Final Recommendations
Texas Essential Knowledge and Skills (TEKS)
Scientific and Engineering Practices, Kindergarten–High School

This document reflects final recommendations from the State Board of Education's TEKS work group for scientific and engineering practices and indicates the changes from the previous draft completed in June 2020. Proposed deletions are shown in red font with strikethroughs (~~deletions~~). Text proposed to be moved from its original proposed location 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*). Additions are shown in green font with underlines (additions).

The Scientific and Engineering Practices Work Group is in agreement with the recommendation from Work Group A and the content advisors to integrate scientific and engineering practices into the process skills in the current TEKS. Additionally, the work group is in agreement with the recommendation to rename the strand as "Scientific and engineering practices." The decision to call the strand scientific and engineering practices stems from the need to emphasize to teachers these are actual experiences we want students to have in their K-12 science education. Using the word "practices" encourages exploration and promotes hands on experiences as opposed to only following a prescriptive process. Students, although making connections between science and engineering, must engage in the practice of investigating and designing in order to answer questions and solve problems. An alternative strand name that would be acceptable to the workgroup would be "Scientific processes and engineering practices."

The work group reorganized the structure of the knowledge and skills statements and student expectations in the current Scientific Processes strand to reflect key domains of the scientific and engineering process: designing investigations, evaluating data, and developing explanations and solutions. The organization of the scientific and engineering practices strand coincides with practices in which a scientist or engineer would engage to answer a question or solve a problem. The current TEKS (process skills) include many of these practices, however, the workgroup wanted to ensure each step of the scientific process was well-defined and in an order that is most applicable for teachers. The work group maintained student expectations specific to issues related to science and society to give a context to science and engineering.

Using the K-12 Framework for Science Education, the workgroup made an effort to maintain as much of the language in the current TEKS as possible. The additional language serves to further define certain processes (example: New SE (1)(E) "quantitative and qualitative data"). Some SEs reference both the scientific practice as well as the engineering practice with differing language, however, since there are multiple ways science and engineering overlap, it would be misleading to have "separate" TEKS just for engineering.

To support vertical alignment the work group developed student expectations for K-12, using common vocabulary, phrases, and numbering. In addition, the work group recommends keeping SEs consistent within each grade band. This allows for teachers to deepen their knowledge and understanding of the TEKS and for students to work to gain mastery of those skills and practices over multiple years, increasing in rigor as the content rigor increases. The SEs concerning tools and representations of data, however, should be differentiated based on grade-level content or appropriateness.

The work group maintained the requirement for percentage of instructional time for investigations for grades 6-12 (40%) within the knowledge and skills statements. The work group recommends maintaining the percentage of instructional time for investigations that is recommended for K-5 and including it in the introduction. The work group recommends moving current SEs (2)(A), (B), and (C) from Biology, Chemistry, and Physics into the introduction for all high school courses. These student expectations are definitions which are more appropriately presented in the introduction. The student expectation (2)(D) in Biology and Chemistry is an applicable, measurable practice; therefore, the work group recommends maintaining its inclusion in the student expectations for grades 6-12.

1. Scientific and engineering practices. The student asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, ~~seek answers,~~ explain phenomena, or design solutions using appropriate tools and models.		1. 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 answer questions, ~~seek answers,~~ explain phenomena, or design solutions using appropriate tools and models.		Current TEKS address the planning and implementation in one SE; KS 1 introduces the planning and implementation process and the SEs breakdown the process into steps. Adds clarity and specificity for teachers so they can address each component of the process. "Phenomena" is a term used in the scientific community. Use of this term in the TEKS builds teacher's depth of knowledge and gives them the correct scientific language to describe objects or events occurring in the natural world which inspire curiosity from students. Including the term in the student expectations can help foster connections to those phenomena present in the content standards (organisms, objects, and events observed in the natural world) to the practices used in exploring them.
Kindergarten-Grade 2	**Grades 3-5**	**Grades 6-8**	**High school**	**Comments**
A. ask questions and define problems based on observations or information from text, phenomena, models, or investigations	A. ask questions and define problems based on observations or information from text, phenomena, models, or investigations	A. ask questions and define problems based on observations or information from text, phenomena, models, or investigations	A. ask questions and define problems based on observations or information from text, phenomena, models, or investigations	Specific and grade-appropriate phenomena can be addressed in the content and TEKS Guide. Current 3-8 (2)(A) and high school (2)(E) combine asking questions with implementing an investigation. These have been broken up into multiple SEs.

Kindergarten-Grade 2	Grades 3-5	Grades 6-8	High school	Comments
B. use scientific practices to plan and conduct simple descriptive investigations and use engineering practices to *design* ~~develop~~ solutions to ~~*design*~~ problems	B. use scientific practices to plan and conduct descriptive investigations and use engineering practices to *design* ~~develop~~ solutions to ~~*design*~~ problems (Grades 3-4) B. use scientific practices to plan and conduct descriptive and simple experimental investigations and use engineering practices to *design* ~~develop~~ solutions to ~~*design*~~ problems (Grade 5)	B. use scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to *design* ~~develop~~ solutions to ~~*design*~~ problems	B. apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to *design* ~~develop~~ solutions to ~~*design*~~ problems	Current TEKS use "implement" versus "conduct" but the expectation is the same. The investigations listed are consistent with the current TEKS with the exception of adding descriptive investigations to the grade 5 SE. Designing solutions includes the creation of end products to engineering tasks. End products could be physical devices, prototypes, models, drawings, or processes. It should be noted the content standards can offer more direction for specific products students should develop based on the student expectations for the course.
C. identify, describe, and demonstrate safe practices during classroom and field investigations as outlined in Texas Education Agency-approved safety standards	C. demonstrate safe practices and the use of safety equipment during classroom and field investigations as outlined in Texas Education Agency-approved safety standards	**C.** use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency approved safety standards	C. use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency approved safety standards	For K-5 TEKS the specific measures in the current TEKS were deleted to allow for choice based on the needs of the investigation. Recommend linking to the cohesive safety standards to the TEA approved safety standard.

Kindergarten-Grade 2	Grades 3-5	Grades 6-8	High school	Comments
D. use tools to observe, measure, test, and compare ~~to make observations and design solutions to problems,~~ including (grade-level work group will list tools based on standards)*	D. use tools to observe, measure, test, and analyze information ~~to make observations and design solutions to problems, including~~ (grade-level work group will list tools based on standards)*	D. use appropriate tools, such as ~~including~~ (list should be grade-level specific)*	D. use appropriate tools such as use appropriate tools such as	The current TEKS address appropriate tools. For K-5, it's important to introduce and scaffold an understanding of tools and the context in which they are selected and used.
			Biology— microscopes, slides, Petri dishes, laboratory glassware, metric rulers, digital balances, pipets, filter paper, micropipettes, gel electrophoresis and PCR apparatuses, microcentrifuges, water baths, incubators, thermometers, hot plates, data collection probes, test tube holders, lab notebooks or journals, hand lenses, and models, diagrams, or samples of biological specimens or structures	
			IPC— data-collecting probes, apps, standard laboratory glassware, metric rulers, meter sticks, spring scales, multimeters, Gauss meters, wires, batteries, light bulbs, switches, magnets, electronic balances, mass sets, Celsius thermometers, hot plates, an adequate supply of consumable chemicals, lab notebooks or journals, timing devices, models, diagrams and the internet	
			Chemistry— Safety Data Sheets (SDS), scientific or graphing calculators, computers and probes, electronic balances, an adequate supply of consumable chemicals, and sufficient scientific glassware such as beakers, Erlenmeyer flasks, pipettes, graduated cylinders, volumetric flasks, and burettes	

*Future K-8 work groups will develop recommendations for grade-level specific SEs

Kindergarten-Grade 2	Grades 3-5	Grades 6-8	High school	
			D. (continued) use appropriate tools such as **Physics—** balances, ballistic carts or equivalent, batteries, computers, constant velocity cars, convex lenses, copper wire, discharge tubes with power supply (H, He, Ne, Ar), data acquisition probes and software, dynam ics and force demonstration equipment, electrostatic generators, electrostatic kits, friction blocks, graph paper, graphing technology, hand-held visual spectroscopes, inclined planes, iron filings, lab masses, laser pointers, magnets, magnetic compasses, metric rulers, motion detectors, multimeters (current, voltage, resistance), optics bench, optics kit, photogates, plane mirrors, prisms, protractors, pulleys, resistors, rope/string, scientific calculators, stopwatches, springs, spring scales, switches, tuning forks, wave generators, and/or other equipment and materials that will produce the same results	
E. collect observations and measurements as evidence ~~to answer questions, explain phenomena, or test design solutions~~	E. collect observations and measurements as evidence ~~to answer questions, explain phenomena, or test design solutions~~	E. collect quantitative data using the International System of Units (SI) and qualitative data as evidence ~~to answer questions, explain phenomena, or test design solutions~~	E. collect quantitative data using the International System of Units (SI) and qualitative data as evidence ~~to answer questions, explain phenomena, or test design solutions~~	The current TEKS address collection of data. For K-5 it's helpful to scaffold for teachers that observations and measurements are data. For high school, aligned the SEs related to the types of data that is collected across the courses. The purpose for collecting data (to answer questions, explain phenomena, or design solutions) is more appropriate in the KS because it applies to all of SEs in this section. (streamlining).

Kindergarten-Grade 2	Grades 3-5	Grades 6-8	High School	Comments
F. record and organize data using pictures, numbers, words, and simple graphs (insert grade-level appropriate graphs)*	F. construct appropriate simple tables, graphs, maps, and charts to organize data (insert grade-level appropriate graphs)*	F. construct appropriate tables, graphs, maps, and charts using repeated trials and means, to organize data (insert grade-level appropriate graphs)*	F. organize qualitative and quantitative data using **Biology—** scatter plots, line graphs, bar graphs, charts, data tables, digital tools, diagrams, scientific drawings, and student-prepared models **IPC—** labeled drawings and diagrams, graphic organizers, charts, tables, and graphs **Chemistry—** oral or written lab reports, labeled drawings, particle diagrams, charts, tables, graphs, journals, summaries, or technology-based reports **Physics—** bar charts, line graphs, scatter plots, data tables, labeled diagrams, and conceptual mathematical relationships	The current TEKS address organization of data. The revisions reinforce the alignment with grade-level math TEKS. For high school, aligned the SEs related to organization of data that is collected across the courses.

*Future K-8 work groups will develop recommendations for grade-level specific SEs

Kindergarten-Grade 2	Grades 3-5	Grades 6-8	High school	Comments
G. develop and use ~~a~~ models to ~~conceptually~~ represent phenomena, objects, and processes ~~and tools~~ or design a prototype for a solution to a problem	G. develop and use a models to represent phenomena, objects, and processes ~~for tools, objects, and things that cannot be experienced or~~ or design a prototype for a solution to a problem	G. develop and use models to represent phenomena, systems, ~~or~~ processes, or solutions to engineering problems ~~in order to answer questions or to refine designs~~	G. develop and use models to represent phenomena, systems, ~~and~~ processes, or solutions to engineering problems ~~in order to answer questions or to refine designs~~	The current K-2 TEKS do not include models. For grades 3- 8 and high school, using or evaluating models are addressed but developing models is only in grade 5. The types of models can be addressed in the TEKS Guide and left open for teachers to select. Developing a model can be an end product in designing a solution.
		H. distinguish between scientific hypotheses, theories, and laws	H. distinguish between scientific hypotheses, theories, and laws	Scientific hypotheses and theories are not addressed in the current TEKS for every high school course. The revisions aligns the SE across high school courses and adds the SE to 6-8.

2. 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:			**Comment:** Current TEKS address the evaluation and analysis of data; however, KS 2 breaks the process down into steps that are clearer and more specific for teachers. The SEs in this KS emphasize the importance of evaluating and analyzing data in scientific and engineering practices.	
Kindergarten-Grade 2	**Grades 3-5**	**Grades 6-8**	**High school**	**Comments**
A. identify basic advantages and limitations of models such as their size, scale, properties, and materials	A. identify advantages and limitations of models such as their size, scale, properties, and materials	A. identify advantages and limitations of models such as their size, scale, properties, and materials	A. identify advantages and limitations of models such as their size, scale, properties, and materials	Limitation of models are in the current TEKS with the exception of K-2. For high school, aligned the SEs related to limitations of models across the courses and added what the limitations are. The complexity of models and their limitations increase across grade-levels and courses and are dependent on the content.
B. analyze data by identifying significant features and patterns	B. analyze data by identifying any significant features, ~~and~~ patterns, ~~and take into account~~ or sources of error ~~or limitations~~	B. analyze data by identifying any significant descriptive statistical features, ~~and~~ patterns, ~~apply statistics and probability, and take into account~~ sources of error, or limitations	B. analyze data by identifying any significant statistical features, ~~and~~ patterns, ~~apply statistics and probability, and take into account~~ sources of error, and ~~or~~ limitations	The current TEKS require students to analyze data in grades 3-12. Students in K-2 have the ability to analyze data and are already expected to do so in the current TEKS, e.g., using seasonal and weather data to make choices. Students in grades 3-5 also have the ability to identify errors in sources of data such as why an experiment didn't work. Recommend providing grade-level appropriate examples of statistical and descriptive statistical features of data, sources of error, and limitations in the TEKS Guide.

Kindergarten-Grade 2	Grades 3-5	Grades 6-8	High school	Comments
C. ~~explain and compare numerical representations of data and patterns to explore scientific questions and engineering problems~~ C. use mathematical concepts to compare two objects with common attributes	C. ~~explain and compare numerical representations of data and patterns to explore scientific questions and engineering problems~~ C. use mathematical calculations to compare patterns and relationships	C. use mathematical calculations ~~concepts and processes~~ to assess quantitative relationships in data ~~patterns or correlations while investigating scientific questions and engineering problems~~.	C. use mathematical calculations ~~concepts and processes~~ to assess ~~patterns or correlations and apply~~ quantitative relationships in data ~~while investigating scientific questions and engineering problems~~	The current TEKS include mathematical concepts and calculations. The revisions reinforce the alignment with grade-level math TEKS. For high school, aligned the SEs related to mathematical concepts and calculations across the courses.
D. evaluate a design or object using criteria to determine if it works as intended	D. evaluate a design or object using criteria ~~to refine a problem statement or solution~~ (Grades 3-4) D. evaluate experimental and engineering designs (Grade 5)	D. evaluate experimental and engineering designs	D. evaluate experimental and engineering designs	Currently process skills do not have students evaluating a design. Clarify in the TEKS Guide that designs can include end products but also drawings, models, and processes.

3. Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions.			**Comment:** In the current TEKS students are developing and communication explanations. The proposed KS and SEs in this section are organized into three parts: developing explanations and proposing solutions; communicating explanations and solutions; and engaging in scientific argumentation to encourage critical thinking.	
Kindergarten-Grade 2	**Grades 3-5**	**Grades 6-8**	**High school**	**Comments**
A. develop explanations and propose solutions supported by data and models	A. develop explanations and propose solutions supported by data and models	A. develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories	A. develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories	Proposing a solution is an engineering practice. At the early grade levels students are already providing reasons for explanations using student-generated data in the current TEKS. (1.2.E)
B. communicate explanations and solutions individually and collaboratively in a variety of settings and formats	B. communicate explanations and solutions individually and collaboratively in a variety of settings and formats	B. communicate explanations and solutions individually and collaboratively in a variety of settings and formats	B. communicate explanations and solutions individually and collaboratively in a variety of settings and formats	In the current TEKS, students communicate explanations (valid conclusions). The proposed SEs build 21st century skills used in science and engineering practices which includes collaborations and communication. Designing solutions is an engineering practice and this SE requires students to communicate about their solutions. The complexity of explanations increase across grade-levels and courses and are dependent on the content.

Kindergarten-Grade 2	Grades 3-5	Grades 6-8	High school	Comments
C. listen actively to others' explanations to identify important ~~relevant~~ evidence and engage respectfully in scientific discussion ~~argumentation~~	C. listen actively to others' explanations to identify relevant evidence and engage respectfully in scientific discussion ~~argumentation~~	C. engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence	C. engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence	Current SEs do not include argumentation. Scientific argumentation is a process of supporting claims with evidence based data. Scientists and engineers are required to defend their process and explanations and questions other claims, processes, and explanations Argumentation is a 21st Century skill that supports critical thinking and literacy in reading, writing, listening, and speaking skills while encouraging the "soft" skills of listening to others and questioning others' claims respectfully.

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4. Scientific and engineering practices. The students knows the contributions of scientists and recognizes the importance of scientific research and innovation on society.				
Kindergarten-Grade 2	**Grades 3-5**	**Grades 6-8**	**High school**	**Comments**
A. ~~B.~~ make informed decisions when reviewing promotional materials for products and services	A. ~~B.~~ make informed decisions when reviewing informational resources and promotional materials for products and services	A. ~~B.~~ make informed decisions by evaluating evidence from multiple appropriate sources to assess the credibility, accuracy, and methods used	~~A. make informed decisions by evaluating evidence from multiple appropriate sources to assess the credibility, accuracy, and methods used~~ 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*	Returning current TEKS 3A to high school while maintaining vertical alignment with earlier grades.
B. ~~A.~~ explain how science or an innovation can help others	B. ~~A.~~ explain how scientific discoveries and innovative solutions to problems impact science and society	B. ~~A.~~ relate the impact of past and current research on scientific thought and society, including the process of science and contributions of diverse scientists as related to the content	B. ~~A.~~ relate the impact of past and current research on scientific thought and society, including research methodology, ethics, and contributions of diverse scientists as related to the content	Current TEKS focus on historical scientific discoveries and scientists. The proposed SEs expand the concept to include current research and innovation and modern scientists. This SE also includes the connection between science and society.

Kindergarten-Grade 2	Grades 3-5	Grades 6-8	High school	Comments
C. identify what a scientist or engineer is and explore what different scientists and engineers do	C. research and explore connections (connect) between grade-level appropriate science concepts and STEM careers	C. research and explore connections between grade-level appropriate science concepts and STEM careers	C. research and explore connections between grade-level appropriate science concepts and STEM careers	Current TEKS in K-5 had a science career focus. The workgroup opted to divide the original history of science SE into two components: (4B) is history and current research while (4C) focuses on STEM careers. This SE was not part of all high school courses but is being added for alignment purposes.
			~~*D. 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*~~	Moved to proposed new (4)(A)