Career and Technical Education TEKS Review Draft Recommendations

Texas Essential Knowledge and Skills (TEKS) for Career and Technical Education Draft Recommendations

Science, Technology, Mathematics, and Engineering (STEM) Cluster

Programs of Study:

Engineering

Programming & Software Design

The document reflects draft recommendations to the career and technical education Texas Essential Knowledge and Skills (TEKS) that have been recommended by the State Board of Education's TEKS review work groups for the following programs of study from the STEM Career Cluster: **Engineering and Programming & Software Design**.

Proposed additions are shown in green font with underline (additions). Proposed deletions are shown in red font with strikethroughs (~~deletions~~). Text proposed to be moved from its current student expectation is shown in purple italicized font with strikethrough (*~~moved text~~*) and is shown in the proposed new location in purple italicized font with underlines (*new text location*). Numbering for the knowledge and skills statements in the document will be finalized when the proposal is prepared to file with the *Texas Register*.

Comments in the right-hand column provide explanations for the proposed changes. The following notations may be used as part of the explanations.

Skills Gap/Gap Analysis:	refers to gap analysis report on essential knowledge and skills aligned to in-demand high-wage occupations
CCRS:	refers to the College and Career Readiness Standards
MV:	refers to multiple viewpoints expressed by work group members

Table of Contents

§130.402. Principles of Applied Engineering (One Credit), Adopted 2015.		
	TEKS with edits	Work Group Comments/Rationale
(a)	General requirements. This course is recommended for students in Grades 9 and 10. Students shall be awarded one credit for successful completion of this course.	
(b)	Introduction.	
(1)	Career and technical education instruction provides content aligned with challenging academic standards, industry ~~and~~ relevant technical knowledge, and college and career readiness skills for students to further their education and succeed in current and ~~or~~ emerging professions.	
(2)	The Science, Technology, Engineering, and Mathematics (STEM) Career Cluster focuses on planning, managing, and providing scientific research and professional and technical services, including laboratory and testing services, and research and development services.	
(3)	Principles of Applied Engineering provides an overview of the various fields of science, technology, engineering, and mathematics and their interrelationships. Students will develop engineering communication skills, which include computer graphics, modeling, and presentations, by using a variety of computer hardware and software applications to complete assignments and projects. Upon completing this course, students will have an understanding of the various fields of engineering and will be able to make informed career decisions. Further, students will have worked on a design team to develop a product or system. Students will use multiple software applications to prepare and present course assignments.	
(4)	Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.	
(5)	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)	The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	
(A)	demonstrate knowledge of how to dress, speak, and conduct oneself in a manner appropriate for the profession;	
(B)	show the ability to cooperate, contribute, and collaborate as a member of a group in an effort to achieve a positive collective outcome;	CCRS: ELAR IE2 CCRS: Cross-Disciplinary: I(E)(2) 1C II(B)(1)
(C)	present written and oral communication in a clear, concise, and effective manner;	

(D)	demonstrate time-management skills in prioritizing tasks, following schedules, and performing goal-relevant activities in a way that produces efficient results; and	CCRS: Cross-Disciplinary I(E)(1) 1E I(E)(1)
(E)	demonstrate punctuality, dependability, reliability, and responsibility in performing assigned tasks as directed.	
(2)	The student investigates the components of engineering and technology systems. The student is expected to:	
(A)	investigate and report on the history of engineering disciplines, including chemical, civil, electrical, and mechanical engineering ~~science~~;	Group decided we needed to be more specific and list disciplines to encompass all areas of engineering. CCRS: ELA V.C.1 Cross-Disciplinary: I(A)(1) II(C)(2)
(B)	identify the inputs, processes, and outputs associated with technological systems;	CCRS: Cross-Disciplinary: II(A)(4) 2C I(B)(2)
(C)	describe the difference between open and closed systems;	
(D)	describe how technological systems interact to achieve common goals;	CCRS: Cross-Disciplinary: I(B)(2) 2F I(A)(1)
(E)	compare and contrast engineering, science, and technology career~~s~~ paths; such as the variety of career and educational opportunities, including, but not limited to, entry-level employment, military service, apprenticeships, community and technical colleges, and universities;	Group decided to add career paths to include looking at trade certifications and opportunities beyond a 4 year degree.
(F)	conduct and present research on emerging and innovative technology; and	
(G)	demonstrate proficiency of the engineering design process.	
(3)	The student presents conclusions, research findings, and designs using a variety of media throughout the course. The student is expected to:	
(A)	use clear and concise written, verbal, and visual communication techniques;	CCRS: ELA III.A.5 CCRS: Social Studies, IV.A.1, IV.A.6, IV.B3
(B)	maintain a design and computation engineering notebook;	CCRS: MATH IX.C.1, IX.C.2 CCRS: ELA V.A.1, I.A.2
(C)	use sketching and computer-aided drafting and design (CADD) to develop and present ideas;	
(D)	use industry standard visualization techniques and media; ~~and~~	
(E)	use the engineering documentation process to maintain a paper or digital portfolio; and	

(F)	use desktop or web-based applications to demonstrate the use of collaborative tools to share and develop information.	Group wanted to add an option to use online based tools as well as stand-alone software to design and collaborate.
(4)	The student uses appropriate tools and demonstrates safe work habits. The student is expected to:	
(A)	master relevant safety tests;	
(B)	follow lab safety guidelines as prescribed by instructor in compliance with local, state, and federal regulations;	CCRS: Cross-Disciplinary: I(F)(4)
(C)	identify and define industry safety terminology related personal work environment safety such as OSHA (Occupational Safety and Health Administration), ASME (American Society of Mechanical Engineers), and PPE (personal protective equipment);	Group wanted to add an introduction to specific safety standards related to engineering. Changed up letter corresponding to SEs. CCRS: Cross-Disciplinary: II(A)(4)
(D) ~~(C)~~	recognize the classification of hazardous materials and wastes;	
(E) ~~(D)~~	dispose of hazardous materials and wastes appropriately;	
(F) ~~(E)~~	maintain, safely handle, and properly store laboratory equipment;	
(G) ~~(F)~~	describe the implications of negligent or improper maintenance; and	
(H) ~~(G)~~	demonstrate the use of precision measuring instruments.	CCRS: Math IV.A.1 CCRS: Cross-Disciplinary: I(A)(1) I(B)(2)
(5)	The student describes the factors that affect the progression of technology and the potential intended and unintended consequences of technological advances. The student is expected to:	
(A)	describe how technology has affected individuals, societies, cultures, economies, and environments;	CCRS: ELA V.A.2, V.C.1 CCRS: Cross-Disciplinary: I(B)(2) I(A)(1)
(B)	describe how the development and use of technology influenced past events;	CCRS: Cross-Disciplinary: I(B)(2) I(A)(1)
(C)	describe how and why technology progresses; and	CCRS: Cross-Disciplinary: I(B)(2) I(A)(1)
(D)	predict possible changes caused by the advances of technology.	CCRS: Social Studies I.B.1, I.B.3
(6)	The student thinks critically and applies fundamental principles of system modeling and design to multiple design projects. The student is expected to:	
(A)	identify and describe an engineering design ~~the fundamental~~ process needed for a project, including the design process and prototype development and initiating, planning, executing, monitoring and controlling, and closing a project;	Group wanted to make sure engineering design process is addressed to parallel STEM standards. CCRS: ELA V.A.2-3, V.C.1 CCRS: Cross-Disciplinary: I(C)(1)

(B)	identify the chemical, mechanical, and physical properties of engineering materials and identify testing methods associated with the materials;	Group wanted to have students not only identify materials but also identify testing methods to understand failure/strength of materials
(C)	use problem-solving techniques to develop technological solutions such as product, process, or system;	Group wanted to define technological further by providing a "such as" CCRS: Math VIII.A.1-3 CCRS: Cross-Disciplinary: II(A)(4)
(D)	use consistent units for all measurements and computations; and	CCRS: Math IV.B.1
(E)	assess the risks and benefits of a design solution.	CCRS: Cross-Disciplinary: I(A)(1)
(7)	The student understands the opportunities and careers in fields related to robotics, process control, and automation systems. The student is expected to:	
(A)	describe applications of robotics, process control, and automation systems;	CCRS: Cross-Disciplinary: I(A)(1) I(B)(2)
(B)	apply design concepts to problems in robotics, process control, and automation systems;	
(C)	identify fields and career opportunities related to robotics, process control, and automation systems; and	
(D)	identify emerging trends in robotics, process control, and automation systems.	CCRS: Cross-Disciplinary: II(A)(4)
(8)	The student understands the opportunities and careers in fields related to, electrical, mechanical systems. The student is expected to:	
(A)	describe the applications of electrical, and mechanical systems;	CCRS: Cross-Disciplinary: I(A)(1) I(B)(2)
(B)	describe career opportunities in electrical, and mechanical systems;	
(C)	identify emerging trends in electrical, and mechanical systems; and	
(D)	describe and apply basic electronic theory.	CCRS: Math VIII.C.1 CCRS: Cross-Disciplinary: I(A)(1)
(9)	The student demonstrates the ability to function as a team member while completing a comprehensive project. The student is expected to:	
(A)	apply the design process as a team participant, including decision matrices;	Group wanted to make sure students understand industry decision tree options when working as a team in the design process. CCRS: Cross-Disciplinary: I(C)(2)
(B)	assume different roles as a team member within the project;	CCRS: Cross-Disciplinary: I(E)(1) I(E)(2)

(C)	formulate decisions using collaborative strategies such as; decision and design matrices and conflict resolutions;	Group suggested to include an area to describe the decision-making process and process conflict.
(D)~~(C)~~	maintain an engineering notebook for the project;	
(E)~~(D)~~	develop and test the model for the project; and	CCRS: Math VIII.C.1 CCRS: Cross-Disciplinary: II(B)(2)
(F)~~(E)~~	demonstrate communication skills by preparing and presenting the project,~~;~~ including building consensus setback resolution and decision matrices.	Group suggests adding in industry based language for project presentation and preparation. CCRS: Math IX.C.1 CCRS: ELA III.B.3 CCRS: Cross-Disciplinary: II(B)(1)
(10)	The student demonstrates a knowledge of drafting by completing a series of drawings that can be published by various media. The student is expected to:	
(A)	set up, create, and modify drawings;	
(B)	store and retrieve geometry;	
(C)	demonstrate an understanding of the use of line-types in engineering drawings;	
(D)	draw 2-D single view objects;	
(E)	create multi-view working drawings using orthographic projection;	CCRS: Math III.C.3
(F)	dimension objects using current American National Standards Institute (ANSI) standards;	
(G)	draw single line 2-D pictorial representations; and	
(H)	create working drawings that include section views.~~; and~~	
~~(I)~~	~~demonstrate a knowledge of screw thread design per ANSI standards by drawing a hex head bolt with standard, square, and acme threads.~~	Removed because it is generated/imported as parts in the software and would be covered in a more advanced course.

(11)	The student creates justifiable solutions to open-ended real-world problems using engineering design practices and processes. The student is expected to:	Added a new KS and SEs to make sure foundational engineering practices/engineering design process foundational knowledge is present in all TEKs based engineering courses that TEA offers that isn't PLTW. Did not add these to Engineering Science since the science/engineering principles are there. However, copied these from Engineering Design and Problem solving that is in fact for Sci credit, but these particular SEs were not centered around the science area.
(A)	identify and define an engineering problem;	
(B)	formulate goals, objectives, and requirements to solve an engineering problem;	
(C)	determine the design parameters associated with an engineering problem such as materials, personnel, resources, funding, manufacturability, feasibility, and time;	
(D)	establish and evaluate constraints pertaining to a problem, including health, safety, social, environmental, ethical, political, regulatory, and legal;	
(E)	identify or create alternative solutions to a problem using a variety of techniques such as brainstorming, reverse engineering, and researching engineered and natural solutions;	
(F)	test and evaluate proposed solutions using methods such as models, prototypes, mock-ups, simulations, critical design review, statistical analysis, or experiments;	
(G)	apply structured techniques to select and justify a preferred solution to a problem such as a decision tree, design matrix, or cost-benefit analysis;	
(H)	predict performance, failure modes, and reliability of a design solution; and	
(I)	prepare a project report that clearly documents the designs, decisions, and activities during each phase of the engineering design process.	

§130.410. Engineering Design and Presentation I (One Credit), Adopted 2015.		
	TEKS with edits	Work Group Comments/Rationale
(a)	General requirements. This course is recommended for students in Grades 10-12. Prerequisite: Algebra I Recommended prerequisite: Principles of Applied Engineering. Students shall be awarded one credit for successful completion of this course.	Committee recommends moving this course to a level 2 in the Engineering program of study.
(b)	Introduction.	
(1)	Career and technical education instruction provides content aligned with challenging academic standards, industry ~~and~~ relevant technical knowledge, and college and career readiness skills for students to further their education and succeed in current and ~~or~~ emerging professions.	
(2)	The Science, Technology, Engineering, and Mathematics (STEM) Career Cluster focuses on planning, managing, and providing scientific research and professional and technical services, including laboratory and testing services, and research and development services.	
(3)	Engineering Design and Presentation I is a continuation of knowledge and skills learned in Principles of Applied Engineering. Students enrolled in this course will demonstrate knowledge and skills of the design process as it applies to engineering fields and project management using multiple software applications and tools necessary to produce and present working drawings, solid model renderings, and prototypes. Students will be introduced ~~use a~~ to a variety of computer hardware and software applications to complete assignments and projects. Through implementation of the design process, students will transfer advanced academic skills to component designs. Additionally, students explore career opportunities in engineering, technology, and drafting and what is required to gain and maintain employment in these areas.	Project management wording was included to emphasize the role students will take in participating in projects.
(4)	Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.	
(5)	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)	The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	
(A)	demonstrate knowledge of how to dress appropriately, speak politely, and conduct oneself in a manner appropriate for the profession and work site;	
(B)	cooperate, contribute, and collaborate as a member of a group in an effort to attain agreement and achieve a collective outcome;	ELA CCRS: IV.B.1-3, SCI CCRS: C I.C.1

(C)	present written and oral communication in a clear, concise, and effective manner, including explaining and justifying actions;	ELA CCRS: I.A.1-5, ELA: III.A.1-2
(D)	use time-management skills in prioritizing tasks, following schedules, and tending to goal-relevant activities in a way that optimizes efficiency and results; and	
(E)	complete a consistent demonstration of punctuality, dependability, reliability, and responsibility in reporting for duty and performing assigned tasks as directed.	
(2)	The student gains knowledge of and demonstrates the skills necessary for success in the workplace. The student is expected to:	
(A)	distinguish the differences between an engineering technician, engineering technologist, and engineer;	
(B)	identify employment and career opportunities;	
(C)	investigate and work toward industry-based certifications;	added –"based" to industry-based certification to parallel language used across the agency. CCRS: ELA V.B.1
(D)	demonstrate the principles of teamwork related to engineering and technology;	CCRS: ELA III.V.2, ELA IV.B.2-3
(E)	identify and use appropriate work habits;	
(F)	demonstrate knowledge related to governmental regulations, including health and safety;	
(G)	discuss ethical issues related to engineering and technology and incorporate proper ethics in submitted projects;	
(H)	demonstrate respect for diversity in the workplace;	
(I)	demonstrate appropriate actions and identify consequences relating to discrimination, harassment, and inequality;	
(J)	demonstrate effective oral and written communication skills using a variety of software applications and media; and	CCRS ELA: III.A.1-2, III.B.1-3, I.A.1-5 CCRS SCI: DI.D.1
(K)	explore career preparation learning experiences, including job shadowing, mentoring, and apprenticeship training.	
(3)	The student participates in team projects in various roles. The student is expected to:	
(A)	demonstrate an understanding of and discuss how teams function;	
(B)	apply teamwork to solve problems; and	

(C)	serve as both a team leader and member and demonstrate appropriate attitudes while participating in team projects.	
(4)	The student develops skills for managing a project. The student is expected to:	
(A)	implement project management methodologies, including initiating, planning, executing, monitoring and controlling, and closing a project;	
(B)	develop a project schedule and complete work according to established criteria;	
(C)	participate in the organization and operation of a real or simulated engineering project; and	
(D)	develop a plan for production of an individual product.	
(5)	The student practices safe and proper work habits. The student is expected to:	CCRS: SCI: CI.C2-3
(A)	master relevant safety tests;	
(B)	comply with safety guidelines as described in various manuals, instructions, and regulations;	
(C)	identify and classify hazardous materials and wastes according to Occupational Safety and Health Administration (OSHA) regulations;	
(D)	dispose of hazardous materials and wastes appropriately;	
(E)	perform maintenance on selected tools, equipment, and machines;	
(F)	handle and store tools and materials correctly; and	
(G)	describe the results of negligent or improper maintenance.	
(6)	The student applies the concepts of sketching and skills associated with computer-aided drafting and design. The student is expected to:	
(A)	use single and multi-view projections;	
(B)	use orthographic and pictorial views;	
(C)	use auxiliary views;	
(D)	use section views;	
(E)	use advanced construction techniques;	
(F)	prepare and revise annotated multi-dimensional production drawings in computer-aided drafting and design to industry standards;	
(G)	demonstrate knowledge of effective file structure and management;	
(H)	use advanced dimensioning techniques;	

(I)	construct and use basic 3D parametric drawings; and	
(J)	develop and use prototype drawings for presentation.	
(7)	The student uses engineering design methodologies. The student is expected to:	
(A)	demonstrate an understanding of and discuss principles of ideation;	
(B)	demonstrate critical thinking, identify the solution ~~system~~ constraints, and make fact-based decisions;	Changed system to "solution" to encompass system, product, and processes which = solution CCRS: SCI: AI.A.4
(C)	use rational thinking to develop or improve a product;	
(D)	apply decision-making strategies when developing solutions;	
(E)	use an engineering notebook to record prototypes, corrections, and/or mistakes in the design process; and	
(F)	use an engineering notebook and portfolio to record the final design, construction, and manipulation of finished projects.	
(8)	The student applies concepts of engineering to specific problems. The student is expected to:	
(A)	use a variety of technologies to design components;	
(B)	use tools, laboratory equipment, and precision measuring instruments to develop prototypes;	
(C)	research applications of different types of computer-aided drafting and design software; and	
(D)	use multiple software applications for concept presentations.	
(9)	The student designs products using appropriate design processes and techniques. The student is expected to:	
(A)	interpret engineering drawings;	
(B)	identify areas where quality, reliability, and safety can be designed into a product;	
(C)	improve a product design to meet a specified need;	
(D)	produce engineering drawings to industry standards; and	
(E)	describe potential patents and the patenting process.	
(10)	The student builds a prototype using the appropriate tools, materials, and techniques. The student is expected to:	
(A)	identify and describe the steps needed to produce a prototype;	

(B)	identify and use appropriate tools, equipment, machines, and materials to produce the prototype; and	
(C)	present the prototype using a variety of media.	
(11)	The student creates justifiable solutions to open-ended real-world problems using engineering design practices and processes. The student is expected to:	Added a new KS and SEs to make sure foundational engineering practices/engineering design process foundational knowledge is present in all TEKs based engineering courses that TEA offers that isn't PLTW or for science credit. Did not add these to Engineering Science since the science/engineering principles are there. However, copied these from Engineering Design and Problem solving that is in fact for Sci credit, but these particular SEs were not centered around the science area. Suggested to be placed at the top of the TEKS for this course.
(A)	identify and define an engineering problem;	
(B)	formulate goals, objectives, and requirements to solve an engineering problem;	
(C)	determine the design parameters associated with an engineering problem such as materials, personnel, resources, funding, manufacturability, feasibility, and time;	
(D)	establish and evaluate constraints pertaining to a problem, including health, safety, social, environmental, ethical, political, regulatory, and legal;	
(E)	identify or create alternative solutions to a problem using a variety of techniques such as brainstorming, reverse engineering, and researching engineered and natural solutions;	
(F)	test and evaluate proposed solutions using methods such as models, prototypes, mock-ups, simulations, critical design review, statistical analysis, or experiments; and	
(G)	apply structured techniques to select and justify a preferred solution to a problem such as a decision tree, design matrix, or cost-benefit analysis.	

§130.411. Engineering Design and Presentation II (Two Credits), Adopted 2015.		
	TEKS with edits	Work Group Comments/Rationale
(a)	General requirements. This course is recommended for students in Grades 11 and 12. Prerequisites: Algebra I and Geometry ~~Recommended~~ Prerequisite: Principles of Applied Engineering or Engineering Design and Presentation I. Students shall be awarded two credits for successful completion of this course.	Principles of Applied Engineering: recommended that it is a true prerequisite. Engineering Design and Presentation I recommended as a true prerequisite.
(b)	Introduction.	Committee is recommending that this course move to a Level 3 in the Engineering program of study.
(1)	Career and technical education instruction provides content aligned with challenging academic standards, industry ~~and~~ relevant technical knowledge, and college and career readiness skills for students to further their education and succeed in current and ~~or~~ emerging professions.	
(2)	The Science, Technology, Engineering, and Mathematics (STEM) Career Cluster focuses on planning, managing, and providing scientific research and professional and technical services, including laboratory and testing services, and research and development services.	
(3)	Engineering Design and Presentation II is a continuation of knowledge and skills learned in Engineering Design and Presentation I. Students enrolled in this course will demonstrate advanced knowledge and skills of the design process as it applies to engineering fields and project management using multiple software applications and tools necessary to produce and present working drawings, solid model renderings, and prototypes. Students will expand on the use of a variety of computer hardware and software applications to complete assignments and projects. Through implementation of the design process, students will transfer advanced academic skills to component designs. Emphasis will be placed on using skills from ideation through prototyping.	Committee suggests adding in "advanced" to knowledge and skills to build off of Eng. Design and Presentation I. In addition, committee suggests adding "project management" language to emphasize the role students will take in participating in projects.
(4)	Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.	
(5)	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)	The student gains knowledge of and demonstrates the skills necessary for success in the workplace. The student is expected to: ~~The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:~~	Wanted to match the KS statement that exists in Eng Design and Presentation I

(A)	distinguish the differences between an engineering technician, engineering technologist, and engineer;	
(B)	identify employment and career opportunities;	
(C)	investigate and work toward industry-based certifications;	Addition of industry “based” to match Texas Education Agency CTE language. CCRS: ELA V.B.1
(D)	demonstrate the principles of teamwork related to engineering and technology;	CCRS: ELA III.V.2, ELA IV.B.2-3
(E)	identify and use appropriate work habits;	
(F)	demonstrate knowledge related to governmental regulations, including health and safety;	
(G)	discuss ethical issues related to engineering and technology and incorporate proper ethics in submitted projects;	
(H)	demonstrate respect for diversity in the workplace;	
(I)	demonstrate appropriate actions and identify consequences relating to discrimination, harassment, and inequality;	
(J)	demonstrate effective oral and written communication skills using a variety of software applications and media; and	CCRS ELA: III.A.1-2, III.B.1-3, I.A.1-5 CCRS SCI: DI.D.1
(K)	explore career preparation learning experiences, including job shadowing, mentoring, and apprenticeship training.	
(2)	The student participates in team projects in various roles. The student is expected to:	Feedback, analyzing other teams and within the group.
(A)	demonstrate an understanding of and discuss how teams function;	
(B)	demonstrate ~~apply~~ teamwork to solve problems; and	
(C)	serve as a team leader and member and demonstrate appropriate attitudes while participating in team projects.	
(3)	The student develops skills for managing a project. The student is expected to:	
(A)	create, implement, and evaluate project management methodologies, including initiating, planning, executing, monitoring and controlling, and closing a project;	Added stronger verbs to increase rigor for level II course
(B)	develop a project schedule and complete projects according to established criteria; utilizing processes such as decision matrices, flow charts, or Gantt charts.	Added project graphic examples that are found in industry
(C)	participate in the organization and operation of a real or simulated engineering project; and	
(D)	develop a plan for production of an individual product.	

(4)	The student demonstrates principles of project documentation, ~~and~~ workflow, and evaluated results. The student is expected to:	Added in “evaluate results” to increase rigor of not only documenting and understanding workflow but being able to look at those results and draw conclusions and make changes in the future.
(A)	complete work orders and related documentation;	
(B)	identify and defend factors affecting cost and strategies to minimize costs;	Added “defend” to increase rigor for students
(C)	formulate ~~prepare~~ a project budget;	Higher level verb
(D)	develop ~~prepare~~ a production schedule;	Higher level verb
(E)	identify intellectual property and other legal restrictions; and	
(F)	read and interpret technical drawings, manuals, and bulletins.	CCRS ELA: II.A.2, ELA: II.B.1 and 3
(5)	The student applies the concepts and skills of computer-aided drafting and design software to perform the following tasks. The student is expected to:	
(A)	prepare drawings to American National Standards Institute (ANSI) and International Organization for Standardization (*ISO*) graphic standards;	
(B)	customize software user interface;	
(C)	prepare and use advanced views such as auxiliary, section, and break-away;	
(D)	draw detailed parts, assembly diagrams, and sub-assembly diagrams;	
(E)	indicate tolerances and standard fittings using appropriate library functions;	
(F)	demonstrate understanding of annotation styles and setup by defining units, fonts, dimension styles, notes, and leader lines;	
(G)	identify and incorporate the use of advanced layout techniques and viewports using paper-space and modeling areas;	
(H)	use management techniques by setting up properties to define and control individual layers;	
(I)	create and use custom templates for advanced project management;	
(J)	prepare and use advanced development drawings;	
(K)	use advanced polar tracking and blocking techniques to increase drawing efficiency;	
(L)	create drawings that incorporate external referencing;	
(M)	create and render objects using parametric modeling tools; and	
(N)	model individual parts or assemblies and produce rendered or animated output.	

(6)	The student practices safe and proper work habits. The student is expected to:	CCRS: SCI: CI.C2-3
(A)	master relevant safety tests;	
(B)	comply with safety guidelines as described in various manuals, instructions, and regulations;	
(C)	identify and classify hazardous materials and wastes according to Occupational Safety and Health Administration (OSHA) regulations;	
(D)	dispose of hazardous materials and wastes appropriately;	
(E)	perform maintenance on selected tools, equipment, and machines;	
(F)	handle and store tools and materials correctly; and	
(G)	describe the results of negligent or improper maintenance.	
(7)	The student uses engineering design methodologies. The student is expected to:	
(A)	demonstrate an understanding of and discuss principles of solution ~~system~~ ideation;	Changed system to solution to encompass system, product, and processes which = solution
(B)	demonstrate critical thinking, identify the solution ~~system~~ constraints, and make fact-based decisions;	Changed system to solution to encompass system, product, and processes which = solution CCRS: SCI: AI.A.4
(C)	use rational thinking to develop or improve a solution ~~system~~;	Changed system to solution to encompass system, product, and processes which = solution
(D)	apply decision-making strategies when developing solutions;	
(E)	identify quality-control issues in engineering design and production;	
(F)	describe perceptions of the quality of products and how they affect engineering decisions;	
(G)	use an engineering notebook to record prototypes, corrections, and/or mistakes in the design process; and	
(H)	use an engineering notebook to record and justify the final design, construction, and manipulation of finished projects.	Increase rigor beyond recording to evaluation mindset.
(8)	The student applies concepts of engineering to specific problems. The student is expected to:	
(A)	use a variety of technologies to design solution ~~systems~~;	Changed system to solution to encompass system, product, and processes which = solution

(B)	experiment with the use of tools, laboratory equipment, and precision measuring instruments to develop prototypes;	
(C)	explore ~~research~~ ~~applications of~~ different types of computer-aided drafting and design software and their applications for use in design systems and problem solving; and	Changed language to reflect rigor from I to II course
(D)	use multiple software applications for concept presentations.	
(9)	The student addresses a need or problem ~~designs~~ ~~systems~~ using appropriate engineering design processes and techniques. The student is expected to:	
(A)	create and interpret engineering drawings;	Students should not only interpret but be able to create engineering drawings.
(B)	identify areas where quality, reliability, and safety can be designed into a solution such as a product, process or system;	
(C)	improve a system design to meet a specified need, including properties of materials selected~~;~~	
(D)	produce engineering drawings to industry standards; and	
(E)	describe potential patents and the patenting process.	
(10)	The student builds a prototype using the appropriate tools, materials, and techniques. The student is expected to:	
(A)	implement ~~identify~~ and delineate ~~describe~~ the steps needed to produce a prototype such as defining the problem and generating concepts;	Changed language to reflect rigor from I to II course.
(B)	identify industry ~~and use~~ appropriate tools, equipment, machines, and materials; ~~to~~ ~~***produce the prototype using comparable materials; and***~~	Broke up letter B into two SEs to produce letter (C)
(C)	fabricate ***the prototype using comparable materials; and***	Since letter C was added new, put old SE "c" as letter D.
(D)	present and validate the prototype using a variety of media, and defend engineering practices.	Rigor with the addition of validate (changed SE letter to D)

(11)	The student creates justifiable solutions to open-ended real-world problems using engineering design practices and processes. The student is expected to:	Added a new KS and SEs to make sure foundational engineering practices/engineering design process foundational knowledge is present in all TEKs based engineering courses that TEA offers that is not PLTW. Did not add these to Engineering Science since the science/engineering principles are there. However, copied these from Engineering Design and Problem solving that is in fact for Sci credit, but these SEs were not centered around the science area. Please place this higher up in the course. Like #3 KS.
(A)	identify and define an engineering problem;	
(B)	formulate goals, objectives, and requirements to solve an engineering problem;	
(C)	determine the design parameters associated with an engineering problem such as materials, personnel, resources, funding, manufacturability, feasibility, and time;	
(D)	establish and evaluate constraints pertaining to a problem, including health, safety, social, environmental, ethical, political, regulatory, and legal;	
(E)	identify or create alternative solutions to a problem using a variety of techniques such as brainstorming, reverse engineering, and researching engineered and natural solutions;	
(F)	test and evaluate proposed solutions using methods such as models, prototypes, mock-ups, simulations, critical design review, statistical analysis, or experiments; and	
(G)	apply structured techniques to select and justify a preferred solution to a problem such as a decision tree, design matrix, or cost-benefit analysis.	

§130.412. Engineering Design and Problem Solving (One Credit), Adopted 2015.		
	TEKS with edits	Work Group Comments/Rationale
(a)	General requirements. This course is recommended for students in Grades 11 and 12. Prerequisites: Algebra I and Geometry. Recommended prerequisites: two Science, Technology, Engineering, and Mathematics (STEM) Career Cluster credits. Students must meet the 40% laboratory and fieldwork requirement. This course satisfies a high school science graduation requirement. Students shall be awarded one credit for successful completion of this course.	
(b)	Introduction.	
(1)	Career and technical education instruction provides content aligned with challenging academic standards, industry ~~and~~ relevant technical knowledge, and college and career readiness skills for students to further their education and succeed in current and ~~or~~ emerging professions.	
(2)	The STEM Career Cluster focuses on planning, managing, and providing scientific research and professional and technical services, including laboratory and testing services, and research and development services.	
(3)	The Engineering Design and Problem Solving course is the creative process of solving problems by identifying needs and then devising solutions. The solution may be a product, technique, structure, or process depending on the problem. Science aims to understand the natural world, while engineering seeks to shape this world to meet human needs and wants. Engineering design takes into consideration limiting factors or "design under constraint." Various engineering disciplines address a broad spectrum of design problems using specific concepts from the sciences and mathematics to derive a solution. The design process and problem solving are inherent to all engineering disciplines.	
(4)	Engineering Design and Problem Solving reinforces and integrates skills learned in previous mathematics and science courses. This course emphasizes solving problems, moving from well-defined toward more open-ended, with real-world application. Students will apply critical-thinking skills to justify a solution from multiple design options. Additionally, the course promotes interest in and understanding of career opportunities in engineering.	
(5)	This course is intended to stimulate students' ingenuity, intellectual talents, and practical skills in devising solutions to engineering design problems. Students use the engineering design process cycle to investigate, design, plan, create, and evaluate solutions. At the same time, this course fosters awareness of the social and ethical implications of technological development.	

(6)	Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not currently scientifically testable. ~~Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.~~	
(7)	Scientific hypotheses and theories. Students are expected to know that: ~~Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation are experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.~~	
(A)	hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions are incorporated into theories; and	
(B)	scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well established and highly reliable explanations, but they may be subject to change as new areas of science and new technologies are developed.	
(8)	Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world using scientific and engineering practices. Scientific methods of investigation are descriptive, comparative, or experimental. The method chosen should be appropriate to the question being asked. Student learning for different types of investigations include descriptive investigations, which involve collecting data and recording observations without making comparisons; comparative investigations, which involve collecting data with variables that are manipulated to compare results; and experimental investigations, which involve processes similar to comparative investigations but in which a control is identified. ~~Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information).~~	
(A)	Scientific practices. Students should be able to ask questions, plan and conduct investigations to answer questions, and explain phenomena using appropriate tools and models.	

(B)	Engineering practices. Students should be able to identify problems and design solutions using appropriate tools and models.	
(9)	Science and social ethics. Scientific decision making is a way of answering questions about the natural world involving its own set of ethical standards about how the process of science should be carried out. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information). ~~A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.~~	
(10)	Science consists of recurring themes and making connections between overarching concepts. Recurring themes include systems, models, and patterns. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested, while models allow for boundary specification and provide a tool for understanding the ideas presented. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.	
(11)~~(10)~~	Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.	
(12) ~~(11)~~	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)	The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	
(A)	demonstrate knowledge of how to dress appropriately, speak politely, and conduct oneself in a manner appropriate for the profession;	
(B)	show the ability to cooperate, contribute, and collaborate as a member of a group in an effort to achieve a positive collective outcome;	
(C)	present written and oral communication in a clear, concise, and effective manner;	
(D)	demonstrate time-management skills in prioritizing tasks, following schedules, and performing goal-relevant activities in a way that produces efficient results; and	

(E)	demonstrate punctuality, dependability, reliability, and responsibility in performing assigned tasks as directed.	
(2)	Scientific and engineering practices. The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to explain phenomena, or design solutions using appropriate tools and models. The student is expected to:	Scientific and engineering practices approved by the SBOE in November 2020 for science high school courses.
(A)	ask questions and define problems based on observations or information from text, phenomena, models, or investigations;	
(B)	apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems;	
(C)	use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards;	
(D)	use appropriate tools such as such as dial caliper, micrometer, protractor, compass, scale rulers, multimeter, circuit components etc.;	Added in examples of tools
(E)	collect quantitative data using the International System of Units (SI) and United States customary units and qualitative data as evidence;	Committee wanted to add additional use of US customary units in addition to international systems of units
(F)	organize quantitative and qualitative data using spreadsheets, engineering notebooks, graphs, and charts;	Added in examples of what students would use to organize quantitative and qualitative data
(G)	develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and	
(H)	distinguish among scientific hypotheses, theories, and laws.	
(3)	Scientific and engineering practices. The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:	
(A)	identify advantages and limitations of models such as their size, scale, properties, and materials;	
(B)	analyze data by identifying significant statistical features, patterns, sources of error, and limitations;	
(C)	use mathematical calculations to assess quantitative relationships in data; and	
(D)	evaluate experimental and engineering designs.	Added and engineering to include both language for science and engineering

(4)	Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:	
(A)	develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories;	
(B)	communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and	
(C)	engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.	
(5)	Scientific and engineering practices. The student knows the contributions of scientists and engineers and recognizes the importance of scientific research and innovation on society. The student is expected to:	Include "engineers" with and along with scientists to be able to see contributions of both.
(A)	analyze, evaluate, and critique scientific explanations and solutions by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student;	
(B)	relate the impact of past and current research on scientific thought and society, including research methodology, cost-benefit analysis, and contributions of diverse scientists and engineers as related to the content; and	Added "engineers" again to include contributions of both.
(C)	research and explore resources such as museums, libraries, professional organizations, private companies, online platforms, and mentors employed in a science, technology, engineering, and mathematics (STEM) field.	
~~(2)~~	~~The student, for at least 40% of instructional time, conducts engineering laboratory and field activities using safe, environmentally appropriate, and ethical practices. The student is expected to:~~	Replaced with scientific and engineering practices
~~(A)~~	~~demonstrate safe practices during engineering laboratory and field activities; and~~	
~~(B)~~	~~demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.~~	
~~(3)~~	~~The student uses scientific methods and equipment during laboratory and field investigations. The student is expected to:~~	
~~(A)~~	~~know the definition of science and understand that it has limitations, as specified in subsection (b)(6) of this section;~~	
~~(B)~~	~~know that hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions are incorporated into theories;~~	

~~(C)~~	~~know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but they may be subject to change as new areas of science and new technologies are developed;~~	
~~(D)~~	~~distinguish between scientific hypotheses and scientific theories;~~	
~~(E)~~	~~plan and implement descriptive, comparative, and experimental investigations, including asking questions, formulating testable hypotheses, and selecting equipment and technology;~~	
~~(F)~~	~~collect and organize qualitative and quantitative data and make measurements with accuracy and precision using tools such as calculators, spreadsheet software, data-collecting probes, computers, standard laboratory glassware, microscopes, various prepared slides, stereoscopes, metric rulers, electronic balances, gel electrophoresis apparatuses, micropipettors, hand lenses, Celsius thermometers, hot plates, lab notebooks or journals, timing devices, cameras, Petri dishes, lab incubators, dissection equipment, meter sticks, and models, diagrams, or samples of biological specimens or structures;~~	
~~(G)~~	~~analyze, evaluate, make inferences, and predict trends from data; and~~	
~~(H)~~	~~communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.~~	
(6)~~(4)~~	The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:	
(A)	in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;	
(B)	communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;	
(C)	draw inferences based on data related to promotional materials for products and services;	
(D)	evaluate the impact of scientific research on society and the environment;	

(E)	evaluate models according to their constraints ~~limitations~~ in representing biological or chemical objects and ~~or~~ events; and	Group added in chemical to include a more rounded look at the types of objects and events that might occur to foster a solution via engineering. Added in “constraints”. Science reviewers asked we add “advantages” and limitations and we combined it to say constraints so both the teacher and student are comfortable with industry-based terminology.
(F)	research and describe the evolution of scientific advances and inventions, including ~~history of biology and~~ the contributions of diverse scientists.	Group wanted to make sure numerous scientific aspects were covered beyond biology, like chemical, material, physical, etc. and inventions and the people that did it Per science review added in “diverse” next to scientists
(7)~~(5)~~	The student applies knowledge of science and mathematics and the tools of technology to solve engineering design problems. The student is expected to:	
(A)	apply scientific processes and concepts outlined in the Texas essential knowledge and skills (TEKS) for Biology, Chemistry, or Physics relevant to engineering design problems;	
(B)	apply concepts, procedures, and functions outlined in the TEKS for Algebra I, Geometry, and Algebra II relevant to engineering design problems;	
(C)	select appropriate mathematical models to develop solutions to engineering design problems;	
(D)	integrate advanced mathematics and science skills as necessary to develop solutions to engineering design problems;	
(E)	judge the reasonableness of mathematical models and solutions;	
(F)	investigate and apply relevant chemical, mechanical, biological, electrical, and physical properties of materials to engineering design problems;	
(G)	identify the inputs, processes, outputs, control, and feedback associated with open and closed systems;	
(H)	describe the difference between open-loop and closed-loop control systems;	

(I)	evaluate different measurement tools and make measurements with accuracy and precision and specify tolerances; such as dial caliper, micrometer, protractor, compass, scale rulers, multimeter, etc.	Group wanted to add an elaboration on measuring tools and wanted to make sure student understood tools and where to use them, hence the "evaluate" Added in examples of tools per science review request.
(J)	use appropriate measurement systems, including customary and International System (SI) of units; and	
(K)	use conversions between measurement systems to solve real-world problems.	
(8)~~(6)~~	The student communicates through written documents, presentations, and graphic representations using the tools and techniques of professional engineers. The student is expected to:	
(A)	communicate visually by sketching and creating technical drawings using established engineering graphic tools, techniques, and standards;	
(B)	read and comprehend technical documents, including specifications and procedures;	
(C)	prepare written documents such as memorandums, emails, design proposals, procedural directions, letters, and technical reports using the formatting and terminology conventions of technical documentation;	
(D)	organize information for visual display and analysis using appropriate formats for various audiences, including technical drawings, graphs, and tables such as file conversion and appropriate file types in order to collaborate with a wider audience;	Group wanted to reiterate the addition of technical drawings beyond graphs and charts and then make sure students know how to convert software related files into more readable content for all audiences to see the work.
(E)	evaluate the quality and relevance of sources and cite appropriately; and	
(F)	defend a design solution in a presentation.	
(9)~~(7)~~	The student recognizes the history, development, and practices of the engineering professions. The student is expected to:	
(A)	identify and describe career options, working conditions, earnings, and educational requirements of various engineering disciplines such as those listed by the Texas Board of Professional Engineers;	
(B)	recognize that engineers are guided by established codes emphasizing high ethical standards;	
(C)	explore the differences, similarities, and interactions among engineers, scientists, and mathematicians;	

(D)	describe how technology has evolved in the field of engineering and consider how it will continue to be a useful tool in solving engineering problems;	
(E)	discuss the history and importance of engineering innovation on the U.S. economy and quality of life; and	
(F)	describe the importance of patents and the protection of intellectual property rights.	
(10)~~(8)~~	The student creates justifiable solutions to open-ended real-world problems using engineering design practices and processes. The student is expected to:	
(A)	identify and define an engineering problem;	
(B)	formulate goals, objectives, and requirements to solve an engineering problem;	
(C)	determine the design parameters associated with an engineering problem such as materials, personnel, resources, funding, manufacturability, feasibility, and time;	
(D)	establish and evaluate constraints pertaining to a problem, including health, safety, social, environmental, ethical, political, regulatory, and legal;	
(E)	identify or create alternative solutions to a problem using a variety of techniques such as brainstorming, reverse engineering, and researching engineered and natural solutions;	
(F)	test and evaluate proposed solutions using methods such as models, prototypes, mock-ups, simulations, critical design review, statistical analysis, or experiments;	
(G)	apply structured techniques to select and justify a preferred solution to a problem such as a decision tree, design matrix, or cost-benefit analysis;	
(H)	predict performance, failure modes, and reliability of a design solution; and	
(I)	prepare a project report that clearly documents the designs, decisions, and activities during each phase of the engineering design process.	
(11)~~(9)~~	The student manages an engineering design project. The student is expected to:	
(A)	participate in the design and implementation of a real-world or simulated engineering project using project management methodologies, including initiating, planning, executing, monitoring and controlling, and closing a project;	
(B)	develop a plan and project schedule for completion of a project;	
(C)	work in teams and share responsibilities, acknowledging, encouraging, and valuing contributions of all team members;	
(D)	compare and contrast the roles of a team leader and other team responsibilities;	

(E)	identify and manage the resources needed to complete a project;	
(F)	use a budget to determine effective strategies to meet cost constraints;	
(G)	create a risk assessment for an engineering design project;	
(H)	analyze and critique the results of an engineering design project; and	
(I)	maintain an engineering notebook that chronicles work such as ideas, concepts, inventions, sketches, and experiments.	

§130.414. Engineering Science (One Credit), Adopted 2015.		
	TEKS with edits	Work Group Comments/Rationale
(a)	General requirements. This course is recommended for students in Grades 10-12. Prerequisite: Algebra I and Biology~~, Chemistry~~, ~~Integrated Physics and Chemistry (IPC), or Physics~~. Recommended prerequisite: ***Chemistry***, Geometry, ***Integrated Physics and Chemistry (IPC), or Physics***. Students must meet the 40% laboratory and fieldwork requirement. This course satisfies a high school science graduation requirement. Students shall be awarded one credit for successful completion of this course.	Committee recommends moving Engineering Science to a level 2. Since suggesting to move to level 2 in the program of study, committee changed up prereq and recommended prereq. Will need TAC update for course and C022 table.
(b)	Introduction.	
(1)	Career and technical education instruction provides content aligned with challenging academic standards, industry ~~and~~ relevant technical knowledge, and college and career readiness skills for students to further their education and succeed in current and ~~or~~ emerging professions.	
(2)	The Science, Technology, Engineering, and Mathematics (STEM) Career Cluster focuses on planning, managing, and providing scientific research and professional and technical services, including laboratory and testing services, and research and development services.	
(3)	Engineering Science is an engineering course designed to expose students to some of the major concepts and technologies that they will encounter in a postsecondary program of study in any engineering domain. Students will have an opportunity to investigate engineering and high-tech careers. In Engineering Science, students will employ science, technology, engineering, and mathematical concepts in the solution of real-world challenge situations. Students will develop problem-solving skills and apply their knowledge of research and design to create solutions to various challenges. Students will also learn how to document their work and communicate their solutions to their peers and members of the professional community.	

(4)	Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not currently scientifically testable. ~~Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.~~	
(5)	Scientific hypotheses and theories. Students are expected to know that: ~~Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation are experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.~~	
(A)	hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions are incorporated into theories; and	
(B)	scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well established and highly reliable explanations, but they may be subject to change as new areas of science and new technologies are developed.	
(6)	Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world using scientific and engineering practices. Scientific methods of investigation are descriptive, comparative, or experimental. The method chosen should be appropriate to the question being asked. Student learning for different types of investigations include descriptive investigations, which involve collecting data and recording observations without making comparisons; comparative investigations, which involve collecting data with variables that are manipulated to compare results; and experimental investigations, which involve processes similar to comparative investigations but in which a control is identified. ~~Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information).~~	
(A)	Scientific practices. Students should be able to ask questions, plan and conduct investigations to answer questions, and explain phenomena using appropriate tools and models.	

(B)	Engineering practices. Students should be able to identify problems and design solutions using appropriate tools and models.	
(7)	Science and social ethics. Scientific decision making is a way of answering questions about the natural world involving its own set of ethical standards about how the process of science should be carried out. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information). ~~A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.~~	
(8)	Science consists of recurring themes and making connections between overarching concepts. Recurring themes include systems, models, and patterns. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested, while models allow for boundary specification and provide a tool for understanding the ideas presented. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.	
(9)~~(8)~~	Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.	
(10)~~(9)~~	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)	The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	
(A)	demonstrate knowledge of how to dress appropriately, speak politely, and conduct oneself in a manner appropriate for the profession;	
(B)	show the ability to cooperate, contribute, and collaborate as a member of a group in an effort to achieve a positive collective outcome;	
(C)	present written and oral communication in a clear, concise, and effective manner;	
(D)	demonstrate time-management skills in prioritizing tasks, following schedules, and performing goal-relevant activities in a way that produces efficient results; and	

(E)	demonstrate punctuality, dependability, reliability, and responsibility in performing assigned tasks as directed.	
(2)	Scientific and engineering practices. The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to explain phenomena, or design solutions using appropriate tools and models. The student is expected to:	Scientific and engineering practices approved by the SBOE in November 2020 for science high school courses.
(A)	ask questions and define problems based on observations or information from text, phenomena, models, or investigations;	
(B)	apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems;	
(C)	use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards;	
(D)	use appropriate tools such as such as dial caliper, micrometer, protractor, compass, scale rulers, multimeter, circuit components, etc.;	Added in tool examples
(E)	collect quantitative data using the International System of Units (SI) and United States customary units and qualitative data as evidence;	
(F)	organize quantitative and qualitative data using spreadsheets, engineering notebooks, graphs and charts;	Added in examples of organizing data
(G)	develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and	
(H)	distinguish among scientific hypotheses, theories, and laws.	
(3)	Scientific and engineering practices. The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:	
(A)	identify advantages and limitations of models such as their size, scale, properties, and materials;	
(B)	analyze data by identifying significant statistical features, patterns, sources of error, and limitations;	
(C)	use mathematical calculations to assess quantitative relationships in data; and	
(D)	evaluate experimental and engineering designs.	Addition of engineering to include both language from scientific practices and engineering.

(4)	Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:	
(A)	develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories;	
(B)	communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and	
(C)	engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.	
(5)	Scientific and engineering practices. The student knows the contributions of scientists and engineers recognizes the importance of scientific research and innovation on society. The student is expected to:	SEP committee addition of "engineers" to support language in science and engineering.
(A)	analyze, evaluate, and critique scientific explanations and solutions by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student;	
(B)	relate the impact of past and current research on scientific thought and society, including research methodology, cost-benefit analysis, and contributions of diverse scientists and engineers as related to the content; and	Added in "and engineers" to include language specific to both scientific practices and engineering.
(C)	research and explore resources such as museums, libraries, professional organizations, private companies, online platforms, and mentors employed in a science, technology, engineering, and mathematics (STEM) field.	
~~(2)~~	~~The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:~~	Replaced with scientific and engineering practices
~~(A)~~	~~demonstrate safe practices during laboratory and field investigations; and~~	
~~(B)~~	~~demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.~~	
~~(3)~~	~~The student uses scientific methods and equipment during laboratory and field investigations. The student is expected to:~~	
~~(A)~~	~~know the definition of science and understand that it has limitations, as specified in subsection (b)(4) of this section;~~	
~~(B)~~	~~know that hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;~~	

~~(C)~~	~~know scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but they may be subject to change as new areas of science and new technologies are developed;~~	
~~(D)~~	~~distinguish between scientific hypotheses and scientific theories;~~	
~~(E)~~	~~plan and implement descriptive, comparative, and experimental investigations, including asking questions, formulating testable hypotheses, and selecting equipment and technology;~~	
~~(F)~~	~~collect and organize qualitative and quantitative data and make measurements with accuracy and precision using tools such as spreadsheet software, data-collecting probes, computers, standard laboratory glassware, microscopes, various prepared slides, stereoscopes, electronic balances, micropipettors, hand lenses, surgical and imagining equipment, thermometers, hot plates, lab notebooks or journals, timing devices, Petri dishes, lab incubators, dissection equipment, and models, diagrams, or samples of biological specimens or structures;~~	
~~(G)~~	~~analyze, evaluate, make inferences, and predict trends from data; and~~	
~~(H)~~	~~communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.~~	
~~(4)~~	~~The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:~~	
~~(A)~~	~~in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking;~~	
~~(B)~~	~~communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;~~	
~~(C)~~	~~draw inferences based on data related to promotional materials for products and services;~~	
~~(D)~~	~~evaluate the impact of scientific research on society and the environment; and~~	
~~(E)~~	~~evaluate models according to their limitations in representing objects or events.~~	
(6)~~(5)~~	The student investigates engineering-related fields and career opportunities. The student is expected to:	
(A)	differentiate between engineering and engineering technology;	

(B)	compare the roles or job descriptions for career opportunities in the fields of pure science, engineering, and engineering technology;	
(C)	identify and differentiate between the different engineering disciplines; and	
(D)	demonstrate appropriate oral, written, and visual forms of technical communication.	CCRS: ELA III.B.1, III.B.3
(7)~~(6)~~	The student demonstrates an understanding of design problems and works individually and as a member of a team to solve design problems. The student is expected to:	
(A)	solve design problems individually and in a team;	
(B)	create solutions to existing problems using a design process;	
(C)	use a design brief to identify problem specifications and establish project constraints;	
(D)	use communication to achieve a desired goal within a team; and	CCRS ELA III.B.1&3
(E)	work as a member of a team to conduct research to develop a knowledge base, stimulate creative ideas, and make informed decisions.	CCRS: ELA, V.A.2, V.A.3 CCRS: Social Studies, I.F.1
(8)~~(7)~~	The student understands mechanisms, including simple and compound machines, and performs calculations related to mechanical advantage, drive ratios, work, and power. The student is expected to:	
(A)	explain the purpose and operation of components, including gears, sprockets, pulley systems, and simple machines;	
(B)	explain how components, including gears, sprockets, pulley systems, and simple machines, make up mechanisms;	
(C)	distinguish between the six simple machines and their attributes and components;	
(D)	measure forces and distances related to a mechanism;	
(E)	calculate work and power in mechanical systems;	
(F)	determine experimentally the efficiency of mechanical systems; and	
(G)	calculate mechanical advantage and drive ratios of mechanisms.	CCRS: Math VIC1
(9)~~(8)~~	The student understands energy sources, energy conversion, and circuits and performs calculations related to work and power. The student is expected to:	
(A)	identify and categorize energy sources as nonrenewable, renewable, or inexhaustible;	
(B)	define and calculate work and power in electrical systems;	CCRS: Math VIC1

(C)	calculate and explain how power in a system ~~that~~ converts energy from electrical to mechanical; and	Added additional verb of explain to increase rigor. Feedback from science workgroup to add in PBL focused verbs with calculate CCRS: Math VIIA3
(D)	define voltage, current, and resistance and calculate each quantity in series, parallel, and combination electrical circuits using Ohm's law.	CCRS: Math VIIA2
(10)~~(9)~~	The student understands system energy requirements and how energy sources can be combined to convert energy into useful forms. The student understands the relationships among material conductivity, resistance, and geometry in order to calculate energy transfer and determine power loss and efficiency. The student is expected to:	
(A)	explain the purpose of energy management;	
(B)	evaluate system energy requirements in order to select the proper energy source;	
(C)	explain and design how multiple energy sources can be combined to convert energy into useful forms;	Added additional verbs to increase rigor per science reviewer feedback to include PBL focused verbs with existing verbs in SEs.
(D)	describe how hydrogen fuel cells create electricity and heat and how solar cells create electricity;	
(E)	measure and analyze how thermal energy is transferred via convection, conduction, and radiation;	CCRS: Math: VIID1
(F)	analyze how thermal energy transfer is affected by conduction, thermal resistance values, convection, and radiation; and	CCRS: Math: VIID1
(G)	calculate resistance, efficiency, and power transfer in power transmission and distribution applications for various material properties.	CCRS: Math: VIID1
(11)~~(10)~~	The student understands the interaction of forces acting on a body and performs calculations related to structural design. The student is expected to:	
(A)	illustrate, calculate, and experimentally measure all forces acting upon a given body;	CCRS MATH: IIIC1
(B)	locate the centroid of structural members mathematically or experimentally;	CCRS Math: VIIA1
(C)	calculate moment of inertia of structural members;	CCRS Math: VIIA1
(D)	define and calculate static equilibrium;	CCRS Math: VIIA1
(E)	differentiate between scalar and vector quantities;	CCRS Math: VIIIA2
(F)	identify properties of a vector, including magnitude and direction;	CCRS Math: VIIIA2

(G)	calculate the X and Y components given a vector;	CCRS Math: VIIIA1
(H)	calculate moment forces given a specified axis;	CCRS Math: VIC1
(I)	calculate unknown forces using equations of equilibrium; and	CCRS Math: IIC2
(J)	calculate external and internal forces in a statically determinate truss using translational and rotational equilibrium equations.	CCRS Math: VIC2
(12)~~(11)~~	The student understands material properties and the importance of choosing appropriate materials for design. The student is expected to:	
(A)	conduct investigative non-destructive material property tests on selected common household products;	
(B)	calculate and measure the weight, volume, mass, density, and surface area of selected common household products; and	CCRS Math: IID2
(C)	identify the manufacturing processes used to create selected common household products.	
(13)~~(12)~~	The student uses material testing to determine a product's function and performance. The student is expected to:	
(A)	use a design process and mathematical formulas to solve and document design problems;	
(B)	obtain measurements of material samples such as length, width, height, and mass;	
(C)	use material testing to determine a product's reliability, safety, and predictability in function;	
(D)	identify and calculate test sample material properties using a stress-strain curve; and	CCRS Math: VIC1
(E)	identify and compare measurements and calculations of sample material properties such as elastic range, proportional limit, modulus of elasticity, elastic limit, resilience, yield point, plastic deformation, ultimate strength, failure, and ductility using stress-strain data points.	CCRS Math: VIC1
(14)~~(13)~~	The student understands that control systems are designed to provide consentient process control and reliability and uses computer software to create flowcharts and control system operating programs. The student is expected to:	
(A)	create detailed flowcharts using a computer software application;	
(B)	create control system operating programs using computer software;	
(C)	create system control programs that use flowchart logic;	
(D)	select appropriate input and output devices based on the need of a technological system; and	
(E)	judge between open- and closed-loop systems in order to select the most appropriate system for a given technological problem.	

(15)~~(14)~~	The student demonstrates an understanding of fluid power systems and calculates values in a variety of systems. The student is expected to:	
(A)	identify and explain basic components and functions of fluid power devices;	
(B)	differentiate between pneumatic and hydraulic systems and between hydrodynamic and hydrostatic systems;	
(C)	use Pascal's Law to calculate values in a fluid power system;	CCRS Math: VIC1
(D)	distinguish between gauge pressure and absolute pressure and between temperature and absolute temperature;	
(E)	calculate values in a pneumatic system using the ideal gas laws; and	CCRS Math: VIC1
(F)	calculate and experiment with flow rate, flow velocity, and mechanical advantage in a hydraulic system model.	Added additional verb with calculate per science reviewer feedback to increase rigor and add additional PBL component. CCRS Math: VIA3
(16)~~(15)~~	The student demonstrates an understanding of statistics and applies the concepts to real-world engineering design problems. The student is expected to:	
(A)	calculate and test the theoretical probability that an event will occur;	Added additional verb with calculate per science reviewer feedback to increase rigor and add additional PBL component CCRS Math: IVB1
(B)	calculate the experimental frequency distribution of an event occurring;	CCRS Math: IVB1
(C)	apply the Bernoulli process to events that only have two distinct possible outcomes;	CCRS Math: IVB2
(D)	apply AND, OR, and NOT logic to solve complex probability scenarios;	
(E)	apply Bayes's theorem to calculate the probability of multiple events occurring;	CCRS Math: IVB2
(F)	calculate the central tendency of a data array, including mean, median, and mode;	CCRS Math: VB3
(G)	calculate data variation, including range, standard deviation, and variance; and	CCRS Math: BC1
(H)	create and explain a histogram to illustrate frequency distribution.	Added additional verb with calculate per science reviewer feedback to increase rigor and add additional PBL component
(17)~~(16)~~	The student demonstrates an understanding of kinematics in one and two dimensions and applies the concepts to real-world engineering design problems. The student is expected to:	
(A)	calculate distance, displacement, speed, velocity, and acceleration from data;	CCRS Math: VIIA3

(B)	calculate experimentally the acceleration due to gravity given data from a free-fall device;	CCRS Math: VIIA3
(C)	calculate the X and Y components of an object in projectile motion; and	CCRS Math: VIIA3
(D)	determine and test the angle needed to launch a projectile a specific range given the projectile's initial velocity.	Added additional verb with calculate per science reviewer feedback to increase rigor and add additional PBL component CCRS Math: VIIA2

§130.XXX Introduction to Computer Aided Design and Drafting

	TEKS with edits	Work Group Comments/Rationale
(a)	General requirements. This course is recommended for students in Grades 9-12. Recommended Prerequisite: Principles of Applied Engineering, Principles of Architecture and Design or Principles of Manufacturing. Students shall be awarded one credit for successful completion of this course.	Group wants this course to span multiple programs of study and therefore is recommended that students can take many different principles courses prior to enrolling. Also, since so many of the principles courses are moving down to 8th grade, it was suggested that this course span 9-12 instead of 10-12.
(b)	Introduction.	Committee is recommending that this course be placed in Level 1 in the program of study for Engineering.
(1)	Career and technical education instruction provides content aligned with challenging academic standards, industry relevant technical knowledge, and college and career readiness skills for students to further their education and succeed in current and emerging professions.	
(2)	The STEM Career Cluster focuses on planning, managing, and providing scientific research and professional and technical services, including laboratory and testing services, and research and development services.	Group decided to change it to the STEM Career cluster since these courses are first being asked to fit in the Engineering program of study.
(3)	Introduction to computer-aided design and drafting (CADD) allows students to acquire knowledge and skills needed to use design software including an introduction to CADD equipment and software selection and interfaces. Students will gain skills in setting up a CADD workstation; upgrading a computer to run advanced CADD software; working with storage devices; storing, retrieving, backing-up and sharing databases; file servers and local area networks (LANs); and transferring drawing files over the Internet.	Group decided to change "architectural" to just design software to be used in different course.
(4)	Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.	
(5)	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)	The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	
(A)	describe the roles, responsibilities, and dynamics of a team as applied in the manufacturing industry;	

(B)	explain employers' work expectations;	
(C)	use effective and accurate architectural and/or engineering vocabulary throughout design and drafting process;	
(D)	demonstrate knowledge of the concepts and skills related to health; and	
(E)	demonstrate safety in the workplace as specified by appropriate governmental regulations.	
(2)	The student demonstrates knowledge of the CADD software. The student is expected to:	
(A)	describe computer-aided design, drafting, and CADD applications;	
(B)	demonstrate how to start and exit CADD software without corrupting files;	
(C)	use draw files;	
(D)	save, close, and open saved files;	
(E)	determine and specify drawing units and limits;	
(F)	describe and use the Cartesian coordinate system;	
(G)	use drawing snap and grid functions; and	
(H)	demonstrate the use of dynamic input and the command line.	
(3)	The student demonstrates the use of CADD tools for basic drawing and plotting. The student is expected to:	
(A)	draw objects using the line tool;	
(B)	draw circles, arcs, ellipses, and elliptical arcs;	
(C)	draw polylines, rectangles, donuts, and filled circles;	
(D)	draw true spline curves;	
(E)	create drawing templates;	
(F)	describe basic line conventions;	
(G)	create and manage layers;	
(H)	draw objects on separate layers;	
(I)	print and plot drawings;	
(J)	demonstrate organizational skills to influence the sequential process when creating drawings;	
(K)	construct geometric figures of lines, splines, circles, and arcs;	

(L)	create and edit text using appropriate style and size to annotate drawings;	
(M)	use control accuracy enhancement tools for entity positioning methods such as snap and xyz;	
(N)	use editing commands;	
(O)	use viewing commands to perform zooming and panning;	
(P)	plot drawings on media using layout and scale;	
(Q)	use query commands to interrogate database for entity characteristics, distance, area, and status;	
(R)	move, stretch, and offset objects;	
(S)	create a radius between objects;	
(T)	trim and extend objects;	
(U)	break and join objects;	
(V)	change object properties; and	
(W)	create hatching and manipulate properties such as calculating the area of an enclosed shape.	Adding an SE to match requirements of industry-based certification requirements
(4)	The student demonstrates the use of CADD tools display and viewpoints. The student is expected to:	
(A)	create multiple viewpoints in the drawing window;	
(B)	select appropriate object snaps for various drawing tasks;	
(C)	create orthographic drawings;	
(D)	analyze challenges and identify solutions for design problems;	
(E)	investigate the use of space, scale, and environmental features to create three-dimensional form or the illusion of depth and form;	
(F)	prepare multi-view scaled drawings;	
(G)	select proper drawing scale, views, and layout;	
(H)	create drawings containing horizontal and vertical surfaces;	
(I)	create drawings containing circles and arcs;	Added in a space between and & arc.
(J)	create removed details and conventional breaks using sectional drawing techniques; technics	Added correct spelling of "techniques"
(K)	create assembly drawings;	
(L)	create detail drawings; and	

(M)	create technical drawings and title blocks associated with the different CAD drawings.	Group wanted to add in aspects of title blocks as a technical software requirement needed for most technical drawings
(5)	The student demonstrates the use of CAD software tools to properly create text within a CADD drawing. The student is expected to:	
(A)	use proper text standards for technical drawings;	
(B)	calculate drawing scale and text height using a scale ratio;	
(C)	apply text styles to enhance readability of drawings;	
(D)	demonstrate the use of tools to create multiline text objects and single-line text;	
(E)	edit existing text; and	
(F)	create, insert, and modify tables.	
(6)	The student demonstrates the use of CADD editing tools within drawings. The student is expected to:	
(A)	draw chamfers and fillets;	
(B)	use editing tools to modify existing drawings;	
(C)	edit polylines and splines;	
(D)	move and copy objects;	
(E)	create mirror images and align objects; and	
(F)	scale and array objects.	
(7)	The student demonstrates the use of grips in drawings. The student is expected to:	
(A)	apply grips to stretch, move, rotate, scale, mirror, and copy objects;	
(B)	demonstrate the use of Quick Properties and the Properties palette to access CADD tools; and	
(C)	create selections by using the Quick Select dialog box.	

(8)	The student demonstrates the use of scale and dimension standards and practices. The student is expected to:	
(A)	apply standard dimensioning rules;	
(B)	draw scales and dimensions;	
(C)	create, edit, and manage dimension styles;	
(D)	add linear and angular dimensions to a drawing;	
(E)	draw datum and chain dimensions;	
(F)	dimension circles and arcs;	
(G)	control the appearance of existing dimensions and dimension text; and	
(H)	change dimension line spacing and alignment.	
(9)	The student creates and demonstrates standard blocks using tool palettes. The student is expected to:	
(A)	create and save text information blocks;	
(B)	insert blocks into a drawing;	
(C)	edit and update a block in a drawing;	
(D)	create blocks as a drawing file;	
(E)	construct and use a symbol library of blocks; and	
(F)	purge unused items from a drawing.	
(10)	The student prepares surface developments. The student is expected to:	
(A)	prepare developments of prisms, cylinders, cones, and pyramids;	
(B)	prepare developments of a transition piece; and	
(C)	prepare drawings involving intersecting pieces.	
(11)	The student designs and prepares basic architectural drawings. The student is expected to:	
(A)	solve design problems, to gain new perspectives;	
(B)	apply critical-thinking and problem-solving skills to develop creative solutions for design problems;	
(C)	draw a site plan;	

(D)	draw a floor plan;	
(E)	draw interior and exterior elevations;	
(F)	draw a roof plan;	
(G)	prepare door and window schedules;	
(H)	draw wall sections;	
(I)	draw a plot plan; and	
(J)	draw an electrical and reflected ceiling plan.	Added in additional rigor with ceiling plan
(12)	The student designs and prepares a technical drawing. The student is expected to:	Added in an engineering aspect to match with the architectural KS above to student have a project in both areas.
(A)	draw individual parts;	
(B)	draw the closed assembly drawings per the parts; and	
(C)	draw and explode the assembly with the parts list.	

130.XXX Intermediate Computer-Aided Design and Drafting

	TEKS with edits	Work Group Comments/Rationale
(a)	General requirements. This course is recommended for students in Grades 10-12. Prerequisite: Architectural Design I, Introduction to Computer Aided Drafting and Design (CADD), or Engineering Design I. Students shall be awarded one credit for successful completion of this course.	Recommending move from innovative to TEKS based course and add to the Engineering POS as a level 2 course. However, writing the prereq for course so that it may work in the Architectural and Manufacturing programs of study for future implementation.
(b)	Introduction.	
(1)	Career and technical education instruction provides content aligned with challenging academic standards, industry relevant technical knowledge, and college and career readiness skills for students to further their education and succeed in current and emerging professions.	
(2)	The STEM Career Cluster focuses on planning, managing, and providing scientific research and professional and technical services, including laboratory and testing services, and research and development services.	Group decided to change it to the STEM Career cluster since these courses are first being asked to fit in the Engineering program of study.
(3)	In Intermediate CADD, students develop practices and techniques used in computer-aided drafting, emphasizing the development and use of prototype drawings, construction of pictorial drawings, construction of three-dimensional drawings, interfacing two-dimensional and three-dimensional environments, and extracting data. Basic rendering techniques will also be developed. Emphasis is placed on drawing set-up; creating and modifying geometry; storing and retrieving predefined shapes; placing, rotating, and scaling objects; adding text and dimensions; using layers and coordinating systems; as well as using input and output devices.	
(4)	Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.	
(5)	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)	The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	
(A)	describe the roles, responsibilities, and dynamics of a team as applied in the manufacturing industry;	
(B)	explain employers' work expectations;	

(C)	demonstrate knowledge of the concepts and skills related to health and safety in the workplace as specified by appropriate governmental regulations;	
(D)	evaluate and justify decisions based on ethical reasoning;	
(E)	evaluate alternative responses to workplace situations based on personal, professional, ethical, legal responsibilities and employer policies;	
(F)	identify and explain personal and long-term consequences of unethical or illegal behaviors in the workplace;	
(G)	interpret and explain written organizational policies and procedures; and	
(H)	demonstrate personal responsibility, ethics and integrity, including respect for intellectual property, when accessing information and creating design projects.	
(2)	The student demonstrates an understanding of computer-aided drafting and design (CADD) terminology, tools, and symbols. The student is expected to:	
(A)	apply the Cartesian Coordinate Systems to illustrate the application of Z coordinates;	Increase rigor to add in z-coordinate to begin the knowledge of 3D and space beyond X and Y
(B)	describe the CADD menu structure;	
(C)	differentiate between type-in commands, icons, and pull down menus;	
(D)	manipulate the standard draw commands;	
(E)	demonstrate modifying commands;	
(F)	explain the various modes of viewing drawings; and	
(G)	define and modify dimension styles.	Increase rigor in not only defining but modifying.
(3)	The student produces hand sketches to organize ideas and communicate design ideas. The student is expected to:	
(A)	demonstrate the use of graphic descriptions;	
(B)	develop skill in sketching or mark making to plan, execute and construct two-dimensional images and three-dimensional models;	Put in "or" to allow both architectural and engineering concepts to be taught through sketching.
(C)	demonstrate methods of projection; and	
(D)	use proper drafting techniques to convert sketches into an electronic drawing utilizing CADD.	Added use and "an" and use

(4)	The student demonstrates an understanding of commands in a CADD system. The student is expected to:	
(A)	operate CADD software;	
(B)	demonstrate draw commands;	
(C)	modify drawn objects in CADD software;	
(D)	create 2D and 3D objects;	
(E)	convert 2D drawings to 3D drawings;	
(F)	convert 3D drawings to 2D drawings;	
(G)	prepare text blocks in CADD software;	
(H)	manipulate an external reference or file;	
(I)	import files of different formats into CADD;	
(J)	demonstrate the plot command in print or plot drawings; and	
(K)	import and export data utilizing attributes.	
(5)	The student preforms computed aided drafting functions. The student is expected to:	
(A)	create text styles, text justification, and multi-line text;	
(B)	create and use multi-leaders;	
(C)	edit dimensions;	
(D)	work with dimension styles;	
(E)	crosshatch objects;	
(F)	isolate and hide objects;	
(G)	use selection set methods;	
(H)	use rectangular, polar, and path arrays;	Added additional content to assist with industry based certification requirements
(I)	use rotation reference angles;	
(J)	use elements of creativity and organizational principles to create visually coherent viewports and layouts;	
(K)	create and manage layers and properties;	And properties as an addition to increase rigor
(L)	use page setup for plotting;	

(M)	create, insert, and edit reusable content such as symbols and blocks;	
(N)	use specific line types utilizing the Standard Alphabet of Lines;	
(O)	create fills and gradients; and	
(P)	edit hatch patterns and fills.	
(6)	The student creates drawings using the CADD software. The student is expected to:	
(A)	translate hand sketches into CADD software;	
(B)	create projected mechanical drawings;	
(C)	create drawings with external references;	
(D)	complete a 3D parametric model;	
(E)	organize a complex assembly, including an animated exploded assembly;	Increase rigor by adding in additional assembly visualization techniques
(F)	compare various methods of drawing solids;	
(G)	make use of multiple drawings to construct a composite drawing;	
(H)	justify correct drawing methods;	
(I)	draw lines, arcs, circles, etc. to represent plans and/or mechanical assemblies;	
(J)	create text styles, text justification and multi-line text;	
(K)	create and use multi-leaders;	
(L)	edit dimensions, including dimension styles;	Moved dimension styles and external references from (M) and combined it to SE (L)
(M)	isolate and hide objects;	
(N)	use selection set methods;	
(O)	use elements of creativity and organizational principles to create visually coherent viewports and layouts;	
(P)	create and manage layers;	
(Q)	use page setup for plotting; and	
(R)	prepare multi view drawings, including sectional and auxiliary views.	Moved sectional and auxiliary that were in (U) and (V) up to (T)
(7)	The student creates electrical drawings. The student is expected to:	

(A)	prepare schematic drawings;	
(B)	prepare printed circuit board assembly drawing packages;	
(A)	prepare connection drawings;	
(B)	prepare interconnection drawings;	
(C)	prepare wiring drawings;	
(D)	prepare cable drawings and/ or harness drawings;	
(E)	prepare component drawings; and	
(F)	prepare logic diagrams.	
(8)	The student creates mechanical drawings. The student is expected to:	
(A)	prepare fastener, cam, gear, spring, and bearing drawings;	Combined SE to add elements from (C), (B), and (J)
(B)	prepare detail drawings;	
(C)	prepare surface developments;	
(D)	prepare welding drawings;	
(E)	prepare bearing drawings;	
(F)	prepare casting drawings;	
(G)	prepare forging drawings;	
(H)	prepare tool drawings;	
(I)	prepare molding diagrams;	
(J)	prepare stamping drawings;	
(K)	prepare numerical-control drawings;	
(L)	modify drawings to include material specifications and parts list; and	
(M)	identify geometric tolerances and dimensioning of specific machined surfaces.	
(9)	The student prepares computer aided drawings (CAD) project designs. The student is expected to:	
(A)	develop a floor plan depicting all elements of the building, including BIM (building information modeling);	Added to increase rigor and technology knowledge to project visualization all parts that may conflict or work with each other.
(B)	render a site plan that depicts all elements of the site;	Added render to increase rigor

(C)	render exterior and interior elevations;	Added render to increase rigor
(D)	draw a specified roof type within a plan;	increase rigor with application of different roof types
(E)	prepare door and window schedules;	
(F)	draw a wall and building section	
(G)	draw an overall site plan;	
(H)	draw a building plot plan;	
(I)	review and revise plans throughout the design process to refine and achieve design objective;	
(J)	demonstrate flexibility and adaptability throughout the design process; and	
(K)	define a basic project materials list.	

§130.420. Fundamentals of Computer Science (One Credit).

	TEKS with edits	Work Group Comments/Rationale
(a)	General requirements. Students shall be awarded one credit for successful completion of this course. This course is recommended for students in Grades 7~~9~~-12.	Rationale: expanding the grade level to allow flexibility for districts and students.
(b)	Introduction.	
(1)	Career and technical education instruction provides content aligned with challenging academic standards, industry ~~and~~ relevant technical knowledge, and college and career readiness skills for students to further their education and succeed in current and ~~or~~ emerging professions.	Gap Analysis: Line 90
(2)	The Science, Technology, Engineering, and Mathematics (STEM) Career Cluster focuses on planning, managing, and providing scientific research and professional and technical services such as~~, including~~ laboratory and testing services, and research and development services.	Rationale: changed including to such as because “laboratory and testing services” does not directly relate to computer science.
(3)	Fundamentals of Computer Science is intended as a first course for those students just beginning the study of computer science. Students will learn about the computing tools that are used every day. Students will foster their creativity and innovation through opportunities to design, implement, and present solutions to real-world problems. Students will collaborate and use computer science concepts to access, analyze, and evaluate information needed to solve problems. Students will learn computational thinking, ~~the~~ problem-solving, and reasoning skills that are the foundation of computer science. By using computer science knowledge and skills that support the work of individuals and groups in solving problems, students will select the technology appropriate for the task, synthesize knowledge, create solutions, and evaluate the results. Students will learn digital citizenship by researching current laws and regulations, best practices, and by practicing integrity and respect. Students will gain an understanding of the principles of computer science through the study of technology operations and concepts. ~~The six strands include creativity and innovation; communication and collaboration; research and information fluency; critical thinking; problem solving, and decision making; digital citizenship; and technology operations and concepts.~~	Rationale: Computational thinking updating to current terminology related to computer science. We deleted the number six because the statement is more general. Rationale: We added best practices to allow the teacher to talk about password security and things that are not necessary laws, but also covering safety. It also allows for future developments in security. Rationale: No longer using the same six strands in each course and previous explanation is sufficient.
(4)	Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.	Gap Analysis: Line 88
(5)	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)	Employability. The student identifies various employment opportunities in the Computer Science field. The student is expected to:	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report
(A)	identify job opportunities and accompanying job duties and tasks;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report
(B)	examine the role of certifications, resumes, and portfolios in the Computer Science profession;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report
(C)	employ effective technical reading and writing skills;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: CD, II. A. 1-7 CD, II. B. 1-2 ELA, II. A. 4 SC, III. A. 1 SC, III. B. 1-4 SC, III. C. 1
(D)	employ effective verbal and nonverbal communication skills;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: SC, I. E.1-2 ELA, IV. A. 1-2 ELA, III. A. 1-2, 4-5
(E)	solve problems and think critically;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: Math, VII. A. 1-5 Math, VII. D.1-2 Math, VII. C.1-2 CD, I. C. 1-3
(F)	demonstrate leadership skills and function effectively as a team member;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: CD, I. E. 2 SC, I. C. 1-3 ELA, III. A. 1-2 ELA, IV. A. 1-2

(G)	demonstrate an understanding of legal and ethical responsibilities in relation to the field of computer science;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: CD. I. F.1-4 SC, IV. B. 1-2 ELA, V. B. 3
(H)	demonstrate planning and time-management skills; and	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: CD, III. C. 3 CD, I. D. 1-2, 4 CD, II. D. 2 ELA, V. A. 3
(I)	compare university computer science programs.	Rationale: students to have exposure to university programs CCRS: CD, II. C. 1-4 CD, II. C. 2
(2)~~(1)~~	Creativity and innovation. The student develops products and generates new knowledge, understanding, and skills.~~by extending existing knowledge.~~ The student is expected to:	Rationale: removed "extended existing knowledge" because this is the beginning course so they will be building new knowledge.
(A)	investigate and explore various career opportunities within the computer science field and report findings through various media;	CCRS: ELA. V.A.1-3 CD, II.E.1 ELA, V.B 1-3
~~(B)~~	~~create and publish interactive stories, games, and animations;~~	Rationale: duplicated in 4E
~~(C)~~	~~create and publish interactive animations;~~	Rationale: removed this standard because it is redundant with 1B.
(B)~~(D)~~	create algorithms for the solution of various problems;	CCRS: CD, II.C.6 CD, I.C.1 Math, VII.A.3-4
(C)~~(E)~~	discuss methods, create, and ***publish*** web pages using a ~~mark-up~~ web-based language such as HTML, Java Script, or XML; and	Rationale: add "discuss methods" because there are multiple ways to create a web page currently. Added examples to provide clarification and flexibility for educators. Moved "publish" from 1F to 1E. Gap Analysis: Line 81 Gap Analysis: Line 68 Gap Analysis: Line 63

~~(F)~~	~~use the Internet to create and *publish* solutions; and~~	Rationale: removed language to eliminate privacy concerns using the internet and moved published to 1E where webpages can be published locally.
(D)~~(G)~~	use generally accepted design standards for spacing, fonts, and color schemes to create functional ~~creative and effective~~ user interfaces, including static and interactive screens.	Rationale: removed vague terminology, added clarification, and added language to align to industry perspectives. Gap Analysis: Line 68 Gap Analysis: Line 66 Gap Analysis: Line 64 Gap Analysis: Line 63
(3)~~(2)~~	Communication and collaboration. The student communicates and collaborates with peers to contribute to his or her own learning and the learning of others. The student is expected to:	CCRS: ELA, III.A.1-5 ELA, IV.A.1-5 S. III. A, 1 S. III. C, 1
(A)	seek and respond to advice or feedback from peers, educators, ~~and~~ or professionals ~~in~~ when evaluating problem solutions;	Rationale: clarified the audience for advice and feedback. Gap Analysis: Line 19 CCRS: CD, I.A.2 CD, I.E.2
(B)	debug and solve problems using reference materials and effective strategies; and	CCRS: CD, II.C.5 CD, I.C.2
(C)	publish information in a variety of ways such as print, monitor display, web pages, or ~~and~~ video.	Rationale: adding flexibility for educators
~~(3)~~	~~Research and information fluency. The student locates, analyzes, processes, and organizes data. The student is expected to:~~	Rationale: removed this strand because this section would align to the Research and Design course.
~~(A)~~	~~construct appropriate electronic search strategies; and~~	Rationale: removed because it is outdated.
~~(B)~~	~~use a variety of resources, including other subject areas, together with various productivity tools to gather authentic data as a basis for individual and group programming projects.~~	Rationale: removed because it is above the level of the course
(4)	Critical thinking, problem solving, and decision making. The student uses appropriate strategies to analyze problems and design algorithms. The student is expected to:	CCRS: CD, I.C.1-3 CD II.C.5-6 S, II.D.1
(A)	demonstrate the ability to insert external standalone objects, such as ***scripts*** or widgets, ~~applets~~ into web pages;	Rationale: updated terminology and added scripting from 4B.

~~(B)~~	~~find, download, and insert *scripting code* into web pages to enhance interactivity;~~	Rationale: removed because it was a security concern to have students searching for scripted codes and downloading. Moved scripting code to 4A.
(B)~~(C)~~	demonstrate understanding of binary representation of data in computer systems, perform conversions between decimal and binary number systems, and count in binary number systems;	Rationale: added a verb to increase the rigor. CCRS: Math: 1.A.1 Math: IX.A.1-2
(C)~~(D)~~	identify ~~read and define~~ a problem's description, purpose, and goals;	Rationale: clarified the verb. Gap Analysis: Line 34 CCRS: Math: VII.A.1
(D)~~(E)~~	demonstrate coding proficiency in a ~~contemporary~~ programming language by developing solutions that create stories, games, and animations;	Rationale: provide flexibility for the educator. Gap Analysis: Line 67 CCRS: Math: VII.A.3-4
(E)~~(F)~~	~~choose,~~ identify~~,~~ and use the appropriate data type to properly represent data in a problem solution;	Rationale: removed choose because it is redundant
(F)~~(G)~~	demonstrate an understanding of and use variables within a programmed story, game, or animation;	Gap Analysis: Line 67
(G)~~(H)~~	demonstrate proficiency in the use of arithmetic operators to create mathematical expressions, including addition, subtraction, multiplication, real division, integer division, and modulus division;	CCRS: Math: IX.A.1-2
(H)~~(I)~~	demonstrate an understanding of and use sequence within a programmed story, game, or animation;	Gap Analysis: Line 67
(I)~~(J)~~	demonstrate an understanding of and use conditional statements within a programmed story, game, or animation;	Gap Analysis: Line 67
(J)~~(K)~~	demonstrate an understanding of and use iteration within a programmed story, game, or animation;	Gap Analysis: Line 67
~~(L)~~	~~create an interactive story, game, or animation;~~	Rationale: removed duplication from 4E
(K)~~(M)~~	use random numbers within a programmed story, game, or animation; and	CCRS: Math: IX.A.1-2
(L)~~(N)~~	test program solutions by investigating intended outcomes ~~valid and invalid data~~.	Rationale: removed "valid and invalid data" to clarify meaning. Gap Analysis: Line 80 Gap Analysis: Line 48

(5)	Digital citizenship. The student explores and understands safety, legal, cultural, and societal issues relating to the use of technology and information. The student is expected to:	CCRS: S, IV. B, 1-2 CD, I.F.4 ELA: III.A.1-5 ELA: IV.A.1-4
(A)	discuss privacy and copyright laws/issues and model ethical acquisition of digital information by citing sources using established methods;	Rationale: align to the CSI digital citizenship standard. Gap Analysis: Line 22 CCRS: ELA: V.B.3 ELA: V.C.2 Math VII.C.1
(B)	compare various non-copyright asset sharing options such as open source, freeware, public domain.	Rationale: added to cover non-copyright sharing as well as copyright discussed in 5A. CCRS: ELA: V.B.3 ELA V.C.2
(C)~~(B)~~	demonstrate proper digital etiquette and knowledge of acceptable use policies when using networks, ~~especially resources on the Internet and on intranets~~;	Rationale: removed because it redundant with the word network.
(D)~~(C)~~	discuss the value of strong ~~investigate measures such as~~ passwords and ~~or~~ virus detection/prevention for privacy and security ~~to protect computer systems and databases from unauthorized use and tampering~~;	Rationale: clarified and simplified complexity.
~~(D)~~	~~understand the safety risks associated with the use of social networking sites;~~	Rationale: removed because it is covered in K-8 Health.
(E)	discuss the impact of computing and computing related advancements on society; and	CCRS: CD, 1.F.3
(F)	discuss how electronic media can affect ~~determine the~~ reliability of information ~~available through electronic media~~.	Rationale: reordered and stressed the importance of reliability of electronic media. CCRS: CD, I.F.2 Math VII.C.1
(6)	Technology operations and concepts. The student understands technology concepts, systems, and operations as they apply to computer science. The student is expected to:	CCRS: CD, II.C.5
(A)	demonstrate knowledge of the basic computer components, including a central processing unit (CPU), storage, and input/output devices;	
(B)	use ~~operating~~ system tools, including appropriate file management;	Rationale: remove "operating" because it implies command prompt interaction.
(C)	demonstrate knowledge ~~and appropriate use~~ of different operating systems;	Rationale: remove "and appropriate use" to increase flexibility within district restrictions.
~~(D)~~	~~demonstrate knowledge and understanding of basic network connectivity;~~	Rationale: removed because this is aligned to the Networking course not the Fundamentals of CS course.

(D)~~(E)~~	describe~~, compare, and contrast~~ the differences between an application and an operating system; and	Rationale: removed duplicate language.
(E)~~(F)~~	~~compare, contrast, and appropriately~~ use various input, processing, output, and primary/secondary storage devices.	Rationale: simplified the expectation and provides flexibility for the educator.

§140.421. Computer Science I (One Credit).		
	TEKS with edits	Work Group Comments/Rationale
(a)	General requirements. Students shall be awarded one credit for successful completion of this course. Required Co-~~Pre~~requisite: Algebra I. This course is recommended for students in Grades 8~~9~~-12.	Rationale: removed prerequisite of Algebra I and changed it to co-requisite and changed the grade level to include 8th graders to allow flexibility for districts and students.
(b)	Introduction.	
(1)	Career and technical education instruction provides content aligned with challenging academic standards, industry ~~and~~ relevant technical knowledge, and college and career readiness skills for students to further their education and succeed in current and ~~or~~ emerging professions.	Gap Analysis: Line 90
(2)	The Science, Technology, Engineering, and Mathematics (STEM) Career Cluster focuses on planning, managing, and providing scientific research and professional and technical services, such as ~~including~~ laboratory and testing services, and research and development services.	Rationale: changed including to such as because "laboratory and testing services" does not directly relate to computer science.
(3)	Computer Science I will foster students' creativity and innovation by presenting opportunities to design, implement, and present meaningful programs through a variety of media. Students will collaborate with one another, their instructor, and various electronic communities to solve the problems presented throughout the course. Through computational thinking and data analysis, students will identify task requirements, plan search strategies, and use computer science concepts to access, analyze, and evaluate information needed to solve problems. By using computer science knowledge and skills that support the work of individuals and groups in solving problems, students will select the technology appropriate for the task, synthesize knowledge, create solutions, and evaluate the results. Students will learn digital citizenship by researching current laws and regulations, best practices, and by practicing integrity and respect. Students will gain an understanding of the principles of computer science through the study of technology operations, systems, and concepts. ~~The six strands include creativity and innovation; communication and collaboration; research and information fluency; critical thinking; problem solving, and decision making; digital citizenship; and technology operations and concepts.~~	Rationale: Computational thinking updating to current terminology related to computer science. We deleted the number six because the statement is more general. Rationale: We added best practices to allow the teacher to talk about password security and things that are not necessary laws, but also covering safety. It also allows for future developments in security. Rationale: No longer using the same six strands in each course and previous explanation is sufficient.
(4)	Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.	Gap Analysis: Line 88
(5)	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)	Employability. The student identifies various employment opportunities in the Computer Science field. The student is expected to:	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report
(A)	identify job opportunities and accompanying job duties and tasks;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report
(B)	examine the role of certifications, resumes, and portfolios in the Computer Science profession;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report
(C)	employ effective technical reading and writing skills;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: CD, II. A. 1-7 CD, II. B. 1-2 ELA, II. A. 4 SC, III. A. 1 SC, III. B. 1-4 SC, III. C. 1
(D)	employ effective verbal and nonverbal communication skills;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: SC, I. E.1-2 ELA, IV. A. 1-2 ELA, III. A. 1-2, 4-5
(E)	solve problems and think critically;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: Math, VII. A. 1-5 Math, VII. D.1-2 Math, VII. C.1-2 CD, I. C. 1-3
(F)	demonstrate leadership skills and function effectively as a team member;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: CD, I. E. 2 SC, I. C. 1-3 ELA, III. A. 1-2 ELA, IV. A. 1-2

(G)	demonstrate an understanding of legal and ethical responsibilities in relation to the field of computer science;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: CD, I. F.1-4 SC, IV. B. 1-2 ELA, V. B. 3
(H)	demonstrate planning and time-management skills; and	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: CD, III. C. 3 CD, I. D. 1-2, 4 CD, II. D. 2 ELA, V. A. 3
(I)	compare university computer science programs.	Rationale: students to have exposure to university programs CCRS: CD, II. C. 1-4 CD, II. E. 2
(2)~~(1)~~	*Communication and collaboration. The student communicates and collaborates with peers to contribute to his or her own learning and the learning of others. The student is expected to:* ~~Creativity and innovation. The student develops products and generates new understandings by extending existing knowledge. The student is expected to~~:	Rationale: Better describes Student Expectations. Gap Analysis: Line 76 CCRS: CD, I. E. 2 ELA III A 1-5 ELA IV A 1-5 S, I. C. 1-3 CD, I.A.1-2
(A)	participate in learning ~~with electronic~~ communities as a learner, initiator, contributor, and teacher/mentor;	Rationale: removed "electronic" to update the standard to current practices.
~~(B)~~	~~extend the learning environment beyond the school walls with digital products created to increase teaching and learning in the other subject areas; and~~	Rationale: removed the standard because it is outdated and inappropriate.
~~(C)~~	~~participate in relevant, meaningful activities in the larger community and society to create electronic projects.~~	Rationale: removed because it is duplicated in mobile app development.
(B)	*seek and respond to advice from peers,* educators, or ~~*and*~~ *professionals* ~~*in*~~ when *evaluating quality and accuracy* of the student's product.	Rationale: Moved 2H here because this standard better fits in the creativity KS.

(3)~~(2)~~	Programming style and presentation. The student utilizes proper programming style and develops appropriate visual presentation of data, input, and output. The student is expected to: ~~*Communication and collaboration. The student communicates and collaborates with peers to contribute to his or her own learning and the learning of others. The student is expected to:*~~	Rationale: Better describes Student Expectations. CCRS: CD, II.E.2-3 S, I. E. 1
(A)	create and properly label and display ~~meaningful~~ output;	Rationale: removed "meaningful" to clarify language.
(B)	create interactive ~~console display~~ input interfaces, with ~~appropriate~~ relevant user prompts, to acquire data from a user such as console displays or *Graphical User Interfaces (GUIs)*;	Rationale: removed "appropriate" to clarify language and merged information from 2C to add flexibility to the standard. Gap Analysis: Line 66
~~(C)~~	~~use *Graphical User Interfaces (GUIs)* to create interactive interfaces to acquire data from a user and display program results;~~	Rationale: removed this standard and added GUI to 2B
(C)~~(D)~~	write programs with proper programming style to enhance the readability and functionality of the code by using ~~meaningful~~ descriptive identifiers, internal comments, white space, spacing, indentation, and a standardized program style;	Rationale: removed "meaningful" to clarify language.
(D)~~(E)~~	format data ~~improve numeric~~ displays using standard formatting styles; and ~~by optimizing data visualization;~~	Rationale: clarified language
(E)~~(F)~~	display simple vector graphics using lines, circles, and rectangles.~~;~~	
~~(G)~~	~~display simple bitmap images; and~~	Rationale: removed because it is inappropriate for this course.
~~*(H)*~~	~~*seek and respond to advice from peers and professionals in evaluating quality and accuracy.*~~	
~~(3)~~	~~Research and information fluency. The student locates, analyzes, processes, and organizes data. The student is expected to:~~	Rationale: removed because it is not related to the CS course.
~~(A)~~	~~use a variety of resources, including foundation and enrichment curricula, to gather authentic data as a basis for individual and group programming projects; and~~	Rationale: removed because it is not related to the CS course.
~~(B)~~	~~use various productivity tools to gather authentic data as a basis for individual and group programming projects.~~	Rationale: removed because it is not related to the CS course.
(4)	Critical thinking, problem solving, and decision making. The student uses appropriate strategies to analyze problems and design algorithms. The student is expected to:	CCRS: CD, I.C.1-3 MATH VII A 1-5 S, I. D, 1.
(A)	use program design problem-solving strategies to create program solutions;	Gap Analysis: Line 34

(B)	create a high-level program plan using a visual tool such as a flow chart or graphic organizer; ~~define and specify the purpose and goals of solving a problem~~;	Rationale: clarification and added detailed language. Gap Analysis: Line 72 Gap Analysis: Line 54 Gap Analysis: Line 9
(C)	identify the tasks and subtasks needed to solve a problem;	Rationale: clarification Gap Analysis: Line 34
(D)	identify the data types and objects needed to solve a problem;	
(E)	identify reusable components from existing code;	
(F)	design a solution to a problem;	
(G)	code a solution from a program design;	
(H)	identify ~~and debug~~ error~~s~~ types, including syntax, lexical, run time, and logic;	Rationale: added specificity and removed duplication in 4J. Gap Analysis: Line 50
(I)	test program solutions with ~~appropriate~~ valid and invalid test data and analyze resulting behavior ~~for correctness~~;	Rationale: removed redundant language and added clarity for instructor.
(J)	debug and solve problems using error messages, reference materials, language documentation, and effective strategies;	Gap Analysis: Line 50
(K)	explore common algorithms such as~~, including~~ finding greatest common divisor, finding the biggest number out of three, finding primes, making change, and finding the average;	Rationale: removed "including" to allow flexibility CCRS: Math, IX.A.1-2
~~(L)~~	~~analyze and modify existing code to improve the underlying algorithm;~~	Rationale: this concept is covered in CS II and is more appropriate in a higher-level course.
(L)~~(M)~~	create program solutions that address basic error handling such as ~~exhibit robust behavior by understanding, avoiding, and preventing runtime errors, including~~ preventing division by zero and type mismatch;	Rationale: clarification Gap Analysis: Line 50 CCRS: Math, IX.A.1-2
(M)~~(N)~~	select the most appropriate construct ~~algorithm~~ for a defined problem;	Rationale: clarification
(N)~~(O)~~	create program solutions by using ~~demonstrate proficiency in the use of~~ the arithmetic operators to create mathematical expressions, including addition, subtraction, multiplication, real division, integer division, and modulus division;	Rationale: clarified the verb to be more specific to the task. CCRS: Math, IX.A.1-2
(O)~~(P)~~	create program solutions to problems using available mathematics library ~~libraries~~ functions or operators, including absolute value, round, power, square, and square root;	Rationale: clarification CCRS: Math, IX.A.1-2

(P)~~(Q)~~	develop program solutions that use assignment;	
(Q)~~(R)~~	develop sequential algorithms to solve non-branching and non-iterative problems;	
(R)~~(S)~~	develop algorithms to decision-making problems using branching control statements;	
(S)~~(T)~~	develop iterative algorithms and code programs to solve practical problems;	
(T)~~(U)~~	demonstrate proficiency in the use of the relational operators;	
(U)~~(V)~~	demonstrate proficiency in the use of the logical operators; and	CCRS: Math, IX.A.1-2
(V)~~(W)~~	generate and use random numbers.	CCRS: Math, IX.A.1-2
(5)	Digital citizenship. The student explores and understands safety, legal, cultural, and societal issues relating to the use of technology and information. The student is expected to:	CCRS: S, IV. B. 1-2 CD, I.F.4
(A)	discuss intellectual property, privacy, sharing of information, copyright laws, and software licensing agreements;	Gap Analysis: Line 71 CCRS: ELA, V.B.1-3
(B)	model ethical acquisition and use of digital information;	CCRS: ELA V.C.2 CD, I.F.1
(C)	demonstrate proper digital etiquette, responsible use of software, and knowledge of acceptable use policies;	CCRS: CD, I.F.1 CD, II.E.4
(D)	investigate measures, including strong passwords, pass phrases, and other methods of authentication, as well as ~~and~~ virus detection/prevention for privacy and security ~~to protect computer systems and databases from unauthorized use and tampering~~; and	Rationale: clarified and expanded content to include pass phrases and authentication. Gap Analysis: Line 71
(E)	investigate computing and computing related advancements ~~how technology has changed,~~ and the social and ethical ramifications of computer usage.	Rationale: clarification CCRS: CD, II.E.4 ELA, V.B.1-3
(6)	Technology operations, systems, and concepts. The student understands technology concepts, systems, and operations as they apply to computer science. The student is expected to:	CCRS: CD, II.C.5-6 CD, I,C.1-3 S, I. D. 1-2
~~(A)~~	~~compare and contrast types of operating systems, *software applications*, and programming languages;~~	Rationale: removed because it is duplicated in Fundamental of CS. Moved "software applications" to 5C.
(A)~~(B)~~	demonstrate knowledge of major hardware components, including primary and secondary memory, a central processing unit (CPU), and peripherals;	

(B)~~(C)~~	differentiate among current programming languages, discuss the general purpose for each language, ~~discuss the use of those languages in other fields of study, and~~ demonstrate knowledge of specific programming terminology and concepts, and types of *software* development *applications*;	Rationale: clarified language and added types of software development applications from 5A to be more specific.
(C)~~(D)~~	differentiate between a high-level compiled language and an interpreted language;	
(D)~~(E)~~	identify and use ~~understand~~ concepts of object-oriented design;	Rationale: removed understand and changed to identify and use to increase the rigor.
(E)~~(F)~~	differentiate between ~~use~~ local and global scope access variable declarations;	Rationale: removed "use" and replaced with a high-level verb
(F)~~(G)~~	encapsulate data and associated subroutines into an abstract data type;	
(G)~~(H)~~	create subroutines that do not return values with and without the use of arguments and parameters;	
(H)~~(I)~~	create subroutines that return typed values with and without the use of arguments and parameters;	
(I)~~(J)~~	~~understand and identify~~ create calls to processes ~~parameters, the data-binding~~ passing ~~process between~~ arguments that match parameters by number, type, and position ~~and parameters~~;	Rationale: removed advanced concept of data binding and replaced with terminology appropriate for CS I.
(J)~~(K)~~	compare data elements ~~objects~~ using logical and relational operators ~~reference values and a comparison routine~~;	Rationale: removed Java specific language and broadening the scope of the standard.
(K)~~(L)~~	identify and convert ~~understand the~~ binary representation of numeric and nonnumeric data in computer systems using ASCII or Unicode;	Rationale: removed understand and changed to identify and convert to increase the rigor. CCRS: Math: IX.A.1-2
(L)~~(M)~~	identify ~~understand the~~ finite limits of numeric data such as integer wrap around and floating point precision;	Rationale: removed understand and changed to identify to make this standard measurable and added clarification through examples. CCRS: Math: IX.A.1-2
(M)~~(N)~~	perform numerical conversions between the decimal and binary number systems and count in the binary number system;	CCRS: Math: IX.A.1-2 Math: I.A.1
(N)~~(O)~~	choose, identify, and use the appropriate data types for integer, real, and Boolean data when writing program solutions;	CCRS: Math: IX.A.1-2 Math: I.A.1 Math: V.B.1
(O)~~(P)~~	demonstrate an understanding of the concept of a variable including primitives and objects;	Rationale: added examples to add clarity
~~(Q)~~	~~demonstrate an understanding of and use reference variables for objects;~~	Rationale: removed because it is Java specific and might exclude other languages.

(P)~~(R)~~	demonstrate an understanding of how to represent and manipulate text data, including concatenation and other string functions;	CCRS: Math: V.B.1
~~(S)~~	~~demonstrate an understanding of the concept of scope;~~	Rationale: removed because it is redundant with 6F.
(Q)~~(R)~~	identify and use the structured data type of one-dimensional arrays to traverse, search, and modify data;	
(R)~~(S)~~	choose, identify, and use the appropriate data type or ~~and~~ structure to properly represent the data in a program problem solution; and	Rationale: removed "and" because it is inaccurate.
(S)~~(T)~~	compare ~~and contrast~~ strongly typed and un-typed programming languages.	Rationale: removed contrast to align to the language of other TEKS.

§130.422. Computer Science II (One Credit).

	TEKS with edits	Work Group Comments/Rationale
(a)	General requirements. Students shall be awarded one credit for successful completion of this course. Prerequisite: Algebra I and ~~either~~ Computer Science I or AP Computer Science Principles ~~or Fundamentals of Computer Science~~. This course is recommended for students in Grades 10 through ~~11 and~~ 12.	Rationale: Changed the grade levels because a Program of Study could begin in 8th grade. The courses were changed because the jump from Fundamentals of CS to CS II is not appropriate. We included AP Computer Science Principles because the rigor is appropriate and equivalent to CS I.
(b)	Introduction.	
(1)	Career and technical education instruction provides content aligned with challenging academic standards, industry ~~and~~ relevant technical knowledge, and college and career readiness skills for students to further their education and succeed in current and ~~or~~ emerging professions.	Gap Analysis: Line 90
(2)	The Science, Technology, Engineering, and Mathematics (STEM) Career Cluster focuses on planning, managing, and providing scientific research and professional and technical services such as ~~including~~ laboratory and testing services, and research and development services.	Rationale: changed including to such as because "laboratory and testing services" does not directly relate to computer science.
(3)	Computer Science II will foster students' creativity and innovation by presenting opportunities to design, implement, and present meaningful programs through a variety of media. Students will collaborate with one another, their instructor, and various electronic communities to solve the problems presented throughout the course. Through computational thinking and data analysis, students will identify task requirements, plan search strategies, and use computer science concepts to access, analyze, and evaluate information needed to solve problems. By using computer science knowledge and skills that support the work of individuals and groups in solving problems, students will select the technology appropriate for the task, synthesize knowledge, create solutions, and evaluate the results. ~~Students will learn digital citizenship by researching current laws and regulations and by practicing integrity and respect.~~ Students will gain an understanding of computer science through the study of technology operations, systems, and concepts. ~~The six strands include creativity and innovation; communication and collaboration; research and information fluency; critical thinking; problem solving, and decision making; digital citizenship; and technology operations and concepts.~~	Rationale: Computational thinking updating to current terminology related to computer science. Rationale: Removed the digital citizenship because it is covered in CS 1 and Fundamentals of CS. In the CS II course, there was no new information in the digital citizenship section and was removed to gain instructional time. Rationale: No longer using the same six strands in each course and previous explanation is sufficient.
(4)	Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.	Gap Analysis: Line 88
(5)	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)	Employability. The student identifies various employment opportunities in the Computer Science field. The student is expected to:	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report
(A)	identify job opportunities and accompanying job duties and tasks;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report
(B)	examine the role of certifications, resumes, and portfolios in the Computer Science profession;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report
(C)	employ effective technical reading and writing skills;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: CD, II. A. 1-7 CD, II.B.1-2 ELA, II. A. 4 SC, III. A. 1 SC, III. B. 1-4 SC, III. C. 1
(D)	employ effective verbal and nonverbal communication skills;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: SC, I. E.1-2 ELA, IV. A. 1-2 ELA, III. A. 1-2, 4-5
(E)	solve problems and think critically;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: Math, VII. A. 1-5 Math, VII. D.1-2 Math, VII. C.1-2 CD, I. C. 1-3
(F)	demonstrate leadership skills and function effectively as a team member;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: CD, I. E. 2 SC, I. C. 1-3 ELA, III. A. 1-2 ELA, IV. A. 1-2

(G)	demonstrate an understanding of legal and ethical responsibilities in relation to the field of computer science;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: CD. I. F.1-4 SC, IV. B. 1-2 ELA, V. B. 3
(H)	demonstrate planning and time-management skills; and	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: CD, III. C. 3 CD, I. D. 1-2, 4 CD, II. D. 2 ELA, V. A. 3
(I)	compare university computer science programs.	Rationale: students to have exposure to university programs CCRS: CD, II. C. 1-4 CD, II. C. 2
(2)~~(1)~~	Creativity and innovation. The student develops products and generates new understandings by extending existing knowledge. The student is expected to:	Gap Analysis: Line 66 Gap Analysis: Line 48 Gap Analysis: Line 34
(A)	use program design problem-solving strategies to create program solutions;	CCRS: Math, VII. A. 1-5 Math, VII. D. 1-2 CD, II. C. 6 CD, I. C. 1-2 Gap Analysis: Line 72 Gap Analysis: Line 54

(B)	~~demonstrate the ability to~~ read, analyze, and modify ~~large~~ programs, including any accompanying documentation such as an API, internal code comments, external documentation, or readme files ~~the design description and process development~~;	Rationale: The focus of the standard is looking at all programs and size is not important. Removed "the design description and process development" because it was ambiguous, and it was very specific to something that might not be in the program they are looking at in class. We added accompanying documentation and examples because documentation is a critical part of software development. Added analyze and omitted demonstrate to increase the rigor of the standard. CCRS: CD, I. C. 1-2 CD, II. E. 1-4 CD, II. A. 4-5 SC, III. B. 1, 3 SC, III. C. 1 ELA, I. A. 5 Math, VII. A. 1
(C)	follow a ~~the~~ systematic problem-solving process of identifying the ~~specifications of~~ purpose and goals, the data types and objects needed, and the subtasks to be performed;	Rationale: Changed "the" to "a" because there is more than one process. Removed specifications because it is redundant, and it adds complexity that is unintended. CCRS: Math, VII. A. 1-5 Math, VII. D. 1-2 CD, I. C. 1-2
(D)	compare ~~and contrast~~ design methodologies and implementation techniques such as top-down, bottom-up, and black box;	Rationale: "and contrast" was removed to match TEKS language throughout the grade levels. CCRS: SC, I. B. 1 CD, I. C. 2
(E)	trace ~~analyze, modify, and evaluate existing code by performing a case study on~~ a ~~large~~ program, including inheritance and black box programming;	Rationale: Removed redundant content and added trace to specify what should be taught.
~~(F)~~	~~identify the data types and objects needed to solve a problem;~~	Rationale: Removed because this is mentioned in 1C
(F)~~(G)~~	choose, identify, and use the appropriate abstract data type, advanced data structure, and supporting algorithms to properly represent the data in a program problem solution;	CCRS: Math, V. B. 1-2 CD, II. D. 1-3

(G)~~(H)~~	use object-oriented programming development methodology, data abstraction, encapsulation with information hiding, inheritance, and procedural abstraction in program development and testing; and	Rationale: added inheritance because it is an integral part of object-oriented programming. CCRS: CD, II. C. 4 CD, I. C. 2
~~(I)~~	~~create, edit, and manipulate bitmap images that are used to enhance user interfaces and program functionality.~~	Rationale: This was removed because it would be better in a digital forensics class and not a part of the core cs classes.
(3)~~(1)~~	Communication and collaboration. The student communicates and collaborates with peers to contribute to his or her own learning and the learning of others. The student is expected to:	CCRS: (Applies to all the SEs below) SC, I. C. 1 SC, I. E. 2 CD, I. E. 2 ELA, III. A. 1-2 ELA, IV. A. 1-2 Gap Analysis: Line 19
(A)	use the principles of software development ~~engineering~~ to work in software design teams, ~~*break a problem statement into specific solution requirements, create a program development plan, code part of a solution from a program development plan while a partner codes the remaining part, team test the solution for correctness, and develop presentations to report the solution findings*~~;	Rationale: Removed engineering because it implies skills beyond the scope of this class. Development was added because it is more specific. 2A had too many breakouts and was separated into multiple SEs.
(B)	*break a problem statement into specific solution requirements;* ~~create interactive console display interfaces with appropriate user prompts;~~	Content moved from 2A CCRS: CD, I. C. 1-3 Math, VII. A. 1-3 Rationale: removed because it is covered in CS I.
(C)	*create a program development plan;* ~~create interactive human interfaces to acquire data from a user and display program results using an advanced Graphical User Interface (GUI);~~	Content moved from 2A CCRS: Math, VII. A. 2 CD, I. C. 1-3 ELA, V. A. 3 Rationale: removed because it is covered in CS I.
(D)	*code part of a solution from a program development plan while a partner codes the remaining part;* ~~write programs and communicate with proper programming style to enhance the readability and functionality of the code by using meaningful descriptive identifiers, internal comments, white space, indentation, and a standardized program style;~~	Content moved from 2A CCRS: Math, VI. C. 1-2 CD, I. C. 2-3 Rationale: removed because it is covered in CS I.

(E)	*team test* ~~the~~ a *solution*, including boundary and standard cases; and ~~improve data display by optimizing data visualization;~~	Content moved from 2A Removed correctness because it is not clear what to measure. CCRS: CD, I. C. 3 CD, II. C. 4 Rationale: removed because it is covered in CS I.
(F)	*develop presentations to report the solution findings*. ~~display simple vector graphics to interpret and display program results; and~~	Content moved from 2A CCRS: ELA, III. A. 5 SC, III. C. 1 Math, VII. A. 4 CD, II. C. 8 Rationale: removed because it is covered in CS I.
~~(G)~~	~~display simple bitmap images.~~	Rationale: removed because it is covered in CS I.
(4)~~(2)~~	Data Literacy and Management. ~~Research and information fluency~~. The student locates, analyzes, processes, and organizes data. The student is expected to:	Rationale: Better describes Student Expectations.
~~(A)~~	~~use local area networks (LANs) and wide area networks (WANs), including the Internet and intranets, in research, file management, and collaboration;~~	Rationale: removed because it is not appropriate for this course.
(A)~~(B)~~	utilize ~~understand~~ programming file structure and file access for required resources;	Rationale: provides clarity
(B)~~(C)~~	acquire and process information from text files, including files of known and unknown sizes;	
(C)~~(D)~~	manipulate data ~~structures~~ using string processing;	Rationale: removed structures because string processing only applies to data.
(D)~~(E)~~	manipulate data values by casting between data types;	
(E)~~(F)~~	~~identify and~~ use the structured data type of one-dimensional arrays to traverse, search, modify, insert, and delete data;	Rationale: removed identify because the verb in CS I was identify.
(F)~~(G)~~	identify and use the structured data type of two-dimensional arrays to traverse, search, modify, insert, and delete data; and	
(G)~~(H)~~	identify and use a list object data structure to traverse, search, insert, and delete data.	
(H)	*differentiate among the categories of programming languages, including machine, assembly, high-level compiled, high-level interpreted, and scripted.*	Rationale: moved 6F here to satisfy the information fluency requirement CCRS: CD, II. C. 2

(5)~~(3)~~	Critical thinking, problem solving, and decision making. The student uses appropriate strategies to analyze problems and design algorithms. The student is expected to:	CCRS: (Applies to all SEs in this section) SC, I. A. 1 SC, I. B. 1 SC, I.D.1-2 CD, I. C. 1-2 CD, II. C. 6 Math, VII. A. 1-5 Math, VII. D. 2 Math, IX. A. 2 Gap Analysis: Line 76
(A)	develop sequential algorithms using branching control statements, including nested structures, to create solutions to decision-making problems;	CCRS: Math, II. B. 1
(B)	develop choice algorithms using selection control statements based on ordinal values;	CCRS: Math, II. B. 1
(C)	demonstrate proficiency in the use of short-circuit evaluation;	CCRS: Math, II. B. 1
(D)	demonstrate proficiency in the use of Boolean algebra, including De Morgan's Law;	CCRS: SC, IV. A. 1 SC, IV. C. 2 CCRS: Math, II. B. 1 Math. VI. C. 1
(E)	develop iterative algorithms using nested loops;	CCRS: Math, II. B. 1
(F)	identify, trace, and appropriately use recursion in programming solutions, including algebraic computations;	CCRS: Math, VII. C. 2
(G)	trace ~~design~~, construct, evaluate, and compare search algorithms, including linear searching and binary searching;	Rationale: removed design because they are not designing algorithms. Changed to trace because that would be the appropriate verb. CCRS: Math, VI. B. 1
(H)	identify, describe, trace ~~design, create~~, evaluate, and compare standard sorting algorithms, including selection sort, bubble sort, insertion sort, and merge sort;	Rationale: removed design and create because they are not designing algorithms. Changed to trace because that would be the appropriate verb. CCRS: Math, VI. B. 1
(I)	measure time/space efficiency of various sorting algorithms, including *analyz*~~e~~ing *algorithms using "big-O" notation for best, average, and worst-case data patterns*	Rationale: Moved 4K to 4I because it is a logical extension. CCRS: Math, V. C. 1,3 Math, VI. B. 1 Math, VII. D. 1-2 SC, II. A. 7 CD, II. D .2 Gap Analysis: Line 84

~~*(J)*~~	~~compare and contrast~~ ~~*search and sort algorithms, including linear, quadratic, and recursive strategies, for time/space efficiency;*~~	Rationale: Moved 4J to 4O
~~*(K)*~~	~~*analyze algorithms using "big-O" notation for best, average, and worst-case data patterns;*~~	Rationale: Moved 4K to 4I because it is a logical extension.
(J)~~(L)~~	develop algorithms to solve various problems such as~~,~~ ~~including~~ factoring, summing a series, finding the roots of a quadratic equation, and generating Fibonacci numbers;	Rationale: removed including because it is not necessary to do all of those to meet this criterion. CCRS: Math, II. B. 1 Math, VI. C. 1-2
(K)~~(M)~~	test program solutions by investigating boundary conditions; testing classes, methods, and libraries in isolation; and performing stepwise refinement;	CCRS: Math, VI. C. 2 Gap Analysis: Line 80
(L)~~(N)~~	identify and debug compile, syntax, runtime, and logic errors;	CCRS: SC, II. A. 6 Math, I. B. 2 CD, II. A. 4 Gap Analysis: Line 50
(M)~~(O)~~	compare ~~and contrast~~ algorithm efficiency of *linear, quadratic, and recursive strategies*~~*, for time/space efficiency*~~ by using informal runtime comparisons, exact calculation of statement execution counts, and theoretical efficiency values using "big-O" notation, including worst-case, best-case, and average-case time/space analysis of *search and sort algorithms,* ~~including~~	Rationale: "and contrast" was removed to match TEKS language throughout the grade levels. Combined 4O and 4J to avoid duplication. CCRS: SC, II. A. 7 CD, II. D .2 Math, VI. B. 1 Gap Analysis: Line 84
(N)~~(P)~~	demonstrate the ability to count, convert, and perform mathematical operations in the decimal, binary, octal, and hexadecimal number systems;	Rationale: included all four number systems because they are important for this SE. CCRS: Math, I. A. 1 Math, I. B. 2 Math, I. C. 1
(O)~~(Q)~~	demonstrate knowledge of the maximum integer boundary, minimum integer boundary, imprecision of real number representations, and round-off errors;	CCRS: SC, II. A.1 CD, II. D. 2
(P)~~(R)~~	create program solutions to problems using a ~~the~~ mathematics library~~ class~~;	Rationale: removed Java specific language.
(Q)~~(S)~~	use random number generator algorithms to create simulations~~ that model the real world~~;	Rationale: clarified language and removed "the model the real world" because it doesn't make sense. CCRS: Math, VII. D. 1 Gap Analysis: Line 33

(R)~~(T)~~	use composition and inheritance relationships to~~ among classes~~ identify~~, understand~~ and create class definitions ~~specifications~~ and relationships.	Rationale: removed understand because it is not measurable and reordered the standard. The verb use was added to provide rigor to the SE. CCRS: Math, VI. C. 2
(S)~~(U)~~	~~understand and~~ explain and use object relationships among defined classes, abstract classes, and interfaces;	Rationale: removed understand because it is not measurable. Added use to increase rigor.
(T)~~(V)~~	create object-oriented class definitions and declarations using ~~class declarations,~~ variables ~~declarations~~, constants ~~declarations~~, methods ~~declarations~~, parameters ~~declarations~~, and interface implementations ~~declarations~~;	Rationale: Clarified language
~~(W)~~	~~create robust classes that encapsulate data and the methods that operate on that data and incorporate overloading to enrich the object's behavior;~~	Rationale: removed because it is redundant to 4V and 4BB.
~~(X)~~	~~design and implement a set of interactive classes;~~	Rationale: Duplication of 4U
~~(Y)~~	~~design, create, and evaluate multiclass programs that use abstract classes and interfaces;~~	Rationale: Duplication of 4X and 4U
~~(Z)~~	~~understand and implement a student-created class hierarchy;~~	Rationale: Duplicate standard removed. Covered in CS III
~~(AA)~~	~~extend, modify, and improve existing code using inheritance;~~	Rationale: Duplicate standard removed. Covered in CS III
(U) ~~(BB)~~	create adaptive behaviors~~, including overloading,~~ using polymorphism;	Rationale: removed including so all aspects of polymorphism are implied.
(V) ~~(CC)~~	~~understand and~~ use reference variables for object and string data types;	Rationale: removed understand because it is not measurable.
(W)	use value and reference parameters appropriately in method definitions and method calls;	Rationale: added because it is an important missing topic
(X) ~~(DD)~~	~~understand and~~ implement access scope modifiers;	Rationale: removed understand because it is not measurable.
(Y) ~~(EE)~~	use ~~understand and demonstrate how to compare~~ object~~s~~ comparison for content quality;	Rationale: removed understand because it is not measurable. Added to the standard for clarification.
(Z)~~(FF)~~	duplicate objects using the appropriate deep ~~and/~~or shallow copy;	Rationale: removed "and" because it cannot be both deep and shallow.
~~(GG)~~	~~define and implement abstract classes and interfaces in program problem solutions;~~	Rationale: removed because it is a duplicate of 4U.
(AA) ~~(HH)~~	apply functional decomposition to a program solution;	

(BB) ~~(II)~~	create ~~simple and robust~~ objects from class definitions through instantiation;	Rationale: removed "simple and robust" because it is subjective
~~(JJ)~~	~~apply class membership of variables, constants, and methods;~~	Rationale: removed because it is redundant with 4U.
(CC) ~~(KK)~~	examine and mutate the properties of an object using accessors and modifiers;	
~~(LL)~~	~~understand and implement a composite class; and~~	Rationale: removed because it is redundant with 4U.
~~(MM)~~	~~design and implement an interface.~~	Rationale: removed because it is redundant with 4U.
~~(4)~~	~~Digital citizenship. The student explores and understands safety, legal, cultural, and societal issues relating to the use of technology and information. The student is expected to:~~	Rationale: removed because this information is covered in Fundamentals of Computer science and CS I
~~(A)~~	~~model ethical acquisition and use of digital information;~~	
~~(B)~~	~~demonstrate proper digital etiquette, responsible use of software, and knowledge of acceptable use policies; and~~	
~~(C)~~	~~investigate digital rights management.~~	
~~(6)~~	~~Technology operations and concepts. The student understands technology concepts, systems, and operations as they apply to computer science. The student is expected to:~~	Rationale: removed all student expectations except 6F which was moved under KS 3
~~(A)~~	~~compare and contrast types of operating systems, software applications, hardware platforms, and programming languages;~~	Rationale: removed because this is covered in CS I.
~~(B)~~	~~demonstrate knowledge of major hardware components, including primary and secondary memory, a central processing unit (CPU), and peripherals;~~	Rationale: removed because this is covered in CS I.
~~(C)~~	~~demonstrate knowledge of major networking components, including hosts, servers, switches, and routers;~~	Rationale: This standard is a networking standard.
~~(D)~~	~~demonstrate knowledge of computer communication systems, including single-user, peer-to-peer, workgroup, client-server, and networked;~~	Rationale: This standard is a networking standard.
~~(E)~~	~~demonstrate knowledge of computer addressing systems, including Internet Protocol (IP) address and Media Access Control (MAC) address; and~~	Rationale: This standard is a networking standard.
~~*(F)*~~	~~*differentiate among the categories of programming languages, including machine, assembly, high-level compiled, high-level interpreted, and scripted.*~~	Rationale: moved to 3H

§130.423. Computer Science III (One Credit).

	TEKS with edits	Work Group Comments/Rationale
(a)	General requirements. Students shall be awarded one credit for successful completion of this course. Prerequisite: Computer Science II, Advanced Placement (AP) Computer Science A, or International Baccalaureate (IB) Computer Science. This course is recommended for students in Grades 11 and 12.	
(b)	Introduction.	
(1)	Career and technical education instruction provides content aligned with challenging academic standards, industry ~~and~~ relevant technical knowledge, and college and career readiness skills for students to further their education and succeed in current and ~~or~~ emerging professions.	
(2)	The Science, Technology, Engineering, and Mathematics (STEM) Career Cluster focuses on planning, managing, and providing scientific research and professional and technical services such as~~, including~~ laboratory and testing services, and research and development services.	Rationale: changed including to such as because "laboratory and testing services" does not directly relate to computer science.
(3)	Computer Science III will foster students' creativity and innovation by presenting opportunities to design, implement, and present meaningful programs through a variety of media. Students will collaborate with one another, their instructor, and various electronic communities to solve the problems presented throughout the course. Through computational thinking and data analysis, students will identify task requirements, plan search strategies, and use computer science concepts to access, analyze, and evaluate information needed to solve problems. By using computer science knowledge and skills that support the work of individuals and groups in solving problems, students will select the technology appropriate for the task, synthesize knowledge, create solutions, and evaluate the results. ~~Students will learn digital citizenship by researching current laws and regulations and by practicing integrity and respect.~~ Students will gain an understanding of advanced computer science data structures through the study of technology operations, systems, and concepts. ~~The six strands include creativity and innovation; communication and collaboration; research and information fluency; critical thinking; problem solving, and decision making; digital citizenship; and technology operations and concepts.~~	Rationale: Computational thinking updating to current terminology related to computer science. We deleted the number six because the number of strands has changed, and this statement is more general. Rationale: Removed the digital citizenship because it is covered in CS 1 and Fundamentals of CS. In the CS III course, there was no new information in the digital citizenship section and was removed to gain instructional time. Rationale: No longer using the same six strands in each course and previous explanation is sufficient.
(4)	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.	
(5)	Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.	Gap Analysis: Line 88
(c)	Knowledge and skills.	

(1)	Employability. The student identifies various employment opportunities in the Computer Science field. The student is expected to:	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report
(A)	identify job opportunities and accompanying job duties and tasks; and	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report
(B)	examine the role of certifications, resumes, and portfolios in the Computer Science profession	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report
(C)	employ effective technical reading and writing skills	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: CD, II. A. 1-7 CD, II. B. 1-2 ELA, II. A. 4 SC, III. A. 1 SC, III. B. 1-4 SC, III. C. 1
(D)	employ effective verbal and nonverbal communication skills	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: SC, I. E. 1-2 ELA, IV. A. 1-2 ELA, III. A. 1-2, 4-5
(E)	solve problems and think critically	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: Math, VII. A. 1-5 Math, VII. D. 1-2 Math, VII. C. 1-2 CD, I. C. 1-3 Gap Analysis: Line 48
(F)	demonstrate leadership skills and function effectively as a team member;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: CD, I. E. 2 SC, I. C. 1-3 ELA, III. A. 1-2 ELA, IV. A. 1-2

(G)	demonstrate an understanding of legal and ethical responsibilities in relation to the field of computer science;	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: CD. I. F. 1-4 SC, IV. B. 1-2 ELA, V. B. 3
(H)	demonstrate planning and time-management skills	Rationale: alignment to CTE employment language brought over from IT course and aligning to gap analysis skill report CCRS: CD, III. C. 3 CD, I. D. 1-2,4 CD, II. D. 2 ELA, V. A. 3
(I)	compare university computer science programs	Rationale: students to have exposure to university programs CCRS: CD, II. C. 1-4 CD, II. C. 2
(2)~~(1)~~	Creativity and innovation. The student develops products and generates new understandings by extending existing knowledge. The student is expected to:	
(A)	apply object-oriented programming including data abstraction, ~~and~~ encapsulation, inheritance, and polymorphism to manage complexity;	Rationale: clarification and alignment to previous object-oriented programming work in CSII.
(B)	design and implement a ~~student-created~~ class hierarchy;	Rationale: clarification and verb added to replace student created.
(C)	read and write class specifications using visual organizers, including Unified Modeling Language;	CCRS: CD, II. C. 5 CD, II. D. 3 SC, III. C. 1 GAP: Line 9, 72
~~(D)~~	~~use black box programming methodology;~~	Rationale: foundational knowledge covered in earlier classes and use of black box programming is implied in SE1(G)
~~(E)~~	~~design, create, and use interfaces to apply protocols;~~	Rationale: deleted because it is inappropriate for this course and the phrase "apply protocols" is ambiguous to interpret. It would be a better fit with mobile app design.

(D)~~(F)~~	identify, describe, ~~design, create,~~ evaluate, ~~and~~ compare, and implement standard sorting algorithms that perform sorting operations on data structures, including quick sort and heap sort; and	Rationale: clarification CCRS: CD, II. D. 1-3 Math, V. B. 1-2, 4
(E)~~(G)~~	~~select,~~ identify~~,~~ and use the appropriate abstract data type, advanced data structure, and supporting algorithms to properly represent the data in a program problem solution.~~; and~~	Rationale: select and identify are similar verbs so select was eliminated. CCRS: CD, II. D. 1-3 Math, V. B. 2, 4 Math, VII. A. 1-5
~~(H)~~	~~manage complexity by using a systems approach.~~	Rationale: ambiguity
(3)~~(2)~~	Communication and collaboration. The student communicates and collaborates with peers to contribute to his or her own learning and the learning of others. The student is expected to:	
(A)	use networked tools such as GitHub for file management and collaboration ~~use local area networks (LANs) and wide area networks (WANs), including the Internet and intranets, in research, file management, and collaboration~~; and	Rationale: modernized and removed ambiguity CCRS: CD, II. E. 1-4
~~(B)~~	~~create interactive human interfaces to acquire data from a user and display program results using an advanced Graphical User Interface (GUI);~~	Rationale: already covered in CSII
~~(C)~~	~~write programs and communicate with proper programming style to enhance the readability and functionality of the code by using meaningful descriptive identifiers, internal comments, white space, indentation, and standardized program style; and a~~	Rationale: We deleted because this is taught in CS II
(B)~~(D)~~	work in software design teams.	CCRS: CD, I. E. 2 ELA, III. A. 1-2 ELA, IV. A. 1-2 ELA, I. B. 1-2
(4)~~(3)~~	Data Literacy and Management ~~Research and information fluency.~~. The student locates, analyzes, processes, and organizes data. The student is expected to:	Rationale: Better describes Student Expectations. CCRS: CD, II. D. 1-3 (Applies to the whole section)
~~(A)~~	~~identify and use the structured data type of arrays of objects to traverse, search, modify, insert, and delete data;~~	Rationale: Covered in CSII
(A)~~(B)~~	identify and use two-dimensional ragged arrays to traverse, search, modify, insert, and delete data;	

~~(C)~~	~~identify and use a list object data structure, including vector, to traverse, search, insert, and delete object data;~~	Rationale: Covered in CSI, CSII, and CSP
(B)~~(D)~~	describe and demonstrate proper linked list management, including maintaining the head and safe addition and deletion of linked objects~~understand describe and trace a linked list data structure~~;	Rationale: understand is not measurable, need more clarification
(C)~~(E)~~	create or trace program solutions using a linked-list data structure, including unordered single, ordered single, double, and circular linked;	Rationale: the word trace added as a time saving measure.
(D)~~(F)~~	describe ~~understand~~ composite data structures, including a linked list of linked lists;	Rationale: understand is not measurable
(E)~~(G)~~	~~understand and~~ create or trace program solutions using stacks, queues, trees, heaps, priority queues, graph theory, and enumerated data types;	Rational: understand is not measurable and the word trace added as a time saving measure
(F)~~(H)~~	~~understand and~~ create or trace program solutions using sets, including hash and tree-based data structures ~~HashSet and TreeSet~~;	Rationale: understand is not measurable; the word trace added as a time saving measure and removing program specific language
(G)~~(I)~~	~~understand and~~ create or trace program solutions using map~~s~~ style data structures ~~including HashMap and TreeMap~~; and	Rationale: understand is not measurable; the word trace added as a time saving measure and removing program specific language
(H)~~(J)~~	write and modify text file data.	
(5)~~(4)~~	Critical thinking, problem solving, and decision making. The student uses appropriate strategies to analyze problems and design algorithms. The student is expected to:	CCRS: Math, VII. A. 1-5 (Applies to the whole section) CD, I. C. 2 (Applies to the whole section)
~~(A)~~	~~develop choice algorithms using selection control statements, including break, label, and continue;~~	Rationale: Covered in CSII
(A)~~(B)~~	evaluate expressions using ~~demonstrate proficiency in the use of the~~ bitwise operators;	Rationale: clarifies expected behavior CCRS: Math, IX. A. 2

(C)	develop iterative algorithms using do-while loops;	Rationale: covered in CS Fundamentals, CSI, CSII
(B)(D)	evaluate expressions using demonstrate proficiency in the use of the ternary operator;	Rationale: clarifies expected behavior CCRS: Math, IX. A. 2
(E)	create program solutions that use iterators;	Rationale: covered in CS Fundamentals, CSI, CSII
(C)(F)	identify, trace, and appropriately use recursion in programming solutions including processing binary trees;	Rationale: covered in CSII, clarifies expected behavior and increased rigor CCRS: Math, VII. C. 2
(D)(G)	understand and create or trace program solutions using hashing;	Rationale: understand is not measurable; the word trace added as a time saving measure and removing program specific language
(H)	perform pattern recognition using regular expressions;	Rationale: not appropriate for this course level
(E)(I)	explore common algorithms such as, including matrix addition and multiplication, fractals, Towers of Hanoi, and magic square; and	Rationale: to give the course more flexibility CCRS: Math, IX. A. 2
(F)(J)	create program solutions that exhibit robust behavior by recognizing understanding and avoiding runtime errors and handling anticipated errors.;	Rationale: understanding is not measurable CCRS: CD, II. D. 1 Gap: 50
(K)	understand object-oriented design concepts of inner classes, outer classes, and anonymous classes;	Rationale: beyond the scope of a high school program
(L)	use object reference scope identifiers, including null, this, and super;	Rationale: covered in CSA; ensure that it is in CSII
(M)	provide object functionality to primitive data types;	Rationale: covered in CSII
(N)	*write program assumptions in the form of assertions;*	Create a unit testing and documentation section in the TEKS moved to 5B
(O)	*write a Boolean expression to test a program assertion; and*	Create a unit testing and documentation section in the TEKS moved to 5C
(P)	*construct assertions to make explicit program invariants.*	Create a unit testing and documentation section in the TEKS moved to 5D

~~(5)~~	~~Digital citizenship~~. ~~The student explores and understands safety, legal, cultural, and societal issues relating to the use of technology and information. The student is expected to:~~	Rationale: Removed digital citizenship and replaced with testing and documentation because it is covered in CS Fundamentals and CSI.
~~(A)~~	~~model ethical acquisition and use of digital information; and~~	Rationale: covered in CS Fundamentals, CSI, and CSII
~~(B)~~	~~demonstrate proper digital etiquette, responsible use of software, and knowledge of acceptable use policies.~~	Rationale: covered in CS Fundamentals, CSI, and CSII
(6)	Testing and documentation. The student demonstrates appropriate documentation and testing practices. The student is expected to:	Rationale: These topics are important enough to be made into their own category CCRS: (Applies to SEs in 6) CD, II. B. 1-3 CD, II. C. 4 SC, III. B. 1, 4 SC, III. A. 1
(A)	*use appropriate formatting and write documentation to support code maintenance including pre- and post-condition statements.*	Rationale: New standard created because it was missing from the current standards.
(B)	*write program assumptions in the form of assertions;*	Rationale: moved from 4N because it is documentation
(C)	*write a Boolean expression to test a program assertion; and*	Rationale: moved from 4O because it is testing GAP: 80
(D)	*construct assertions to make explicit program invariants.*	Rationale: moved from 4P because it is testing
(7)~~(6)~~	Practical application of technology ~~Technology operations and concepts~~. The student utilizes ~~understands~~ technology concepts, systems, and operations as they apply to computer science. The student is expected to:	Rationale: clarification
~~(A)~~	~~compare and contrast high-level programming languages;~~	Rationale: covered in CSI and CSII
~~(B)~~	~~create a small workgroup network;~~	Rationale: concept already covered in 2A
~~(C)~~	~~create and apply a basic network addressing scheme; and~~	Rationale: concept does not belong in this course; is not CS related

(A)	analyze and create computer program workflow charts and basic system diagrams, documenting system functions, features, and operations;	Rationale: student to exposure to computer program workflow charts and basic system diagrams CCRS: CD, II. C. 6 SC, III. A. 1 SC, III. C. 1 Gap: 9, 20, 34, 54, 72
(B)	gather requirements, design, and implement a process by which programs can interact with each other, such as using interfaces;	Rationale: clarification and realigning from a1E to 6B CCRS: CD, II. C. 6 CD, II. C. 5 GAP: 46, 66
(C)	create simple ~~discovery~~ programs using ~~in~~ a low-level language such as assembly~~, high-level language, and scripting language~~;	Rationale: student to have exposure to low-level language CCRS: CD, II. C. 6
(D)	create discovery programs in a high-level language;	Rationale: student to have exposure to a high-level language. CCRS: CD, II. C. 6
(E)	create scripts for an operating system;	Rationale: students to have exposure to scripting for operating systems CCRS: CD, II. C. 6
(F)	explore industry best practices for secure programming; and	Rationale: students to have exposure to best practices for secure programming
(G)	explore emerging industry or technology trends.	Rationale: students to have exposure to emerging industry or technology trends CCRS: SC, IV. A. 1 CD, II. E. 1-2, 4 Gap: 47, 90