

# Project/Problem-Based Learning (PBL) STEM Connections

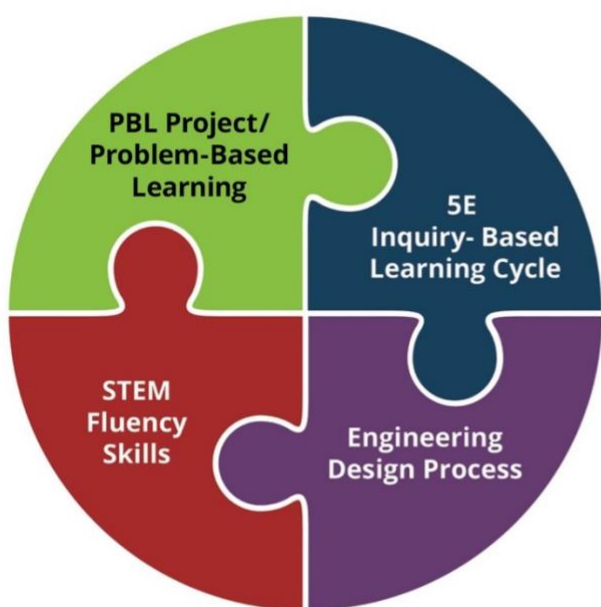
**Project/problem-based learning (PBL)** is an instructional method in which students are engaged in active learning and inquiry through authentic, real-world problems and personally meaningful projects. PBL involves sustained or ongoing inquiry into challenging questions or problems students learn content and can apply the content through their solutions and conclusions. PBL requires critical thinking, problem solving, collaboration, multiple perspectives, and various methods of communication. As students work to answer driving questions, they move beyond remembering information and use higher-order thinking skills to solve problems and work together in teams.

In **project-based learning**, students develop a plan and create a product, process, or proof of concept by completing authentic tasks that solve real-world problems. In **problem-based learning**, students develop a solution to a problem that lacks a well defined answer through scenarios and case studies.

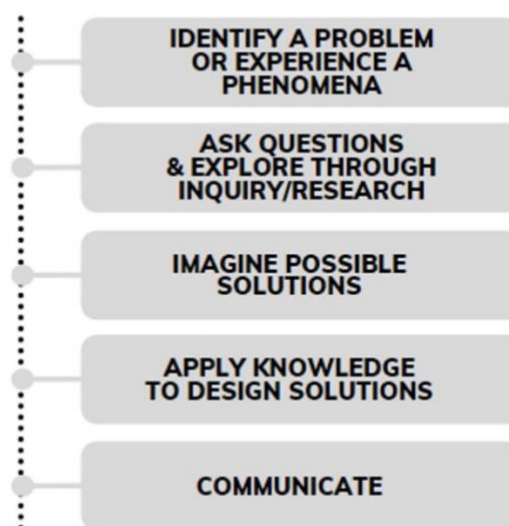
There are several research-based PBL frameworks, but all are comprised of similar components.

- The learning process is framed by a challenging problem, question, or phenomena
- Students are engaged in an extended process of inquiry
- Projects/problems are based on authentic, real-world contexts
- The learning is student-centered
- Students and teachers engage in reflective practices
- Students improve their process based on critique and feedback
- Projects/solutions are shared publicly
- STEM fluency skills – students use communication, collaboration, creativity, critical thinking, resilience, adaptability, time management, innovation, and promptness when finding solutions to a question or problem

When these design elements are in place, the learning experience is heightened and provides a meaningful context for the application of content and skills.



## STEM Instructional Components



When STEM is embedded into PBL, students implement a process to solve a problem.

Typically, the thinking process is the engineering design process, but computational thinking may also be involved, depending on the problem. For example, learners may be engaged in sustained inquiry about a STEM-related problem, issue, or challenge.

Students may participate in active learning through research or investigation to gain insight or more information. Learners may then apply this knowledge in a design challenge in which they are tasked with designing a solution to the problem. This design challenge uses the engineering design process to solve the problem. After designing their solutions, students craft an explanation and presentation to share with the class or another intended audience.

This experience is considered a STEM PBL because the engineering design process (EDP) is employed as the problem-solving process.

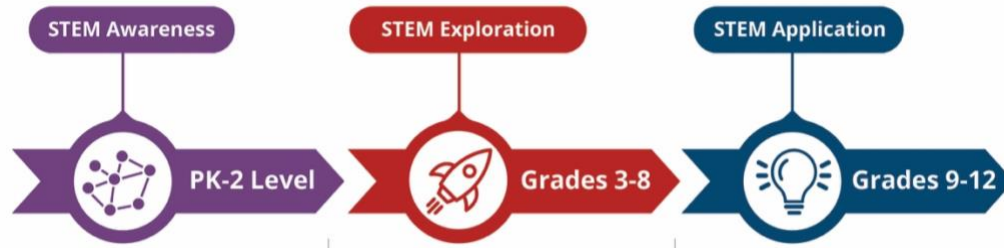
### **Additional Aspects of PBL**

Project/problem-based learning can be conducted within individual content areas and in a cross curricular manner to engage with interdisciplinary ideas and content. Situating the problem or project in local or global contexts allows for multiple content connection opportunities. In addition to connecting disciplinary content knowledge, inquiry and literacy skills (reading, writing, listening, and speaking) are embedded in the learning process.

Student mentoring is an essential component of PBL. Reaching out to local [Texas EcosySTEM](#) hubs consisting of community partners, non-profits, industry professionals, higher education faculty, or graduate students can provide PK-12 students meaningful feedback, encouragement, and socio-emotional support. Likewise, mentoring gives students an adult role model and a guide who works or studies in the field they are interested in or are exploring.

Through the PBL process, learners are introduced to a wide variety of careers. Students may also complete projects associated with specific jobs, engage with experts from different career paths, and solve real-world problems through the lens of a career they have been studying.

## STEM PBL Continuum



**At the PK-2 level, high-quality STEM PBL experiences may include:**

- Connections to the science recurring themes and concepts
- Integration of scientific and engineering practices
- Phenomenon-driven instruction
- Cross curricular connections
- Integration of literacy in STEM
- Creative design processes
- The introduction of STEM fluency skills
- Scaffolding for a wide range of learners

**In grades 3-8, high quality STEM PBL experiences may include:**

Any components of previous grade-levels and:

- Real-world problems
- Exploration and application of STEM disciplinary content
- Communication of solutions justified by evidence-based reasoning and/or cost-benefit analysis
- Exploration of STEM careers aligned with PBL experiences
- Further development of STEM fluency skills

**In grades 9-12, high-quality STEM PBL experiences may include:**

Any components of previous grade-levels and:

- Authentic real-world problems
- Authentic research experiences
- Complex application of STEM disciplinary content
- Communication throughout the experience with authentic stakeholders
- Integration of academic and technical skills within PBL experiences
- PBL experiences aligned to STEM careers
- Mastery of STEM fluency skill