PLTW PRINCIPLES OF ENGINEERING (PoE)	
CURRICULUM/CONTENT AREA	COURSE LENGTH
Applied & Technical Education (ATE)	*2 terms*
GRADE LEVEL	DATE LAST REVIEWED
9-12	*2023*
PREREQUISITE(s) *if applicable*	BOARD APPROVAL DATE
PLTW Intro to Engineering recommended	*9/10/2024*
PRIMARY RESOURCE *if applicable*	
Project Lead the Way resources	

DESIRED RESULTS

COURSE DESCRIPTION AND PURPOSE

What type of engineer or engineering technologist would you like to be?
Through problems that engage and challenge, students explore a broad range of engineering topics, including mechanisms, the strength of materials and structures, automation, and motion. Students develop skills in problem solving, research, and design while learning strategies for design process documentation, collaboration, and presentation.
Students have the opportunity to develop skills and understanding of course concepts through activity-, project-, and problem-based (APB) learning. By solving rigorous and relevant design problems using engineering and science concepts within a collaborative learning environment, APB learning challenges students to continually hone their interpersonal skills, creative abilities, and problem solving skills. Students will also learn how to document their work and communicate their solutions to their peers and members of the professional community.

ENDURING UNDERSTANDINGS *Students will understand that...*	ESSENTIAL QUESTIONS *Students will keep considering...*
Creativity, innovation, and critical thinking are essential for success in a technologically advanced world.	Why is creativity and innovation important? How is creativity and innovation used in [name of career pathway]?
	How do teams efficiently and effectively solve problems in an increasingly complex world?
	What strategies and processes can I use to become a more effective creator, thinker and problem solver?

The ability to communicate and collaborate with people with diverse backgrounds and perspectives is key to participation in a global economic society.	Why is communication and collaboration important? How do positive work behaviors and personal qualities impact communication and collaboration?
	What is effective teamwork? What strategies can I use/teams use to work better together? How can perspectives and experiences of a diverse group develop innovative solutions to a given problem?
Career and technical education provides pathways to high-demand, high-wage career opportunities, and personal fulfillment.	Why is career and life readiness important? What jobs and careers are available to meet individual and societal needs locally, regionally, and nationally?
	How might technical knowledge and skills influence one's employability and advancement opportunities within various work settings?
	What are employability skills? How do I prepare myself for a career that is in demand now and in 5, 10, or 20 years from now?

PRIORITY CAREER & TECHNICAL STANDARDS
Students will be skilled at...

Creativity, Critical Thinking, Communication and Collaboration
4C2: Students will formulate and defend judgments and decisions by employing critical thinking skills.
a: I develop effective resolutions for a given problem, decision or opportunity using available information.
b: I develop and implement a resolution for a new situation using personal knowledge and experience.

Career Development
CD4: Students will identify and apply employability skills.
a: I identify and demonstrate positive work behaviors and personal qualities needed to be employable.
b: I demonstrate skills related to seeking and applying for employment to find and obtain a desired job.
c: I identify and exhibit traits for retaining employment.
d: I develop positive relationships with others.

Information, Media, Technology
IMT1: Students will access, interpret and evaluate information from a variety of sources in order to inform and support premises, arguments, decisions, ideas and initiatives.
a: I choose appropriate sources of data and information for a given purpose.
b: I determine the relevance, validity and timeliness of data and information.
c: I select relevant information necessary for making decisions and solving problems
d: I apply data and information to communicate ideas and create new opportunities.

PRIORITY CONTENT STANDARDS *Students will know...*	
Standard: BB1: Students will analyze the core concepts of technology.	
Standard: ENG1: Students will analyze and demonstrate the attributes of design.	
Standard: ENG3: Students will demonstrate and analyze the role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.	
Standard: ICT1: Students will analyze, select and use information and communication technologies.	
Standard: MNF1: Students will be able to select and use manufacturing technologies.	
Potential INDUSTRY-RECOGNIZED CREDENTIALS (IRCs) Opportunties associated with the course	**Potential WORK BASED LEARNING (WBL) opportunities associated with the course**
Potential DUAL CREDIT Opportunties associated with the course	
Students can apply for credit at different universities pending a high enough score on the End Of Course Assessment (EOC).	

Unit 1 Energy and Power		
The goal of Unit 1 is to introduce students to mechanisms, energy sources, and alternative energy applications. Students will gain an understanding of mechanisms through the application of theory-based calculations accompanied by lab experimentation. They will also learn that as energy and power are transferred and transformed, losses to friction in the system will occur. Students will understand that such losses affect the overall efficiency of the system. They will have an opportunity to investigate thermal energy and alternative energy applications. Students will explore and gain experiences relating to solar hydrogen systems and thermal energy transfer through materials. The unit concludes with students working in teams to solve a design problem that focuses on energy and power. They will use the knowledge and understanding built through the previous learning events to create a solution to the problem. It is important for students to understand that an acceptable solution is one that fits the criteria and constraints of the design brief.		
STAGE 1: Desired Unit Results *What will students understand as a result of the unit?*		**STAGE 2: Assessment Evidence** *By what criteria will performances of understanding be assessed? Through what authentic performance tasks will students demonstrate the desired unit results?*
ESSENTIAL QUESTION (s) *What thought-provoking questions will foster inquiry, understanding, and transfer of learning?*		**Success Criteria with Standards** *The criteria for evaluating performance on standards is constant.*
How do teams efficiently and effectively solve problems in an increasingly complex world?		CTE standards-based Rubric: Throughout the course, students and teachers use the rubric for communication of success criteria, reflection, goal setting, and feedback.
What is effective teamwork? What strategies can I use/teams use to work better together? How can perspectives and experiences of a diverse group develop innovative solutions to a given problem?		
How might technical knowledge and skills influence one's employability and advancement opportunities within various work settings?		
PRIORITY CAREER & TECHNICAL STANDARDS & Learning Targets		**Performance Tasks Options/ Assessment Strategies by Standard** *Students may be given options to show their learning in varied ways.*
Creativity, Critical Thinking, Communication and Collaboration **4C2: Students will formulate and defend judgments and decisions by employing critical thinking skills.**		
a: I develop effective resolutions for a given problem, decision or opportunity using available information.	4C2.a.11.h: I can determine the information needed to address an identified problem.	*-Using the engineering notebook to document, reflect, and refine. -Quick Write Reflections 1. What strategies and processes did I use to become a more effective creator, thinker and problem solver? 2. Why is communication and collaboration important?3. How have positive work behaviors and personal qualities impacted communication and collaboration?*
	4C2.a.12.h: I can contrast the benefits and drawbacks of various proposed resolutions to a given situation.	
	4C2.a.13.h: I can predict how an action could result in unintended consequences, both positive and negative.	
	4C2.a.14.h: I can analyze the impact of a decision using a systems thinking model.	
	4C2.a.15.h: I can determine the best resolution for a problem, decision or opportunity based on given criteria.	
	C2.a.16.h: I can defend an action taken or a decision implemented.	
b: I develop and implement a resolution for a new situation using personal knowledge and experience.	4C2.b.5.h: I can apply past experience to develop a course of action for a new situation.	*Collaboratively build and test simple and compound designs to complete tasks.*
	4C2.b.6.h: I can use existing knowledge to develop a resolution for a new situation, problem or opportunity.	
Career Development **CD4: Students will identify and apply employability skills.**		
a: I identify and demonstrate positive work behaviors and personal qualities needed to be employable.	CD4.a.8.h: I can apply communication strategies when adapting to a culturally diverse environment.	*Collaboratively build and test simple and compound designs to complete tasks.*
	CD4.a.10.h: I can manage work roles and responsibilities to balance them with other life roles and responsibilities.	
c: I identify and exhibit traits for retaining employment.	CD4.c.4.h: I can model behaviors that demonstrate reliability and dependability.	*Collaboratively build and test simple and compound designs to complete tasks.*

	CD4.c.5.h: I can maintain appropriate dress and behavior for the job to contribute to a safe and effective workplace/jobsite.	
d: I develop positive relationships with others.	CD4.d.6.h: I can evaluate the best method to assist co-workers in accomplishing goals and tasks.	*Collaboratively build and test simple and compound designs to complete tasks.*
Information, Media, Technology **IMT1: Students will access, interpret and evaluate information from a variety of sources in order to inform and support premises, arguments, decisions, ideas and initiatives.**		
a: I choose appropriate sources of data and information for a given purpose.	IMT1.a.6.h: I can justify the selection of various information sources for a given purpose.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.a.7.h: I can explain the level of objectivity for a given source of information.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.a.8.h: I can model how raw data can be applied differently to support opposing arguments or premises.	*Document original design and design iterations in Engineering Notebook.*
b: I determine the relevance, validity and timeliness of data and information.	IMT1.b.7.h: I can use raw data and information appropriately to support an argument, idea or initiative.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.b.8.h: I can compare and contrast validity of information from electronic and non-electronic sources.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.b.9.h: I can defend a position or decision using relevant, valid and timely data and information.	*Document original design and design iterations in Engineering Notebook.*
c: I select relevant information necessary for making decisions and solving problems	IMT1.c.5.h: I can defend a solution or conclusion using appropriate data and information.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.c.6.h: I can interpret and select appropriate information to develop a resolution for a given situation.	*Document original design and design iterations in Engineering Notebook.*
d: I apply data and information to communicate ideas and create new opportunities.	IMT1.d.6.h: I can defend a proposal for a new product or service based on data and information analysis.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.d.7.h: I can synthesize data and information from multiple sources to identify new trends.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.d.8.h: I can manage and share stored data and information for a specific purpose.	*Document original design and design iterations in Engineering Notebook.*
PRIORITY CONTENT STANDARDS & Learning Targets		**Performance Tasks Options/ Assessment Strategies by Standard** *Students may be given options to show their learning in varied ways.*
Standard: ENG1: Students will analyze and demonstrate the attributes of design.	*enter learning targets associated with the standard, add more rows as needed.*	*Document original design and design iterations in Engineering Notebook.*
Standard: ENG3: Students will demonstrate and analyze the role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.	*enter learning targets associated with the standard, add more rows as needed.*	
SUPPORTING STANDARDS AND LEARNING TARGETS		**Performance Tasks Options/ Assessment Strategies by Standard** *Students may be given options to show their learning in varied ways.*
ENG1 .a.1.e: Design is a creative process.	Apply concurrent engineering practices to solve problems.	
ENG1 .a.2.e: Everyone can design solutions to a problem.	Work effectively in teams and apply the design process to develop acceptable solutions to problems and case studies.	

ENG1 .a.9.h: Examine how the design needs to continually be evaluated and the ideas of the design must be redefined and improved.	Apply appropriate design principles to create design solutions.
ENG2.a.2.e: Explore when designing an object, it is important to be creative and consider all ideas.	Develop and fabricate engineering systems in mechanical, thermodynamic, fluid, electrical, and control.
ENG2.b.3.m: Modeling, testing, evaluating and modifying are used to transform ideas into practical solutions.	Determine the proper mechanical/electrical system to use in a compound machine design.
ENG2.b.4.h: A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.	Analyze the overall system efficiency for a compound machine.
ENG3.a.3.e: Explain troubleshooting is a way of finding out why something does not work so that it can be improved.	
ENG4.a.3.m: Specify criteria and constraints for the design.	
ENG4.b.2.e: Build or construct an object using the design process.	
ENG4.b.3.m: Apply a design process to solve problems in and beyond the laboratory-classroom.	
ENG5.a.6.h: Diagnose a system that is malfunctioning and use tools, materials, or machines to repair it. ENG5.a.7.h: Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.	
ENG5.b.2.e: Use computers and technology to access and organize information.	
ENG5.b.5.m: Use computers, calculators and technology in various applications.	
ENG5.b.8.h: Troubleshoot, analyze and maintain systems to ensure proper function, accuracy and precision.	

Stage 3: Learning Activities

A brief summary of the key learning activities- How will students build knowledge & develop skills? How will learning be relevant, accessible, and engaging? How will the learning unforld in a natural flow?

GUIDING UNIT QUESTIONS *Using Costas Level of Thinking, what questions will hook and hold students so that they develop a deep understanding of the desired results? The guiding questions are more topic-specific to the particular unit. They guide the exploration of the essential questions and rigor of the standards. This may include questions that guide project based/ problem based learning*	STRATEGIES/ACTIVITIES *What learning strategies and experiences will authentically engage students so that they gain understanding the desired results? This includes strategies and activities that help learners acquire targeted knowledge and skills, make meaning of important ideas, and transfer their learning to new situations. Consider how the learning will be tailored and flexible to address the interests and learning styles of all students.*	RESOURCES/MATERIALS *This includes an applicable textbooks, software, industry recognized certification software/tools, subcriptions (such asPLTW), etc.*
Why is a design process, and the documentation of said process, so important to follow when creating a solution to a problem?	Simple machine build and test	VEX Robotics 5V Robot Brain Kits
How can an existing product be changed to incorporate different processes to make it less expensive and provide better performance?	compound machine build and test	Various tools and equipment for projects and activities
What emerging technologies are or may be on the horizon that will provide energy more efficiently?	Energy research presentation	equipment lists are included in PLTW POE course guide
Why would an engineer use theory-based vs. experiment-based data interpretation in the decision-making process?	Electrical circuits actvities	
Why are programmable logic devices used to control machines versus monitoring and adjusting processes manually?	Thermodynamic activities	
Why do teams use consensus to make decisions?	Hydrogen fuel Cell activity	
Why are engineers concerned about material properties?		
Why do engineers and designers use scientific principles when creating solutions.		

Why is it crucial for designers and engineers to utilize statistics throughout the design process?		

<table>
<tr><th colspan="3">Unit 2 Materials and Structures</th></tr>
<tr><td colspan="3">The goal of Unit 2 is for students to have a more concrete understanding of engineering through materials properties and statics. Students begin by learning about beam deflection and then forces on truss structures. They learn to identify forces acting on those structures and then gain the ability to calculate internal and external forces acting on those structures. The students learn about material properties, which lead students to the ability to properly select a material for a given task. Creating new products to meet a given need or want is not the only concern in this area of study. How to reuse/recycle materials for continued and unique uses is also learned. The primary way of studying materials properties in this unit is through destructive and non-destructive material testing on various materials. Tensile testing is the major destructive test. Students are engaged in how machines perform these tests and use either a classroom machine or a simulation to further their understanding of these processes. This unit concludes with a design problem whereby students, working in teams, follow the design process to solve a design problem.</td></tr>
<tr><th colspan="2">STAGE 1: Desired Unit Results
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c: I identify and exhibit traits for retaining employment.	CD4.c.4.h: I can model behaviors that demonstrate reliability and dependability.	*Collaboratively build and test simple and compound designs to complete tasks.*
	CD4.c.5.h: I can maintain appropriate dress and behavior for the job to contribute to a safe and effective workplace/jobsite.	
d: I develop positive relationships with others.	CD4.d.6.h: I can evaluate the best method to assist co-workers in accomplishing goals and tasks.	*Collaboratively build and test simple and compound designs to complete tasks.*
Information, Media, Technology **IMT1: Students will access, interpret and evaluate information from a variety of sources in order to inform and support premises, arguments, decisions, ideas and initiatives.**		
a: I choose appropriate sources of data and information for a given purpose.	IMT1.a.6.h: I can justify the selection of various information sources for a given purpose.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.a.7.h: I can explain the level of objectivity for a given source of information.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.a.8.h: I can model how raw data can be applied differently to support opposing arguments or premises.	*Document original design and design iterations in Engineering Notebook.*
b: I determine the relevance, validity and timeliness of data and information.	IMT1.b.7.h: I can use raw data and information appropriately to support an argument, idea or initiative.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.b.8.h: I can compare and contrast validity of information from electronic and non-electronic sources.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.b.9.h: I can defend a position or decision using relevant, valid and timely data and information.	*Document original design and design iterations in Engineering Notebook.*
c: I select relevant information necessary for making decisions and solving problems	IMT1.c.5.h: I can defend a solution or conclusion using appropriate data and information.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.c.6.h: I can interpret and select appropriate information to develop a resolution for a given situation.	*Document original design and design iterations in Engineering Notebook.*
d: I apply data and information to communicate ideas and create new opportunities.	IMT1.d.6.h: I can defend a proposal for a new product or service based on data and information analysis.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.d.7.h: I can synthesize data and information from multiple sources to identify new trends.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.d.8.h: I can manage and share stored data and information for a specific purpose.	*Document original design and design iterations in Engineering Notebook.*
PRIORITY CONTENT STANDARDS & Learning Targets		Performance Tasks Options/ Assessment Strategies by Standard *Students may be given options to show their learning in varied ways.*
Standard: ENG1: Students will analyze and demonstrate the attributes of design.	*ENG1.a.9.h: I can examine how the design needs to continually be evaluated and the ideas of the design must be redefined and improved.*	*Document original design and design iterations in Engineering Notebook.*
Standard: ENG3: Students will demonstrate and analyze the role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.	*ENG3.b.2.e: Describe that the process of experimentation, which is common in science, can also be used to solve technological problems.*	
SUPPORTING STANDARDS AND LEARNING TARGETS		Performance Tasks Options/ Assessment Strategies by Standard *Students may be given options to show their learning in varied ways.*

ENG2.b.2.e: Discuss how models are used to communicate and test design ideas and processes.	*Apply concurrent engineering practices to solve problems.*	
ENG2.b.3.m: Modeling, testing, evaluating and modifying are used to transform ideas into practical solutions.	*Work effectively in teams and apply the design process to develop acceptable solutions to problems and case studies.*	
ENG4.b.2.e: Build or construct an object using the design process.	*Apply appropriate design principles to create design solutions.*	
ENG4.b.3.m: Apply a design process to solve problems in and beyond the laboratory-classroom.	*Develop and fabricate engineering systems in mechanical, thermodynamic, fluid, electrical, and control.*	
ENG5.a.6.h: Diagnose a system that is malfunctioning and use tools, materials, or machines to repair it.	*Utilizing statics, mathematically analyze a system to determine the types and magnitude of forces within.*	
ENG5.b.2.e: Use computers and technology to access and organize information.	*Explain the effects that stress has on a material and explain how the material will react.*	
ENG5.b.5.m: Use computers, calculators and technology in various applications.		
ENG6.a.2.m: Design and use instruments and technology to gather data.		

Stage 3: Learning Activities

A brief summary of the key learning activities- How will students build knowledge & develop skills? How will learning be relevant, accessible, and engaging? How will the learning unforld in a natural flow?

GUIDING UNIT QUESTIONS *Using Costas Level of Thinking, what questions will hook and hold students so that they develop a deep understanding of the desired results? The guiding questions are more topic-specific to the particular unit. They guide the exploration of the essential questions and rigor of the standards. This may include questions that guide project based/ problem based learning*	STRATEGIES/ACTIVITIES *What learning strategies and experiences will authentically engage students so that they gain understanding the desired results? This includes strategies and activities that help learners acquire targeted knowledge and skills, make meaning of important ideas, and transfer their learning to new situations. Consider how the learning will be tailored and flexible to address the interests and learning styles of all students.*	RESOURCES/MATERIALS *This includes an applicable textbooks, software, industry recognized certification software/tools, subcriptions (such asPLTW), etc.*
Why is a design process, and the documentation of said process, so important to follow when creating a solution to a problem?	Trusses	VEX Robotics 5V Robot Brain Kits
How can an existing product be changed to incorporate different processes to make it less expensive and provide better performance?	Materials and their properties	Various tools and equipment for projects and activities
What emerging technologies are or may be on the horizon that will provide energy more efficiently?	Manufacturing processes	equipment lists are included in PLTW POE course guide
Why would an engineer use theory-based vs. experiment-based data interpretation in the decision-making process?	Bridge design and structural strength	
Why are programmable logic devices used to control machines versus monitoring and adjusting processes manually?		
Why do teams use consensus to make decisions?		
Why are engineers concerned about material properties?		
Why do engineers and designers use scientific principles when creating solutions.		
Why is it crucial for designers and engineers to utilize statistics throughout the design process?		

Unit 3 Automation and Control Systems		
The goal of Unit 3 is for students to recognize the abundance of and infinite variety of computer use in our daily lives. Students learn to control mechanical systems by recognizing computer outputs and gaining an understanding of how to write code to control them. They additionally experiment with various input devices and learn how they can adapt computer code to control computer outputs. Furthermore students gain an understanding of fluid power, both hydraulic and pneumatic. They begin to recognize the power and control advantages of fluid power. The unit concludes with students working in teams to solve a design problem that focuses on using control systems. They will integrate their prior knowledge, skills, and understandings from Unit 1: Simple Machines, Unit 2: Material Properties, and this unit. Students will decide what input devices to use, how to code their use, and the various output devices necessary to create a solution to the problem.		
STAGE 1: Desired Unit Results *What will students understand as a result of the unit?*		**STAGE 2: Assessment Evidence** *By what criteria will performances of understanding be assessed? Through what authentic performance tasks will students demonstrate the desired unit results?*
ESSENTIAL QUESTION (s) *What thought-provoking questions will foster inquiry, understanding, and transfer of learning?*		**Success Criteria with Standards** *The criteria for evaluating performance on standards is constant.*
How do teams efficiently and effectively solve problems in an increasingly complex world?		CTE standards-based Rubric: Throughout the course, students and teachers use the rubric for communication of success criteria, reflection, goal setting, and feedback.
What is effective teamwork? What strategies can I use/teams use to work better together? How can perspectives and experiences of a diverse group develop innovative solutions to a given problem?		
How might technical knowledge and skills influence one's employability and advancement opportunities within various work settings?		
PRIORITY CAREER & TECHNICAL STANDARDS & Learning Targets		**Performance Tasks Options/ Assessment Strategies by Standard** *Students may be given options to show their learning in varied ways.*
Creativity, Critical Thinking, Communication and Collaboration **4C2: Students will formulate and defend judgments and decisions by employing critical thinking skills.**		
a: I develop effective resolutions for a given problem, decision or opportunity using available information.	4C2.a.11.h: I can determine the information needed to address an identified problem.	*-Using the engineering notebook to document, reflect, and refine.* *-Quick Write Reflections 1. What strategies and processes did I use to become a more effective creator, thinker and problem solver? 2. Why is communication and collaboration important?3. How have positive work behaviors and personal qualities impacted communication and collaboration?*
	4C2.a.12.h: I can contrast the benefits and drawbacks of various proposed resolutions to a given situation.	
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b: I develop and implement a resolution for a new situation using personal knowledge and experience.	4C2.b.5.h: I can apply past experience to develop a course of action for a new situation.	*Collaboratively build and test simple and compound designs to complete tasks.*
	4C2.b.6.h: I can use existing knowledge to develop a resolution for a new situation, problem or opportunity.	
Career Development **CD4: Students will identify and apply employability skills.**		
a: I identify and demonstrate positive work behaviors and personal qualities needed to be employable.	CD4.a.8.h: I can apply communication strategies when adapting to a culturally diverse environment.	*Collaboratively build and test simple and compound designs to complete tasks.*
	CD4.a.10.h: I can manage work roles and responsibilities to balance them with other life roles and responsibilities.	

c: I identify and exhibit traits for retaining employment.	CD4.c.4.h: I can model behaviors that demonstrate reliability and dependability.	*Collaboratively build and test simple and compound designs to complete tasks.*
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d: I develop positive relationships with others.	CD4.d.6.h: I can evaluate the best method to assist co-workers in accomplishing goals and tasks.	*Collaboratively build and test simple and compound designs to complete tasks.*
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a: I choose appropriate sources of data and information for a given purpose.	IMT1.a.6.h: I can justify the selection of various information sources for a given purpose.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.a.7.h: I can explain the level of objectivity for a given source of information.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.a.8.h: I can model how raw data can be applied differently to support opposing arguments or premises.	*Document original design and design iterations in Engineering Notebook.*
b: I determine the relevance, validity and timeliness of data and information.	IMT1.b.7.h: I can use raw data and information appropriately to support an argument, idea or initiative.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.b.8.h: I can compare and contrast validity of information from electronic and non-electronic sources.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.b.9.h: I can defend a position or decision using relevant, valid and timely data and information.	*Document original design and design iterations in Engineering Notebook.*
c: I select relevant information necessary for making decisions and solving problems	IMT1.c.5.h: I can defend a solution or conclusion using appropriate data and information.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.c.6.h: I can interpret and select appropriate information to develop a resolution for a given situation.	*Document original design and design iterations in Engineering Notebook.*
d: I apply data and information to communicate ideas and create new opportunities.	IMT1.d.6.h: I can defend a proposal for a new product or service based on data and information analysis.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.d.7.h: I can synthesize data and information from multiple sources to identify new trends.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.d.8.h: I can manage and share stored data and information for a specific purpose.	*Document original design and design iterations in Engineering Notebook.*
PRIORITY CONTENT STANDARDS & Learning Targets		**Performance Tasks Options/ Assessment Strategies by Standard** *Students may be given options to show their learning in varied ways.*
Standard: ENG1: Students will analyze and demonstrate the attributes of design.	*ENG1.a.9.h: I can examine how the design needs to continually be evaluated and the ideas of the design must be redefined and improved.*	*Document original design and design iterations in Engineering Notebook.*
Standard: ENG3: Students will demonstrate and analyze the role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.	*ENG3.a.3.e: Explain troubleshooting is a way of finding out why something does not work so that it can be improved.*	
SUPPORTING STANDARDS AND LEARNING TARGETS		**Performance Tasks Options/ Assessment Strategies by Standard** *Students may be given options to show their learning in varied ways.*

ENG2.b.4.h: A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.	*Apply concurrent engineering practices to solve problems.*	
ENG3.b.5.h: Describe how many technological problems require a multidisciplinary approach.	*Work effectively in teams and apply the design process to develop acceptable solutions to problems and case studies.*	
ENG4.b.2.e: Build or construct an object using the design process.	*Apply appropriate design principles to create design solutions.*	
ENG4.b.3.m: Apply a design process to solve problems in and beyond the laboratory-classroom.	*Develop and fabricate engineering systems in mechanical, thermodynamic, fluid, electrical, and control.*	
ENG5.a.3.e: Recognize and use everyday symbols such as numbers and symbols to communicate key ideas.	*Develop, control and fabricate an automated system that is designed to perform a specific function within a specified tolerance.*	
ENG5.a.6.h: Diagnose a system that is malfunctioning and use tools, materials, or machines to repair it.	*Develop a mathematical estimation of a system's long-term performance.*	
ENG5.a.7.h: Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.		
ENG5.b.2.e: Use computers and technology to access and organize information.		
ENG5.b.5.m: Use computers, calculators and technology in various applications.		
ENG5.b.8.h: Troubleshoot, analyze and maintain systems to ensure proper function, accuracy and precision.		

Stage 3: Learning Activities

A brief summary of the key learning activities- How will students build knowledge & develop skills? How will learning be relevant, accessible, and engaging? How will the learning unforld in a natural flow?

GUIDING UNIT QUESTIONS *Using Costas Level of Thinking, what questions will hook and hold students so that they develop a deep understanding of the desired results? The guiding questions are more topic-specific to the particular unit. They guide the exploration of the essential questions and rigor of the standards. This may include questions that guide project based/ problem based learning*	STRATEGIES/ACTIVITIES *What learning strategies and experiences will authentically engage students so that they gain understanding the desired results? This includes strategies and activities that help learners acquire targeted knowledge and skills, make meaning of important ideas, and transfer their learning to new situations. Consider how the learning will be tailored and flexible to address the interests and learning styles of all students.*	RESOURCES/MATERIALS *This includes an applicable textbooks, software, industry recognized certification software/tools, subcriptions (such asPLTW), etc.*
Why is a design process, and the documentation of said process, so important to follow when creating a solution to a problem?	Hydraulics	VEX Robotics 5V Robot Brain Kits
How can an existing product be changed to incorporate different processes to make it less expensive and provide better performance?	Pneumatics	Various tools and equipment for projects and activities
What emerging technologies are or may be on the horizon that will provide energy more efficiently?	Programing	equipment lists are included in PLTW POE course guide
Why would an engineer use theory-based vs. experiment-based data interpretation in the decision-making process?	Robotics	
Why are programmable logic devices used to control machines versus monitoring and adjusting processes manually?	Flow Charts	
Why do teams use consensus to make decisions?		

Why are engineers concerned about material properties?		
Why do engineers and designers use scientific principles when creating solutions.		
Why is it crucial for designers and engineers to utilize statistics throughout the design process?		

Unit 4 Kinematics		
In Unit 4 students are engaged in learning to use statistics to evaluate an experiment. Later they begin a study of dynamics, specifically kinematics, and apply statistical skills to study freefall motion. Students use theoretical and experimental data as a basis for learning statistical analysis. By collecting, organizing, and interpreting the data, students build the skills needed to understand data results. They further use these new skills and knowledge to design a vehicle that will propel itself. Later, students will address the problem of designing a machine to accurately launch an object a specified distance. Examining projectile motion is at the core of this design problem		
STAGE 1: Desired Unit Results *What will students understand as a result of the unit?*		**STAGE 2: Assessment Evidence** *By what criteria will performances of understanding be assessed? Through what authentic performance tasks will students demonstrate the desired unit results?*
ESSENTIAL QUESTION (s) *What thought-provoking questions will foster inquiry, understanding, and transfer of learning?*		**Success Criteria with Standards** *The criteria for evaluating performance on standards is constant.*
How do teams efficiently and effectively solve problems in an increasingly complex world?		CTE standards-based Rubric: Throughout the course, students and teachers use the rubric for communication of success criteria, reflection, goal setting, and feedback. Using the knowledge and skills gained during the course, students are able to construct a detailed response to any of the essential questions.
What is effective teamwork? What strategies can I use/teams use to work better together? How can perspectives and experiences of a diverse group develop innovative solutions to a given problem?		
How might technical knowledge and skills influence one's employability and advancement opportunities within various work settings?		
Why is creativity and innovation important? How is creativity and innovation used in the STEM career pathway?		
PRIORITY CAREER & TECHNICAL STANDARDS & Learning Targets		**Performance Tasks Options/ Assessment Strategies by Standard** *Students may be given options to show their learning in varied ways.*
Creativity, Critical Thinking, Communication and Collaboration **4C2: Students will formulate and defend judgments and decisions by employing critical thinking skills.**		
a: I develop effective resolutions for a given problem, decision or opportunity using available information.	4C2.a.11.h: I can determine the information needed to address an identified problem.	*-Using the engineering notebook to document, reflect, and refine. -Quick Write Reflections 1. What strategies and processes did I use to become a more effective creator, thinker and problem solver? 2. Why is communication and collaboration important?3. How have positive work behaviors and personal qualities impacted communication and collaboration?*
	4C2.a.12.h: I can contrast the benefits and drawbacks of various proposed resolutions to a given situation.	
	4C2.a.13.h: I can predict how an action could result in unintended consequences, both positive and negative.	
	4C2.a.14.h: I can analyze the impact of a decision using a systems thinking model.	
	4C2.a.15.h: I can determine the best resolution for a problem, decision or opportunity based on given criteria.	
	C2.a.16.h: I can defend an action taken or a decision implemented.	
b: I develop and implement a resolution for a new situation using personal knowledge and experience.	4C2.b.5.h: I can apply past experience to develop a course of action for a new situation.	*Collaboratively build and test simple and compound designs to complete tasks.*
	4C2.b.6.h: I can use existing knowledge to develop a resolution for a new situation, problem or opportunity.	
Career Development **CD4: Students will identify and apply employability skills.**		
a: I identify and demonstrate positive work behaviors and personal qualities needed to be employable.	CD4.a.8.h: I can apply communication strategies when adapting to a culturally diverse environment.	*Collaboratively build and test simple and compound designs to complete tasks.*
	CD4.a.10.h: I can manage work roles and responsibilities to balance them with other life roles and responsibilities.	
c: I identify and exhibit traits for retaining employment.	CD4.c.4.h: I can model behaviors that demonstrate reliability and dependability.	*Collaboratively build and test simple and compound designs to complete tasks.*

	CD4.c.5.h: I can maintain appropriate dress and behavior for the job to contribute to a safe and effective workplace/jobsite.	
d: I develop positive relationships with others.	CD4.d.6.h: I can evaluate the best method to assist co-workers in accomplishing goals and tasks.	*Collaboratively build and test simple and compound designs to complete tasks.*
Information, Media, Technology **IMT1: Students will access, interpret and evaluate information from a variety of sources in order to inform and support premises, arguments, decisions, ideas and initiatives.**		
a: I choose appropriate sources of data and information for a given purpose.	IMT1.a.6.h: I can justify the selection of various information sources for a given purpose.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.a.7.h: I can explain the level of objectivity for a given source of information.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.a.8.h: I can model how raw data can be applied differently to support opposing arguments or premises.	*Document original design and design iterations in Engineering Notebook.*
b: I determine the relevance, validity and timeliness of data and information.	IMT1.b.7.h: I can use raw data and information appropriately to support an argument, idea or initiative.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.b.8.h: I can compare and contrast validity of information from electronic and non-electronic sources.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.b.9.h: I can defend a position or decision using relevant, valid and timely data and information.	*Document original design and design iterations in Engineering Notebook.*
c: I select relevant information necessary for making decisions and solving problems	IMT1.c.5.h: I can defend a solution or conclusion using appropriate data and information.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.c.6.h: I can interpret and select appropriate information to develop a resolution for a given situation.	*Document original design and design iterations in Engineering Notebook.*
d: I apply data and information to communicate ideas and create new opportunities.	IMT1.d.6.h: I can defend a proposal for a new product or service based on data and information analysis.	*Document original design and design iterations in Engineering Notebook.*
	IMT1.d.7.h: I can synthesize data and information from multiple sources to identify new trends.	*Document original design and design iterations in Engineering Notebook.*
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PRIORITY CONTENT STANDARDS & Learning Targets		**Performance Tasks Options/ Assessment Strategies by Standard** *Students may be given options to show their learning in varied ways.*
Standard: ENG1: Students will analyze and demonstrate the attributes of design.	*ENG1.a.9.h: I can examine how the design needs to continually be evaluated and the ideas of the design must be redefined and improved.*	*Document original design and design iterations in Engineering Notebook.*
Standard: ENG3: Students will demonstrate and analyze the role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.	*ENG3.a.3.e: Explain troubleshooting is a way of finding out why something does not work so that it can be improved.*	
SUPPORTING STANDARDS AND LEARNING TARGETS		**Performance Tasks Options/ Assessment Strategies by Standard** *Students may be given options to show their learning in varied ways.*
ENG4.b.2.e: Build or construct an object using the design process.	*Apply concurrent engineering practices to solve problems.*	
ENG4.b.3.m: Apply a design process to solve problems in and beyond the laboratory-classroom.	*Work effectively in teams and apply the design process to develop acceptable solutions to problems and case studies.*	

ENG4.c.3.e: Improve the design solutions.	*Apply appropriate design principles to create design solutions.*	
ENG5.a.6.h: Diagnose a system that is malfunctioning and use tools, materials, or machines to repair it.	*Develop and fabricate engineering systems in mechanical, thermodynamic, fluid, electrical, and control.*	
ENG5.b.2.e: Use computers and technology to access and organize information.	*Determine the characteristics of a system involving an object in flight.*	
ENG5.b.5.m: Use computers, calculators and technology in various applications.		
ENG5.b.8.h: Troubleshoot, analyze and maintain systems to ensure proper function, accuracy and precision.		

Stage 3: Learning Activities

A brief summary of the key learning activities- How will students build knowledge & develop skills? How will learning be relevant, accessible, and engaging? How will the learning unforld in a natural flow?

GUIDING UNIT QUESTIONS *Using Costas Level of Thinking, what questions will hook and hold students so that they develop a deep understanding of the desired results? The guiding questions are more topic-specific to the particular unit. They guide the exploration of the essential questions and rigor of the standards. This may include questions that guide project based/ problem based learning*	STRATEGIES/ACTIVITIES *What learning strategies and experiences will authentically engage students so that they gain understanding the desired results? This includes strategies and activities that help learners acquire targeted knowledge and skills, make meaning of important ideas, and transfer their learning to new situations. Consider how the learning will be tailored and flexible to address the interests and learning styles of all students.*	RESOURCES/MATERIALS *This includes an applicable textbooks, software, industry recognized certification software/tools, subcriptions (such asPLTW), etc.*
Why is a design process, and the documentation of said process, so important to follow when creating a solution to a problem?	Statistics	VEX Robotics 5V Robot Brain Kits
How can an existing product be changed to incorporate different processes to make it less expensive and provide better performance?	Probability	Various tools and equipment for projects and activities
What emerging technologies are or may be on the horizon that will provide energy more efficiently?	Projectile Motion	equipment lists are included in PLTW POE course guide
Why would an engineer use theory-based vs. experiment-based data interpretation in the decision-making process?	Balistics	
Why are programmable logic devices used to control machines versus monitoring and adjusting processes manually?	Firing Range	
Why do teams use consensus to make decisions?	Mountain Pass	
Why are engineers concerned about material properties?	Parachute Drop	
Why do engineers and designers use scientific principles when creating solutions.	Obstacle Course	
Why is it crucial for designers and engineers to utilize statistics throughout the design process?		

<table>
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<tr><td>CD4.a.7.h: I can assess how flexibility and willingness to learn new knowledge and skills affect employment status.</td></tr>
<tr><td>CD4.a.9.h: I can use positive workqualities typically desired in each of the career cluster's pathways.</td></tr>
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<tr><td rowspan="3">b: I demonstrate skills related to seeking and applying for employment to find and obtain a desired job.</td><td>CD4.b.5.h: I can use multiple resources to locate job opportunities.</td></tr>
<tr><td>CD4.b.6.h: I can prepare a resume, cover letter, employment application.</td></tr>
<tr><td>CD4.b.7.h: I can employ critical thinking and decision-making skills to exhibit qualifications to a potential employer in an interview.</td></tr>
<tr><td rowspan="4">c: I identify and exhibit traits for retaining employment.</td><td>CD4.c.4.h: I can model behaviors that demonstrate reliability and dependability.</td></tr>
<tr><td>CD4.c.5.h: I can maintain appropriate dress and behavior for the job to contribute to a safe and effective workplace/jobsite.</td></tr>
<tr><td>CD4.c.6.h: I can complete required employment forms and documentation.</td></tr>
<tr><td>CD4.c.7.h: I can summarize key activities necessary to retain a job in an industry.</td></tr>
<tr><td>d: I develop positive relationships with others.</td><td>CD4.d.7.h: I can examine the skills required to enable students to successfully transition to postsecondary opportunities.</td></tr>
</table>

	CD4.d.8.h: I can use a systematic approach to academic and career planning for students to achieve their learning, socio-cultural and work goals.	
Information, Media, Technology **IMT1: Students will access, interpret and evaluate information from a variety of sources in order to inform and support premises, arguments, decisions, ideas and initiatives.**		
a: I choose appropriate sources of data and information for a given purpose.	IMT1.a.6.h: I can justify the selection of various information sources for a given purpose. IMT1.a.7.h: I can explain the level of objectivity for a given source of information.	*Career Exploration Project and Research*
b: I determine the relevance, validity and timeliness of data and information.	IMT1.b.7.h: I can use raw data and information appropriately to support an argument, idea or initiative.	
c: I select relevant information necessary for making decisions and solving problems	IMT1.c.5.h: I can defend a solution or conclusion using appropriate data and information. IMT1.c.6.h: I can interpret and select appropriate information to develop a resolution for a given situation.	
d: I apply data and information to communicate ideas and create new opportunities.	IMT1.d.6.h: I can defend a proposal for a new product or service based on data and information analysis.	
PRIORITY CONTENT STANDARDS & Learning Targets		**Performance Tasks Options/ Assessment Strategies by Standard** *Students may be given options to show their learning in varied ways.*
Standard: BB1: Students will analyze the core concepts of technology.	BB1.a: Analyze and use technological systems.	
Standard: ICT1: Students will analyze, select and use information and communication technologies.	ICT1.a: Analyze how communication happens, the different forms of communication and how it affects society.	
Stage 3: Learning Activities *A brief summary of the key learning activities- How will students build knowledge & develop skills? How will learning be relevant, accessible, and engaging? How will the learning unforld in a natural flow?*		
GUIDING UNIT QUESTIONS *Using Costas Level of Thinking, what questions will hook and hold students so that they develop a deep understanding of the desired results? The guiding questions are more topic-specific to the particular unit. They guide the exploration of the essential questions and rigor of the standards. This may include questions that guide project based/ problem based learning*	**STRATEGIES/ACTIVITIES** *What learning strategies and experiences will authentically engage students so that they gain understanding the desired results? This includes strategies and activities that help learners acquire targeted knowledge and skills, make meaning of important ideas, and transfer their learning to new situations. Consider how the learning will be tailored and flexible to address the interests and learning styles of all students.*	**RESOURCES/MATERIALS** *This includes an applicable textbooks, software, industry recognized certification software/tools, subcriptions (such asPLTW), etc.*
What careers are associated with engineering?	Career Exploration in Engineering	Computer or Chromebook
What are the educational requirements for these careers?	Sample Resume Building	internet access
What skills and experiences should I be getting now and in the future in order to pursue these careers?	Sample Job Application writing	
What gaps do I have in a resume?		
