DYCD OUT-OF-SCHOOL-TIME STEM

STEM ATTITUDES & SKILLS IN PRACTICE

Skills

Questioning: ask questions or identify problems to be solved

Imagining: brainstorm ideas, plan, and predict what will happen if certain actions are taken

Testing ideas: create, design, or experiment in order to answer questions, explore solutions, and test hypotheses

Observing/measuring: record what is noticed and what happens during actions; find patterns

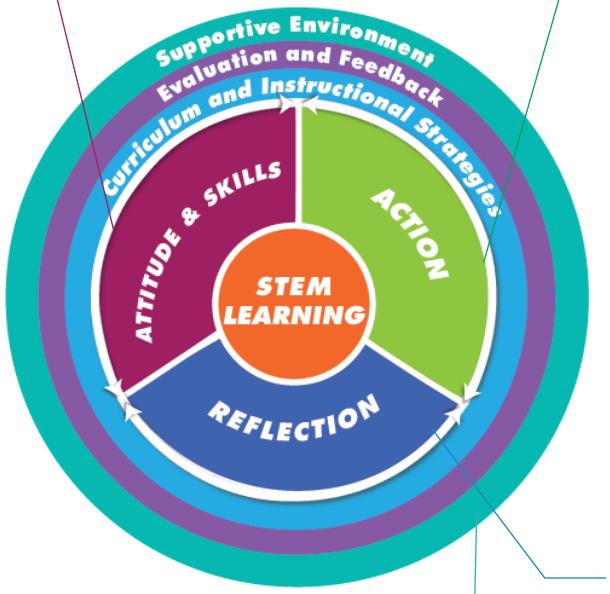
Collaborating: work together in teams

Explaining: use evidence to argue for the right way to find something out and make sense of findings

Attitudes

Growth mindset: participants learn failure can direct next steps of learning; they re-design and re-test based on results.

Expanded horizons: participants come to see themselves as future scientists, engineers, mathematicians, and technologists



STEM IN ACTION

Investigations: participants seek answers to questions or solutions to problems related to one or more STEM concept

Relevant: participants engage with STEM topics that are relevant to the world in which they live

Hands-on: participants hands are on the materials and tools; they experience STEM concepts firsthand instead of read about them

Project-based: activities are part of a multi-session project

Many solutions: participants solve problems and tackle questions that can be answered in more than one way

Engage community: participants are exposed to the natural and built resources of the city and their local surroundings

Leadership opportunities: participants choose STEM topics, lead investigations, and step into leadership roles

REFLECTING ON STEM LEARNING

Participants: During activities, share what they're trying and noticing. Following activities, reflect on what went well, what didn't, why, what was learned, and goals for next time

Staff: Engage participants to openly discuss attainment of three goals:

~ Did the activity grow participants' **interest** in STEM?

~ Did it grow participants' **capacity** to do STEM?

~ Did it help participants see the **importance** of knowing STEM?

Plan STEM programming to make strides in meeting these

CREATE THE RIGHT ENVIRONMENTAL CONDITIONS FOR STEM LEARNING

Materials & tools: should be accessible, abundant, and safe for all participants to put their hands on and see STEM concepts and ideas in action; start with what your site already has!

Space: participants should be free to move around, get a little messy, take things apart, and put them back together again

Time: participants should have plenty of time to explore authentic, open-ended STEM questions

Engage experts: invite professionals who model how participants can use STEM in the future

The right staff: hire and invest in staff with STEM interests, passions, or hobbies

Staff training: train staff so they reinforce the value of STEM, keep participants motivated, and act as co-learners, giving *just* enough help so participants can make their own discoveries

Equitable: activities consider interests of girls and boys, and staff encourage all to participate

Family inclusion: families are informed and encouraged to work alongside program participants

Adapted from Afterschool Alliance's "Defining Youth Outcomes for STEM Learning in Afterschool" and the New York City Department of Education's "STEM Education Framework"

NYC Department of Youth & Community Development

The purpose of this framework is to build a common language for DYCD-funded STEM activities and to assist providers in mapping out and designing the core components and supports that are needed for quality STEM programming.

CORE COMPONENTS

Skills & Attitudes

STEM is more than a new name for teaching science and math; it is more than including technology and engineering in traditional science and math problems. STEM is a process where individuals collaborate and think creatively to solve particular problems and questions. Through this act, academic concepts & principles related to the disciplines of science, technology, engineering, and mathematics are applied and unearthed for the learner. In other words, they discover how things works instead of reading about them. The STEM skills described in this framework form the core steps of this investigative process. When participants are guided through them, they are learning STEM.

Action

To really learn STEM, it must be done— not watched or researched, but experienced firsthand. Participants must be given the opportunity to explore, investigate, and take risks by using tools and learning from failure. When something isn't working, participants think about why that is and plan to do it again. Individual STEM activities should be linked and take participants through multi-step problems that have no single "right" answer but that shine light upon a particular STEM concept, principle, or skill. They should culminate in the presentation of work.

Reflection

Reflection occurs throughout the STEM learning process. During investigations, participants should reflect on what is working, what's not, and adjust their plans accordingly. Following STEM activities, participants should look back on and learn from their experience or action. Reflection allows everyone to hear another's perspective and provides opportunities to develop skills in making good judgments. Reflection can happen through writing, speaking, reading, drawing, or acting. Likewise, staff can reflect too; they gauge the effectiveness of STEM programming by considering how it has developed participants' interest in STEM, their capacity to do it, and a sense of its importance in their lives.

SUPPORTS

Curriculum and Instructional Strategies

STEM curricula can be created organically, based on the interests and expertise of staff and participants, obtained through a curriculum developer, or delivered through subcontractors. When choosing a STEM curriculum to implement, it will be important to check and see if its focus aligns with the STEM skills and actions reflected in this framework. Rather than acting as the holders of knowledge, staff should act as coaches and co-learners. They should visit teams of participants briefly and often, show enthusiasm for discoveries and questions, refer students' questions to other students, give just enough help, and ask more questions (like "What did you notice?" or "Why do you think it happened that way?") than they answer. If your staff write their own lessons, have them use a 5E model, which will support engagement in authentic STEM inquiry.

Evaluation and Feedback

An important learning process for young people and staff is to evaluate and elicit feedback. Evaluations can focus on the usefulness of the STEM program, the relevance of STEM activities and trips, suggestions for changes, and the identification of ways in which participants might apply what they learned. Staff and community members must be seen as equal stakeholders in the provision of STEM programming, and should be empowered to give (and receive) constructive feedback regarding STEM activities. It is important that an atmosphere of trust and acceptance be developed so that all stakeholders are comfortable with both giving and receiving feedback.

Supportive Environments

The environment is a crucial aspect of STEM programming. A planning framework that sites can use to focus on getting the environment "right" can be found here. The space and materials must be conducive to hands-on, experiential activities. Staff should be trained so they do not take over work for participants. Instead, they should step back and ask questions or make suggestions to ensure participants are the ones doing the learning. Staff must make sure the environment is one that promotes a playful approach to STEM, where failure does not stop learning but informs it. To help build staff capacity, programs must invest in staff who have an interest for STEM topics. Programs should also consider involving adults from the community whose work involves science, technology, engineering, or mathematics. Participants will then be given the opportunity to see the themselves as individuals who engage with STEM on a daily basis and who could eventually use STEM in their future careers!