0$, including when $a > b$;

(B) decompose a fraction in more than one way into a sum of fractions with the same denominator using concrete and pictorial models and recording results with symbolic representations;

(C) determine if two given fractions are equivalent using a variety of methods;

(D) compare two fractions with different numerators and different denominators and represent the comparison using the symbols >, =, or <;

(E) represent and solve addition and subtraction of fractions with equal denominators using objects and pictorial models that build to the number line and properties of operations;

(F) evaluate the reasonableness of sums and differences of fractions using benchmark fractions 0, 1/4, 1/2, 3/4, and 1, referring to the same whole; and

(G) represent fractions and decimals to the tenths or hundredths as distances from zero on a number line.

(4) Number and operations. The student applies mathematical process standards to develop and use strategies and methods for whole number computations and decimal sums and differences in order to solve problems with efficiency and accuracy. The student is expected to:

(A) add and subtract whole numbers and decimals to the hundredths place using the standard algorithm;

(B) determine products of a number and 10 or 100 using properties of operations and place value understandings;

(C) represent the product of 2 two-digit numbers using arrays, area models, or equations, including perfect squares through 15 by 15;

(D) use strategies and algorithms, including the standard algorithm, to multiply up to a four-digit number by a one-digit number and to multiply a two-digit number by a two-digit number. Strategies may include mental math, partial products, and the commutative, associative, and distributive properties;

(E) represent the quotient of up to a four-digit whole number divided by a one-digit whole number using arrays, area models, or equations;

(F) use strategies and algorithms, including the standard algorithm, to divide up to a four-digit dividend by a one-digit divisor;

(G) round to the nearest 10, 100, or 1,000 or use compatible numbers to estimate solutions involving whole numbers; and

(H) solve with fluency one- and two-step problems involving multiplication and division, including interpreting remainders.

(5) Algebraic reasoning. The student applies mathematical process standards to develop concepts of expressions and equations. The student is expected to:

(A) represent multi-step problems involving the four operations with whole numbers using strip diagrams and equations with a letter standing for the unknown quantity;

(B) represent problems using an input-output table and numerical expressions to generate a number pattern that follows a given rule representing the relationship of the values in the resulting sequence and their position in the sequence;

(C) use models to determine the formulas for the perimeter of a rectangle *(l + w + l + w* or 2*l* + 2*w),* including the special form for perimeter of a square (4*s)* and the area of a rectangle *(l* x *w);* and

(D) solve problems related to perimeter and area of rectangles where dimensions are whole numbers.

(6) Geometry and measurement. The student applies mathematical process standards to analyze geometric attributes in order to develop generalizations about their properties. The student is expected to:

(A) identify points, lines, line segments, rays, angles, and perpendicular and parallel lines;

(B) identify and draw one or more lines of symmetry, if they exist, for a two-dimensional figure;

(C) apply knowledge of right angles to identify acute, right, and obtuse triangles; and

(D) classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines or the presence or absence of angles of a specified size.

(7) Geometry and measurement. The student applies mathematical process standards to solve problems involving angles less than or equal to 180 degrees. The student is expected to:

(A) illustrate the measure of an angle as the part of a circle whose center is at the vertex of the angle that is "cut out" by the rays of the angle. Angle measures are limited to whole numbers;

(B) illustrate degrees as the units used to measure an angle, where 1/360 of any circle is one degree and an angle that "cuts" *n* /360 out of any circle whose center is at the angle's vertex has a measure of *n* degrees. Angle measures are limited to whole numbers;

(C) determine the approximate measures of angles in degrees to the nearest whole number using a protractor;

(D) draw an angle with a given measure; and

(E) determine the measure of an unknown angle formed by two non-overlapping adjacent angles given one or both angle measures.

(8) Geometry and measurement. The student applies mathematical process standards to select appropriate customary and metric units, strategies, and tools to solve problems involving measurement. The student is expected to:

(A) identify relative sizes of measurement units within the customary and metric systems;

(B) convert measurements within the same measurement system, customary or metric, from a smaller unit into a larger unit or a larger unit into a smaller unit when given other equivalent measures represented in a table; and

(C) solve problems that deal with measurements of length, intervals of time, liquid volumes, mass, and money using addition, subtraction, multiplication, or division as appropriate.

(9) Data analysis. The student applies mathematical process standards to solve problems by collecting, organizing, displaying, and interpreting data. The student is expected to:

(A) represent data on a frequency table, dot plot, or stem-and-leaf plot marked with whole numbers and fractions; and

(B) solve one- and two-step problems using data in whole number, decimal, and fraction form in a frequency table, dot plot, or stem-and-leaf plot.

(10) Personal financial literacy. The student applies mathematical process standards to manage one's financial resources effectively for lifetime financial security. The student is expected to:

(A) distinguish between fixed and variable expenses;

(B) calculate profit in a given situation;

(C) compare the advantages and disadvantages of various savings options;

(D) describe how to allocate a weekly allowance among spending; saving, including for college; and sharing; and

(E) describe the basic purpose of financial institutions, including keeping money safe, borrowing money, and lending.

Grade 5

(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace;

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(E) create and use representations to organize, record, and communicate mathematical ideas;

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(2) Number and operations. The student applies mathematical process standards to represent, compare, and order positive rational numbers and understand relationships as related to place value. The student is expected to:

(A) represent the value of the digit in decimals through the thousandths using expanded notation and numerals;

(B) compare and order two decimals to thousandths and represent comparisons using the symbols >, <, or =; and

(C) round decimals to tenths or hundredths.

(3) Number and operations. The student applies mathematical process standards to develop and use strategies and methods for positive rational number computations in order to solve problems with efficiency and accuracy. The student is expected to:

(A) estimate to determine solutions to mathematical and real-world problems involving addition, subtraction, multiplication, or division;

(B) multiply with fluency a three-digit number by a two-digit number using the standard algorithm;

(C) solve with proficiency for quotients of up to a four-digit dividend by a two-digit divisor using strategies and the standard algorithm;

(D) represent multiplication of decimals with products to the hundredths using objects and pictorial models, including area models;

(E) solve for products of decimals to the hundredths, including situations involving money, using strategies based on place-value understandings, properties of operations, and the relationship to the multiplication of whole numbers;

(F) represent quotients of decimals to the hundredths, up to four-digit dividends and two-digit whole number divisors, using objects and pictorial models, including area models;

(G) solve for quotients of decimals to the hundredths, up to four-digit dividends and two-digit whole number divisors, using strategies and algorithms, including the standard algorithm;

(H) represent and solve addition and subtraction of fractions with unequal denominators referring to the same whole using objects and pictorial models and properties of operations;

(I) represent and solve multiplication of a whole number and a fraction that refers to the same whole using objects and pictorial models, including area models;

(J) represent division of a unit fraction by a whole number and the division of a whole number by a unit fraction such as 1/3 ÷ 7 and 7 ÷ 1/3 using objects and pictorial models, including area models;

(K) add and subtract positive rational numbers fluently; and

(L) divide whole numbers by unit fractions and unit fractions by whole numbers.

(4) Algebraic reasoning. The student applies mathematical process standards to develop concepts of expressions and equations. The student is expected to:

(A) identify prime and composite numbers;

(B) represent and solve multi-step problems involving the four operations with whole numbers using equations with a letter standing for the unknown quantity;

(C) generate a numerical pattern when given a rule in the form $y = ax$ or $y = x + a$ and graph;

(D) recognize the difference between additive and multiplicative numerical patterns given in a table or graph;

(E) describe the meaning of parentheses and brackets in a numeric expression;

(F) simplify numerical expressions that do not involve exponents, including up to two levels of grouping;

(G) use concrete objects and pictorial models to develop the formulas for the volume of a rectangular prism, including the special form for a cube *($V = l$ x w x h, $V = s$ x s x s,* and *$V = Bh$);* and

(H) represent and solve problems related to perimeter and/or area and related to volume.

(5) Geometry and measurement. The student applies mathematical process standards to classify two-dimensional figures by attributes and properties. The student is expected to classify two-dimensional figures in a hierarchy of sets and subsets using graphic organizers based on their attributes and properties.

(6) Geometry and measurement. The student applies mathematical process standards to understand, recognize, and quantify volume. The student is expected to:

(A) recognize a cube with side length of one unit as a unit cube having one cubic unit of volume and the volume of a three-dimensional figure as the number of unit cubes *(n* cubic units) needed to fill it with no gaps or overlaps if possible; and

(B) determine the volume of a rectangular prism with whole number side lengths in problems related to the number of layers times the number of unit cubes in the area of the base.

(7) Geometry and measurement. The student applies mathematical process standards to select appropriate units, strategies, and tools to solve problems involving measurement. The student is expected to solve problems by calculating conversions within a measurement system, customary or metric.

(8) Geometry and measurement. The student applies mathematical process standards to identify locations on a coordinate plane. The student is expected to:

(A) describe the key attributes of the coordinate plane, including perpendicular number lines (axes) where the intersection (origin) of the two lines coincides with zero on each number line and the given point (0, 0); the *x*- coordinate, the first number in an ordered pair, indicates movement parallel to the *x*- axis starting at the origin; and the *y*- coordinate, the second number, indicates movement parallel to the *y*- axis starting at the origin;

(B) describe the process for graphing ordered pairs of numbers in the first quadrant of the coordinate plane; and

(C) graph in the first quadrant of the coordinate plane ordered pairs of numbers arising from mathematical and real-world problems, including those generated by number patterns or found in an input-output table.

(9) Data analysis. The student applies mathematical process standards to solve problems by collecting, organizing, displaying, and interpreting data. The student is expected to:

(A) represent categorical data with bar graphs or frequency tables and numerical data, including data sets of measurements in fractions or decimals, with dot plots or stem-and-leaf plots;

(B) represent discrete paired data on a scatterplot; and

(C) solve one- and two-step problems using data from a frequency table, dot plot, bar graph, stem-and-leaf plot, or scatterplot.

(10) Personal financial literacy. The student applies mathematical process standards to manage one's financial resources effectively for lifetime financial security. The student is expected to:

(A) define income tax, payroll tax, sales tax, and property tax;

(B) explain the difference between gross income and net income;

(C) identify the advantages and disadvantages of different methods of payment, including check, credit card, debit card, and electronic payments;

(D) develop a system for keeping and using financial records;

(E) describe actions that might be taken to balance a budget when expenses exceed income; and

(F) balance a simple budget.

Grade 6

(b) Knowledge and skills.

(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace;

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(E) create and use representations to organize, record, and communicate mathematical ideas;

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(2) Number and operations. The student applies mathematical process standards to represent and use rational numbers in a variety of forms. The student is expected to:

(A) classify whole numbers, integers, and rational numbers using a visual representation such as a Venn diagram to describe relationships between sets of numbers;

(B) identify a number, its opposite, and its absolute value;

(C) locate, compare, and order integers and rational numbers using a number line;

(D) order a set of rational numbers arising from mathematical and real-world contexts; and

(E) extend representations for division to include fraction notation such as a/b represents the same number as $a \div b$ where $b \neq 0$.

(3) Number and operations. The student applies mathematical process standards to represent addition, subtraction, multiplication, and division while solving problems and justifying solutions. The student is expected to:

(A) recognize that dividing by a rational number and multiplying by its reciprocal result in equivalent values;

(B) determine, with and without computation, whether a quantity is increased or decreased when multiplied by a fraction, including values greater than or less than one;

(C) represent integer operations with concrete models and connect the actions with the models to standardized algorithms;

(D) add, subtract, multiply, and divide integers fluently; and

(E) multiply and divide positive rational numbers fluently.

(4) Proportionality. The student applies mathematical process standards to develop an understanding of proportional relationships in problem situations. The student is expected to:

(A) compare two rules verbally, numerically, graphically, and symbolically in the form of $y = ax$ or $y = x + a$ in order to differentiate between additive and multiplicative relationships;

(B) apply qualitative and quantitative reasoning to solve prediction and comparison of real-world problems involving ratios and rates;

(C) give examples of ratios as multiplicative comparisons of two quantities describing the same attribute;

(D) give examples of rates as the comparison by division of two quantities having different attributes, including rates as quotients;

(E) represent ratios and percents with concrete models, fractions, and decimals;

(F) represent benchmark fractions and percents such as 1%, 10%, 25%, 33 1/3%, and multiples of these values using 10 by 10 grids, strip diagrams, number lines, and numbers;

(G) generate equivalent forms of fractions, decimals, and percents using real-world problems, including problems that involve money; and

(H) convert units within a measurement system, including the use of proportions and unit rates.

(5) Proportionality. The student applies mathematical process standards to solve problems involving proportional relationships. The student is expected to:

(A) represent mathematical and real-world problems involving ratios and rates using scale factors, tables, graphs, and proportions;

(B) solve real-world problems to find the whole given a part and the percent, to find the part given the whole and the percent, and to find the percent given the part and the whole, including the use of concrete and pictorial models; and

(C) use equivalent fractions, decimals, and percents to show equal parts of the same whole.

(6) Expressions, equations, and relationships. The student applies mathematical process standards to use multiple representations to describe algebraic relationships. The student is expected to:

(A) identify independent and dependent quantities from tables and graphs;

(B) write an equation that represents the relationship between independent and dependent quantities from a table; and

(C) represent a given situation using verbal descriptions, tables, graphs, and equations in the form $y = kx$ or $y = x + b$.

(7) Expressions, equations, and relationships. The student applies mathematical process standards to develop concepts of expressions and equations. The student is expected to:

(A) generate equivalent numerical expressions using order of operations, including whole number exponents and prime factorization;

(B) distinguish between expressions and equations verbally, numerically, and algebraically;

(C) determine if two expressions are equivalent using concrete models, pictorial models, and algebraic representations; and

(D) generate equivalent expressions using the properties of operations: inverse, identity, commutative, associative, and distributive properties.

(8) Expressions, equations, and relationships. The student applies mathematical process standards to use geometry to represent relationships and solve problems. The student is expected to:

(A) extend previous knowledge of triangles and their properties to include the sum of angles of a triangle, the relationship between the lengths of sides and measures of angles in a triangle, and determining when three lengths form a triangle;

(B) model area formulas for parallelograms, trapezoids, and triangles by decomposing and rearranging parts of these shapes;

(C) write equations that represent problems related to the area of rectangles, parallelograms, trapezoids, and triangles and volume of right rectangular prisms where dimensions are positive rational numbers; and

(D) determine solutions for problems involving the area of rectangles, parallelograms, trapezoids, and triangles and volume of right rectangular prisms where dimensions are positive rational numbers.

(9) Expressions, equations, and relationships. The student applies mathematical process standards to use equations and inequalities to represent situations. The student is expected to:

(A) write one-variable, one-step equations and inequalities to represent constraints or conditions within problems;

(B) represent solutions for one-variable, one-step equations and inequalities on number lines; and

(C) write corresponding real-world problems given one-variable, one-step equations or inequalities.

(10) Expressions, equations, and relationships. The student applies mathematical process standards to use equations and inequalities to solve problems. The student is expected to:

(A) model and solve one-variable, one-step equations and inequalities that represent problems, including geometric concepts; and

(B) determine if the given value(s) make(s) one-variable, one-step equations or inequalities true.

(11) Measurement and data. The student applies mathematical process standards to use coordinate geometry to identify locations on a plane. The student is expected to graph points in all four quadrants using ordered pairs of rational numbers.

(12) Measurement and data. The student applies mathematical process standards to use numerical or graphical representations to analyze problems. The student is expected to:

(A) represent numeric data graphically, including dot plots, stem-and-leaf plots, histograms, and box plots;

(B) use the graphical representation of numeric data to describe the center, spread, and shape of the data distribution;

(C) summarize numeric data with numerical summaries, including the mean and median (measures of center) and the range and interquartile range (IQR) (measures of spread), and use these summaries to describe the center, spread, and shape of the data distribution; and

(D) summarize categorical data with numerical and graphical summaries, including the mode, the percent of values in each category (relative frequency table), and the percent bar graph, and use these summaries to describe the data distribution.

(13) Measurement and data. The student applies mathematical process standards to use numerical or graphical representations to solve problems. The student is expected to:

(A) interpret numeric data summarized in dot plots, stem-and-leaf plots, histograms, and box plots; and

(B) distinguish between situations that yield data with and without variability.

(14) Personal financial literacy. The student applies mathematical process standards to develop an economic way of thinking and problem solving useful in one's life as a knowledgeable consumer and investor. The student is expected to:

(A) compare the features and costs of a checking account and a debit card offered by different local financial institutions;

(B) distinguish between debit cards and credit cards;

(C) balance a check register that includes deposits, withdrawals, and transfers;

(D) explain why it is important to establish a positive credit history;

(E) describe the information in a credit report and how long it is retained;

(F) describe the value of credit reports to borrowers and to lenders;
(G) explain various methods to pay for college, including through savings, grants, scholarships, student loans, and work-study; and
(H) compare the annual salary of several occupations requiring various levels of post-secondary education or vocational training and calculate the effects of the different annual salaries on lifetime income.

Grade 7
(b) Knowledge and skills.
(1)Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:
(A) apply mathematics to problems arising in everyday life, society, and the workplace;
(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;
(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;
(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;
(E) create and use representations to organize, record, and communicate mathematical ideas;
(F) analyze mathematical relationships to connect and communicate mathematical ideas; and
(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.
(2) Number and operations. The student applies mathematical process standards to represent and use rational numbers in a variety of forms. The student is expected to extend previous knowledge of sets and subsets using a visual representation to describe relationships between sets of rational numbers.
(3) Number and operations. The student applies mathematical process standards to add, subtract, multiply, and divide while solving problems and justifying solutions. The student is expected to:
(A) add, subtract, multiply, and divide rational numbers fluently; and
(B) apply and extend previous understandings of operations to solve problems using addition, subtraction, multiplication, and division of rational numbers.
(4) Proportionality. The student applies mathematical process standards to represent and solve problems involving proportional relationships. The student is expected to:
(A) represent constant rates of change in mathematical and real-world problems given pictorial, tabular, verbal, numeric, graphical, and algebraic representations, including $d = rt$;
(B) calculate unit rates from rates in mathematical and real-world problems;
(C) determine the constant of proportionality $(k = y/x)$ within mathematical and real-world problems;
(D) solve problems involving ratios, rates, and percents, including multi-step problems involving percent increase and percent decrease, and financial literacy problems; and
(E) convert between measurement systems, including the use of proportions and the use of unit rates.

(5) Proportionality. The student applies mathematical process standards to use geometry to describe or solve problems involving proportional relationships. The student is expected to:

(A) generalize the critical attributes of similarity, including ratios within and between similar shapes;

(B) describe π as the ratio of the circumference of a circle to its diameter; and

(C) solve mathematical and real-world problems involving similar shape and scale drawings.

(6) Proportionality. The student applies mathematical process standards to use probability and statistics to describe or solve problems involving proportional relationships. The student is expected to:

(A) represent sample spaces for simple and compound events using lists and tree diagrams;

(B) select and use different simulations to represent simple and compound events with and without technology;

(C) make predictions and determine solutions using experimental data for simple and compound events;

(D) make predictions and determine solutions using theoretical probability for simple and compound events;

(E) find the probabilities of a simple event and its complement and describe the relationship between the two;

(F) use data from a random sample to make inferences about a population;

(G) solve problems using data represented in bar graphs, dot plots, and circle graphs, including part-to-whole and part-to-part comparisons and equivalents;

(H) solve problems using qualitative and quantitative predictions and comparisons from simple experiments; and

(I) determine experimental and theoretical probabilities related to simple and compound events using data and sample spaces.

(7) Expressions, equations, and relationships. The student applies mathematical process standards to represent linear relationships using multiple representations. The student is expected to represent linear relationships using verbal descriptions, tables, graphs, and equations that simplify to the form $y = mx + b$.

(8) Expressions, equations, and relationships. The student applies mathematical process standards to develop geometric relationships with volume. The student is expected to:

(A) model the relationship between the volume of a rectangular prism and a rectangular pyramid having both congruent bases and heights and connect that relationship to the formulas;

(B) explain verbally and symbolically the relationship between the volume of a triangular prism and a triangular pyramid having both congruent bases and heights and connect that relationship to the formulas; and

(C) use models to determine the approximate formulas for the circumference and area of a circle and connect the models to the actual formulas.

(9) Expressions, equations, and relationships. The student applies mathematical process standards to solve geometric problems. The student is expected to:

(A) solve problems involving the volume of rectangular prisms, triangular prisms, rectangular pyramids, and triangular pyramids;

(B) determine the circumference and area of circles;

(C) determine the area of composite figures containing combinations of rectangles, squares, parallelograms, trapezoids, triangles, semicircles, and quarter circles; and

(D) solve problems involving the lateral and total surface area of a rectangular prism, rectangular pyramid, triangular prism, and triangular pyramid by determining the area of the shape's net.

(10) Expressions, equations, and relationships. The student applies mathematical process standards to use one-variable equations and inequalities to represent situations. The student is expected to:

(A) write one-variable, two-step equations and inequalities to represent constraints or conditions within problems;

(B) represent solutions for one-variable, two-step equations and inequalities on number lines; and

(C) write a corresponding real-world problem given a one-variable, two-step equation or inequality.

(11) Expressions, equations, and relationships. The student applies mathematical process standards to solve one-variable equations and inequalities. The student is expected to:

(A) model and solve one-variable, two-step equations and inequalities;

(B) determine if the given value(s) make(s) one-variable, two-step equations and inequalities true; and

(C) write and solve equations using geometry concepts, including the sum of the angles in a triangle, and angle relationships.

(12) Measurement and data. The student applies mathematical process standards to use statistical representations to analyze data. The student is expected to:

(A) compare two groups of numeric data using comparative dot plots or box plots by comparing their shapes, centers, and spreads;

(B) use data from a random sample to make inferences about a population; and

(C) compare two populations based on data in random samples from these populations, including informal comparative inferences about differences between the two populations.

(13) Personal financial literacy. The student applies mathematical process standards to develop an economic way of thinking and problem solving useful in one's life as a knowledgeable consumer and investor. The student is expected to:

(A) calculate the sales tax for a given purchase and calculate income tax for earned wages;

(B) identify the components of a personal budget, including income; planned savings for college, retirement, and emergencies; taxes; and fixed and variable expenses, and calculate what percentage each category comprises of the total budget;

(C) create and organize a financial assets and liabilities record and construct a net worth statement;

(D) use a family budget estimator to determine the minimum household budget and average hourly wage needed for a family to meet its basic needs in the student's city or another large city nearby;

(E) calculate and compare simple interest and compound interest earnings; and

(F) analyze and compare monetary incentives, including sales, rebates, and coupons.

Grade 8

(b) Knowledge and skills.

(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace;

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(E) create and use representations to organize, record, and communicate mathematical ideas;

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(2) Number and operations. The student applies mathematical process standards to represent and use real numbers in a variety of forms. The student is expected to:

(A) extend previous knowledge of sets and subsets using a visual representation to describe relationships between sets of real numbers;

(B) approximate the value of an irrational number, including π and square roots of numbers less than 225, and locate that rational number approximation on a number line;

(C) convert between standard decimal notation and scientific notation; and

(D) order a set of real numbers arising from mathematical and real-world contexts.

(3) Proportionality. The student applies mathematical process standards to use proportional relationships to describe dilations. The student is expected to:

(A) generalize that the ratio of corresponding sides of similar shapes are proportional, including a shape and its dilation;

(B) compare and contrast the attributes of a shape and its dilation(s) on a coordinate plane; and

(C) use an algebraic representation to explain the effect of a given positive rational scale factor applied to two-dimensional figures on a coordinate plane with the origin as the center of dilation.

(4) Proportionality. The student applies mathematical process standards to explain proportional and non-proportional relationships involving slope. The student is expected to:

(A) use similar right triangles to develop an understanding that slope, m, given as the rate comparing the change in y- values to the change in x- values, $(y_2 - y_1) / (x_2 - x_1)$, is the same for any two points (x_1, y_1) and (x_2, y_2) on the same line;

(B) graph proportional relationships, interpreting the unit rate as the slope of the line that models the relationship; and

(C) use data from a table or graph to determine the rate of change or slope and y- intercept in mathematical and real-world problems.

(5) Proportionality. The student applies mathematical process standards to use proportional and non-proportional relationships to develop foundational concepts of functions. The student is expected to:

(A) represent linear proportional situations with tables, graphs, and equations in the form of $y = kx$;

(B) represent linear non-proportional situations with tables, graphs, and equations in the form of $y = mx + b$, where $b \neq 0$;

(C) contrast bivariate sets of data that suggest a linear relationship with bivariate sets of data that do not suggest a linear relationship from a graphical representation;

(D) use a trend line that approximates the linear relationship between bivariate sets of data to make predictions;

(E) solve problems involving direct variation;

(F) distinguish between proportional and non-proportional situations using tables, graphs, and equations in the form $y = kx$ or $y = mx + b$, where $b \neq 0$;

(G) identify functions using sets of ordered pairs, tables, mappings, and graphs;

(H) identify examples of proportional and non-proportional functions that arise from mathematical and real-world problems; and

(I) write an equation in the form $y = mx + b$ to model a linear relationship between two quantities using verbal, numerical, tabular, and graphical representations.

(6) Expressions, equations, and relationships. The student applies mathematical process standards to develop mathematical relationships and make connections to geometric formulas. The student is expected to:

(A) describe the volume formula $V = Bh$ of a cylinder in terms of its base area and its height;

(B) model the relationship between the volume of a cylinder and a cone having both congruent bases and heights and connect that relationship to the formulas; and

(C) use models and diagrams to explain the Pythagorean theorem.

(7) Expressions, equations, and relationships. The student applies mathematical process standards to use geometry to solve problems. The student is expected to:

(A) solve problems involving the volume of cylinders, cones, and spheres;

(B) use previous knowledge of surface area to make connections to the formulas for lateral and total surface area and determine solutions for problems involving rectangular prisms, triangular prisms, and cylinders;

(C) use the Pythagorean Theorem and its converse to solve problems; and

(D) determine the distance between two points on a coordinate plane using the Pythagorean Theorem.

(8) Expressions, equations, and relationships. The student applies mathematical process standards to use one-variable equations or inequalities in problem situations. The student is expected to:

(A) write one-variable equations or inequalities with variables on both sides that represent problems using rational number coefficients and constants;

(B) write a corresponding real-world problem when given a one-variable equation or inequality with variables on both sides of the equal sign using rational number coefficients and constants;

(C) model and solve one-variable equations with variables on both sides of the equal sign that represent mathematical and real-world problems using rational number coefficients and constants; and

(D) use informal arguments to establish facts about the angle sum and exterior angle of triangles, the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles.

(9) Expressions, equations, and relationships. The student applies mathematical process standards to use multiple representations to develop foundational concepts of simultaneous linear equations. The student is expected to identify and verify the values of x and y that simultaneously

satisfy two linear equations in the form $y = mx + b$ from the intersections of the graphed equations.

(10) Two-dimensional shapes. The student applies mathematical process standards to develop transformational geometry concepts. The student is expected to:

(A) generalize the properties of orientation and congruence of rotations, reflections, translations, and dilations of two-dimensional shapes on a coordinate plane;

(B) differentiate between transformations that preserve congruence and those that do not;

(C) explain the effect of translations, reflections over the *x*- or *y*- axis, and rotations limited to 90°, 180°, 270°, and 360° as applied to two-dimensional shapes on a coordinate plane using an algebraic representation; and

(D) model the effect on linear and area measurements of dilated two-dimensional shapes.

(11) Measurement and data. The student applies mathematical process standards to use statistical procedures to describe data. The student is expected to:

(A) construct a scatterplot and describe the observed data to address questions of association such as linear, non-linear, and no association between bivariate data;

(B) determine the mean absolute deviation and use this quantity as a measure of the average distance data are from the mean using a data set of no more than 10 data points; and

(C) simulate generating random samples of the same size from a population with known characteristics to develop the notion of a random sample being representative of the population from which it was selected.

(12) Personal financial literacy. The student applies mathematical process standards to develop an economic way of thinking and problem solving useful in one's life as a knowledgeable consumer and investor. The student is expected to:

(A) solve real-world problems comparing how interest rate and loan length affect the cost of credit;

(B) calculate the total cost of repaying a loan, including credit cards and easy access loans, under various rates of interest and over different periods using an online calculator;

(C) explain how small amounts of money invested regularly, including money saved for college and retirement, grow over time;

(D) calculate and compare simple interest and compound interest earnings;

(E) identify and explain the advantages and disadvantages of different payment methods;

(F) analyze situations to determine if they represent financially responsible decisions and identify the benefits of financial responsibility and the costs of financial irresponsibility; and

(G) estimate the cost of a two-year and four-year college education, including family contribution, and devise a periodic savings plan for accumulating the money needed to contribute to the total cost of attendance for at least the first year of college.

Algebra I

(c) Knowledge and skills.

(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace;

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(E) create and use representations to organize, record, and communicate mathematical ideas;

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(2) Linear functions, equations, and inequalities. The student applies the mathematical process standards when using properties of linear functions to write and represent in multiple ways, with and without technology, linear equations, inequalities, and systems of equations. The student is expected to:

(A) determine the domain and range of a linear function in mathematical problems; determine reasonable domain and range values for real-world situations, both continuous and discrete; and represent domain and range using inequalities;

(B) write linear equations in two variables in various forms, including $y = mx + b$, $Ax + By = C$, and $y - y_1 = m(x - x_1)$, given one point and the slope and given two points;

(C) write linear equations in two variables given a table of values, a graph, and a verbal description;

(D) write and solve equations involving direct variation;

(E) write the equation of a line that contains a given point and is parallel to a given line;

(F) write the equation of a line that contains a given point and is perpendicular to a given line;

(G) write an equation of a line that is parallel or perpendicular to the X or Y axis and determine whether the slope of the line is zero or undefined;

(H) write linear inequalities in two variables given a table of values, a graph, and a verbal description; and

(I) write systems of two linear equations given a table of values, a graph, and a verbal description.

(3) Linear functions, equations, and inequalities. The student applies the mathematical process standards when using graphs of linear functions, key features, and related transformations to represent in multiple ways and solve, with and without technology, equations, inequalities, and systems of equations. The student is expected to:

(A) determine the slope of a line given a table of values, a graph, two points on the line, and an equation written in various forms, including $y = mx + b$, $Ax + By = C$, and $y - y_1 = m(x - x_1)$;

(B) calculate the rate of change of a linear function represented tabularly, graphically, or algebraically in context of mathematical and real-world problems;

(C) graph linear functions on the coordinate plane and identify key features, including x- intercept, y- intercept, zeros, and slope, in mathematical and real-world problems;

(D) graph the solution set of linear inequalities in two variables on the coordinate plane;

(E) determine the effects on the graph of the parent function $f(x) = x$ when $f(x)$ is replaced by $af(x)$, $f(x) + d$, $f(x - c)$, $f(bx)$ for specific values of a, b, c, and d;

(F) graph systems of two linear equations in two variables on the coordinate plane and determine the solutions if they exist;

(G) estimate graphically the solutions to systems of two linear equations with two variables in real-world problems; and

(H) graph the solution set of systems of two linear inequalities in two variables on the coordinate plane.

(4) Linear functions, equations, and inequalities. The student applies the mathematical process standards to formulate statistical relationships and evaluate their reasonableness based on real-world data. The student is expected to:

(A) calculate, using technology, the correlation coefficient between two quantitative variables and interpret this quantity as a measure of the strength of the linear association;

(B) compare and contrast association and causation in real-world problems; and

(C) write, with and without technology, linear functions that provide a reasonable fit to data to estimate solutions and make predictions for real-world problems.

(5) Linear functions, equations, and inequalities. The student applies the mathematical process standards to solve, with and without technology, linear equations and evaluate the reasonableness of their solutions. The student is expected to:

(A) solve linear equations in one variable, including those for which the application of the distributive property is necessary and for which variables are included on both sides;

(B) solve linear inequalities in one variable, including those for which the application of the distributive property is necessary and for which variables are included on both sides; and

(C) solve systems of two linear equations with two variables for mathematical and real-world problems.

(6) Quadratic functions and equations. The student applies the mathematical process standards when using properties of quadratic functions to write and represent in multiple ways, with and without technology, quadratic equations. The student is expected to:

(A) determine the domain and range of quadratic functions and represent the domain and range using inequalities;

(B) write equations of quadratic functions given the vertex and another point on the graph, write the equation in vertex form $(f(x) = a(x - h)^2 + k)$, and rewrite the equation from vertex form to standard form $(f(x) = ax^2 + bx + c)$; and

(C) write quadratic functions when given real solutions and graphs of their related equations.

(7) Quadratic functions and equations. The student applies the mathematical process standards when using graphs of quadratic functions and their related transformations to represent in multiple ways and determine, with and without technology, the solutions to equations. The student is expected to:

(A) graph quadratic functions on the coordinate plane and use the graph to identify key attributes, if possible, including x- intercept, y- intercept, zeros, maximum value, minimum values, vertex, and the equation of the axis of symmetry;

(B) describe the relationship between the linear factors of quadratic expressions and the zeros of their associated quadratic functions; and

(C) determine the effects on the graph of the parent function $f(x) = x^2$ when $f(x)$ is replaced by $af(x)$, $f(x) + d$, $f(x - c)$, $f(bx)$ for specific values of a, b, c, and d.

(8) Quadratic functions and equations. The student applies the mathematical process standards to solve, with and without technology, quadratic equations and evaluate the reasonableness of their solutions. The student formulates statistical relationships and evaluates their reasonableness based on real-world data. The student is expected to:

(A) solve quadratic equations having real solutions by factoring, taking square roots, completing the square, and applying the quadratic formula; and

(B) write, using technology, quadratic functions that provide a reasonable fit to data to estimate solutions and make predictions for real-world problems.

(9) Exponential functions and equations. The student applies the mathematical process standards when using properties of exponential functions and their related transformations to write, graph, and represent in multiple ways exponential equations and evaluate, with and without technology, the reasonableness of their solutions. The student formulates statistical relationships and evaluates their reasonableness based on real-world data. The student is expected to:

(A) determine the domain and range of exponential functions of the form $f(x) = ab^x$ and represent the domain and range using inequalities;

(B) interpret the meaning of the values of a and b in exponential functions of the form $f(x) = ab^x$ in real-world problems;

(C) write exponential functions in the form $f(x) = ab^x$ (where b is a rational number) to describe problems arising from mathematical and real-world situations, including growth and decay;

(D) graph exponential functions that model growth and decay and identify key features, including y- intercept and asymptote, in mathematical and real-world problems; and

(E) write, using technology, exponential functions that provide a reasonable fit to data and make predictions for real-world problems.

(10) Number and algebraic methods. The student applies the mathematical process standards and algebraic methods to rewrite in equivalent forms and perform operations on polynomial expressions. The student is expected to:

(A) add and subtract polynomials of degree one and degree two;

(B) multiply polynomials of degree one and degree two;

(C) determine the quotient of a polynomial of degree one and polynomial of degree two when divided by a polynomial of degree one and polynomial of degree two when the degree of the divisor does not exceed the degree of the dividend;

(D) rewrite polynomial expressions of degree one and degree two in equivalent forms using the distributive property;

(E) factor, if possible, trinomials with real factors in the form $ax^2 + bx + c$, including perfect square trinomials of degree two; and

(F) decide if a binomial can be written as the difference of two squares and, if possible, use the structure of a difference of two squares to rewrite the binomial.

(11) Number and algebraic methods. The student applies the mathematical process standards and algebraic methods to rewrite algebraic expressions into equivalent forms. The student is expected to:

(A) simplify numerical radical expressions involving square roots; and

(B) simplify numeric and algebraic expressions using the laws of exponents, including integral and rational exponents.

(12) Number and algebraic methods. The student applies the mathematical process standards and algebraic methods to write, solve, analyze, and evaluate equations, relations, and functions. The student is expected to:

(A) decide whether relations represented verbally, tabularly, graphically, and symbolically define a function;

(B) evaluate functions, expressed in function notation, given one or more elements in their domains;

(C) identify terms of arithmetic and geometric sequences when the sequences are given in function form using recursive processes;

(D) write a formula for the n^{th} term of arithmetic and geometric sequences, given the value of several of their terms; and

(E) solve mathematic and scientific formulas, and other literal equations, for a specified variable.

Algebra II

(c) Knowledge and skills.

(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace;

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(E) create and use representations to organize, record, and communicate mathematical ideas;

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(G) display, explain, or justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(2) Attributes of functions and their inverses. The student applies mathematical processes to understand that functions have distinct key attributes and understand the relationship between a function and its inverse. The student is expected to:

(A) graph the functions $f(x)=\sqrt{x}$, $f(x)=1/x$, $f(x)=x^3$, $f(x)=\sqrt[3]{x}$, $f(x)=b^x$, $f(x)=|x|$, and $f(x)=\log_b(x)$ where b is 2, 10, and e, and, when applicable, analyze the key attributes such as domain, range, intercepts, symmetries, asymptotic behavior, and maximum and minimum given an interval;

(B) graph and write the inverse of a function using notation such as $f^{-1}(x)$;

(C) describe and analyze the relationship between a function and its inverse (quadratic and square root, logarithmic and exponential), including the restriction(s) on domain, which will restrict its range; and

(D) use the composition of two functions, including the necessary restrictions on the domain, to determine if the functions are inverses of each other.

(3) Systems of equations and inequalities. The student applies mathematical processes to formulate systems of equations and inequalities, use a variety of methods to solve, and analyze reasonableness of solutions. The student is expected to:

(A) formulate systems of equations, including systems consisting of three linear equations in three variables and systems consisting of two equations, the first linear and the second quadratic;

(B) solve systems of three linear equations in three variables by using Gaussian elimination, technology with matrices, and substitution;

(C) solve, algebraically, systems of two equations in two variables consisting of a linear equation and a quadratic equation;

(D) determine the reasonableness of solutions to systems of a linear equation and a quadratic equation in two variables;

(E) formulate systems of at least two linear inequalities in two variables;

(F) solve systems of two or more linear inequalities in two variables; and

(G) determine possible solutions in the solution set of systems of two or more linear inequalities in two variables.

(4) Quadratic and square root functions, equations, and inequalities. The student applies mathematical processes to understand that quadratic and square root functions, equations, and quadratic inequalities can be used to model situations, solve problems, and make predictions. The student is expected to:

(A) write the quadratic function given three specified points in the plane;

(B) write the equation of a parabola using given attributes, including vertex, focus, directrix, axis of symmetry, and direction of opening;

(C) determine the effect on the graph of $f(x) = \sqrt{x}$ when $f(x)$ is replaced by $af(x)$, $f(x) + d$, $f(bx)$, and $f(x - c)$ for specific positive and negative values of a, b, c, and d;

(D) transform a quadratic function $f(x) = ax^2 + bx + c$ to the form $f(x) = a(x - h)^2 + k$ to identify the different attributes of $f(x)$;

(E) formulate quadratic and square root equations using technology given a table of data;

(F) solve quadratic and square root equations;

(G) identify extraneous solutions of square root equations; and

(H) solve quadratic inequalities.

(5) Exponential and logarithmic functions and equations. The student applies mathematical processes to understand that exponential and logarithmic functions can be used to model situations and solve problems. The student is expected to:

(A) determine the effects on the key attributes on the graphs of $f(x) = b^x$ and $f(x) = \log_b(x)$ where b is 2, 10, and e when $f(x)$ is replaced by $af(x)$, $f(x) + d$, and $f(x - c)$ for specific positive and negative real values of a, c, and d;

(B) formulate exponential and logarithmic equations that model real-world situations, including exponential relationships written in recursive notation;

(C) rewrite exponential equations as their corresponding logarithmic equations and logarithmic equations as their corresponding exponential equations;

(D) solve exponential equations of the form $y = ab^x$ where a is a nonzero real number and b is greater than zero and not equal to one and single logarithmic equations having real solutions; and

(E) determine the reasonableness of a solution to a logarithmic equation.

(6) Cubic, cube root, absolute value and rational functions, equations, and inequalities. The student applies mathematical processes to understand that cubic, cube root, absolute value and rational functions, equations, and inequalities can be used to model situations, solve problems, and make predictions. The student is expected to:

(A) analyze the effect on the graphs of $f(x) = x^3$ and $f(x) = \sqrt[3]{x}$ when $f(x)$ is replaced by $af(x)$, $f(bx)$, $f(x - c)$, and $f(x) + d$ for specific positive and negative real values of a, b, c, and d;

(B) solve cube root equations that have real roots;

(C) analyze the effect on the graphs of $f(x) = |x|$ when $f(x)$ is replaced by $af(x)$, $f(bx)$, $f(x-c)$, and $f(x) + d$ for specific positive and negative real values of a, b, c, and d;

(D) formulate absolute value linear equations;

(E) solve absolute value linear equations;

(F) solve absolute value linear inequalities;

(G) analyze the effect on the graphs of $f(x) = 1/x$ when $f(x)$ is replaced by $af(x)$, $f(bx)$, $f(x-c)$, and $f(x) + d$ for specific positive and negative real values of a, b, c, and d;

(H) formulate rational equations that model real-world situations;

(I) solve rational equations that have real solutions;

(J) determine the reasonableness of a solution to a rational equation;

(K) determine the asymptotic restrictions on the domain of a rational function and represent domain and range using interval notation, inequalities, and set notation; and

(L) formulate and solve equations involving inverse variation.

(7) Number and algebraic methods. The student applies mathematical processes to simplify and perform operations on expressions and to solve equations. The student is expected to:

(A) add, subtract, and multiply complex numbers;

(B) add, subtract, and multiply polynomials;

(C) determine the quotient of a polynomial of degree three and of degree four when divided by a polynomial of degree one and of degree two;

(D) determine the linear factors of a polynomial function of degree three and of degree four using algebraic methods;

(E) determine linear and quadratic factors of a polynomial expression of degree three and of degree four, including factoring the sum and difference of two cubes and factoring by grouping;

(F) determine the sum, difference, product, and quotient of rational expressions with integral exponents of degree one and of degree two;

(G) rewrite radical expressions that contain variables to equivalent forms;

(H) solve equations involving rational exponents; and

(I) write the domain and range of a function in interval notation, inequalities, and set notation.

(8) Data. The student applies mathematical processes to analyze data, select appropriate models, write corresponding functions, and make predictions. The student is expected to:

(A) analyze data to select the appropriate model from among linear, quadratic, and exponential models;

(B) use regression methods available through technology to write a linear function, a quadratic function, and an exponential function from a given set of data; and

(C) predict and make decisions and critical judgments from a given set of data using linear, quadratic, and exponential models.

Geometry

(c) Knowledge and skills.

(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace;

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(E) create and use representations to organize, record, and communicate mathematical ideas;

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(2) Coordinate and transformational geometry. The student uses the process skills to understand the connections between algebra and geometry and uses the one- and two-dimensional coordinate systems to verify geometric conjectures. The student is expected to:

(A) determine the coordinates of a point that is a given fractional distance less than one from one end of a line segment to the other in one- and two-dimensional coordinate systems, including finding the midpoint;

(B) derive and use the distance, slope, and midpoint formulas to verify geometric relationships, including congruence of segments and parallelism or perpendicularity of pairs of lines; and

(C) determine an equation of a line parallel or perpendicular to a given line that passes through a given point.

(3) Coordinate and transformational geometry. The student uses the process skills to generate and describe rigid transformations (translation, reflection, and rotation) and non-rigid transformations (dilations that preserve similarity and reductions and enlargements that do not preserve similarity). The student is expected to:

(A) describe and perform transformations of figures in a plane using coordinate notation;

(B) determine the image or pre-image of a given two-dimensional figure under a composition of rigid transformations, a composition of non-rigid transformations, and a composition of both, including dilations where the center can be any point in the plane;

(C) identify the sequence of transformations that will carry a given pre-image onto an image on and off the coordinate plane; and

(D) identify and distinguish between reflectional and rotational symmetry in a plane figure.

(4) Logical argument and constructions. The student uses the process skills with deductive reasoning to understand geometric relationships. The student is expected to:

(A) distinguish between undefined terms, definitions, postulates, conjectures, and theorems;

(B) identify and determine the validity of the converse, inverse, and contrapositive of a conditional statement and recognize the connection between a biconditional statement and a true conditional statement with a true converse;

(C) verify that a conjecture is false using a counterexample; and

(D) compare geometric relationships between Euclidean and spherical geometries, including parallel lines and the sum of the angles in a triangle.

(5) Logical argument and constructions. The student uses constructions to validate conjectures about geometric figures. The student is expected to:

(A) investigate patterns to make conjectures about geometric relationships, including angles formed by parallel lines cut by a transversal, criteria required for triangle congruence, special segments of triangles, diagonals of quadrilaterals, interior and exterior angles of polygons, and special segments and angles of circles choosing from a variety of tools;

(B) construct congruent segments, congruent angles, a segment bisector, an angle bisector, perpendicular lines, the perpendicular bisector of a line segment, and a line parallel to a given line through a point not on a line using a compass and a straightedge;

(C) use the constructions of congruent segments, congruent angles, angle bisectors, and perpendicular bisectors to make conjectures about geometric relationships; and

(D) verify the Triangle Inequality theorem using constructions and apply the theorem to solve problems.

(6) Proof and congruence. The student uses the process skills with deductive reasoning to prove and apply theorems by using a variety of methods such as coordinate, transformational, and axiomatic and formats such as two-column, paragraph, and flow chart. The student is expected to:

(A) verify theorems about angles formed by the intersection of lines and line segments, including vertical angles, and angles formed by parallel lines cut by a transversal and prove equidistance between the endpoints of a segment and points on its perpendicular bisector and apply these relationships to solve problems;

(B) prove two triangles are congruent by applying the Side-Angle-Side, Angle-Side-Angle, Side-Side-Side, Angle-Angle-Side, and Hypotenuse-Leg congruence conditions;

(C) apply the definition of congruence, in terms of rigid transformations, to identify congruent figures and their corresponding sides and angles;

(D) verify theorems about the relationships in triangles, including proof of the Pythagorean Theorem, the sum of interior angles, base angles of isosceles triangles, midsegments, and medians, and apply these relationships to solve problems; and

(E) prove a quadrilateral is a parallelogram, rectangle, square, or rhombus using opposite sides, opposite angles, or diagonals and apply these relationships to solve problems.

(7) Similarity, proof, and trigonometry. The student uses the process skills in applying similarity to solve problems. The student is expected to:

(A) apply the definition of similarity in terms of a dilation to identify similar figures and their proportional sides and the congruent corresponding angles; and

(B) apply the Angle-Angle criterion to verify similar triangles and apply the proportionality of the corresponding sides to solve problems.

(8) Similarity, proof, and trigonometry. The student uses the process skills with deductive reasoning to prove and apply theorems by using a variety of methods such as coordinate, transformational, and axiomatic and formats such as two-column, paragraph, and flow chart. The student is expected to:

(A) prove theorems about similar triangles, including the Triangle Proportionality theorem, and apply these theorems to solve problems; and

(B) identify and apply the relationships that exist when an altitude is drawn to the hypotenuse of a right triangle, including the geometric mean, to solve problems.

(9) Similarity, proof, and trigonometry. The student uses the process skills to understand and apply relationships in right triangles. The student is expected to:

(A) determine the lengths of sides and measures of angles in a right triangle by applying the trigonometric ratios sine, cosine, and tangent to solve problems; and

(B) apply the relationships in special right triangles 30°-60°-90° and 45°-45°-90° and the Pythagorean theorem, including Pythagorean triples, to solve problems.

(10) Two-dimensional and three-dimensional figures. The student uses the process skills to recognize characteristics and dimensional changes of two- and three-dimensional figures. The student is expected to:

(A) identify the shapes of two-dimensional cross-sections of prisms, pyramids, cylinders, cones, and spheres and identify three-dimensional objects generated by rotations of two-dimensional shapes; and

(B) determine and describe how changes in the linear dimensions of a shape affect its perimeter, area, surface area, or volume, including proportional and non-proportional dimensional change.

(11) Two-dimensional and three-dimensional figures. The student uses the process skills in the application of formulas to determine measures of two- and three-dimensional figures. The student is expected to:

(A) apply the formula for the area of regular polygons to solve problems using appropriate units of measure;

(B) determine the area of composite two-dimensional figures comprised of a combination of triangles, parallelograms, trapezoids, kites, regular polygons, or sectors of circles to solve problems using appropriate units of measure;

(C) apply the formulas for the total and lateral surface area of three-dimensional figures, including prisms, pyramids, cones, cylinders, spheres, and composite figures, to solve problems using appropriate units of measure; and

(D) apply the formulas for the volume of three-dimensional figures, including prisms, pyramids, cones, cylinders, spheres, and composite figures, to solve problems using appropriate units of measure.

(12) Circles. The student uses the process skills to understand geometric relationships and apply theorems and equations about circles. The student is expected to:

(A) apply theorems about circles, including relationships among angles, radii, chords, tangents, and secants, to solve non-contextual problems;

(B) apply the proportional relationship between the measure of an arc length of a circle and the circumference of the circle to solve problems;

(C) apply the proportional relationship between the measure of the area of a sector of a circle and the area of the circle to solve problems;

(D) describe radian measure of an angle as the ratio of the length of an arc intercepted by a central angle and the radius of the circle; and

(E) show that the equation of a circle with center at the origin and radius r is $x^2 + y^2 = r^2$ and determine the equation for the graph of a circle with radius r and center (h, k), $(x - h)^2 + (y - k)^2 = r^2$.

(13) Probability. The student uses the process skills to understand probability in real-world situations and how to apply independence and dependence of events. The student is expected to:

(A) develop strategies to use permutations and combinations to solve contextual problems;

(B) determine probabilities based on area to solve contextual problems;

(C) identify whether two events are independent and compute the probability of the two events occurring together with or without replacement;

(D) apply conditional probability in contextual problems; and

(E) apply independence in contextual problems.

Precalculus

(c) Knowledge and skills.

(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace;

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(E) create and use representations to organize, record, and communicate mathematical ideas;

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(2) Functions. The student uses process standards in mathematics to explore, describe, and analyze the attributes of functions. The student makes connections between multiple representations of functions and algebraically constructs new functions. The student analyzes and uses functions to model real-world problems. The student is expected to:

(A) use the composition of two functions to model and solve real-world problems;

(B) demonstrate that function composition is not always commutative;

(C) represent a given function as a composite function of two or more functions;

(D) describe symmetry of graphs of even and odd functions;

(E) determine an inverse function, when it exists, for a given function over its domain or a subset of its domain and represent the inverse using multiple representations;

(F) graph exponential, logarithmic, rational, polynomial, power, trigonometric, inverse trigonometric, and piecewise defined functions, including step functions;

(G) graph functions, including exponential, logarithmic, sine, cosine, rational, polynomial, and power functions and their transformations, including $af(x)$, $f(x) + d$, $f(x - c)$, $f(bx)$ for specific values of a, b, c, and d, in mathematical and real-world problems;

(H) graph arcsin x and arccos x and describe the limitations on the domain;

(I) determine and analyze the key features of exponential, logarithmic, rational, polynomial, power, trigonometric, inverse trigonometric, and piecewise defined functions, including step functions such as domain, range, symmetry, relative maximum, relative minimum, zeros, asymptotes, and intervals over which the function is increasing or decreasing;

(J) analyze and describe end behavior of functions, including exponential, logarithmic, rational, polynomial, and power functions, using infinity notation to communicate this characteristic in mathematical and real-world problems;

(K) analyze characteristics of rational functions and the behavior of the function around the asymptotes, including horizontal, vertical, and oblique asymptotes;

(L) determine various types of discontinuities in the interval $(-\infty, \infty)$ as they relate to functions and explore the limitations of the graphing calculator as it relates to the behavior of the function around discontinuities;

(M) describe the left-sided behavior and the right-sided behavior of the graph of a function around discontinuities;

(N) analyze situations modeled by functions, including exponential, logarithmic, rational, polynomial, and power functions, to solve real-world problems;

(O) develop and use a sinusoidal function that models a situation in mathematical and real-world problems; and

(P) determine the values of the trigonometric functions at the special angles and relate them in mathematical and real-world problems.

(3) Relations and geometric reasoning. The student uses the process standards in mathematics to model and make connections between algebraic and geometric relations. The student is expected to:

(A) graph a set of parametric equations;

(B) convert parametric equations into rectangular relations and convert rectangular relations into parametric equations;

(C) use parametric equations to model and solve mathematical and real-world problems;

(D) graph points in the polar coordinate system and convert between rectangular coordinates and polar coordinates;

(E) graph polar equations by plotting points and using technology;

(F) determine the conic section formed when a plane intersects a double-napped cone;

(G) make connections between the locus definition of conic sections and their equations in rectangular coordinates;

(H) use the characteristics of an ellipse to write the equation of an ellipse with center *(h, k);* and

(I) use the characteristics of a hyperbola to write the equation of a hyperbola with center *(h, k).*

(4) Number and measure. The student uses process standards in mathematics to apply appropriate techniques, tools, and formulas to calculate measures in mathematical and real-world problems. The student is expected to:

(A) determine the relationship between the unit circle and the definition of a periodic function to evaluate trigonometric functions in mathematical and real-world problems;

(B) describe the relationship between degree and radian measure on the unit circle;

(C) represent angles in radians or degrees based on the concept of rotation and find the measure of reference angles and angles in standard position;

(D) represent angles in radians or degrees based on the concept of rotation in mathematical and real-world problems, including linear and angular velocity;

(E) determine the value of trigonometric ratios of angles and solve problems involving trigonometric ratios in mathematical and real-world problems;

(F) use trigonometry in mathematical and real-world problems, including directional bearing;

(G) use the Law of Sines in mathematical and real-world problems;

(H) use the Law of Cosines in mathematical and real-world problems;

(I) use vectors to model situations involving magnitude and direction;

(J) represent the addition of vectors and the multiplication of a vector by a scalar geometrically and symbolically; and

(K) apply vector addition and multiplication of a vector by a scalar in mathematical and real-world problems.

(5) Algebraic reasoning. The student uses process standards in mathematics to evaluate expressions, describe patterns, formulate models, and solve equations and inequalities using properties, procedures, or algorithms. The student is expected to:

(A) evaluate finite sums and geometric series, when possible, written in sigma notation;

(B) represent arithmetic sequences and geometric sequences using recursive formulas;

(C) calculate the n^{th} term and the n^{th} partial sum of an arithmetic series in mathematical and real-world problems;

(D) represent arithmetic series and geometric series using sigma notation;

(E) calculate the n^{th} term of a geometric series, the n^{th} partial sum of a geometric series, and sum of an infinite geometric series when it exists;

(F) apply the Binomial Theorem for the expansion of $(a + b)^n$ in powers of a and b for a positive integer n, where a and b are any numbers;

(G) use the properties of logarithms to evaluate or transform logarithmic expressions;

(H) generate and solve logarithmic equations in mathematical and real-world problems;

(I) generate and solve exponential equations in mathematical and real-world problems;

(J) solve polynomial equations with real coefficients by applying a variety of techniques in mathematical and real-world problems;

(K) solve polynomial inequalities with real coefficients by applying a variety of techniques and write the solution set of the polynomial inequality in interval notation in mathematical and real-world problems;

(L) solve rational inequalities with real coefficients by applying a variety of techniques and write the solution set of the rational inequality in interval notation in mathematical and real-world problems;

(M) use trigonometric identities such as reciprocal, quotient, Pythagorean, cofunctions, even/odd, and sum and difference identities for cosine and sine to simplify trigonometric expressions; and

(N) generate and solve trigonometric equations in mathematical and real-world problems

Mathematical Models with Applications

(c) Knowledge and skills.

Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace;

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(E) create and use representations to organize, record, and communicate mathematical ideas;

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(2) Mathematical modeling in personal finance. The student uses mathematical processes with graphical and numerical techniques to study patterns and analyze data related to personal finance. The student is expected to:

(A) use rates and linear functions to solve problems involving personal finance and budgeting, including compensations and deductions;

(B) solve problems involving personal taxes; and

(C) analyze data to make decisions about banking, including options for online banking, checking accounts, overdraft protection, processing fees, and debit card/ATM fees.

(3) Mathematical modeling in personal finance. The student uses mathematical processes with algebraic formulas, graphs, and amortization modeling to solve problems involving credit. The student is expected to:

(A) use formulas to generate tables to display series of payments for loan amortizations resulting from financed purchases;

(B) analyze personal credit options in retail purchasing and compare relative advantages and disadvantages of each option;

(C) use technology to create amortization models to investigate home financing and compare buying a home to renting a home; and

(D) use technology to create amortization models to investigate automobile financing and compare buying a vehicle to leasing a vehicle.

(4) Mathematical modeling in personal finance. The student uses mathematical processes with algebraic formulas, numerical techniques, and graphs to solve problems related to financial planning. The student is expected to:

(A) analyze and compare coverage options and rates in insurance;

(B) investigate and compare investment options, including stocks, bonds, annuities, certificates of deposit, and retirement plans; and

(C) analyze types of savings options involving simple and compound interest and compare relative advantages of these options.

(5) Mathematical modeling in science and engineering. The student applies mathematical processes with algebraic techniques to study patterns and analyze data as it applies to science. The student is expected to:

(A) use proportionality and inverse variation to describe physical laws such as Hook's Law, Newton's Second Law of Motion, and Boyle's Law;

(B) use exponential models available through technology to model growth and decay in areas, including radioactive decay; and

(C) use quadratic functions to model motion.

(6) Mathematical modeling in science and engineering. The student applies mathematical processes with algebra and geometry to study patterns and analyze data as it applies to architecture and engineering. The student is expected to:

(A) use similarity, geometric transformations, symmetry, and perspective drawings to describe mathematical patterns and structure in architecture;

(B) use scale factors with two-dimensional and three-dimensional objects to demonstrate proportional and non-proportional changes in surface area and volume as applied to fields;

(C) use the Pythagorean Theorem and special right-triangle relationships to calculate distances; and

(D) use trigonometric ratios to calculate distances and angle measures as applied to fields.

(7) Mathematical modeling in fine arts. The student uses mathematical processes with algebra and geometry to study patterns and analyze data as it applies to fine arts. The student is expected to:

(A) use trigonometric ratios and functions available through technology to model periodic behavior in art and music;

(B) use similarity, geometric transformations, symmetry, and perspective drawings to describe mathematical patterns and structure in art and photography;

(C) use geometric transformations, proportions, and periodic motion to describe mathematical patterns and structure in music; and

(D) use scale factors with two-dimensional and three-dimensional objects to demonstrate proportional and non-proportional changes in surface area and volume as applied to fields.

(8) Mathematical modeling in social sciences. The student applies mathematical processes to determine the number of elements in a finite sample space and compute the probability of an event. The student is expected to:

(A) determine the number of ways an event may occur using combinations, permutations, and the Fundamental Counting Principle;

(B) compare theoretical to empirical probability; and

(C) use experiments to determine the reasonableness of a theoretical model such as binomial or geometric.

(9) Mathematical modeling in social sciences. The student applies mathematical processes and mathematical models to analyze data as it applies to social sciences. The student is expected to:

(A) interpret information from various graphs, including line graphs, bar graphs, circle graphs, histograms, scatterplots, dot plots, stem-and-leaf plots, and box and whisker plots, to draw conclusions from the data and determine the strengths and weaknesses of conclusions;

(B) analyze numerical data using measures of central tendency (mean, median, and mode) and variability (range, interquartile range or IQR, and standard deviation) in order to make inferences with normal distributions;

(C) distinguish the purposes and differences among types of research, including surveys, experiments, and observational studies;

(D) use data from a sample to estimate population mean or population proportion;

(E) analyze marketing claims based on graphs and statistics from electronic and print media and justify the validity of stated or implied conclusions; and

(F) use regression methods available through technology to model linear and exponential functions, interpret correlations, and make predictions.

(10) Mathematical modeling in social sciences. The student applies mathematical processes to design a study and use graphical, numerical, and analytical techniques to communicate the results of the study. The student is expected to:

(A) formulate a meaningful question, determine the data needed to answer the question, gather the appropriate data, analyze the data, and draw reasonable conclusions; and

(B) communicate methods used, analyses conducted, and conclusions drawn for a data-analysis project through the use of one or more of the following: a written report, a visual display, an oral report, or a multi-media presentation.

Advanced Quantitative Reasoning

(c) Knowledge and skills.

(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace;

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(E) create and use representations to organize, record, and communicate mathematical ideas;

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(2) Numeric reasoning. The student applies the process standards in mathematics to generate new understandings by extending existing knowledge. The student generates new mathematical understandings through problems involving numerical data that arise in everyday life, society, and the workplace. The student extends existing knowledge and skills to analyze real-world situations. The student is expected to:

(A) use precision and accuracy in real-life situations related to measurement and significant figures;

(B) apply and analyze published ratings, weighted averages, and indices to make informed decisions;

(C) solve problems involving quantities that are not easily measured using proportionality;

(D) solve geometric problems involving indirect measurement, including similar triangles, the Pythagorean Theorem, Law of Sines, Law of Cosines, and the use of dynamic geometry software;

(E) solve problems involving large quantities using combinatorics;

(F) use arrays to efficiently manage large collections of data and add, subtract, and multiply matrices to solve applied problems, including geometric transformations;

(G) analyze various voting and selection processes to compare results in given situations; and

(H) select and apply an algorithm of interest to solve real-life problems such as problems using recursion or iteration involving population growth or decline, fractals, and compound interest; the validity in recorded and transmitted data using checksums and hashing; sports rankings, weighted class rankings, and search engine rankings; and problems involving scheduling or routing situations using vertex-edge graphs, critical paths, Euler paths, and minimal spanning trees and communicate to peers the application of the algorithm in precise mathematical and nontechnical language.

(3) Algebraic reasoning (expressions, equations, and generalized relationships). The student applies the process standards in mathematics to create and analyze mathematical models of everyday situations to make informed decisions related to earning, investing, spending, and borrowing money by appropriate, proficient, and efficient use of tools, including technology. The student uses mathematical relationships to make connections and predictions. The student judges the validity of a prediction and uses mathematical models to represent, analyze, and solve dynamic real-world problems. The student is expected to:

(A) collect numerical bivariate data to create a scatterplot, select a function to model the data, justify the model selection, and use the model to interpret results and make predictions;

(B) describe the degree to which uncorrelated variables may or may not be related and analyze situations where correlated variables do or do not indicate a cause-and-effect relationship;

(C) determine or analyze an appropriate growth or decay model for problem situations, including linear, exponential, and logistic functions;

(D) determine or analyze an appropriate cyclical model for problem situations that can be modeled with periodic functions;

(E) determine or analyze an appropriate piecewise model for problem situations;

(F) create, represent, and analyze mathematical models for various types of income calculations to determine the best option for a given situation;

(G) create, represent, and analyze mathematical models for expenditures, including those involving credit, to determine the best option for a given situation; and

(H) create, represent, and analyze mathematical models and appropriate representations, including formulas and amortization tables, for various types of loans and investments to determine the best option for a given situation.

(4) Probabilistic and statistical reasoning. The student uses the process standards in mathematics to generate new understandings of probability and statistics. The student analyzes statistical information and evaluates risk and return to connect mathematical ideas and make informed decisions. The student applies a problem-solving model and statistical methods to design and conduct a study that addresses one or more particular question(s). The student uses multiple representations to communicate effectively the results of student-generated statistical studies and the critical analysis of published statistical studies. The student is expected to:

(A) use a two-way frequency table as a sample space to identify whether two events are independent and to interpret the results;

(B) use the Addition Rule, $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$, in mathematical and real-world problems;

(C) calculate conditional probabilities and probabilities of compound events using tree diagrams, Venn diagrams, area models, and formulas;

(D) interpret conditional probabilities and probabilities of compound events by analyzing representations to make decisions in problem situations;

(E) use probabilities to make and justify decisions about risks in everyday life;

(F) calculate expected value to analyze mathematical fairness, payoff, and risk;

(G) determine the validity of logical arguments that include compound conditional statements by constructing truth tables;

(H) identify limitations and lack of relevant information in studies reporting statistical information, especially when studies are reported in condensed form;

(I) interpret and compare statistical results using appropriate technology given a margin of error;

(J) identify potential misuses of statistics to justify particular conclusions, including assertions of a cause-and-effect relationship rather than an association, and missteps or fallacies in logical reasoning;

(K) describe strengths and weaknesses of sampling techniques, data and graphical displays, and interpretations of summary statistics and other results appearing in a study, including reports published in the media;

(L) determine the need for and purpose of a statistical investigation and what type of statistical analysis can be used to answer a specific question or set of questions;

(M) identify the population of interest for a statistical investigation, select an appropriate sampling technique, and collect data;
(N) identify the variables to be used in a study;
(O) determine possible sources of statistical bias in a study and how bias may affect the validity of the results;
(P) create data displays for given data sets to investigate, compare, and estimate center, shape, spread, and unusual features of the data;
(Q) analyze possible sources of data variability, including those that can be controlled and those that cannot be controlled;
(R) report results of statistical studies to a particular audience, including selecting an appropriate presentation format, creating graphical data displays, and interpreting results in terms of the question studied;
(S) justify the design and the conclusion(s) of statistical studies, including the methods used; and
(T) communicate statistical results in oral and written formats using appropriate statistical and nontechnical language.

Independent Study in Mathematics
c) Knowledge and skills: mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:
(1) apply mathematics to problems arising in everyday life, society, and the workplace;
(2) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;
(3) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;
(4) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;
(5) create and use representations to organize, record, and communicate mathematical ideas;
(6) analyze mathematical relationships to connect and communicate mathematical ideas; and
(7) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

Discrete Mathematics for Problem Solving
(c) Knowledge and skills.
(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:
(A) apply mathematics to problems arising in everyday life, society, and the workplace;
(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;
(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(E) create and use representations to organize, record, and communicate mathematical ideas;

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(2) Graph theory. The student applies the concept of graphs to determine possible solutions to real-world problems. The student is expected to:

(A) explain the concept of graphs;

(B) use graph models for simple problems in management science;

(C) determine the valences of the vertices of a graph;

(D) identify Euler circuits in a graph;

(E) solve route inspection problems by Eulerizing a graph;

(F) determine solutions modeled by edge traversal in a graph;

(G) compare the results of solving the traveling salesman problem (TSP) using the nearest neighbor algorithm and using a greedy algorithm;

(H) distinguish between real-world problems modeled by Euler circuits and those modeled by Hamiltonian circuits;

(I) distinguish between algorithms that yield optimal solutions and those that give nearly optimal solutions;

(J) find minimum-cost spanning trees using Kruskal's algorithm;

(K) use the critical path method to determine the earliest possible completion time for a collection of tasks; and

(L) explain the difference between a graph and a directed graph.

(3) Planning and scheduling. The student uses heuristic algorithms to solve real-world problems. The student is expected to:

(A) use the list processing algorithm to schedule tasks on identical processors;

(B) recognize situations appropriate for modeling or scheduling problems;

(C) determine whether a schedule is optimal using the critical path method together with the list processing algorithm;

(D) identify situations appropriate for modeling by bin packing;

(E) use any of six heuristic algorithms to solve bin packing problems;

(F) solve independent task scheduling problems using the list processing algorithm; and

(G) explain the relationship between scheduling problems and bin packing problems.

(4) Group decision making. The student uses mathematical processes to apply decision-making schemes. The student analyzes the effects of multiple types of weighted voting and applies multiple voting concepts to real-world situations. The student is expected to:

(A) describe the concept of a preference schedule and how to use it;

(B) explain how particular decision-making schemes work;

(C) determine the outcome for various voting methods, given the voters' preferences;

(D) explain how different voting schemes or the order of voting can lead to different results;

(E) describe the impact of various strategies on the results of the decision-making process;

(F) explain the impact of Arrow's Impossibility Theorem;

(G) relate the meaning of approval voting;

(H) explain the need for weighted voting and how it works;

(I) identify voting concepts such as Borda count, Condorcet winner, dummy voter, and coalition; and

(J) compute the Banzhaf power index and explain its significance.

(5) Fair division. The student applies the adjusted winner procedure and Knaster inheritance procedure to real-world situations. The student is expected to:

(A) use the adjusted winner procedure to determine a fair allocation of property;

(B) use the adjusted winner procedure to resolve a dispute;

(C) explain how to reach a fair division using the Knaster inheritance procedure;

(D) solve fair division problems with three or more players using the Knaster inheritance procedure;

(E) explain the conditions under which the trimming procedure can be applied to indivisible goods;

(F) identify situations appropriate for the techniques of fair division;

(G) compare the advantages of the divider and the chooser in the divider-chooser method;

(H) discuss the rules and strategies of the divider-chooser method;

(I) resolve cake-division problems for three players using the last-diminisher method;

(J) analyze the relative importance of the three desirable properties of fair division: equitability, envy-freeness, and Pareto optimality; and

(K) identify fair division procedures that exhibit envy-freeness.

(6) Game (or competition) theory. The student uses knowledge of basic game theory concepts to calculate optimal strategies. The student analyzes situations and identifies the use of gaming strategies. The student is expected to:

(A) recognize competitive game situations;

(B) represent a game with a matrix;

(C) identify basic game theory concepts and vocabulary;

(D) determine the optimal pure strategies and value of a game with a saddle point by means of the minimax technique;

(E) explain the concept of and need for a mixed strategy;

(F) compute the optimal mixed strategy and the expected value for a player in a game who has only two pure strategies;

(G) model simple two-by-two, bimatrix games of partial conflict;

(H) identify the nature and implications of the game called "Prisoners' Dilemma";

(I) explain the game known as "chicken";

(J) identify examples that illustrate the prevalence of Prisoners' Dilemma and chicken in our society; and

(K) determine when a pair of strategies for two players is in equilibrium.

(7) Theory of moves. The student analyzes the theory of moves (TOM). The student uses the TOM and game theory to analyze conflicts. The student is expected to:

(A) compare and contrast TOM and game theory;

(B) explain the rules of TOM;

(C) describe what is meant by a cyclic game;

(D) use a game tree to analyze a two-person game;

(E) determine the effect of approaching Prisoners' Dilemma and chicken from the standpoint of TOM and contrast that to the effect of approaching them from the standpoint of game theory;

(F) describe the use of TOM in a larger, more complicated game; and

(G) model a conflict from literature or from a real-life situation as a two-by-two strict ordinal game and compare the results predicted by game theory and by TOM.

Statistics

(c) Knowledge and skills.

(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace;

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(E) create and use representations to organize, record, and communicate mathematical ideas;

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(G) display, explain, or justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(2) Statistical process sampling and experimentation. The student applies mathematical processes to apply understandings about statistical studies, surveys, and experiments to design and conduct a study and use graphical, numerical, and analytical techniques to communicate the results of the study. The student is expected to:

(A) compare and contrast the benefits of different sampling techniques, including random sampling and convenience sampling methods;

(B) distinguish among observational studies, surveys, and experiments;

(C) analyze generalizations made from observational studies, surveys, and experiments;

(D) distinguish between sample statistics and population parameters;

(E) formulate a meaningful question, determine the data needed to answer the question, gather the appropriate data, analyze the data, and draw reasonable conclusions;

(F) communicate methods used, analyses conducted, and conclusions drawn for a data-analysis project through the use of one or more of the following: a written report, a visual display, an oral report, or a multi-media presentation; and

(G) critically analyze published findings for appropriateness of study design implemented, sampling methods used, or the statistics applied.

(3) Variability. The student applies the mathematical process standards when describing and modeling variability. The student is expected to:

(A) distinguish between mathematical models and statistical models;

(B) construct a statistical model to describe variability around the structure of a mathematical model for a given situation;

(C) distinguish among different sources of variability, including measurement, natural, induced, and sampling variability; and

(D) describe and model variability using population and sampling distributions.

(4) Categorical and quantitative data. The student applies the mathematical process standards to represent and analyze both categorical and quantitative data. The student is expected to:

(A) distinguish between categorical and quantitative data;

(B) represent and summarize data and justify the representation;

(C) analyze the distribution characteristics of quantitative data, including determining the possible existence and impact of outliers;

(D) compare and contrast different graphical or visual representations given the same data set;

(E) compare and contrast meaningful information derived from summary statistics given a data set; and

(F) analyze categorical data, including determining marginal and conditional distributions, using two-way tables.

(5) Probability and random variables. The student applies the mathematical process standards to connect probability and statistics. The student is expected to:

(A) determine probabilities, including the use of a two-way table;

(B) describe the relationship between theoretical and empirical probabilities using the Law of Large Numbers;

(C) construct a distribution based on a technology-generated simulation or collected samples for a discrete random variable; and

(D) compare statistical measures such as sample mean and standard deviation from a technology-simulated sampling distribution to the theoretical sampling distribution.

(6) Inference. The student applies the mathematical process standards to make inferences and justify conclusions from statistical studies. The student is expected to:

(A) explain how a sample statistic and a confidence level are used in the construction of a confidence interval;

(B) explain how changes in the sample size, confidence level, and standard deviation affect the margin of error of a confidence interval;

(C) calculate a confidence interval for the mean of a normally distributed population with a known standard deviation;

(D) calculate a confidence interval for a population proportion;

(E) interpret confidence intervals for a population parameter, including confidence intervals from media or statistical reports;

(F) explain how a sample statistic provides evidence against a claim about a population parameter when using a hypothesis test;

(G) construct null and alternative hypothesis statements about a population parameter;

(H) explain the meaning of the p-value in relation to the significance level in providing evidence to reject or fail to reject the null hypothesis in the context of the situation;

(I) interpret the results of a hypothesis test using technology-generated results such as large sample tests for proportion, mean, difference between two proportions, and difference between two independent means; and

(J) describe the potential impact of Type I and Type II Errors.

(7) Bivariate data. The student applies the mathematical process standards to analyze relationships among bivariate quantitative data. The student is expected to:

(A) analyze scatterplots for patterns, linearity, outliers, and influential points;

(B) transform a linear parent function to determine a line of best fit;

(C) compare different linear models for the same set of data to determine best fit, including discussions about error;

(D) compare different methods for determining best fit, including median-median and absolute value;

(E) describe the relationship between influential points and lines of best fit using dynamic graphing technology; and

(F) identify and interpret the reasonableness of attributes of lines of best fit within the context, including slope and y -intercept.

Algebraic Reasoning

(c) Knowledge and skills.

(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace;

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(E) create and use representations to organize, record, and communicate mathematical ideas;

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(G) display, explain, or justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(2) Patterns and structure. The student applies mathematical processes to connect finite differences or common ratios to attributes of functions. The student is expected to:

(A) determine the patterns that identify the relationship between a function and its common ratio or related finite differences as appropriate, including linear, quadratic, cubic, and exponential functions;

(B) classify a function as linear, quadratic, cubic, and exponential when a function is represented tabularly using finite differences or common ratios as appropriate;

(C) determine the function that models a given table of related values using finite differences and its restricted domain and range; and

(D) determine a function that models real-world data and mathematical contexts using finite differences such as the age of a tree and its circumference, figurative numbers, average velocity, and average acceleration.

(3) Patterns and structure. The student applies mathematical processes to understand the connections among representations of functions and combinations of functions, including the constant function, $f(x) = x$, $f(x) = x^2$, $f(x) = \sqrt{x}$, $f(x) = {}^1/_x$, $f(x) = x^3$, $f(x) = \sqrt[3]{x}$, $f(x) = b^x$, $f(x) = |x|$, and $f(x) = \log_b(x)$ where b is 10 or e; functions and their inverses; and key attributes of these functions. The student is expected to:

(A) compare and contrast the key attributes, including domain, range, maxima, minima, and intercepts, of a set of functions such as a set comprised of a linear, a quadratic, and an

exponential function or a set comprised of an absolute value, a quadratic, and a square root function tabularly, graphically, and symbolically;

(B) compare and contrast the key attributes of a function and its inverse when it exists, including domain, range, maxima, minima, and intercepts, tabularly, graphically, and symbolically;

(C) verify that two functions are inverses of each other tabularly and graphically such as situations involving compound interest and interest rate, velocity and braking distance, and Fahrenheit-Celsius conversions;

(D) represent a resulting function tabularly, graphically, and symbolically when functions are combined or separated using arithmetic operations such as combining a 20% discount and a 6% sales tax on a sale to determine $h(x)$, the total sale, $f(x) = 0.8x$, $g(x) = 0.06(0.8x)$, and $h(x) = f(x) + g(x)$;

(E) model a situation using function notation when the output of one function is the input of a second function such as determining a function $h(x) = g(f(x)) = 1.06(0.8x)$ for the final purchase price, $h(x)$ of an item with price x dollars representing a 20% discount, $f(x) = 0.8x$ followed by a 6% sales tax, $g(x) = 1.06x$; and

(F) compare and contrast a function and possible functions that can be used to build it tabularly, graphically, and symbolically such as a quadratic function that results from multiplying two linear functions.

(4) Number and algebraic methods. The student applies mathematical processes to simplify and perform operations on functions represented in a variety of ways, including real-world situations. The student is expected to:

(A) connect tabular representations to symbolic representations when adding, subtracting, and multiplying polynomial functions arising from mathematical and real-world situations such as applications involving surface area and volume;

(B) compare and contrast the results when adding two linear functions and multiplying two linear functions that are represented tabularly, graphically, and symbolically;

(C) determine the quotient of a polynomial function of degree three and of degree four when divided by a polynomial function of degree one and of degree two when represented tabularly and symbolically; and

(D) determine the linear factors of a polynomial function of degree two and of degree three when represented symbolically and tabularly and graphically where appropriate.

(5) Number and algebraic methods. The student applies mathematical processes to represent, simplify, and perform operations on matrices and to solve systems of equations using matrices. The student is expected to:

(A) add and subtract matrices;

(B) multiply matrices;

(C) multiply matrices by a scalar;

(D) represent and solve systems of two linear equations arising from mathematical and real-world situations using matrices; and

(E) represent and solve systems of three linear equations arising from mathematical and real-world situations using matrices and technology.

(6) Number and algebraic methods. The student applies mathematical processes to estimate and determine solutions to equations resulting from functions and real-world applications with fluency. The student is expected to:

(A) estimate a reasonable input value that results in a given output value for a given function, including quadratic, rational, and exponential functions;

(B) solve equations arising from questions asked about functions that model real-world applications, including linear and quadratic functions, tabularly, graphically, and symbolically; and

(C) approximate solutions to equations arising from questions asked about exponential, logarithmic, square root, and cubic functions that model real-world applications tabularly and graphically.

(7) Modeling from data. The student applies mathematical processes to analyze and model data based on real-world situations with corresponding functions. The student is expected to:

(A) represent domain and range of a function using interval notation, inequalities, and set (builder) notation;

(B) compare and contrast between the mathematical and reasonable domain and range of functions modeling real-world situations, including linear, quadratic, exponential, and rational functions;

(C) determine the accuracy of a prediction from a function that models a set of data compared to the actual data using comparisons between average rates of change and finite differences such as gathering data from an emptying tank and comparing the average rate of change of the volume or the second differences in the volume to key attributes of the given model;

(D) determine an appropriate function model, including linear, quadratic, and exponential functions, for a set of data arising from real-world situations using finite differences and average rates of change; and

(E) determine if a given linear function is a reasonable model for a set of data arising from a real-world situation.

Appendix B: Learning experiences at WCOE

Clinical experiences at the WCOE, including both initial clinical experiences (e.g., classroom observations) and clinical teaching, are an essential part of the professional preparation program. Clinical experiences vary across many WCOE undergraduate programs and are designed and implemented through collaboration with school district and community partners. WCOE teacher candidates gain essential knowledge, skills, and dispositions through observations and teaching opportunities in a wide variety of diverse settings (e.g., urban/rural, SES, special needs, race/ethnicity). WCOE believes in gradual release of responsibilities and exposes and evaluates teacher candidates throughout the program so as to provide them with the best learning experience. Below are the assessments that are used across courses and programs to effectively monitor teacher candidates' progress.

Dispositions

Candidates in the teacher education program are evaluated on their dispositions towards the 10 In TASC standards three times (beginning, middle, end) during their program in Educational Psychology, Professional Methods Block A, and Clinical Teaching in the following areas:

- Candidates respect learners' differing strengths and needs and are committed to using this information to further each learner's development.
- Candidates believe that all learners can achieve at high levels and persist in helping each learner reach his/her full potential.

- Candidates are committed to working with learners, colleagues, families, and communities to establish positive and supportive learning environments.
- Candidates realize that content knowledge is not a fixed body of facts but is complex, culturally situated, and ever evolving. He or she keeps abreast of new ideas and understandings in the field.
- Candidates value flexible learning environments that encourage learner exploration, discovery, and expression across content areas.
- Candidates are committed to using multiple types of assessment processes to support, verify, and document learning.
- Candidates respect learners' diverse strengths and needs and are committed to using this information to plan effective instruction.
- Candidates are committed to deepening awareness and understanding the strengths and needs of diverse learners when planning and adjusting instruction.
- Candidates take responsibility for student learning and use ongoing analysis and reflection to improve planning and practice.
- Candidates actively share responsibility for shaping and supporting the mission of his/her school as one of advocacy for learners and accountability for their success.

Candidates are evaluated by faculty in those courses at a developing, beginning, and mastery level of competency as determined by the academic committee on program quality. The evaluation is based upon evidence gathered through classroom participation, assignments, observed field experiences and unit planning.

Data Literacy Assignment

Teacher candidates are expected to demonstrate the ability to interpret standardized test data and make instructional decisions based on the test data from students. At the conclusion of the Classroom Assessment/Assessment in PE, students will develop an understanding of assessment practices that enable them to accurately read and interpret testing data. In addition, teacher candidates will apply concepts learned in the course to explain what the data means and what, if any, interventions should be implemented for targeting specific groups of students. By identifying weak areas of conceptual understanding of their students, teacher candidates can create appropriate instructional strategies that lead to greater student success.

Lesson Planning

Teacher candidates must demonstrate the ability to plan, assess, and implement instruction. This begins in the Foundational block where the teacher candidates create and write lessons for effective teaching. Teacher candidates are required to develop lesson plans. The specific format can be adapted, but should always include the objectives (TEKS), procedures, materials/resources, and assessment. Student engagement is a key element in a good lesson with a goal of student learning/success is the ultimate goal.

Candidates must form an assessment strategy to determine the extent to which students are able to master learning of objectives. Candidates also describes the instructional delivery method addressing the following step-by-step procedures:

1. Questions and concerns listed in the directions given to you by your instructor
2. Setting purposes ("Today we will be…I want you to…because you will…")
3. Method(s) for engaging students in the lesson
4. Any questions asked during the lesson should be in bold

5. Higher order thinking reflected in questions
6. Instructional Strategies: Modeling, Discussion, "Hands-on", Inquiry, etc.
7. Grouping: when and how
8. Instruction that addresses learners' needs (ELLs, Special Education, 504, Gifted, Struggling Learner)
9. Closure

After teaching the lesson, candidates are then required to reflect on the lesson delivery, appropriateness of instructional strategies, impact for future planning, and opportunities for collaboration with mentor teacher. The skills acquired during lesson planning provides the foundation and are also built upon for unit planning and other key assessments.

Unit Plan

Teacher candidate's ability to demonstrate the ability to plan, assess, and implement instruction continues in the professional block with the Unit plan assessment. The unit plan assessment is a modified form of Midwestern Impact on Student Learning (MISL) that requires teacher candidates to plan a unit of teaching. Candidates are required to determine a set of multiple learning objectives aligned to state content standards Texas Essential Knowledge and Skills (TEKS) appropriate to the lesson(s) the candidate is preparing. This key assignment should be submitted in TK20.

Co-Teaching

WCOE adopts a co-teaching model for the candidates during their clinical experiences. These strategies include the following:

- One Teach, One Observe — One teacher has primary instructional responsibility while the other gathers specific observational information on students or the (instructing) teacher. The key to this strategy is to have a focus for the observation.
- One Teach, One Assist — One teacher has primary instructional responsibility while the other teacher assists students with their work, monitors behaviors, or corrects assignments.
- Station Teaching — The co-teaching pair divide the instructional content into parts and the students into groups. Groups spend a designated amount of time at each station. Often an independent station will be used.
- Parallel Teaching — Each teacher instructs half of the students. The two teachers are addressing the same instructional material and present the lesson using the same teaching strategy. The greatest benefit is the reduction of student to teacher ratio.
- Supplemental Teaching — This strategy allows one teacher to work with students at their expected grade level, while the co-teacher works with those students who need the information and/or materials extended or remediated.
- Alternative/Differentiated Teaching — Alternative teaching strategies provide two different approaches to teaching the same information. The learning outcome is the same for all students, however the instructional methodology is different.
- Team Teaching — Well-planned, team-taught lessons, exhibit an invisible flow of instruction with no prescribed division of authority. Using a team-teaching strategy, both teachers are actively involved in the lesson. From a student's perspective, there is no clearly defined leader, as both teachers share the instruction, are free to interject in-

formation, and available to assist students and answer questions. (Adapted from Cook & Friend (1995))

Midwestern Impact on Student Learning [MISL]

Successful completion and submission of a MISL portfolio is required during the first six weeks of clinical teaching. Teachers candidates are required to plan, implement, and assess student learning within a unit of study. The Midwestern Impact on Student Learning (MISL) measures content knowledge, pedagogical knowledge, and effect on student learning in the following areas/domains: Learning Environments; Individual Development and Diversity; Collaboration; Planning Process and Content; Assessment; Strategies and Methods; Reflection; Professional Development; and Communication.

Each of the 10 areas is scored with one of 4 ratings: Exemplary 4, Competent 3, Needs Improvement 2, and Unsatisfactory 1. An overall score of 20 (meets expectations) is required for successful completion of student teaching for all teacher candidates.

The MISL is a record of candidates' ability to carefully consider all contextual factors that influence instruction and to then use those factors to plan and design a unit of instruction, including an assessment plan that can demonstrate changes in student knowledge, skills, or dispositions resulting from instruction. The MISL includes both reflexive (description of instructional decision making during the unit) and reflective components that encourage candidates to plan instruction strategically and to approach teaching in a purposeful, thoughtful, and methodical manner.

Appendix B: Required assignment/standard alignment matrix

Assignment	Course Objectives - (CO #)	WCOE Standard (WCOE #) EC-6 Competency (EC6C #)
Intro Technology Assignment	CO #10	WCOE #4
Vertical Alignment Assignment	CO #1	WCOE #1,4,5, EC6C #1,2,3,4,5,6
Multicultural Mini Teaching	CO #2,4,5,7,8,10	WCOE #1,2,4,5,7,8, EC6C #1,2,6
Lesson Plan and Reflection	CO #2,4,5,7,8	WCOE #1,2,4,5,6,7,8,10 EC6C #1,2,3,4,5,6
Classroom Observation	CO #2,6,7,8,9	WCOE #1,2,3,4,5,6,7,8,10 EC6C #1,2,3,4,5,6
Technology Lesson and other assignment	CO #3,8,10	WCOE #4,6,8 EC6C #1,2,3,4,5,6
Reflection Assignment	CO #1,3,4,6	WCOE #1,2,5 EC6C #1,2,6
Notice/Wonder/Think Presentation	CO #1,3,4,10	WCOE #2,4,5,6,10 EC6C #1,2,6
Data Analysis Assignment	CO #1,9	WCOE #1,2,3,7,8,9,10 EC6C #1,2,3,4,5,6
Unit Plan	CO #1,2,3	WCOE #1,2,3,4,5,7,8,10 EC6C #1,2,3,4,5,6
Field Experience	CO #1,2,3,4,6,9,10	WCOE #1,2,3,4,5,6,7,8,9,10 EC6C #1,2,3,4,5,6
In Class Activities: class discussion, lecture, guided reading, guest speakers, case study, peer practice, experiential learning, exploration, and role playing	CO #1,2,3,4,5,6,7,8,9,10	WCOE #1,2,3,4,5,6,7,8,9,10 EC6C #1,2,3,4,5,6