PLTW Curriculum Framework – Design and Modeling
Lesson 1 Introduction to Design

Meaning
***Essential Questions**: Students will keep considering…* • EQ1.1 How is a design process used to effectively develop a design solution that solves a problem or addresses a design opportunity? • EQ1.2 Why is communication of design ideas with teams and with stakeholders important throughout the design process? • EQ1.3 How are sketches used to document and communicate design ideas with accuracy? • EQ1.4 What role do team norms play in making a collaborative team more successful? • EQ1.5 Why are accurate measurement, precise dimensioning, and thorough documenting necessary for both mechanical dissection and creative problem solving?

Meaning	*Acquisition*	
Domains/Understandings *Domains are key understandings and long-term takeaways that go beyond factual knowledge into broader and more conceptual comprehensions.* *Domains are areas of expertise that an employer in a specific field may seek.* ***"I will be able to address real-world challenges because I understand…"***	***Transfers/Learning Objectives*** *Objectives articulate what skills students need to be able to do. (The learning objectives will become targets of assessment.)* *Objectives are functions that directly relate to the workplace or in an applied academic setting.* ***"In the workplace or academic setting, I will need to know and be able to…"***	***Knowledge and Skills*** *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.* *Knowledge and skill statements are foundational to the performance of a skill.* ***"After I learn the information, I will be able to use my knowledge and skills to…"***
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.

Format guided by: Wiggins, G., & McTighe, J. (2011). *The understanding by design guide to creating high quality units*. Alexandria, VA: ASCD

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. KS1.2A3: Recognize that all solution attempts should be realistic and based on identified design requirements, which include specifications, constraints, desired features, and testable parameters. KS1.2A6: Create multiple solution options and evaluate those options with tools such as a decision matrix to justify a data-driven path forward.
	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. KS1.2B5: Illustrate how the context in which an artifact is used determines the correctness, usability, functionality, and suitability of the artifact.
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.	LO2.1D: Create a physical model or prototype.	KS2.1D1: Construct a prototype based on design documentation. 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	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.

Format guided by: Wiggins, G., & McTighe, J. (2011). *The understanding by design guide to creating high quality units*. Alexandria, VA: ASCD

tools are critical to effectively communicate and collaborate on design solutions.		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. KS2.3B5: Create a rapid, accurate sketch to communicate ideas.
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.	KS3.1A2: 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.

Format guided by: Wiggins, G., & McTighe, J. (2011). *The understanding by design guide to creating high quality units*. Alexandria, VA: ASCD

D3.2: Communication Communication can often be categorized as technical communication or professional communication.	LO3.2A: Communicate effectively for specific purposes and settings.	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.
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.	LO3.4B: Describe the role, connections between disciplines, and impact of engineering, biomedical science, and computer science on society.	KS3.2B1: Present data and information through a variety of accepted means such as: graphs, charts, images, video, schematics, code, 3D models, and simulations. KS3.4B2: Recognize that engineering, biomedical science, and computer science fields impact various career paths, industries, and our society.

Format guided by: Wiggins, G., & McTighe, J. (2011). *The understanding by design guide to creating high quality units*. Alexandria, VA: ASCD