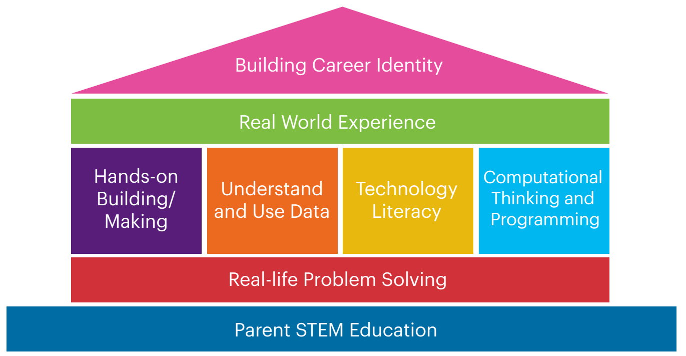
Eight Elements of STEM Preparation

These elements are drawn from input from STEM Pathway Steering Committee members and community listening and include: key skills and experiences that we are hearing are critical to industry, descriptors from Next Generation Science Standards, California Computer Science Standards, California Math Framework, Linked Learning's Work-Based Learning Continuum and other research. These elements are not meant to be taught in isolation, but a quality STEM program (whether focused on students or parents) should: 1) always be contextualized in the real world; 2) develop critical skills in multiple areas; and 3) expose youth to many possible career options as demonstrated by this graphic. Created by The Tech, 2022.



Element Definition	**K-2** | This might look like:	**3-5** | This might look like:	**6-8** | This might look like:	**9-12** | This might look like:
Building Career Identity Seeing self in different careers through exposure to and interactions with role models of similar demographics to students; developing professional networks and skills critical to getting a job, such as resume building, interviewing, social profile.	• Role playing / Explicit connections to real-world STEM work (e.g. Citizen science) • Interactions with role models (e.g., guest speakers, career fairs)	• Interactions with mentors and role models particularly those with whom students can identify- inclusive of varied, non-obvious STEM careers that help children better understand how STEM skills are applied (e.g., guest speakers, career fairs, industry events, virtual connections) • Role playing / Connections to STEM work	• Relationships with mentors and role models of diverse backgrounds and careers that help youth find connections between youth's interests and possible career applications (virtual exchanges, project feedback, mock interviews) • Basic interview skills and professional profile creation	• Sustained relationships with mentors and role models (virtual exchanges, project feedback, mock interviews) • Paid internships • Exposure to career types, geographic demand, salary-level and coursework required • Advanced resume building, interviewing, creating a LinkedIn profile • Information about navigating college and potential pathways that help students pursue their career
Real World Experience Visiting a variety of workplace environments and college campuses with the focus of understanding careers.	• School/district workplace visit (e.g., cafeteria, library, district office)	• Community, gov't or parent workplace visit (e.g., public library, city hall, courthouse, clean room, etc.)	• Industry/college campus visit • Realistic job simulations/ applications* • Industry-driven projects with feedback from industry	• Realistic job simulations/ applications* • Job shadowing • Internship or work study • Industry-driven projects or student-run enterprise with feedback from industry*
Hands-on Building/Making Exploring, creating, building and tinkering with hands-on materials to understand how things work, test ideas or express an idea or message.	• Creating simple sketches, diagrams or models of how things work	• Developing models that perform one function to convey a proposed object, tool or process	• Constructing complex, multi-part models to generate data to test and re-test a system	• Producing abstract representations of complex ideas or systems to generate data, analyze systems or solve problems
Understand and Use Data Collecting and interpreting data to help understand, solve and communicate problems and solutions.	• Making observations, measurements, simple comparisons by size • Sorting, categorizing, describing patterns and relationships • Creating line plots, picture & bar graphs	• Comparing and contrasting data across groups • Generalizing to broader population (Who is missing?) • Add scatterplot, max/min/ mean and fractional units	• Using data software to visualize and interpret graphical displays of large data sets • Using variability, distribution, probability, and certainty to analyze and interpret data • Add dot plot and histogram • Considering limitations, precision and accuracy	• Evaluating complex math, physical and empirical models, including computer simulations to compare predictive strength of models • With authentic, random, multi-variable, large data sets, using cross-validation & inferential statistics to quantify errors from predictions, infer causation and engage in statistical reasoning • Add box plot, 2-way frequency tables, 3-variable visualizations

**Teacher job shadowing opportunities can add inspiration and authenticity to classroom simulations.*

The Bowers Institute

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Technology Literacy Effectively using technology tools to ethically and safely research, communicate, gather and analyze data and engage in virtual collaborations with those at a distance.	• Sharing ideas with others using modern technology • Avoiding harmful behaviors such as sharing passwords or private information and interacting with strangers	• Using technology to communicate ideas and to collaborate • Describing ways to protect personal information and honoring copyright laws	• Using technology to conduct research, present ideas and collaborate • Comparing tradeoffs between publicizing information and keeping information private and secure	• Using technology creatively, ethically and as a tool for practical application and decision making • Explaining the privacy and security concerns related to the collection and generation of data through automated processes
Computational Thinking and Programming Explicitly using computational thinking (CT) elements of patterns, decomposition, algorithms and abstraction to solve problems or model phenomena in all content areas and everyday life in non-programming (unplugged) and programming (plugged) activities. Unplugged activities draw explicit connections to the CT element and how computer scientists and other STEM professionals use these skills when writing programs.	Unplugged Examples: • Noticing patterns in shapes, words, pictures, stories and natural phenomena or decomposing them into parts • Using abstraction and algorithms (steps) to summarize a story Plugged Example: • Analyzing or making simple changes to an existing program to understand sequences and loops	Unplugged Examples: • Using abstraction to model simple science phenomena • Using decomposition to break down an essay or words into parts Plugged Example: • Planning, developing, testing and modifying a computer program by decomposing the problem into smaller manageable tasks	Unplugged Examples: • Observing patterns in data or comparisons of historic peoples/ events to support a claim • Using decomposition and abstraction to identify relevant and irrelevant information in math word problems Plugged Example: • Designing and modifying programs that represent data in a variety of ways, including modifying variables and operators	Unplugged Examples: • Using patterns and abstraction to analyze, draw conclusions and understand large data sets • Decomposing systems of linear equations into variables for elimination Plugged Example: • Using algorithms to develop complex programs and computational models that incorporate user feedback
Real-life Problem Solving Solving real-life problems in any subject area, testing and refining many different solutions and justifying a final solution with evidence.	• Working on simple problems with one or two solutions	• Defining and solving problems individually and in teams • Comparing multiple solutions	• Solving authentic problems on diverse teams using systematic evaluation processes, reading, study, analysis, investigation and routines to help youth experience these skills important to STEM fields[1] • Explicitly discuss how creativity, expression, leading, persuading and following standards are important in STEM careers[1] • Participating in a multi-month challenge or competition	• Solving complex problems with a focus on helping others with diverse teams using detailed statistical analyses • Participating in a multi-month challenge or competition • Connect passions with meaningful scale and impact projects and business incubation[1]
Parent/Caregiver STEM Education Education/supports/relationships helping parents support STEM skill development, build their own STEM skills and navigate the educational system/college requirements to advocate for their child's success.	• Learning with children (e.g., library/ museum/ community programs) • Engaging in strategies for educational play, inquisitive conversation, and open-ended creation • Encouraging engagement with science media[2] and discussion about science at home[3] • Awareness about biases associated with who belongs in STEM careers and how they might be perpetuated	• Learning with children • Engaging in strategies that foster curiosity and design thinking • Recognizing skills family members possess but might not call STEM • Reflecting on STEM biases of both who belongs in STEM and what STEM careers are like • Improving own STEM skills and learning how to navigate the school system	• Increasing awareness of ways to sustain STEM interest during this critical time (where STEM interest drops) including encouragement to take science and math classes[4] • Improving own STEM skills and learning how to navigate the school system • Increasing awareness of ways to support preparation for college	• Improving own STEM skills • Advocating for and supporting preparation for college

[1] *Blotnicky, K.A., Franz-Odendaal, T., French, F. et al. A study of the correlation between STEM career knowledge, mathematics self-efficacy, career interests, and career activities on the likelihood of pursuing a STEM career among middle school students. IJ STEM Ed 5, 22 (2018).* https://doi.org/10.1186/s40594-018-0118-3
[2] *Ho, E. S. C. (2010). Family influences on science learning among Hong Kong adolescents: What we learned from PISA. International Journal of Science and Mathematics Education, 8, 409–428.*
[3] *Lyons, T. (2004). Choosing physical science courses: The importance of cultural and social capital in the enrolment decisions of high achieving students. Paper presented at IOSTE XI Symposium: Science and Technology Education for a Diverse World: Dilemmas, Needs and Partnerships, Lublin, Poland.*
[4] *Brown, B. A., Brown, C. A., & Jayakumar, U. M. (2009). When culture's class: Transposing a college going culture in an urban school. In W. R. Allen, E. Kimura-Walsh, & K. A. Griffin (Eds.), Towards a brigher tomorrow: College barriers, hopes and plans of Black, Latino/a, and Asian American students in California. New York: Information Age Publishers.*