Design and Modeling Course Competencies Framework

PLTW Competency Frameworks

PLTW Competency Frameworks are a representation of the knowledge, skills, and understandings that will empower students to thrive in an evolving world. The Competency Frameworks define the scope of learning and instruction within the PLTW curricula. The framework structure is organized by four levels of understanding that build upon another: Knowledge and Skills, Objectives, Domains, and Competencies. The most fundamental level of learning is defined by course Knowledge and Skills statements. Each Knowledge and Skills statement reflects specifically what students will know and be able to do after they've had the opportunity to learn the course content. Students apply Knowledge and Skills to achieve learning Objectives, which are skills that directly relate to the workplace or applied academic settings. Objectives are organized by higher-level Domains.

Domains are areas of *in-demand* expertise that an employer in a specific field may seek; they are key understandings and long-term takeaways that go beyond factual knowledge into broader, conceptual comprehension. At the highest level, Competencies are general characterizations of the *transportable* skills that benefit students in various professional and academic pursuits. As a whole, the Competency Frameworks illustrate the deep and relevant learning opportunities students experience from PLTW courses and evidence how the courses prepare students for life, not just the next grade level.

To thrive in an evolving world, students need skills that will benefit them regardless of the career path they choose. PLTW Competency Frameworks are organized to showcase alignment to in-demand, transportable skills. This alignment ensures that students learn skills that are increasingly important in the rapidly advancing, innovative workplace.

PLTW | Gateway

Framework Perspectives

The following table shows how the PLTW Competency Frameworks offer a unique view of student learning from three perspectives: classroom teacher, employer, and the learner. For the classroom teacher, the frameworks outline what students will be able to do as a result of their learning. Employers can use the frameworks to examine in-demand and transportable skills students acquire through PLTW. Most importantly, the student perspective reveals the relevancy of the curriculum to real-world challenges. Though education is often seen from different perspectives, the PLTW Competency Frameworks encompass all three perspectives to align students, teachers, and employers in a common vision.

Perspective	Competencies	Domains	Objectives	Knowledge and Skills
Classroom	Big ideas that encompass the core principles and processes that students need to be successful in post-secondary school and career. Students will develop life-long understandings related to the core concepts, principles, and processes of...	Key understandings and long-term takeaways that go beyond factual knowledge into broader and more conceptual comprehensions. Students will develop understandings about...	Articulation of what students need to be able to do. Students will use knowledge and skills to...	Knowledge and skills include the essential facts and basic concepts that a student should know and be able to recall in order to perform the competency. Students will know how and be able to...
Career and Industry	Transferable skills that will benefit students in various professional and academic pursuits.	Areas of expertise that an employer in a specific field may seek.	Functions that directly relate to the workplace or in an applied academic setting.	Foundational statements of performance in the workplace or in an applied academic setting.
Student	"I will be able to make real contributions throughout my life because I understand..."	"I will be able to address real-world challenges because I understand..."	"I will be able to use my knowledge and skills to..."	"After I learn the information, I will know how and be able to ..."

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Competencies	Domains	Objectives	Knowledge and Skills
C1: Problem Solving and Process Thinking Problem solving, inquiry, and process thinking are mindsets that help teams define problems, pursue viable and ethical solutions, and/or optimize systems.	**D1.1: Mindset** Ethics, analytical thinking, creativity, persistence, iteration, and the positive role of failure are important mindsets and habits of action. They are developed over time in problem solving processes, inquiry, and computational thinking.	LO1.1A: Describe and/or analyze moments within a problem solving process where persistence, iteration, and the positive aspect of failure played an important role in gaining understanding about a problem or unexpected observation.	• KS1.1A1: Understand that problem solving and experimentation are cyclical, meaning steps are repeated as many times as needed. • KS1.1A2: Recognize that identifying complex problems, defining them clearly, and proposing solutions can be difficult and requires persistence and iteration. • KS1.1A3: Describe how failure can produce positive outcomes by improving understanding.
		LO1.1B: Demonstrate creativity and courage to take risks in proposing designs.	• KS1.1B1: Describe the importance of creativity and risk taking in all engineering, scientific, and computational processes. • KS1.1B2: Generate ideas or build upon other ideas to innovate. • KS1.1B3: Develop solutions employing non-traditional techniques; novel combinations of artifacts, tools, techniques; and exploration of personal curiosities throughout a creative process.
		LO1.1C: Analyze problems or artifacts when developing solutions.	• KS1.1C1: Demonstrate analytical thinking when evaluating a proposed solution, locating and correcting errors, explaining how something functions, gaining understanding through experimentation, and/or justifying the appropriateness of a solution, model, or artifact.
		LO1.1D: Simplify or optimize a system or process through computational thinking.	• KS1.1D1: Explain how computational thinking is a way of solving problems, designing systems, and understanding human behavior that draws on concepts fundamental to computer science.

Competencies	Domains	Objectives	Knowledge and Skills
			• KS1.1D2: Apply computational thinking skills, such as problem decomposition, abstraction, and the use of algorithms when creating solutions.
		LO1.1E: Recognize that models are used to make predictions and/or learn about a phenomenon, situation, or design.	• KS1.1E1: Identify various models that may be used, which include but are not limited to physical models (prototypes), mathematical models, simulations, schematics, code, and 3D and 2D representations. • KS1.1E2: Compare and contrast the various types of models used when designing a solution.
		LO1.1F: Identify ethical considerations that must be considered when creating solutions or opportunities.	• KS1.1F1: Recognize that ethical considerations include but are not limited to safety, impact on future generations (sustainability), and recognizing the work of others (intellectual property). • KS1.1F2: Explain how universal design considers the broadest possible spectrum of human ability in the design of products, environments and information systems.
	D1.2: Problem Solving Process and/or Design Process Many disciplines, including engineering, computer science, and biomedical science, use an iterative problem solving process or engineering design process.	LO1.2A: Apply an iterative process to solve a problem or create an opportunity that can be justified.	• KS1.2A1: Recall that the goal of any design process is to create solutions and opportunities for people and society, while justifying the cost and effort involved. • KS1.2A2: Identify a problem and justify the pursuit of a solution to the problem. • KS1.2A3: Recognize that all solution attempts should be realistic and based on identified design requirements, which include specifications, constraints, desired features, and testable parameters. • KS1.2A4: Define the problem or opportunity identified through research and stakeholder

Competencies	Domains	Objectives	Knowledge and Skills
			engagement prior to any solution attempt. This includes examining prior solution attempts. • KS1.2A5: Evaluate, define, and/or prioritize realistic design requirements including specifications, constraints, desired features, and testable parameters. • KS1.2A6: Create multiple solution options and evaluate those options with tools such as a decision matrix to justify a data-driven path forward. • KS1.2A7: Create and execute an iterative testing plan to provide evidence that a solution meets the design requirements.
		LO1.2B: Analyze and describe design functionality by observation of an artifact.	• KS1.2B1: Describe reverse engineering as a process that allows designers to gain understanding about the functionality of an artifact, component, assembly, or system. • KS1.2B2: Deconstruct an artifact to gain understanding about its functionality. • KS1.2B3: Recognize that designers must be unbiased in reflecting and presenting their design process. The process only has validity through stakeholder and peer review. • KS1.2B4: Evaluate the validity of a testing plan and conclusions drawn from a process. • KS1.2B5: Illustrate how the context in which an artifact is used determines the correctness, usability, functionality, and suitability of the artifact.
		LO1.2C: Solve a problem using analytical and critical thinking skills.	• KS1.2C1: Devise and execute a plan to solve a problem.

Competencies	Domains	Objectives	Knowledge and Skills
			• KS1.2C2: Explain the importance of collecting data from multiple sources for a problem. • Analyze data and evidence to craft a conclusion supported by evidence. • KS1.2C3: Explain how solutions for complex problems can require interdisciplinary collaboration to incorporate a wide range of perspectives and skills.
	D1.3: Computational Thinking Computational thinking is used to solve problems or create solutions based on an identified need or an opportunity. Common concepts of computational thinking include: the use of algorithms, abstraction, problem decomposition, and data analysis and processing. Computational thinking can support solving problems across many disciplines including math, science, humanities, engineering, and computer science.	LO1.3A: Apply computational thinking to solve problems.	• KS1.3A1: Recognize that computational thinking can be applied in all domains. • KS1.3A2: Demonstrate the ability to decompose a problem into smaller parts. • KS1.3A3: Apply logical reasoning by organizing the steps of an algorithm into the correct sequence. • KS1.3A4: Understand that different algorithms can be used to solve the same problem.
		LO1.3B: Organize, process, and analyze data to understand a real-world situation.	• KS1.3B1: Identify ways to collect and process data. • KS1.3B2: Compare methods of data representation. • KS1.3B3: Collect and process data to facilitate the creation of knowledge. • KS1.3B4: Interpret data to gain insight on a problem and draw conclusions. • KS1.3B5: Understand that computers enable rapid processing of information. • KS1.3B6: Recognize that people gain knowledge from digitally processed information.

Competencies	Domains	Objectives	Knowledge and Skills
C2: Technical Knowledge and Skills Every career field requires specific knowledge and skills.	**D2.1: Modeling** Designing and creating models are essential to the engineering design and problem solving processes. Models are used to represent an artifact or a system to better understand its attributes and/or behavior. Models can be physical, mathematical, computer-generated, and/or simulated.	LO2.1A: Apply a mathematical model to represent an authentic situation.	• KS2.1A1: Recognize that mathematical equations can be used to create models through tables, charts, and simulations.
		LO2.1B: Use computer models and simulations to study an authentic system.	• KS2.1B1: Evaluate what kind of problems can be solved using modeling and simulation. • KS2.1B2: Use models and simulations to better understand a system. • KS2.1B3: Interpret models and simulations to make predictions. • KS2.1B4: Identify parameters in a data model. • KS2.1B5: Observe and analyze the effect of the parameters on a data model. • KS2.1B6: Analyze the degree to which a computer model accurately represents the real world. • KS2.1B7: Recognize that models use a level of abstraction to represent a simplified version of a complex phenomenon.
		LO2.1C: Construct a computer-generated solid model.	• KS2.1C1: Develop solid models using two-dimensional geometric shapes and three-dimensional geometric primitives. • KS2.1C2: Construct new solid models using geometric primitives with additive and subtractive methods. • KS2.1C3: Apply geometric and dimensional constraints to solid model designs. • KS2.1C4: Generate section views in a three-dimensional model to communicate two-dimensional figures and internal dimensions.
		LO2.1D: Create a physical model or prototype.	• KS2.1D1: Construct a prototype based on design documentation.

Competencies	Domains	Objectives	Knowledge and Skills
			• KS2.1D2: Conduct prototype testing to identify design flaws or additional needs. • KS2.1D3: Analyze and interpret testing data collected and make modifications to optimize the design or process.
	D2.2: Measurement and Estimation A common measurement system is essential to design accuracy for sketches, models, and prototypes. Measuring and dimensioning objects using appropriate tools are critical to effectively communicate and collaborate on design solutions.	LO2.2A: Measure and present values appropriate to standards of accuracy and precision.	• KS2.2A1: Identify the proper tool to use to measure and dimension with accuracy and precision. • KS2.2A2: Identify the appropriate equation for area and volume problems. • KS2.2A3: Measure objects to create accurate design sketches.
	D2.3: Spatial Visualization Sketching allows designers to quickly communicate ideas with accurate dimensions and details. Using technology, two-dimensional sketches can be represented in a three-dimensional solid model. Solid models allow designers to view multiple aspects and perspectives of a design.	LO2.3A: Translate and interoperate between 2D and 3D design representations.	• KS2.3A1: Differentiate between two-dimensional and three-dimensional models including the strengths and limitations of each. • KS2.3A2: Interpret multiview drawings, specifications, dimensions, and annotations.
		LO2.3B: Sketch and/or interpret perspective, isometric, and multiview drawings with adequate attention to standards and critical annotations.	• KS2.3B1: Recognize perspective, thumbnail, isometric, and multiview sketches. • KS2.3B2: Recognize that isometric drawings of an object are used to provide information that a perspective drawing may not be able to show. • KS2.3B3: Summarize the reasoning for using sketching as a communication tool. • KS2.3B4: Apply dimensions on a multiview sketch following the guidelines of dimensioning.

Competencies	Domains	Objectives	Knowledge and Skills
			• KS2.3B5: Create a rapid, accurate sketch to communicate ideas.
	D2.4: Tools and Technology There are a variety of tools and technology used during the different stages of an engineering design or problem-solving process. They include, but are not limited to, measuring tools, drawing tools, software applications including computer-aided design (CAD), computer algebra system (CAS) applications, modeling and simulation, data representation, and online resources.	LO2.4A: Select and apply tools and technology appropriately to develop solutions, create artifacts, and/or conduct investigations into engineering, biomedical science, and computational problems/needs.	• KS2.4A1: Recognize the existence of various tools and technology that can be used when developing solutions or artifacts or conducting experiments. • KS2.4A2: Select the appropriate tools and technology based on the needs of the project and the team.

C3: Professional Practices and Communication Professional standards guide all interactions while attempting to solve a problem, gain understanding, optimizing a system, or creating an opportunity.	**D3.1: Collaboration** Effective problem solving, experimentation, and/or design are most often conducted within teams.	LO3.1A: Collaborate effectively on a diverse and multi-disciplinary team.	• KS3.1A1: Describe how diverse perspectives in collaboration typically produce the best results in a process. • KS3.1A2: Identify and value the contributions of each team member. • KS3.1A3: Illustrate successful collaboration through effective communication and constructive feedback. • KS3.1A4: Apply team norms to encourage productivity and define how a team will function and measure its success. • KS3.1A5: Identify and evaluate positive and negative behaviors that impact the team's effectiveness. • KS3.1A6: Recognize individual strengths when defining roles and responsibilities. • KS3.1A7: Recall that there are a wide range of collaboration tools available today that allow teams to share documents and collaborate remotely and in person.
	D3.2: Communication Communication can often be categorized as technical communication or professional communication.	LO3.2A: Communicate effectively for specific purposes and settings.	• KS3.2A1: Identify guidelines and standards that govern technical communication such as ANSI. • KS3.2A2: Distinguish technical communication artifacts that capture a process, including but not limited to engineering notebooks, laboratory journals, technical presentations, sketches, technical drawings, design briefs, design reviews, laboratory reports, and code. • KS3.2A3: Demonstrate best practices that are widely accepted by professionals when they communicate such as how to present visual media, oral presentations, and professional correspondence.

			• KS3.2A4: Communicate to meet the needs of the audience and be appropriate to the situation. • KS3.2A5: Demonstrate proper elements of written and electronic communication (spelling, grammar and formatting) at all times when communicating with a team or stakeholder in a process. • KS3.2A6: Use accurate terminology when communicating about systems and processes.
		LO3.2B: Document a process according to professional standards.	• KS3.2B1: Present data and information through a variety of accepted means such as: graphs, charts, images, video, schematics, code, 3D models, and simulations.
		LO3.2C: Construct and communicate informed decisions supported by evidence.	• KS3.2C1: Recognize that the validity of sources will provide credibility to one's arguments. • KS3.2C2: Use current and accurate research and testing documentation. • KS3.2C3: Identify the differences between subjective and objective information.
		LO3.2D: Present data according to scientific and industry standards.	• KS3.2D1: Apply guidelines for preparing an effective data collection and analysis plan including defining objectives, defining audience, selecting suitable data, selecting appropriate methods and tools, and interpreting results. • KS3.2D2: Apply guidelines for preparing effective data presentation including focusing on and prioritizing important variable and topics, using well formatted graphs and tables, explaining data sources used and any shortcomings related to data, explaining analytical methods and tools selected/used, ensuring references are accurate, and checking for errors.

	D3.3: Project Management The discipline of carefully projecting or planning, organizing, motivating and controlling resources to achieve specific goals and meet specific success criteria.	LO3.3A: Demonstrate the ability to manage multiple resources throughout a project.	• KS3.3A1: Identify resources managed in a project to include time, capital, energy, information, materials, people, tools, and machines. • KS3.3A2: Create and execute a plan to manage and use resources.
		LO3.3B: Justify decisions and provide rationales when making tradeoffs between resources.	• KS3.3B1: Recognize that processes involve tradeoffs when weighing the need against effort and resources available. • KS3.3B2: Demonstrate sound judgement when making decisions regarding resources and their potential tradeoffs.
	D3.4: Career Awareness It is important to prepare a flexible education plan that matches your interests, knowing that you can change or modify that plan as you discover more about career opportunities.	LO3.4A: Identify the variety of careers related to engineering, biomedical sciences, and computer science.	• KS3.4A1: Recognize the education and credentialing requirements for careers in engineering, biomedical science and computer science. • KS3.4A2: Explore a variety of careers related to engineering, biomedical sciences, and computer science.
		LO3.4B: Describe the role, connections between disciplines, and impact of engineering, biomedical science, and computer science on society.	• KS3.4B1: Demonstrate personal responsibility and initiative for independent learning, keeping in mind that technology and processes will always evolve. • KS3.4B2: Recognize that engineering, biomedical science, and computer science fields impact various career paths, industries, and our society. • KS3.4B3: Describe the impact of engineering, biomedical science, and computer science on invention and innovation.

STEM (PROJECT LEAD THE WAY)

BWMS

- Craig King: (Design and Modeling; Robotics)
- Carolyn Yurick (Medical Detectives)
- Arthur Anderson (Design and Modeling; Apps Creator)

EMHS

- Eric Shotts: (Design and Modeling; App Creation; Medical Detectives; Robotics)
- Barb Vanatta: (App Creation; Robotics)

SAMHS

- Jordan Baughman: (App Creators)
- Traci Vile: (Medical Detectives)

YEMS

- Clay Hayes: (Design and Modeling)
- Jenny Watt: (App Creators)
- John Victor: (Design and Modeling)

STEM (PROJECT LEAD THE WAY) PROFESSIONAL DEVELOPMENT DATES

App Creators

TRAINING SITE	START DATE	END DATE	TUITION COST
Bucknell University Barb Vanatta – EMHS Jenny Watt- YEMS Arthur Anderson – BWMS Jordan Baughman - SAMHS	7/30/2018	8/3/2018	$1,200.00
Rochester Institute of Technology **SYRACUSE UNIVERSITY** Eric Shotts - EMHS	8/13/2018	8/17/2018	$1,115.00

- Please Note: These are the two locations that are closest to the Warren County School District.

Design and Modeling

TRAINING SITE	START DATE	END DATE	TUITION COST
West Virginia University Eric Shotts – EMHS Craig King – BWMS Clay Hayes - YEMS	6/11/2018	6/15/2018	$1,200.00
Rochester Institute of Technology John Victor - YEMS	7/9/2018	7/13/2018	$1,115.00
Bucknell University Arthur Anderson - BWMS	7/23/2018	7/27/2018	$1,200.00

- Please Note: These are the three locations that are closest to the Warren County School District.

Medical Detectives

TRAINING SITE	START DATE	END DATE	TUITION COST
Sinclair Community College (Dayton, OH)	7/9/2018	7/13/2018	$1,250.00
NHTI Concord Community College Traci Vile – SAMHS Carolyn Yurick - BWMS	8/6/2018	8/10/2018	$1,200.00
Eastern Michigan University	8/13/2018	8/17/2018	$1,250.00

- Please Note: These are the three locations that are closest to the Warren County School District.

WCSD GOAL FOR 2018-2019

6TH GRADE: DESIGN AND MODELING

7TH GRADE: APPS CREATORS

8TH GRADE: MEDICAL DETECTIVES

If each middle school cannot get teacher(s) trained in all three of these focused STEM areas, that middle school building will only offer the course(s) in which the teacher received professional development.

STEM PROGRAM DISTRICT COORDINATOR FOR PLTW

This role is responsible for overall account, site, and classroom management and serves as the primary point of contact for the accounts. This role is authorized to add/remove sites and programs, select Site Coordinators and teachers, manage users, and complete annual renewal forms and participation surveys. Each account is allowed to have two program coordinators at the district level and two site coordinators per site. You are able to have unlimited number of teacher or general user roles at each site. This can all be managed via your MyPLTW account under the "My Sites" tab on the top left.

You will have access to the student version of units you are participating in, the store to order equipment and pay invoices, professional development tab where there are training resources to get a better idea of what your teachers will be doing, and the community section of online groups. There is also a Help tab and a "see all" under announcements that is a useful way to keep track of any program updates! I would also check out Lynda.com within the Professional Development tab, it is located at the top next to Catalog.

Back to School FAQ

Thanks!

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