California AfterSchool Network

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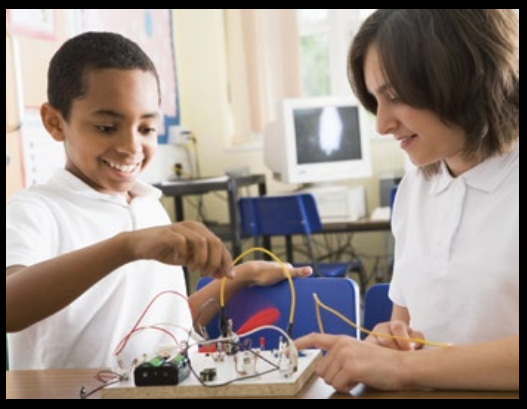
Expanded Learning STEM Quality Elements

A Framework for Quality STEM Learning in Expanded Learning Programs

STEM² THE POWER OF DISCOVERY

California STEM Learning Network
SCIENCE | TECHNOLOGY | ENGINEERING | MATHEMATICS

Expanded Learning STEM Quality Elements were created by the California AfterSchool Network through the implementation of the Power of Discovery: STEM² with the generous support of the S.D. Bechtel, Jr. Foundation, the Noyce Foundation, the Samueli Foundation, and the David and Lucile Packard Foundation.



Expanded Learning STEM Quality Elements

Table of Contents

Why STEM in Expanded Learning Programs?

In order for students in the 21st Century to become productive citizens in the global economy, they must become literate in the fields of Science, Technology, Engineering, and Math (STEM). The next generation of innovators must participate in learning opportunities that inspire interest in STEM while increasing understanding of STEM processes and concepts.

K-12 and expanded learning partnerships can increase the quality and quantity of STEM learning opportunities for students, resulting in increased student engagement and achievement. New Common Core State Standards (CCSS) and Next Generation Science Standards (NGSS) require schools to focus on science and engineering practices like never before. Expanded learning programs increase learning time, provide a flexible environment, and offer a platform to pilot innovative approaches to STEM teaching and learning.

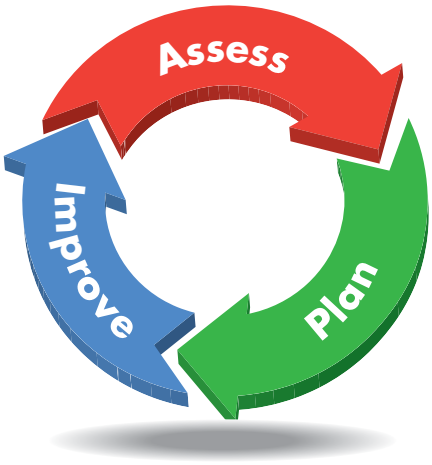
Nearly half of California's public schools have expanded learning programs. Expanded learning programs serve schools with roughly twice as many students eligible for Free and Reduced Price Meals (FRPM) and English Learners than average California schools.* Given disparities in the STEM workforce, it is increasingly important that STEM learning be incorporated into expanded learning programs serving traditionally underrepresented student populations.

*Source: State of the State of Expanded Learning in California (2014-2015) www.afterschoolnetwork.org

What is STEM? Defining STEM in Expanded Learning Contexts

STEM learning is an approach to learning that links concepts of science, technology, engineering, and mathematics with other subjects in a real world context. STEM learning opportunities are active. They offer students the opportunity to apply mathematics and technology through scientific inquiry and the engineering design process. Such opportunities foster skill development (e.g., critical thinking, creativity, problem solving, communication, and collaboration) that prepares students for college, career, and life.

Expanded Learning STEM Quality Elements Described



Quality STEM in expanded learning reflects elements of quality for expanded learning and informal STEM learning programs. Expanded Learning STEM Quality Elements can provide a common framework for **quality STEM learning in Expanded Learning Programs.** Practitioners, partners, and stakeholders interested in advancing STEM-related goals in expanded learning programs can use Expanded Learning STEM Quality Elements as the foundation for an ongoing assessment, planning, implementation, and reflection known as the **continuous quality improvement (CQI) process.** The Expanded Learning STEM Quality Elements are described as **actions that can be taken at the programmatic, staff, and participant levels of the program.** They were intentionally arranged in these three sections to map to the Quality Standards for Expanded Learning in California.

Desired Outcomes for STEM in Expanded Learning Programs

The following outcomes were established as part of the STEM in OST Strategic plan, which was created by over 100 stakeholders from K-12 education, higher education, expanded learning, professional development/technical assistance, and philanthropy. The STEM in OST Strategic plan was implemented over three years through the Power of Discovery: STEM^2 initiative facilitated by the California AfterSchool Network.

Program Outcomes	Staff Outcomes	Student Outcomes
Increased frequency, intensity, duration, and quality of STEM learning opportunities	Increased competence, confidence, and motivation to implement STEM learning opportunities	Increased engagement, interest, and knowledge of STEM processes and concepts

Expanded Learning STEM Quality Elements

Programmatic:

The following describes actions that can be taken by program leaders and their partners to implement systemic quality STEM learning opportunities at one-or-more site(s).

- The program creates a vision for STEM learning that is informed by and shared between the expanded learning program, as well as K-12 and community partners.
- The program creates an intentional, realistic, and attainable plan for STEM implementation that outlines specific STEM learning goals, outcomes, and resource commitments, as well as contributions from partners.
- The program creates intentional partnerships that include clear roles and functions in support of STEM learning goals.
- The program leverages core instructional day resources, support, and expertise, and actively collaborates with core instructional day partners to accomplish collective tasks related to shared STEM learning goals.
- The program communicates with partners, families, and young people about STEM learning goals and assessment of progress toward goals.
- The program implements STEM learning opportunities that are developmentally appropriate, equitable and inclusive for all youth participants including youth of color, immigrant youth, youth living in poverty, youth with special needs, female youth, and English learners.
- The program integrates the Standards for Mathematical Practice and Capacities of a Literate Individual outlined in the Common Core State Standards; as well as the Science and Engineering practices and the Cross-Cutting Concepts outlined in the Next Generation Science Standards into their STEM plans and programmatic activities.
- The program integrates STEM with other learning opportunities and programmatic activities (e.g., language arts, enrichment, recreation, snack, academic support).
- The program incorporates ongoing STEM projects, challenges, or explorations that require persistence and result in meaningful, consequential, culminating events.
- The program supports staff to celebrate youth achievements and create opportunities to publicly highlight skills, knowledge, and talents.
- The program provides ongoing staff development opportunities (including training, observation and coaching, mentoring, participation in peer-learning opportunities, and brokering of appropriate resources) intended to build staff competence, confidence, and motivation to facilitate STEM learning opportunities.
- The program implements a plan to review a variety of data sources related to STEM learning goals, including participant feedback, in order to adapt program design and inform continuous STEM quality improvement efforts.
- Program leaders, staff, and partners implement fiscal and administrative policies that support sustainability of STEM learning opportunities.

Expanded Learning STEM Quality Elements

Staff:

The following describe actions that site-level expanded learning program staff implement to engage participants in quality STEM learning opportunities.

- Staff create site-level plans to advance the program's STEM learning goals through sequenced, purposeful activities, experiences, lessons, and/or projects.
- Staff schedule STEM learning activities during program times that support maximum participation, with the appropriate time allotment, frequency, duration, and dosage necessary to accomplish STEM learning goals.
- Staff regularly plan and prepare for successful implementation of STEM learning opportunities.
- Staff solicit input from participants on STEM activities and program design.
- Staff design and facilitate STEM activities that spark youth interest and curiosity.
- Staff design and facilitate STEM learning opportunities that reflect positive youth development principles, including caring relationships and high expectations for participants.
- Staff design and facilitate STEM activities that challenge participants and allow for creativity.
- Staff design and facilitate STEM activities that involve real world contexts and concepts.
- Staff design and facilitate STEM learning opportunities that complement and expand upon participants' experience in the core instructional day.
- Staff use appropriate, high-quality curricula and materials to support STEM learning goals.
- Staff design and facilitate learning opportunities incorporating accurate STEM content and allow for research and investigation when answers are unknown.
- Staff act as collaborative partners, coaches, and co-inquirers and provide opportunities for participants to lead and make decisions.
- Staff model STEM habits and practices such as observing, making predictions, presenting evidence, and explaining reasoning.
- Staff actively participate in data gathering to inform progress related to STEM learning goals to inform continuous quality improvement efforts.
- Staff regularly reflect on progress toward goals, and discuss new strategies to achieve activity and program goals.

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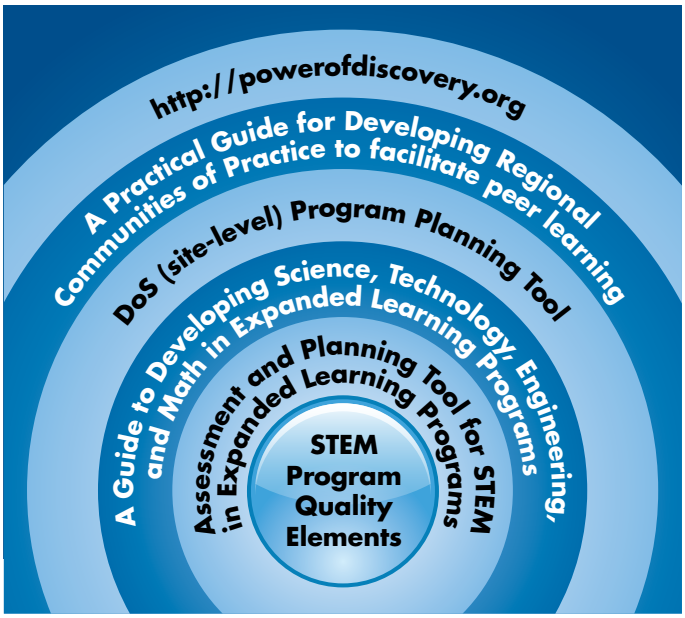
Participant:

The following describes expanded learning program participant engagement in, and support of quality STEM learning opportunities.

- Participants actively engage with a variety of STEM activities, experiences, and concepts both on- and off-site.
- Participants maintain consistent attendance through ongoing STEM learning opportunities and projects.
- Participants engage in an extended process of inquiry, exploration, and sense-making to address a particular question, learning goal, or project.
- Participants assume the responsibility to conduct STEM-related investigations, make decisions, solve problems, and resolve conflicts.
- Participants practice 21st Century skills such as collaboration, communication, information seeking, and critical thinking.
- Participants make predictions and then test, and re-test them through measuring, designing, modeling, interpreting results, and developing explanations.
- Participants obtain, evaluate, and communicate information, and have the opportunity to engage in respectful debate utilizing evidence.
- Participants use appropriate technology to address a particular question, learning goal, or project.
- Participants explore the importance of STEM processes and concepts to the larger community and society.
- Participants actively increase awareness of potential STEM careers and build skills related to those careers.
- Participants reflect on STEM learning experiences, progress toward goals, and celebrate their achievements.
- Participants offer authentic input to inform program goals and activities, including strengths and areas for improvement.

Tools and Resources to Support Quality STEM Learning in Expanded Learning

STEM Quality Elements can be used in conjunction with a variety of tools and resources (see below). The website http://powerofdiscovery.org contains the resources described below, as well as access to curriculum, professional development, funding, and other resources to support STEM program planning, implementation, and continuous quality improvement..



STEM Program Quality Elements
A shared framework to inform planning and goal setting for diverse stakeholders.

Assessment and Planning Tool for STEM in Expanded Learning Programs
Engage multiple stakeholders in a process of planning and assessment that results in planned strategies on achieving realistic goals.

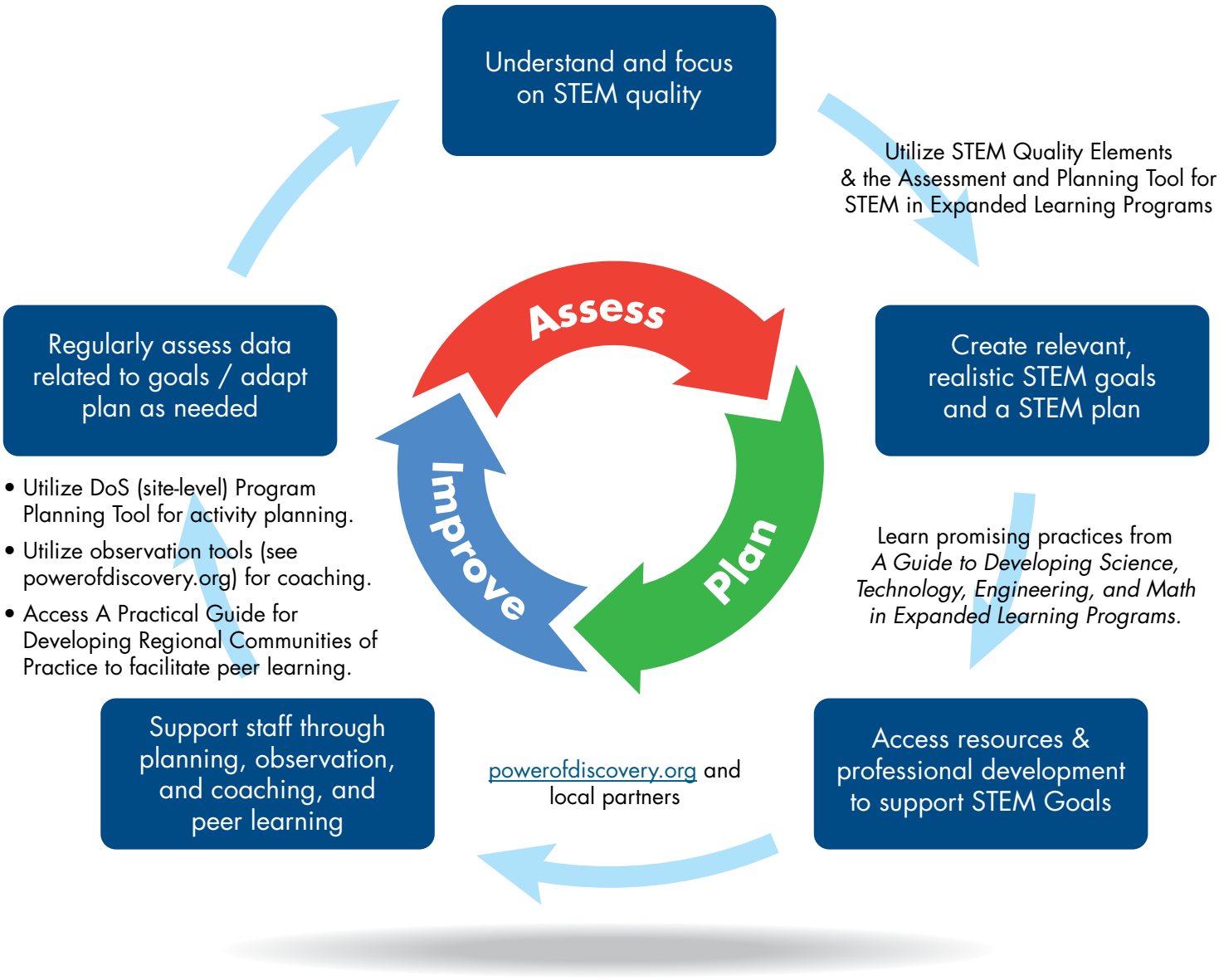
A Guide to Developing Science, Technology, Engineering, and Math in Expanded Learning Programs
Program-level strategies and promising site-level practices to advance quality STEM learning.

DoS (site-level) Program Planning Tool
Assists (site-level) practitioners in developing quality STEM learning activities on site.

A Practical Guide for Developing Regional Communities of Practice to facilitate peer learning
Assists regional TA providers to convene practitioners in order to advance common goals, surface and address common challenges, and learn successful strategies from peers.

Using Expanded Learning STEM Quality Elements in a Process of Continuous Improvement

Practitioners, partners, and stakeholders can use Expanded Learning STEM Quality Elements as the foundation for an ongoing process of assessment, planning, implementation, and continuous quality improvement. Through the implementation of the Power of Discovery: STEM² initiative, CAN has also created a variety of other tools to utilize to support the process of continuous quality improvement related to STEM.



How Expanded Learning STEM Quality Elements Were Created*

As part of the Power of Discovery: STEM², CAN conducted an extensive review of multiple tools, inventories, quality frameworks, and studies related to expanded learning program quality and quality STEM learning. Each of the resources was assessed for commonality, consistency, and overlap. Concepts were grouped into three categories (programmatic, staff, and student) to create intentional alignment with the Quality Standards for Expanded Learning in California. The result is a series of statements about actions that program leaders, staff, and participants take to support and engage in quality STEM learning opportunities. These statements are supported by a variety of relevant data sources that describe quality STEM in expanded learning programs.

Description of Resources Reviewed

Multiple data sources (summarized below) were reviewed in the development of Expanded Learning STEM Quality Elements.

Informing Expanded Learning STEM Outcomes

- *California STEM in OST Initiative Strategic Plan* (2011) Created by a statewide Visioning Team which defined mission, vision, and outcomes for the Power of Discovery: STEM²
- Defining Youth Outcomes for STEM Learning in Afterschool (Afterschool Alliance, 2013) retrieved from http://www.afterschoolalliance.org/STEM_Outcomes_2013.pdf
- Huang, D., Wang , J. *Independent Statewide Evaluations of the After School Education and Safety Program and 21st Century Community Learning Centers Program* (2012). Retrieved from http://www.cde.ca.gov/ls/ba/cp/uclaeval.asp

Models for Learning

- Buck Institute Elements of Project-Based Learning, retrieved June 2014 from http://bie.org/about/what_pbl
- Experiential Science Education Research Collaborative *Experiential Learning Variable and Indicators Scale (ELVIS)* retrieved June 2014 from http://www.xsci.org/research-2/experiential-learning-theory/

Expanded Learning Program Quality Frameworks

- Afterschool Alliance Principles of Quality Expanded Learning Programs (2012) retrieved June 2014 from http://www.afterschoolalliance.org/policyexpandedlearning.cfm
- Learning in Afterschool and Summer Principles (Temescal Associates) retrieved June 2014 from http://www.learninginafterschool.org/position.htm
- Principles of Expanded Learning & Afterschool: Opportunities for Student Success Project retrieved June 2014 from http://www.expandinglearning.org/about_us.html
- *Quality Standards for Expanded Learning in California* retrieved January 2015 from http://www.afterschoolnetwork.org/post/quality-standards-expanded-learning-california

Informal STEM Quality Standards and Frameworks

- Dimensions of Success Observation Tool: Shah, A.M., Wylie, C.E., Gitomer, D., Noam, G.G. (September 2014). Development of an Observation Tool for the Informal STEM Field: Refinement, Fieldtesting, and Establishment of Psychometric Properties. Technical Report for the Dimensions of Success (DoS) Observation Tool. Harvard University. Accessed here: http://www.pearweb.org/research/pdfs/DoSTechReport_092314_final.pdf
- 4-H Science, Engineering, Technology (SET) Ready Checklist retrieved June 2014 from http://4h.ucanr.edu/files/154115.pdf
- Forum for Youth Investment. (2012). STEM Program Quality Assessment (STEM PQA). Ypsilanti, MI: David P. Weikart Center for Youth Program Quality, retrieved June 2014 from http://cypq.org/node/649
- FUSE: Frontiers in Urban Science Education Resource Guide (Second Edition, 2014) Accessed June 2014 from http://www.afterschoolsystems.org/content/document/detail/4020/
- Indiana After School Specialty Standards for STEM (Indiana Statewide After School Network), retrieved June 2014 from http://www.indianaafterschool.org/quality/standards/
- Program in Education, Afterschool, and Resiliency (PEAR) at McLean Hospital and Harvard Medical School. Dimensions of Success (DoS) Program Planning Tool, retrieved June 2014 from http://www.pearweb.org/tools/dos/
- US Department of Education Y4Y STEM Implementation planner, STEM Program Goals, retrieved June 2014 from https://www.y4y.ed.gov/tools/#stem

Staff Practices and Competencies to advance Quality STEM Learning

- Click2SciencePD 20 Skills that Make STEM stick retrieved January 2015 at http://click2sciencepd.org/20-skills-make-stem-click
- Technical Assistance for Program Effectiveness (TAPE) California Core Competencies for Before and/or After School Practitioners (for Grant Managers, and Site Coordinators) retrieved June 2014 from http://asapconnect.org/tape/CoreCompetencies/CACoreComp.html

Educational Standards

- The Common Core State Standards (Capacities of a Literate Individual, and Standards for Mathematical Practice) retrieved June 2014 from http://www.corestandards.org
- The Next Generation Science Standards (Science and Engineering Practices, and Cross-Cutting Concepts) Retrieved June 2014 from http://www.nextgenscience.org

Other Supporting Information

- *Examining the Impacts of Afterschool STEM Programs* (July 2014) written by Krishnamurthi, A., Ballard, M., Noam, G., Commissioned by the Noyce Foundation retrieved August 2014 from http://www.afterschoolalliance.org/STEMresearch.cfm
- Navigating the future of Afterschool Science (2014) SRI International. retrieved June 2014 from http://afterschoolsciencestudy.sri.com
- STEM Learning is Everywhere (2014) National Academies Press, accessed December 2014 from http://www.nap.edu/download.php?record_id=18818

* Expanded Learning STEM Quality Elements were created by Jeff Davis of the California AfterSchool Network with input from the Regional Innovation Support Providers of the Power of Discovery: STEM².

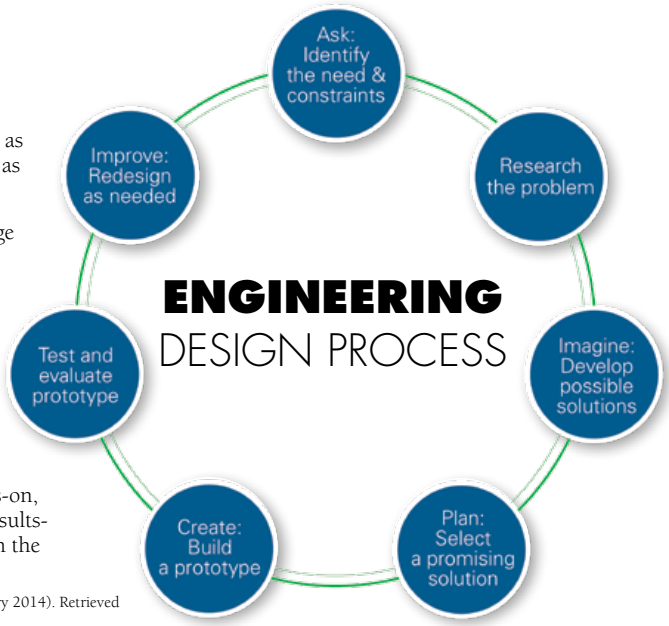
Glossary of Terms

Engineering Design Process

The engineering design process is a series of steps that engineering teams use to guide them as they solve problems. The design process is cyclical, meaning that engineers repeat the steps as many times as needed, making improvements along the way.

Two key themes of the engineering design process are **teamwork** and **design**. Encourage students to follow the steps of the design process to strengthen their understanding of **open-ended design** and emphasize creativity and practicality.

Source: Teachengineering.org, retrieved March 2015 from https://www.teachengineering.org/engrdesignprocess.php



Expanded Learning

The California Department of Education After School Division in *A Vision for Expanded Learning in California: Strategic Plan 2014-2016* outlines Expanded Learning as referring to: "before and after school, summer, intersession learning programs, that focus on developing the academic, social, emotional, and physical needs and interests of students through hands-on, engaging learning experiences. Expanded learning programs should be student-centered, results-driven, include community partners, and complement but not replicate learning activities in the regular school day/year."

Source: *A Vision for Expanded Learning in California: Strategic Plan 2014-2016.* Developed by the California Department (January 2014). Retrieved March 2014 from http://www.cde.ca.gov/ls/ba/cp/documents/asdstrategicplan.pdf

Inquiry

Inquiry teaching and learning have five essential features that apply across all grade levels. These five essential features are:

- Learner Engages in Scientifically Oriented Questions
- Learner Gives Priority to Evidence in Responding to Questions
- Learner Formulates Explanations from Evidence
- Learner Connects Explanations to Scientific Knowledge
- Learner Communicates and Justifies Explanations

Source: *Inquiry and the National Science Standards: A Guide for Teaching and Learning* (National Academies Press, 2000 p. 45 - 47) retrieved March 2015 from http://www.nap.edu/openbook.php?record_id=9596

Participants

Young people that attend and participate in the expanded learning program.

Program Leaders

Includes District Grant Managers and Program Directors responsible for the leadership and administration of the expanded learning program.

- **GRANT MANAGER** is a district, county, city, or community-based organization (CBO) staff member who is ultimately responsible for grant oversight, operations, and overall program direction including ensuring grant compliance, meeting certified assurances, developing or managing budgets, and submitting required reports.
- **PROGRAM DIRECTOR** is someone who oversees two or more site-based programs and may evaluate staff.

Source: Technical Assistance for Program Effectiveness (TAPE) California Core Competencies for Before and/or After School Practitioners (for Grant Managers, and Program Directors) retrieved June 2014 from http://asapconnect.org/tape/CoreCompetencies/CACoreComp.html

Staff

Includes site coordinators and frontline staff responsible for the day-to-day operations of the expanded learning program.

- **SITE COORDINATOR** is someone who oversees a program at one site and has responsibility for the supervision of the frontline staff.
- **FRONTLINE STAFF** is someone who works directly with students in before and/ or after school programs.

Source: Technical Assistance for Program Effectiveness (TAPE) California Core Competencies for Before and/or After School Practitioners (for Site Coordinators and Frontline Staff) retrieved June 2014 from http://asapconnect.org/tape/CoreCompetencies/CACoreComp.html

STEM Learning for Expanded Learning Programs

The definition of STEM was created based on a review of *STEM education: A project to identify the missing components* (Tsupros, N., Kohler, R., & Hallinen, J., 2009) as well as the definition created by the (California) Superintendent of Public Instruction Tom Torlakson's STEM Task Force Report: *INNOVATE: A Blueprint for Science, Technology, Engineering, and Mathematics in California Public Education, as well as the Learning in Afterschool and Summer Principles (Learning that is Active, Collaborative, Meaningful, Supports Mastery, and Expands Horizons).*

STEM learning is an approach to learning that links concepts of science, technology, engineering, and mathematics with other subjects in a real world context. STEM learning opportunities are active. They offer students the opportunity to apply mathematics and technology through scientific inquiry and the engineering design process. Such opportunities foster skill development (e.g., critical thinking, creativity, problem solving, communication, and collaboration) that prepares students for college, career, and life.

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