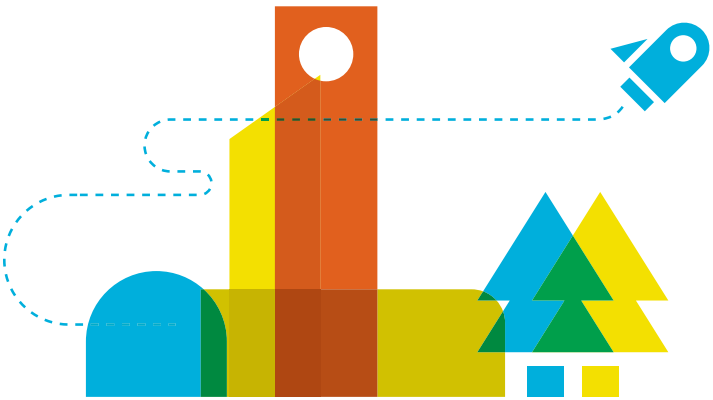
The Dayton Regional STEM Center
Science, Technology, Engineering and Math

STEM EDUCATION QUALITY FRAMEWORK

The purpose of the STEM Education Quality Framework is to create a common framework and language for conceptualizing and communicating about quality STEM teaching and learning.



Its aim is to support education leaders in making informed decisions about the allocation of resources, especially with regard to the planning and delivery of professional development. In addition, the framework and accompanying online assessment tool can provide teachers with a valuable resource for reflection and self-assessment as they design quality STEM learning experiences. Finally, and perhaps most importantly, it can anchor collaborative efforts between educators and STEM professionals as they bridge the world of the classroom with STEM careers.

IMPORTANT POINTS TO CONSIDER

A quality STEM learning experience is not a function of time. A quality STEM experience might take the form of a one-class-period activity, a three-week unit of instruction, or a semester-long project.

The absence of one or more STEM quality elements does not mean the experience is not a quality STEM learning experience. In some cases, an element may be purposefully excluded or does not apply.

– DAYTON REGIONAL STEM CENTER

STEM Learning Quality Component	Not Evident	Emerging	Accomplished	Advanced
COMPONENT ONE **Potential for Engaging Students of Diverse Academic Backgrounds** Quality STEM learning experiences are designed to engage the minds and imaginations of students of diverse academic backgrounds.	The learning experience has little or no potential for student engagement given the prior knowledge and/or skill level of the targeted class.	The learning experience has potential for engaging some of the students in the targeted class given their prior knowledge and experience. For example, the task may be appropriate for some students, while being too challenging, or not challenging enough for others.	The learning experience has potential for engaging most of the students in an academically homogenous class, or is differentiated to meet the needs of subgroups of diverse learners in the targeted class.	The learning experience, in addition to being appropriately leveled or differentiated to provide students with the opportunity for academic success, is designed to challenge the minds and stimulate the imaginations of learners with diverse histories of academic success.
COMPONENT TWO **Degree of STEM Integration** Quality STEM learning experiences are carefully designed to help students integrate knowledge and skills from Science, Technology, Engineering, and Mathematics.	The learning experience provides no opportunities for students to consider the relationships between and among Science, Technology, Engineering, or Mathematics.	The learning experience requires students to complete task(s) that integrate knowledge and/or skills from two of the STEM disciplines. Or, the teacher describes or prompts discussion of the relationships between and among two or more of the STEM Disciplines.	The learning experience requires students to complete task(s) that integrate knowledge and/or skills from three of the STEM disciplines. For example, students use a graphing calculator to apply a mathematics formula to a science data set.	The learning experience is carefully designed to help students integrate knowledge and skills from Science, Technology, Engineering, and Mathematics. For example, science students design and test water filtration devices; calculate their comparative efficiencies; and display the data using computer software.
COMPONENT THREE **Connections to Non-STEM Disciplines** Quality STEM learning experiences help students connect STEM knowledge and skills with academic standards from other disciplines.	The learning experience provides no opportunities for students to make connections between their STEM learning and non-STEM disciplines. (For example, Language Arts, Social Studies, Art, etc.)	The learning experience overtly identifies a connection between the STEM and non-STEM disciplines, but does not require students to perform tasks that integrate those disciplines.	The learning experience requires students to integrate their STEM learning with knowledge and/or skills from at least one non-STEM discipline. For example, researching the economic and environmental impacts of alternative energy sources.	The learning experience requires students to connect STEM learning with one or more non-STEM disciplines, and includes instructional support for quality performance in the non-STEM discipline. For example, providing students with information about quality technical writing.
COMPONENT FOUR **Integrity of the Academic Content** Quality STEM learning experiences are content-accurate, anchored to the relevant content standards, and focused on the big ideas and foundational skills critical to future learning in the targeted discipline(s).	The academic content for the learning experience is inaccurate or is not anchored to the relevant academic content standards.	The academic content for the learning experience is accurately presented and appropriately anchored to at least one academic content standard for each content area represented.	The academic content for the learning experience is accurately portrayed and appropriately anchored to more than one academic content standard for each content area represented. Or, the learning experiences is anchored to one content standard in each targeted discipline that is difficult to teach, or hard to learn.	The academic content for the learning experience is accurately portrayed, tied to multiple content standards, and focused on helping students acquire deep understanding of a "big idea" or "foundational skill" critical to their future learning in the targeted discipline(s).
COMPONENT FIVE **Quality of the Cognitive Task** Quality STEM learning experiences challenge students to develop higher-order thinking skills through processes such as inquiry, problem solving, and creative thinking.	The cognitive task is simplistic, too easily solved, and does not require students to employ higher-order thinking skills.	The cognitive task requires students to develop higher-order thinking skills in addressing a project or problem with the procedures prescribed by the teacher.	The cognitive task requires students to employ higher-order thinking skills in addressing a teacher-defined project or problem where students are responsible for designing the procedures to complete the assigned task(s).	The cognitive task requires students to select and employ the higher-order thinking skills necessary to frame the problem, design the procedures, develop strategies to complete the project, or to generate one or more possible solutions to the problem. (For example, in PBL this is frequently referred to as presenting students with an ill-structured problem.)

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COMPONENT SIX **Connections to STEM Careers** Quality STEM learning experiences place students in learning environments that help them to better understand and personally consider STEM careers.	The learning experience provides no opportunity for students to explore STEM careers that are related to the STEM learning experience taking place in the classroom.	The learning experience engages students in work that occurs in one or more STEM careers, but does not explicitly help students make the connection between their classroom work and work in the STEM career field.	The learning experience engages students in work that occurs in one or more STEM careers and the teacher intentionally helps students see the relationship between their classroom work and the work carried out by STEM professionals.	The learning experience requires students to complete tasks in a simulated or real STEM work environment in which they are working like STEM professionals. In addition, the experience includes an activity intentionally designed to help students explore the relevant STEM careers and their educational requirements.
COMPONENT SEVEN **Individual Accountability in a Collaborative Culture** Quality STEM learning experiences often require students to work and learn independently and in collaboration with others using effective interpersonal skills.	Students are not required to work or learn in collaboration with other students.	Students are encouraged or required to work in teams, but the collaborative work is informal in nature with little or no attention given to individual accountability.	Students are required to work in formally structured teams with specific methods for measuring team and individual accountability for the targeted learning outcomes.	Students are required to work in formally structured teams that have clearly defined expectations for individual and team accountability, including an intentional instructional focus on helping students develop the interpersonal skills valued in real-world work environments such as respect for diverse perspectives, active listening, checking for shared understanding, etc.
COMPONENT EIGHT **Nature of Assessment(s)** Quality STEM learning experiences require students to demonstrate knowledge and skill, in part, through performance-based tasks.	The assessment plan is limited in scope and designed to test primarily for retention using traditional measures such as pencil and paper tests and quizzes.	The assessment plan includes more than one form of assessment, with at least one assessment that requires students to demonstrate knowledge or skill through the completion of a performance-based task.	The assessment plan includes multiple forms of assessment with at least one assessment that is performance-based and anchored to a rubric. The assessment, however, is not an authentic representation of the real world of work outside of school.	The assessment plan includes one or more rubric-based, performance assessments that require students to demonstrate knowledge and/or skill in completing authentic tasks that model performances in the real world of work outside of school.
COMPONENT NINE **Application of the Engineering Design Process** Quality STEM learning experiences require students to demonstrate knowledge and skills fundamental to the engineering design process (e.g., brainstorming, researching, creating, testing, improving, etc.).	The learning experience includes no requirement that students develop thinking skills required in the engineering design process.	The learning experience helps students develop or refine thinking skills that are part of the engineering design process without explicitly referencing the engineering design process.	The learning experience explicitly references the engineering design process and requires students to demonstrate thinking skills across multiple steps in the engineering design process.	The learning experience, in addition to explicitly referencing engineering design, requires students to demonstrate thinking skills in employing all steps in the engineering design process, including opportunities to experience the recursive nature of the process.
COMPONENT TEN **Quality of Technology Integration** Quality STEM learning experiences provide students with hands-on experience in using multiple technologies. (Examples: computer hardware and software, calculators, probes, scales, microscopes, rulers, and hand lenses to name just a few.)	The learning experience includes no opportunities for technology integration and makes no references to the many roles technology plays in the STEM fields.	The learning experience includes one or more technology tools or resources which are employed or demonstrated only by the teacher.	The learning experience engages students in effectively employing at least one technology tool or resource selected by the teacher.	The learning experience requires students to select and effectively employ multiple technology tools and resources to enhance their capacity to complete tasks, solve problems, or manage projects.

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The STEM Education Quality Framework was developed by the Dayton Ohio Regional STEM Center in collaboration with Dr. James Rowley of the University of Dayton's School of Education and Allied Professions. For information about professional development opportunities for teachers and school administrators based on the Framework for Quality STEM Education, contact Margy Stevens, director of the Dayton Regional STEM Center at ***margy.stevens@mcesc.org.***

Additional support was provided by Washington STEM. An interactive self-assessment version of the STEM Education Quality Framework and additional resources are available online at ***washingtonstem.org.***