THE SCHOOL DISTRICT OF PHILADELPHIA

CURRICULUM AND INSTRUCTION

STEAM

Science

Technology

Engineering

arts

Mathematics

Partner Alignment Guide

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Overview & Purpose

The purpose of this guide is to support partner organizations in aligning their programs with the School District of Philadelphia's (SDP) vision for STEAM (Science, Technology, Engineering, Arts, and Mathematics) education. This guide defines what STEAM means in our context, articulates the District's STEAM philosophy, and outlines how partner organizations are vital to realizing this vision.

In the 2024–25 Student Programming Needs Assessment, 139 schools identified STEAM programming as a need or priority need. This widespread interest reflects a shared understanding across our school communities of the power of STEAM to spark curiosity, build critical skills, and expand pathways for student success.

STEAM in SDP is not simply a collection of subjects but an **interdisciplinary, collaborative approach** that spans classroom instruction, after-school programs, external partnerships, community engagement, classroom design, and school-wide planning. Our vision for STEAM is **grounded in equity and access, ensuring all students can explore, engage, and excel in STEAM learning experiences**.

We know that this vision cannot be achieved without the passion, creativity, and expertise of our partner organizations. You bring STEAM to life in countless ways. **This guide is both a roadmap and a recognition**: a resource to support alignment, and a reflection of our deep appreciation for the incredible work you do to enrich and expand STEAM learning across our city.

SDP STEAM Team

The STEAM team operates under the District's Office of Curriculum and Instruction, which includes several content area suboffices. You can find more information about the Office of Curriculum and Instruction here.

The function of the STEAM team is to support the curriculum and instruction needs of schools in order to deliver high quality STEAM learning experiences for all students. To satisfy this function, the team develops curriculum, provides professional development, collaborates with external partners, and works across interdisciplinary offices.

Key Staff

Chief of Office of Curriculum and Instruction	Dr. Nyshawana Francis-Thompson
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Why STEAM Matters

How STEAM benefits students

As we live in a continually evolving science and technology-based society, the vision of the School District of Philadelphia – to prepare students to imagine and realize any future they desire – requires more than just core subject knowledge. It also requires students to develop creativity, the ability to think computationally, a fluency with data, an awareness of social and cultural perspectives, the capability to transfer knowledge and skills across disciplines, the power to understand and express their identities, and skills in problem-solving, communication, and collaboration. These characteristics equip students to participate and lead in social, political, and economic landscapes and empower them to tackle challenges facing their communities and the global society. In brief, our city's future citizens, consumers, workers, and parents must be literate in STEAM.

Nationally

- **Young Students:**
  - Based on research, arts integration in the K-5 grades has proven **benefits for student performance** in several content areas and skills, including engineering, literacy and reading, numeracy and math, writing, vocabulary development, as well as the arts (dance, music, theatre and visual arts).[1]
  - Young students learn best through **play, experience and active engagement** with materials and their classmates, encouraged and facilitated by educators. Several studies examined the impacts of hands-on, play-based and authentic engagement with STEAM subjects and found positive impacts for students.[2]
- **In the workforce:**[3]
  - STEM workforce accounted for **24%** of all U.S. workers in 2021.

[1] https://www.ecs.org/wp-content/uploads/Research-and-Policy-Implications-of-STEAM-Education-for-Young-Students.pdf
[2] https://www.includesnetwork.org/wp-content/uploads/2024/08/Wealth-Equity-and-STEM_Final.pdf
[3] https://ncses.nsf.gov/pubs/nsb20245

- In 2021, **18%** of women worked in STEM compared to **30%** of men.
- Men outnumbered women 2.75 to 1.00 in science and engineering occupations
- In 2021, the percentage of Black or African American workers in STEM occupations (**8%**) was lower than their percentage of the total workforce (**11%**). The percentage of STEM workers that were Hispanic workers was **15%**, compared with **18%** of all workers.

- **STEM Degrees:**[4]
  - **18%** of students in low poverty schools earned a STEM degree within 6 years compared to **9%** of students in high poverty schools
  - **17%** of students from low minority schools earned a STEM degree within 6 years, compared with **10%** of students from high-minority schools

At SDP

The **Student Programming Needs Assessment** (SPNA) is a survey designed and administered annually by the Offices of Strategic Partnerships (OSP) and Research and Evaluation (ORE). The purpose of the survey is to learn about the school needs for additional resources/partnerships in the coming school year.

217 District schools responded to the **2024-25 survey:**

88

schools indicated STEAM programming was a **need**

49

schools indicated STEAM programming was a **priority need**

34

indicated that a **STEAM makerspace** (see Defining Terms and Frameworks #2 Collaborative Space) was a **top corporate sponsorship need** for their school

All partner programs operating in School District of Philadelphia ("the District") schools must have a fully-executed legal agreement in place with the District covering their work in schools. Recurring, school-based partner programs can efficiently satisfy that requirement by completing the **School Partner Agreement (SPA)** process. On SY24/25 School Partner Agreements, **30 organizations named STEAM as a main focus area or supporting focus area**.

[4] https://www.includesnetwork.org/wp-content/uploads/2024/08/Wealth-Equity-and-STEM_Final.pdf

STEAM Classes

In K-8 grades, there are approximately **36 schools with STEAM or similar courses**. While schools may locally refer to these classes as STEAM, STEM, or Makerspace Class, they are often formally rostered as Science Enrichment or Digital Literacy depending on the certification of the teacher, Science or BCIT, respectively. The only formally rostered STEAM class in the District is Engineering, Design and Development which is currently present in 12 schools. The Engineering, Design and Development class must be taught by a teacher certified in Technology.

In high school, there are many courses that may fall under the STEAM umbrella, including math and science college preparatory classes (e.g., Physics, Calculus, Environmental Science, Statistics, etc.), math and science electives (e.g., Forensics, Discrete Math, Anatomy & Physiology, Genetics, etc.), and CTE classes (e.g., Architectural Drafting and Design, Digital Media Production, Aviation and Aerospace, etc.).

Engineering and Computer Science courses include the following:

- Engineering - 7 schools; Engineering Technology (CTE) - 4 schools
- Robotics - 7 schools
- AP CS A - 5 schools; AP CS Principles - 14 schools
- CS - 21 schools
- PLTW Civil Engr and Archt, PLTW Digital Electronics, and PLTW Intro to Engr Design - 1 school

Makerspaces

As of the start of the 2024-25 school year, it is estimated that there were at least 20 makerspaces in K-8 District schools in addition to engineering and technology spaces at many high schools. These spaces have been developed in primarily 3 processes.

- First, makerspaces have been included in most new construction or renovation projects through the Capital Programs office. Forrest, Pollock, Peirce, and Propel are recent examples of this process.
- Second, grants through the Maurice Romy Foundation, Excelon, and Heart of America have created makerspaces at schools such as John Barry, Cook-Wissahickon, and Moffet.
- The third process is one of school-driven efforts. Two examples of this are at Vaux High School and Greenfield.

Defining Terms and Frameworks

Relevant Policies

District's STEAM Definition

STEAM is an interdisciplinary approach to science, technology, engineering, art, and math education grounded in the development of identity, intellect, criticality, skills, and joy. STEAM is often associated with career preparation for the fields included in the acronym STEM (science, technology, engineering, and math). However, it is also a means of enhancing students' capabilities to engage powerfully in a technologically advanced society as active and informed citizens. The District uses the term STEAM instead of STEM to emphasize the importance of creativity, identity, and expression in problem solving. The term is also used to point to the value of using science, technology, engineering, and mathematics in the Arts. The goal of STEAM is the development of literacy in individual STEAM disciplines as well as in specific transdisciplinary competencies necessary to prepare students to imagine and realize any future they desire.

Common terms associated with STEAM

The STEAM and STEM landscape can be a confusing myriad of disciplines, courses, activities, and programs. Virginia Heffernan of Wired Magazine aptly referred to STEM as "pedagogical vapor."[5] STEAM is itself an acronym for virtually all disciplines that we teach in school, so the term can be applied to a wide range of activities. When the District talks about STEAM, **we focus on its interdisciplinary nature and the development of transdisciplinary competencies**. Therefore, while science and math are certainly included under the STEAM umbrella, math and science classes and programs are typically focused on their specific disciplines and are therefore not STEAM programs. However, engineering classes and programs, for example, are inherently interdisciplinary and are therefore typically included as STEAM programs.

- **Makerspace:** Makerspaces are typically spaces (not classes) where STEAM instruction and activities can occur. A makerspace can be defined as a place or community "where students can gather to create, invent, tinker, explore and discover using a variety of tools and materials."[6] Makerspaces "often combine both technical

[5] https://www.wired.com/story/how-we-learned-to-love-pedagogical-vapor-stem/
[6] Rendina, D. (2015, April 2). Defining makerspaces: What the research says. Renovated Learning. http://www.renovatedlearning.com/2015/04/02/defining-makerspaces- part-1

and artisanal approaches, fostering a sense of agency, engagement, ingenuity and problem-solving."[7] The pedagogical roots of makerspaces can be traced back to the theories of Jean Piaget and Seymour Papert. Makerspaces provide an informal, learner-centered environment that allows for activities such as discovery, dreaming, design, development, sharing, testing, and redesign that aren't a part of traditional formal schooling and learning.

- **Science:** In the School District of Philadelphia, science curriculum and instruction are operated through the Science Department of the Office of Curriculum and Instruction. The Pennsylvania Science, Technology, Engineering, Environmental Literacy and Sustainability (STEELS) standards govern what students should know and be able to do. The District utilizes the following high-quality instructional resources in the science curriculum:
    - K-8: Amplify
    - HS: BSCS Biology, SAVVAS Experience Chemistry, SAVVAS Experience Physics

- **Engineering:** Engineering is a discipline with distinct principles and practices that differ from science. Whereas science searches for truth through reason, engineering is primarily a strategy for problem solving that involves "causing the best change in a poorly understood or uncertain situation within the available resources."[8] In the District, engineering is taught in Career and Technical Education classes, in STEELS-aligned science courses, in middle school Engineering, Design, and Development courses, and in elective high school courses.

- **Computational Thinking:** Often confused with computer science, computational thinking includes the skills and knowledge required for people to solve complex problems using the capabilities offered by computers, or, more generally, automation. It may involve coding, but it also includes skills such as using abstraction and algebra to generalize solutions. Computational Thinking includes the ability to decompose complex problems into manageable chunks; use repeated sequences of steps, or algorithms, to solve problems; use abstraction to translate solutions to similar situations; and use a computer to automate the solution process.[9]

[7] Kim, Y. E., Edouard, K., Alderfer, K., & Smith, B. K. (2019). Making culture: A national study of education makerspaces. Drexel University. https://drexel.edu/~/media/Files/ excite/making-culture-full-report.ashx
[8] Koen, B. V. (1985). Definition of the engineering method. American Society for Engineering Education.
[9] Yadav, A., Hong, H., & Stephenson, C. (2016). Computational Thinking for All: Pedagogical Approaches to Embedding 21st Century Problem Solving in K-12 Classrooms. *TechTrends*, *60*(6), 565–568.

SDP STEAM Frameworks Used

The primary goal of SDP STEAM is aligned with the District's mission: **Developing STEAM literacy in order to prepare students to imagine and realize any future they desire**. The School District of Philadelphia defines STEAM Literacy using Ghouldy Muhammed's (2020) Historically Responsive Literacy Framework[10] including the following five dimensions: identity, criticality, skills, intellect, and joy.

IDENTITY



An awareness of society, culture, and personal identity including envisioning themselves in STEAM roles

CRITICALITY



An understanding of and ability to investigate power, inequality, equity, and oppression

SKILLS



Proficiency in 21st Century Skills such as collaboration, computational thinking, critical thinking, and creativity

INTELLECT



Meeting content standards in science, math, ELA, Art, computer science, and technology

JOY



Finding joy in creating, designing, expressing, investigating, collaborating, and tackling local and global problems

[10] Muhammad, Gholdy, (2020), Cultivating Genius: An Equity Framework for Culturally and Historically Responsive Literacy, Scholastic.

What does STEAM look like at SDP?

STEAM takes many different forms in the SDP. Currently, decisions about the offering of STEAM are made solely by schools. There are four different models for how schools in the SDP offer STEAM to students.

1. Curriculum Infusion

This model focuses on curriculum development and implementation on two levels: District-led and teacher-led. For the District-led level, the District integrates STEAM learning throughout content areas in collaboration with external partners and teachers in math, science, ELA, social studies, art, and world language. The intention for this model is to enhance learning activities already in place with STEAM activities rather than create additional activities outside the scope of a core instruction class. For the teacher-led level, the District supports teachers in the development of their own STEAM units that enhance other learning activities. This work requires building the capacity for teachers to develop STEAM units and then supporting their implementation.

2. Collaborative Spaces

According to Diana Rendina of Renovated Learning, a makerspace can be defined as "a place where students can gather to create, invent, tinker, explore and discover using a variety of tools and materials" (Rendina, 2015). The work to support makerspaces involves school-based STEAM staff collaborating with central office staff that develop spaces (e.g., Educational Technology, Capital Programs, Classroom Modernization, and Green Futures) to facilitate the design, preparation, and implementation of new learning spaces including professional development for school leaders and teachers. There are currently approximately 25 makerspaces in the District. The District recommends that schools wishing to create such a space, regardless of whether it is called a makerspace, innovation space, STEAM lab, fabrication lab, etc., do so to serve the entire school community. Classes can rotate into the space periodically to use tools and materials in order to complete projects related to their coursework. Therefore, this model requires the training of *all* staff to utilize the space. Due to the complexity of scheduling and maintenance, it is also beneficial to have a staff person, perhaps a school aide or an SBTL, who can facilitate use of the space.

3. Separate Class

There are currently approximately 36+ K-8 schools with an informally defined STEAM class. These classes are not formally indicated as a STEAM class because there is no certification for STEM/STEAM teachers in Pennsylvania. Classes are formally rostered as Science Enrichment, Digital Literacy, or other classes but are called STEM, STEAM, or Makerspace by

the school. This model focuses on teacher-created curricula for such classrooms because there is no District STEAM curriculum. As such alternate learning classes are organically created in the District, instructional support is needed by host schools. This work involves STEAM staff collaborating with school-based leaders, teachers, and SBTLs to co-create curriculum or identify external curriculum and to build teacher capacity to lead that creation.

4. **Partnerships and Out of School Time (OST)**

Much of the STEAM-related work currently in the District occurs outside the normal school day. This model focuses on growing those OST programs and partnerships so that every student has access to high quality programs. This work involves staff in central administration working with the Office of Strategic Partnerships and local partners to grow programs, facilitate implementation, and evaluate program quality. These programs include but are not limited to internships, career explorations, dual degree programs, summer programs, and after school programs.

Frequently Asked Questions

1. **Does every school have a STEAM teacher? How can I plug in my programming?**

   Many K-8 schools have a teacher designated as a STEAM teacher but most high schools do not. If the school does have a designated teacher, it is most beneficial to connect with this teacher to offer school-day programming. If the school does not have such a teacher, it is best to reach out to the Principal or School-Based Teacher Leader. The District offers high quality curriculum for math, ELA, and science and schools are expected to implement this curriculum. Therefore, only programming that supports this implementation should be offered to these teachers.

2. **How might students have experienced STEAM in the classroom?**

   View the **What does STEAM Look Like at SDP** section of this guide to learn more about how students might have experienced STEAM at their school.

3. **Are there specific schools, grades, or student populations SDP is prioritizing for STEAM programming?**

   The District is currently focused on growing STEAM programs in the middle grades. Additionally, we use SPNA data to identify specific schools that have indicated STEAM programming as a need or priority need.

4. **What does SDP consider to be meaningful outcomes for STEAM enrichment programming?**

   The Framework provided above defines STEAM literacy as having five dimensions: identity, criticality, skills, intellect, and joy. The District defines meaningful outcomes as supporting these five dimensions. Please see the STEAM Guide for additional information.

5. **Is STEAM instruction assessed in any way at the District? Are there outcomes that partners should align their programming to?**

   While STEAM itself is not assessed, STEAM is an acronym that includes subject areas which are assessed and have their own learning outcomes. Pennsylvania's science standards are called Science, Technology, Engineering, Environmental Literacy and Sustainability (STEELS) standards and the state uses Common Core Math and ELA standards. The District also uses National Core Arts Standards. Additionally, the District's STEAM Guide outlines a number of STEAM Core Competencies critical to STEAM literacy. Together, these standards and competencies are the primary outcomes to which partners should align their programming.

Additional Resources

Resource	Description
SDP STEAM Guide	The purpose of this guide is to define STEAM and provide a vision for STEAM education in the School District of Philadelphia including the pedagogical methods for teachers, the support provided to teachers, and the conditions of the learning environment necessary for schools and the District to support implementation of STEAM classes, programs, and activities. The guidance provided in this document focuses on STEAM as an interdisciplinary, collaborative approach to education that involves all staff at a school.
Makerspace Item List	This document provides ideas for materials to purchase for makerspaces and STEAM programs. It is not intended as a recommendation from the District of any thoroughly vetted product. Many items included here were recommended by teachers in the District.
STEM Education Framework	The Global STEM Alliance (GSA) STEM Education Framework aims to identify best practices in science, technology, engineering, and mathematics (STEM) education. It reflects

	current education research and draws on innovative and effective practices employed around the world.
Building a Better STEM Curriculum	Trey Smith from Marian Anderson Neighborhood Academy provides an argument that Districts should move away from plug and play curricular packages and towards comprehensive curriculum developed in collaboration with schools. He argues that schools, districts, and states should be systematically building better STEM curricula using the expertise of educators with the input of community stakeholders.
Inclusive Makerspaces, Fab Labs, and STEM Labs	How can instructors make appropriate accommodations and modifications while maintaining a safer teaching and learning environment for ALL students and themselves?