Product Research

TEKS-BASED ASSESSMENTS

SCIENCE

Supporting documentation for the development of
TEKS-Based Science Assessments

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TEKS-Based Science Assessments

The streamlined revisions of the state standards for K-12 Science were adopted by the State Board of Education in 2017 for Texas schools. Texas Essential Knowledge and Skills (TEKS) for Science (TEA, 2017a) identify what students should know and be able to do at every grade. More specifically, the Science TEKS measure student proficiency in the acquisition of knowledge and skills covered by the curriculum at the specified grade level. Students should not be compared to each other but rather evaluated on how well they are individually meeting grade-level standards. These standards provide a consistent framework to prepare all students for success in K–12 educational years and as they advance to college and careers. Texas measures how well students are progressing in science with the statewide assessment, the State of Texas Assessments of Academic Readiness (STAAR™).

The STAAR™ assessments earmark a significant change in the State of Texas assessment system. According to the Texas Education Agency (TEA), assessments contain rigor beyond what has appeared in past state assessments. Another element to the STAAR assessment is the requirement of a four-hour time limit for each assessment (TEA, 2018a). We recommend timing the assessments, but leave it up to the school/district to decide.

Researchers indicate the importance of a balanced approach to assessments (Black, Harrison, Lee, Marshall, and Wiliam, 2003; Garrison and Ehringhaus, 2007). This approach focuses on summative assessments, benchmark or interim assessments, and formative assessments. A comprehensive system is a balanced approach, with all assessments having a relatedness intended to improve achievement. *TEKS-Based Science Assessments* are summative assessments that measure student progress in science at two different points during the year.

Just as *Individuals with Disabilities Education Act* (IDEA, 2004) mandates that all students participate in a state assessment program so does the 2015 Every Student Succeeds Act (ESSA). Academic assessments are required by the federal law ESSA for "math and reading or language arts be administered annually in grades 3–8 and at least once in grades 9–12; science tests not less than once during grades 3–5, 6–9, and 10–12" (Mandlawitz, 2016, p.1). The critical issue of accountability continues with ESSA, with assessments being used to help improve schools and inform instruction. The law allows the state and local levels the opportunity to create systems for accountability, resources, interventions and teacher evaluation systems. The federal requirements of Every Student Succeeds Act mandate that all students participate in the state assessment program. Therefore, these assessments allow the teacher to gather timely student information to readily and continuously maintain accountability for academic achievement standards in science.

The rationale for inclusion is two-fold: Interest in and preparation for secondary science must begin at the elementary level. Seemingly, teachers and principals de-emphasize science. Perhaps this is due to the emphasis placed on reading and mathematics because of the distinct accountability requirements and consequences that are in place. Unfortunately, some elementary and middle school teachers lack strong content and pedagogical knowledge in the sciences. All too often, it appears that what is tested seems to be the focus of instruction; therefore, science often is neglected. As it is, science is not always seen as important as it should be at the elementary levels. When a foundation is not built and strengthened in science in the elementary years, secondary students will struggle in science, causing many students not to pursue fields such as Science, Technology, Engineering, and Mathematics (STEM). Thus, it is essential that we prepare students to pursue careers in a variety of fields (e.g., science, history, health, art, technology), rather than compromising academic areas that are not tested as often as others in our accountability system. Education's goal is to increase student achievement and prepare students for a diverse and competitive work environment. For this to occur, it seems that accenting excellence only with reading and mathematics scores limits our perspective on achievement.

Summative, benchmark, and formative assessments are necessary for developing an accurate picture of a student's overall academic achievement. Herman, Osmundson, and Dietel (2010) attest to benchmark assessments occupying a space in the middle, yet playing an important role in a balanced assessment system. The National Research Council recognize a comprehensive assessment system as one that is coherent, comprehensive and continuous (NRC, 2001). Classroom assessments correlated to the TEKS provide teachers ongoing interval measurements of student progress, thus the rationale for *TEKS-Based Science Assessments*. Teachers need reliable and ongoing assessment data to determine if the curriculum is aligned to the existing standards and if students are on target for achieving mastery of standards.

TEKS-Based Science Assessments are STAAR™ formatted practice science assessments, based on the currently tested TEKS for levels 5 and 8 and on the required TEKS for levels 3, 4, 6, and 7. Each book will contain two full-length benchmark science assessments. Grades 3, 4, and 5 assessments follow the STAAR™ 5 blueprint, apart from including additional questions on each grade level benchmark to provide student performance data on all standards. The elementary benchmarks are available in English and Spanish. The *TEKS-Based Science Assessments Level 3, 4, and 5* follow the STAAR™ Level 5 Science Blueprint with a minimum of 40% dual-coded to process skills, as well as readiness standards at 60%–65% and supporting standards at 35%–40% of each assessment. Levels 3 and 4 will include a minimum of 40% dual-coded to process skills. Grades 6, 7, and 8 follow the STAAR™ blueprint for Level 8 Science apart from including additional questions on each grade level benchmark to provide student performance data on all standards. A minimum of 40% of the questions are dual-coded to process skills, as well as readiness standards at 60%–65% and supporting standards at 35%–40% of each assessment. Levels 6 and 7 will include a minimum of 40% dual-coded to process skills. For Levels 5 and 8, all Readiness/Supporting Standards eligible for testing on the STAAR™ will be assessed when both test forms are completed by students. For Levels 3, 4, 6, 7, and 8, all standards will be assessed when both test forms are completed by students. Teacher and student directions will be provided to simulate a STAAR™ testing environment. Diagnostic and prescriptive in nature, these benchmark assessments provide educators with detailed information on student progress. The structure of the assessments allows flexibility of use. The assessment booklets include the following descriptors.

- Each standard eligible for testing on levels 5, 8 and all required TEKS for levels 3, 4, 6, and 7 are addressed.
- Two complete benchmark assessments are contained for assessment throughout the year (Forms A, B)
- Levels 6, 7, and 8 include griddable items.
- "Real-world" contexts are utilized when possible.

- Assessment items are aligned to the TEKS as well as correlated to the Depth of Knowledge (DOK) and Bloom's Taxonomy levels.
- A Chart Your Success section is included in order for students to track their progress and set goals.

These assessments could be utilized by district level administrators to analyze student progress through common assessments. Districts could also use this product as a pre-test, mid-year, and post-test for all students. Teachers may desire a product such as this to gather data at various times of the year to determine student achievement. The assessments reflect the structure, format, and rigor students encounter on STAAR™.

The STAAR™ blueprints were used in the development of these assessments in order to achieve the following.

- Include items assessing all standards (readiness and supporting), but have multiple test items addressing each readiness standard for levels 5, 8, and Biology EOC assessments.
- Reflect the state guideline of 40% or greater of items that can be dual-coded to both a content standard and a process standard.
- Include Grade 8 reference materials for Levels 6, 7, and 8.
- Match the percentages of readiness and supporting standards as recommended by the blueprints.
- Have a proportional equivalent of questions for each domain in STAAR™ as defined in the TEA blueprint.

TEKS-Based Science Assessments are designed to measure student acquisition of the knowledge and skills specified in the Texas Essential Knowledge and Skills at different intervals. Herman (2009) noted there are teachers who want students to demonstrate high performance, thus they deliver instruction that accents what will be assessed as well as include the assessment format within instruction. When teachers do not clearly understand the standards or the learning targets and are unsure how to design instruction, they might resort to teaching to the test. Often instruction is designed to prepare students for merely multiple-choice formats. The primary purpose of *TEKS-Based Science Assessments* is to provide a valid measure of the quality of science education in the classroom or across the campus because they are aligned to the content and process standards. Assessments assist campuses in determining how well their science programs are helping students achieve previously set learning goals. The results can depict patterns of performance, noting insufficient performance during the period leading up to the benchmarks or other assessments. Educators might use the assessment data to predict if students are on target to meet specific end-of-the-year goals. Research seems to indicate that students score higher on standardized tests when they experience focused, aligned practice. Therefore, it is imperative that campuses understand why benchmarks are an integral part of the assessment system. Formative assessments are embedded in instruction and used to make informed, ongoing, and timely decisions relative to teaching and learning. The learning targets measured by formative assessments relate to the long-term targets assessed by benchmarks or interim assessments. Multiple assessments address long-term targets, yielding data to show how well students are learning at particular intervals or periods in time. This data relates to the long-term goals as measured by annual assessments (Herman et al., 2010).

At a specific point in time during the year, *TEKS-Based Science Assessments* measure how well students have acquired the knowledge and skills taught during science instruction. The assessments are designed to ensure students are learning at their grade level. Furthermore, *TEKS-Based*

Science Assessments provide data to teachers, schools, and school districts to support improved instructional decisions. The *TEKS-Based Science Assessments* serve as accountability measures to help gauge or predict future performance that might occur on state assessments. With summative assessment data, educators can pinpoint areas that require additional attention and focus.

Periodic exposure to benchmark assessments provides students with opportunities to experience a variety of assessment items and formats for each standard. These experiences will benefit students facing a common assessment. "When assessment is an integral part of science instruction, it contributes significantly to student learning" (Ferrer, 2008). Atkin, Black, and Coffey (2001) offer suggestions noted by the National Research Council (NRC, 1996) to help teachers meaningfully incorporate assessment during science instruction. Assessment should inform and guide teachers as they make instructional decisions. During the school year, students can take practice tests to evaluate their own work and progress. Teachers could create customized assessments by assigning students only the items that measure a specific standard. Students partake in these opportunities to demonstrate what they have learned. After students receive immediate achievement feedback, then students may proceed to intervention settings to develop standard mastery and ensure performance gaps are closed prior to the state or common assessment administrations. As a result, *TEKS-Based Assessments* arm teachers with essential data or information that helps in the preparation of future high-quality instruction.

Results of the *TEKS-Based Science Assessments* provide information about the academic achievement of students. This information is used to identify individual student strengths, determine areas of challenge, and measure the quality of science education across the campus. Utilization of results from various benchmark assessments can help teachers monitor student progress in order to determine future plans for instruction. Students can use the Chart Your Success charts located in the back of the assessment booklet to chart assessment data, self-monitor individual progress over time in science, and compare the knowledge and skills to previous assessments. The involvement of students in assessment promotes student engagement in individual learning targets. Students need to know what learning targets they are responsible for mastering, and at what level (Stiggins, 2007). Marzano (2005) states, "students who can identify what they are learning significantly outscore those who cannot."

After the analysis of assessment data, findings may indicate students require additional instruction to address deficits in order to achieve skill mastery and close learning gaps as students move forward toward annual learning goals. If skill deficits exist, then teachers are encouraged to explore different strategies in order to improve student achievement. Teachers may design learning experiences to revise their curricula, develop formative assessments, examine instructional methods of delivery, target specific populations for remediation and enrichment, create student academic assistance interventions, and/or develop individual plans for student improvement.

For a balanced assessment system, formative assessments must play an essential part of classroom instruction. Formative assessment focuses on improving student performance during classroom instruction whereas summative assessment focuses on accountability and often sorts or classifies students. In formative assessment both teacher and student share responsibility for assessment. The student and teacher share a common understanding of the standards that define quality work. Both student and teacher compare performance to these standards as they assess the work task in progress and when it is completed. Following formative assessment, teaching and learning activities are adjusted to close the gap between the student's performance and the standard. The teacher not only assesses the student's performance, but also provides feedback to the student. Specific, descriptive feedback informs the student as to the next steps to take for improvement in future performance. The teacher will also assess and adjust instruction based on the assessment. Research on formative assessment suggests that students should be aware of their learning targets, their present status, and the next steps in reaching specified goals or closing any gaps (Atkin, Black, and Coffey, 2001; Black, Harrison, Lee, Marshall, and Wiliam, 2003). Such knowledge helps students keep track of their achievements, know how close they are to their learning targets, and determine future steps to advance their learning. When students are aware of individual achievement gaps and teachers motivate students with continuous feedback linked to the expected outcomes and criteria for success, students are able to steadily move forward and close performance gaps in science. Black and Wiliam (1998) note there is evidence to support a strong relationship between interactive feedback and student achievement. Although *TEKS-Based Science Assessments* are summative in nature, the item coding to standards provides teachers optional formative assessment opportunities to administer only select items that relate to the standards being taught. That action would negate the use of the same assessment as a benchmark at a later date. However, used, formative assessments are employed during instruction to advance teaching and learning; benchmark tests provide accountability in determining student learning after instruction. This entire process provides evidence that assessment and instruction are intertwined.

TEKS-Based Science Assessments are diagnostic and prescriptive in nature. These practice assessments provide educators with detailed information on student progress as well as promoting flexibility of use in a variety of classroom settings. For each grade level, there are two different versions of the assessments (Forms A, B) bound into one student assessment booklet. Each form will reflect the state guideline that 40% or greater of items are dual-coded to both a content standard and a process standard. Dual-coding of items shows that students must be more than smart test takers; they must demonstrate scientific investigation and reasoning skills in science as well as conceptual understanding. The resource *TEKS-Based Science Assessments* does have an online platform. Test items are presented in a "real-world" context when possible.

As shared in a document commissioned by The Council of Chief State School Officers (CCSSO, 2016) to help all states understand the provisions of the Every Student Succeeds Act, it is stated that ESSA continues the requirement that states administer assessments aligned with the depth and breadth of their academic content standards. Therefore, all assessment items in the *TEKS-Based Assessments* are coded to the content standard, to the process standard when applicable, to the Depth of Knowledge level (DOK), and to Bloom's Taxonomy.

The model Depth of Knowledge (DOK) was developed by Norman Webb (Webb, 2002a; 2002b). Dr. Webb advocates the necessity of assessment items aligning to the standards. Webb stated educators should be aware of the level of demonstration required by a student when a test item is developed, thus the development of his four levels of DOK. Level 1 assessment items have students recall information. Level 2 items ask students to think beyond reproduction of responses. Students use more than one cognitive process or follow more than one step. Students at Level 3 demonstrate higher levels of thought than the previous levels require as these items are more complex. Responses may have multiple answers, but students must choose one and justify the reasoning behind the selection. Assessment items at Level 4 require students to form several connections with ideas. Typically, performance assessments and open-ended responses are written at this level of thought.

The literature indicates Bloom's Taxonomy is a widely accepted organizational structure to assist students in organizing the content of their thinking to facilitate complex reasoning. According to Sousa (2006), Bloom's Taxonomy is compatible with the manner in which the brain processes information to promote comprehension. Bloom, Englehart, Furst, Hill, and Krathwohl (1956) developed this classification system for levels of intellectual behavior in learning. Bloom's Taxonomy contains three domains: the cognitive, psychomotor, and affective. Within the cognitive domain, Bloom identified six levels: knowledge, comprehension, application, analysis, synthesis, and evaluation. The taxonomy was revised by Anderson and others (2001) to focus on thinking as an active process. Within the cognitive dimension, level names were changed to verbs and the order of the levels was also changed: Remember, Understand, Apply, Analyze, Evaluate, and Create. The original and revised taxonomies continue to be useful today in developing and categorizing the critical thinking skills of students. Thus, student performances on measures of higher-order thinking ability continue to reveal a critical need for students to develop the skills and attitudes of quality thinking. Furthermore, another reason that supports the need for thinking skills instruction is the fact that educators appear to be in general agreement that it is possible to increase students' creative and critical thinking capacities through instruction and practice. Presseisen (1986) asserts that the basic premise is students can learn to think better if schools teach them how to think. Rigorous critical thought is an important issue in education today; thus, the reason for emphasis in *TEKS-Based Science Assessment.* Attention is focused on quality thinking as an important element of life success (Huitt, 1998; Thomas and Smoot, 1994).

In the 1950s, Bloom found that 95% of the test questions developed to assess learning required students to only think at the lowest level of learning, the recall of information. Similar findings indicated an overemphasis on lower-level questions and activities with little emphasis on the development of students' thinking skills (Risner, Skeel, and Nicholson, 1992). "Perhaps most importantly in today's information age, thinking skills are viewed as crucial for educated persons to cope with a rapidly changing world. Many educators believe that specific knowledge will not be as important to tomorrow's workers and citizens as the ability to learn and make sense of new information" (Gough, 1991). "Now, a considerable amount of attention is given to students' abilities to think critically about what they do" (Hobgood, Thibault, and Walberg, 2005). It is imperative for students to communicate their thinking coherently and clearly to peers, teachers, and others.

Critical thinking is crucial in science instruction as indicated by verbiage usage in the Texas Essential Knowledge and Skills for Science (TEA, 2011). Critical thinking tasks allow students to explain their thought processes by making thinking visible and offer teachers opportunities to identify misconceptions and misapplications of science skills. The literature notes that when students use their critical thinking abilities integrated with content instruction, depth of knowledge can result. Teachers are encouraged to refrain from limiting instruction to lectures or tasks to rote memorization that exercise only lower levels of thought as opposed to incorporating those which build conceptual understanding (Bransford, Brown, and Cocking, 2000).

It appears the national shift towards preparing students to survive in the global market has impacted the assessments undertaken by students in Texas. Texas does not adhere to the K–12 NGSS, but supports its own state standards, the TEKS. However, the assessment system in Texas does recognize the importance of preparedness for college and the work force during K–12 education years. Thus, assessments that focus on the TEKS will not only demonstrate if students can succeed in school but also in the real world. STAAR™ assessments will portray which students are meeting the challenge of becoming ready for college and the workforce. For the purpose of the *TEKS-Based Science Assessments*, the various DOK and Bloom's Taxonomy levels are utilized to reflect the rigor and depth in levels of thought required by students on the benchmark assessments. Assessment items displaying rigor require students to use higher-levels of thought, exhibiting a more challenging 21st Century learning environment. Students may be asked to use such processes as examine, create, prioritize, decide, produce, assess, generate, or classify. Assessments items reflecting relevance require students to work with real-world tasks.

Over the past years, changes in accountability and testing have led to data playing a major role in the education of students. The U.S. Department of Education advocates the importance of data utilization for guiding instruction and improving student learning. Schools are being strongly encouraged to respond to assessment data, using it to identify students' academic strengths and needs (U.S. Department of Education, 2010; 2009). As educators face accountability requirements from federal, state, and local entities to improve student achievement, data should become the central element in how students' academic progress is monitored and how instructional practices are evaluated. There is no single assessment that provides a complete picture of student performance. *TEKS-Based Science Assessments* offer two forms in order to keep a pulse on the progress of student performance, rather than a single snapshot assessment. Each assessment plays a prominent role in determining if quality teaching and learning are occurring. As correct and incorrect assessment answers are analyzed, teachers are able to observe the patterns of thought in which students experience difficulty or exhibit success. This data is informative in that teachers may appropriately adjust and revise instruction to more appropriately address the diversity of needs within classrooms. Thus, assessments have important implications for instruction. Research indicates it is essential that assessment data be used to make well informed instructional decisions (Armstrong and Anthes, 2001; Feldman and Tung, 2001; Forman, 2007; Liddle, 2000).

Assessments provide student achievement data on grade-specific Texas Essential Knowledge and Skills throughout the school year, including the ability to report student achievement approaching, falling below, or exceeding the standards. With two forms of assessment per grade, these assessment instruments are capable of providing data to measure science progress and proficiency throughout the year. The assessments for science are summative in nature, intended to be administered in their entirety at two different intervals during the year after instruction has occurred. The assessments may be designated as benchmarks. However, assessment items from a benchmark could be used as part of a formative assessment, if so desired. The assessment items, that align to the specific standard(s) focused on during instruction, could be extracted from a benchmark assessment and utilized during instruction and followed by timely and descriptive feedback. If educators wished take this action, then such usage becomes formative assessment.

Formative assessments provide rapid and meaningful results to teachers to improve or adjust instruction. Positive adjustments to instruction more than likely lead students to master the standard(s) at hand.

TEKS-Based Science Assessments Forms A and B can be used in different ways: as practice, as a diagnostic instrument, and as a teaching tool. Students need opportunities to practice and develop test-taking skills. These tests focus on the skills students will be expected to demonstrate on STAAR™ assessments. Data from the assessments will help teachers identify areas where additional instruction is necessary, thus, using the assessments as teaching tools.

Studies support the use of several measures from which to gauge student achievement. The Science Product Development Team recognizes that assessment systems should include a balance of formative and summative data to be most effective in improving outcomes and in making a significant impact on science education. The development team studied available guidelines released by the Texas Education Agency Assessment Division and a range of sample items, item specifications, released tests, and other resources regarding the assessment of science (TEA, 2017b; TEA, 2018a; TEA, 2018b; TEA, 2018c; TEA, 2018d; TEA, 2018e; TEA, 2010; TEA, 2019a; TEA, 2019b). This information was considered by the Science Product Development Team in order to design assessment items and tasks that measure a deeper understanding. STAAR™ assessments will contain two item types: multiple-choice and open-ended or griddable. Griddable items give students opportunities to formulate responses independently without being influenced by provided answer choices. Multiple-choice items include reverse thinking questions, using *not* and *except*, as well as questions containing the distractors *All of the Above*, *None of the Above, None of These,* and *Not Here*. The format offered for *TEKS-Based Science Assessments* will be paper-pencil or may be taken online, following similar protocol noted in the STAAR™ Blueprints, with the exception of including additional items at each grade level to include complete coverage of all standards. (TEA, 2018b; TEA, 2018c).

As the school year progresses, students who are proficient in the various benchmarks can determine how they might perform on future STAAR™ assessments in science. The two forms offered at each grade enable the *TEKS-Based Science Assessments* to be spread out over the year, leaving a window of time for the state assessments to be administered. As data from the *TEKS-Based Science Assessments* are examined, teachers can identify students who are performing at the grade-specific standard level, those who are exceeding the standards, and those who are approaching or are functioning below the standard. Teachers can also determine and chart the data for the various subgroups (i.e., ethnicity, disadvantaged, special education, and English Language Learners). All subgroups must make sufficient gains and improvement in order for the school to advance or surpass campus and state assessment goals.

The developers of *TEKS-Based Science Assessments* reviewed relevant reform efforts on teaching and learning in science, studied the Science Standards, perused the item specifications released by the state, and employed individual expertise and collective judgment as they designed assessment resources to lead students into the 21st century. *TEKS-Based Science Assessments* focus on the grade-level standards for science. This focus ensures that test items align with the assessed content and process standards, resulting in appropriately written assessment items based on current information. Webb's Depth of Knowledge, Bloom's Taxonomy, and the TEKS form the basis for designing items that stimulate students' higher-order thinking skills and encourage rigor and depth in thinking. With the Science Standards as academic guiding points, the Mentoring Minds Curriculum Development Team for Science crafted *TEKS-Based Science Assessments,* a resource for assessing and strengthening science education.

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