



# Informal STEM Learning

A quality STEM program engages participants in exploring, creating, and building skills and knowledge that are applicable in real-world situations and future careers, and that spark lifelong interest in STEM activities.

A quality science, technology, engineering, and math (STEM) program engages participants with hands-on, exploratory activities that encourage them to ask questions, build explanations, and collaborate. In pursuing questions or participating in the engineering design process, participants should use practices that engage in the thinking and reasoning of STEM professionals through authentic activities, such as developing and using models, analyzing and interpreting data, and planning and carrying out investigations.

## CHECKLIST:

- ✓ Has staff who prepare the room and materials ahead of time to maximize participant time and participation.
- ✓ Matches STEM materials and equipment to participants, considering interest, ability, and safety.

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## Informal STEM Learning, Indicator 1

Arranges space to encourage collaborative STEM explorations with staff and each other.

### Performance Level 1

The space does not accommodate active learning. There may be loud distractions or limited area for participants to interact with the learning. Activity is largely staff-led with participants listening passively for much of the time. Participants remain seated the entire time with little peer-to-peer interaction. Interactions resemble a formal lecture or classroom structure with little or no opportunities to engage with materials or peers.

### Performance Level 2

Facilitators use whatever space they are given in a way that is collaborative and encourages informal learning, but the space limits flexibility. Some activities are not possible due to space limitations. Some participants can engage with materials or peers, but others must listen and observe without the chance to engage because of the space and setup.

### Performance Level 3

Program space is arranged to encourage participants to engage in group work and group discussion. Adults can converse with participants and join their discussions. Space is configured or selected to minimize distractions and still be appropriate to the specific STEM activity.

### Performance Level 4

The learning environment is arranged and configured to support an informal approach to exploration and collaboration with flexibility and encouragement. The space is well-matched to the needs of the activities offered (e.g. access to a sink if needed, space for group work, computers if coding etc.). The learning environment looks and feels different from a formal lecture experience.

## Informal STEM Learning, Indicator 2

Has structures, such as scheduling, staff development, youth development, etc., which support all participants having access to STEM learning enrichment activities.

### Performance Level 1

STEM enrichment activities are only offered to a select group of advanced participants. STEM enrichment activities are not regularly offered at the site, and instead, the program might feature one-off activities, such as a STEM night.

### Performance Level 2

STEM activities are scheduled at a time that directly competes with highly gendered program offerings, such as cheerleading or football, and participants are forced to choose. Enrichment is limited to only one STEM offering (for example, the only STEM class offered is robotics or math tutoring) that does not showcase the broad possibilities of STEM enrichment.

### Performance Level 3

STEM enrichment is offered across the schedule (daily, weekly, semester, etc.) to ensure that all participants can participate. More than one STEM offering is available, showing a range of STEM topics.

### Performance Level 4

STEM activities are scheduled to avoid conflicts with other enrichment offerings. Activities from a wide range of STEM topics occur to help participants experience how STEM is integrated in life (e.g., robotics, outdoor environment, technology and programming, art and design, fashion design and garment making, food science, etc.).

## Informal STEM Learning, Indicator 3

Structures STEM activities to move purposefully towards the understanding of a STEM idea or development of a STEM practice.

### Performance Level 1

STEM activities are STEM in name only, selected for fun without concern for meaning or learning. No thought of STEM purpose is made when planning.

### Performance Level 2

STEM activities are planned with a purpose by the facilitator. Thought is given to STEM purpose, but the participants are not aware of the purpose even after completing the activity. The purpose is not explicitly supported throughout the activities.

### Performance Level 3

STEM activities are selected from a range of sources (colleagues, social media, etc.) with thought given to the STEM purpose. The facilitator supports understanding the deeper STEM purpose through these activities. Participants are explicitly aware of the larger purpose of these activities.

### Performance Level 4

STEM activities are selected from research-based or peer reviewed STEM curricula that builds towards a defined STEM idea or practice (e.g., learning how energy is converted during photosynthesis or learning how to change one variable at a time in an airplane design). Participants are prompted and supported to discover the larger purpose of the designed learning experience.

## Informal STEM Learning, Indicator 4

Provides participants with opportunities to engage in hands-on activities that require critical thinking.

### Performance Level 1

Participants are passively watching, not manipulating material. Participants may be reading STEM-related material or listening to an expert, but are not answering any questions or demonstrating their learning. No application of learning exists.

### Performance Level 2

There are limited opportunities for participants to engage with materials, or not all participants have access to the materials. Participants have limited opportunities to answer questions or demonstrate their learning.

### Performance Level 3

Participants have opportunities to work directly with tools and materials, and describe or discuss what they are doing during the process. Participants are occasionally prompted to think about the process and make sense of the hands-on experience.

### Performance Level 4

All participants have opportunities to explore STEM concepts and ideas in a hands-on way and are prompted to make sense of the experience. Participants change roles over time, so each has an opportunity to lead, facilitate, build, design, ask, test, and otherwise participate in the enrichment. Participants are hands-on with materials and discuss with peers the purpose, meaning, and value in the enrichment. Participants articulate the problems and questions they are trying to solve through their actions.

## Informal STEM Learning, Indicator 5

Ensures STEM facilitators demonstrate an accurate understanding of STEM content.

### Performance Level 1

Participants' comments and questions indicate that they have a weak understanding of the content presented or that they cannot go beyond simply memorizing or repeating ideas presented during the activity. Facilitator has a weak understanding of content, and repeats errors and myths.

### Performance Level 2

Participants discuss isolated facts and ideas but do not engage in sustained discussion of concepts. Only weak attempts are made to form connections among ideas or clarify understanding. Facilitator's comments reflect accurate content understanding for the most part, but he/she struggles to guide participants to understanding.

### Performance Level 3

Participants are supported to move beyond memorization and fact-recall to discuss STEM concepts in a meaningful way. Facilitator comments reflect accurate content understanding, and she/he is able to guide participants to understanding the content.

### Performance Level 4

Participants are supported to move beyond memorization and fact-recall to discuss STEM concepts in a meaningful way. When participants make errors in understanding, the facilitator's comments reflect accurate content understanding, and she/he is able to guide participants to understanding the content. Facilitators allow participants to explore misconceptions to prove them incorrect, in essence allowing failure and assumptions as part of the process towards deeper understanding of the content.

## Informal STEM Learning, Indicator 6

Provides opportunities for participants to use authentic methods that STEM professionals use in age-appropriate, supported ways.

### Performance Level 1

Participants do not engage in identifiable science and engineering practices. Activities are focused on the outcome and follow a controlled plan. Participants cannot fail because the plan is simple, or adults will fix any mistakes.

### Performance Level 2

Participants are exposed to science and engineering practices. These activities do not capture the authenticity of the practices because facilitators are often doing the thinking and reasoning of the practices for participants and minimizing complexity. Participants observe demonstrations with few opportunities to practice what is being demonstrated.

### Performance Level 3

Participants are engaging in authentic scientific or engineering practices. Participants ask questions and design ways to answer those questions. Participants identify problems in the environment and design and build solutions to those problems. They test solutions and improve designs.

### Performance Level 4

Participants engage in authentic science and engineering practices that allow them to delve deeper into their understanding of STEM concepts. There are opportunities for participants to fail and display resiliency or persistence through potential obstacles or needed modifications in their investigations, data collection approaches, programs, or designs. Facilitators provide age-appropriate guidance to support this process, but participants have the confidence and experience with the process to manage their own practices. Participants are engaged in citizen science (supporting ongoing research), or they are engaging in original research themselves. Participants support the design and building process with other makers, or they design and build prototypes of their own. Creation includes software, games, textiles, models, food dishes, structures, etc.

## Informal STEM Learning, Indicator 7

Dedicates time for participants to reflect on their actions and development throughout each STEM activity.

### Performance Level 1

Staff do not consistently use open-ended questioning strategies and instead are limited to yes/no type responses. Participants are not asked to make sense of what they are learning after engaging in an experience.

### Performance Level 2

Reflection is largely staff-led. Sometimes reflection centers more on surface-level questions, such as *Did you like the activity?*, and less on in-depth questions, such as *How does what we learned relate to our lives?* or *What did the way your car moved on the track tell you about velocity?* Even though the staff plan for reflection time, the conversation is often dropped or rushed due to scheduling. Staff use open-ended questioning strategies and ask participants to expand upon their answers beyond yes/no, however, participant responses remain superficial or simply parroting back a summary of what they did.

### Performance Level 3

Program dedicates time for reflection through its planning process. All activities have built-in reflection time. Reflection is consistently prompted by the facilitator or participant-driven with facilitator support, such as discussion, sentence starters, journals, or drawing.

**Performance Level 4**

Staff and participants ask open-ended questions to help make sense of what they are learning. Reflection prompts help participants make sense of the learning. Reflective questions encourage planning for next steps in the process or project. Reflection includes time to discuss what happened, what it means, and what next steps might be. Reflective activities such as journaling, data analysis, and making conclusions happen frequently. Program uses different grouping strategies to ensure all participants have the opportunity to reflect. Individual, small group, and whole group reflective practices are used. Multiple opportunities for reflection are embedded in each lesson plan.

**Informal STEM Learning, Indicator 8**

Includes all participants in STEM activity, at all levels of the activity.

**Performance Level 1**

Program serves many participants, but some participants are always elevated to leadership roles or opportunities while others are never afforded those chances. STEM activities may only be offered to some participants, with other identities, such as girls, not represented at all. Program leadership does not work to address this.

**Performance Level 2**

Program serves diverse participants, but only some participants lead or participate fully during activities. Other participants are regularly sidelined based on identity. Some participants dominate STEM activities at the expense of other participants.

**Performance Level 3**

Staff plan to ensure that all participants have opportunities to lead and be involved, regardless of identity or status. Staff use strategies to ensure no single identity dominates or monopolizes materials and conversation. All participants get an opportunity to try all roles over time. Program leadership works with activity leaders to ensure this happens consistently.

**Performance Level 4**

Staff plan to ensure that all participants have opportunities to lead and be involved, regardless of identity or status. Staff use strategies to ensure no single identity dominates or monopolizes materials and conversation. All participants get an opportunity to try all roles over time. Program actively recruits and includes participants in STEM activities, paying special attention to under-represented groups (e.g., women, people of color, and people from low-income backgrounds). Program leadership tracks participation by different groups to ensure inclusion across the board. Program uses universal design principles to ensure inclusion of any and all participants.

**Informal STEM Learning, Indicator 9**

Supports participants in recognizing the meaning and importance of STEM activity in their lives.

**Performance Level 1**

No effort is made to connect the STEM content to personal lives through discussion, journaling, or reflection. Staff do not feel prepared to lead conversations connecting the STEM goals to participants' lives. There is no dedicated time in each lesson plan for reflection or making connections to the real world.

**Performance Level 2**

Some connections are made between the STEM goals and participants' lives. STEM activities are presented as stand-alone challenges without connection to larger needs or issues in the community. Even though staff members plan to discuss the relevance of the activity to participants' lives, the conversation is often dropped or rushed due to scheduling.

**Performance Level 3**

There is dedicated time in each activity plan for reflection and making connections to the real world. Reflection is participant driven, and facilitators use a variety of tools to make connections (discussion, sentence starters, journals, drawing, etc.). Reflection usually answers a variation of the question, How does what we learned relate to our lives?. Practices from the activity are related back to real-world applications, and some projects deal directly with issues or challenges facing participants' local communities.

**Performance Level 4**

Participants articulate how STEM is a part of the world around them, and how they apply STEM in their own lives. Program facilitates opportunities for participants to apply STEM to solve problems in their lives or community. Program presents multiple opportunities across different STEM activities for participants to reflect on how STEM is relevant in their everyday lives or communities. Program promotes STEM learning as a way for participants and communities to meet needs, solve problems, and understand the world. Time is made during planning, reflection, and within activities to connect STEM activity to participants, their communities, and the world.

**Informal STEM Learning, Indicator 10**

Supports participants in taking ownership of their STEM learning and sharing their ideas with their community.

**Performance Level 1**

Participants are given no opportunities to discuss their activity or results relating to STEM. All activities are adult-driven with little to no participant participation.

**Performance Level 2**

Some participants have opportunities to discuss their STEM learning. Program staff direct STEM activities with some surveying of participant interest.

**Performance Level 3**

When a participant asks a question, staff makes space to answer the question with an authentic activity such as an experiment, bringing in a STEM role model as an expert, or engaging in research. Staff adjust learning opportunities for participant interest and questions. Staff support participants to share their ideas with the greater community.

**Performance Level 4**

Participants generate their own questions and engage in an experiment or community service project to generate results. Staff support participants to share their ideas with the greater community. Participants feel empowered to discuss what they are doing and why, what they have learned, and what is the meaning to each other, to their peers, their families, elected officials, and other community members.

**Informal STEM Learning, Indicator 11**

Connects participants with STEM professionals from diverse backgrounds to encourage STEM career attainment and/or lifelong interest in STEM pursuits.

**Performance Level 1**

STEM professionals, if they are mentioned or featured, do not reflect most participants in the program. STEM activities may reinforce stereotypes of who does science and who does not. Participants are not exposed to diverse role models with images, materials, or visitors in the STEM field (e.g. people of color, people with disabilities, people from low-income backgrounds, or female STEM professionals).



**Performance Level 2**

The program makes an effort to guide participants towards an understanding that scientists and the work of STEM professionals are diverse. Each year, STEM activities incorporate limited guest speakers, articles, and videos about scientists and engineers who come from different backgrounds. Most STEM activities do not feature an explicit connection to a role model or career.

**Performance Level 3**

The program guides participants towards an understanding that STEM professionals are diverse, with multiple career and/ or role model activities each year. Mentors and volunteers visit the program periodically to support the STEM program. Role model opportunities incorporate individuals who use STEM in their daily lives or careers, such as bakers, mechanics, etc. Materials and resources in the environment reflect or explore how STEM impacts the world around us, including showing role models that reflect the culture of the participants in magazines, books, posters, etc. Diverse people are shown in STEM professions and activities, in person, and through media.

**Performance Level 4**

The program guides participants towards an understanding that STEM professionals are diverse, with multiple career and/ or role model activities each year. Mentors and volunteers visit the program regularly to support the STEM program. Role model opportunities incorporate individuals who use STEM in their daily lives or careers, such as bakers, mechanics, etc. The program embeds authentic mentoring relationships with STEM professionals around shared projects. Community STEM institutions are included in the program (e.g. libraries, parks, museums, government, etc.) as partners for STEM in the region. Diverse role models are represented within the space and their stories are referenced during the enrichment.

*The PEAR Institute developed a 12-dimension framework to define quality for STEM programming in afterschool (Dimensions of Success, or DoS). The indicators in this self-assessment tool were heavily based on those 12 dimensions, and consultation with the DoS researchers at PEAR led to the four performance level definitions as well. While these do not exactly match the DoS rubrics and scoring structure, they are well-aligned and much of the language used here is borrowed from the DoS framework. The STEM indicators were also heavily influenced by the DoS Program Planning Tool, which is available from the PEAR Institute web site (<http://www.thepearinstitute.org>).*

