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

DESIRED RESULTS

COURSE DESCRIPTION AND PURPOSE

Where can aerospace engineering take us next? Aerospace engineering transforms the dream of flight into vehicles that ignite our imagination. Students explore fundamentals of flight in air and space through software simulations and hands-on experiences. Students learn how these concepts apply to a career in aerospace engineering and to other engineering fields. The course deepens the skills and knowledge of an engineering student within the context of atmospheric and space flight. Students learn orbital mechanics concepts and apply these by creating models using industry-standard software. They also apply aerospace concepts to alternative applications such as a wind turbine and parachute. Students simulate a progression of operations to explore a planet, including creating a map of the terrain with a model satellite and using the map to execute a mission using an autonomous robot.

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 each university's guidelines.	

<table>
<tr><th colspan="3">UNIT 1: Introduction to Aerospace</th></tr>
<tr><td colspan="3">The goal of this unit is to excite students about aerospace engineering while providing a foundation of knowledge related to flight. In this unit, students explore the rich history of aerospace achievement that advanced the industry. Students are introduced to the physics that allow flight within the atmosphere and the systems which provide safe coordination for aircraft.</td></tr>
<tr><td colspan="2">STAGE 1: Desired Unit Results
What will students understand as a result of the unit?
One important skill that students will learn in this course is design thinking.</td><td>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?</td></tr>
<tr><td colspan="2">ESSENTIAL QUESTION (s)
What thought-provoking questions will foster inquiry, understanding, and transfer of learning?</td><td>Success Criteria with Standards
The criteria for evaluating performance on standards is constant.</td></tr>
<tr><td colspan="2">What strategies and processes can I use to become a more effective creator, thinker and problem solver?</td><td rowspan="2">CTE standards-based Rubric: Throughout the course, students and teachers use the rubric for communication of success criteria, reflection, goal setting, and feedback.</td></tr>
<tr><td colspan="2">Why is communication and collaboration important? How do positive work behaviors and personal qualities impact communication and collaboration?</td></tr>
<tr><td colspan="2">PRIORITY CAREER & TECHNICAL STANDARDS & Learning Targets</td><td>Performance Tasks Options/ Assessment Strategies by Standard
Students may be given options to show their learning in varied ways.</td></tr>
<tr><td colspan="2">Creativity, Critical Thinking, Communication and Collaboration
4C2: Students will formulate and defend judgments and decisions by employing critical thinking skills.</td><td></td></tr>
<tr><td rowspan="6">a: I develop effective resolutions for a given problem, decision or opportunity using available information.</td><td>4C2.a.11.h: I can determine the information needed to address an identified problem.</td><td rowspan="13">They will use the design process to brainstorm, plan, and implement an aerospace design. This unit will walk students through creating the basic parts of aircrafts to familiarize them with the various parts and functions. Students will use their engineering notebook to document the Engineering Design Process. Then they will move on to design and implement their own aerospace designs in the following units.

-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?

Collaboratively build and test aerospace designs to complete tasks.</td></tr>
<tr><td>4C2.a.12.h: I can contrast the benefits and drawbacks of various proposed resolutions to a given situation.</td></tr>
<tr><td>4C2.a.13.h: I can predict how an action could result in unintended consequences, both positive and negative.</td></tr>
<tr><td>4C2.a.14.h: I can analyze the impact of a decision using a systems thinking model.</td></tr>
<tr><td>4C2.a.15.h: I can determine the best resolution for a problem, decision or opportunity based on given criteria.</td></tr>
<tr><td>C2.a.16.h: I can defend an action taken or a decision implemented.</td></tr>
<tr><td rowspan="2">b: I develop and implement a resolution for a new situation using personal knowledge and experience.</td><td>4C2.b.5.h: I can apply past experience to develop a course of action for a new situation.</td></tr>
<tr><td>4C2.b.6.h: I can use existing knowledge to develop a resolution for a new situation, problem or opportunity.</td></tr>
<tr><td colspan="2">Career Development
CD4: Students will identify and apply employability skills.</td></tr>
<tr><td rowspan="2">a: I identify and demonstrate positive work behaviors and personal qualities needed to be employable.</td><td>CD4.a.8.h: I can apply communication strategies when adapting to a culturally diverse environment.</td></tr>
<tr><td>CD4.a.10.h: I can manage work roles and responsibilities to balance them with other life roles and responsibilities.</td></tr>
<tr><td rowspan="2">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>d: I develop positive relationships with others.</td><td>CD4.d.6.h: I can evaluate the best method to assist co-workers in accomplishing goals and tasks.</td></tr>
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Standard: ENG1: Students will analyze and demonstrate the attributes of design.	I can use the design process to brainstorm, plan, and implement a robot design	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.		
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.
How do engineers organize and document the design process?	Set up an engineering notebook	PLTW Online Text: Aerospace Engineering
What is essential for aircraft to fly?	Aircraft trim design challenge	
How can skills and knowledge learned from a simulator be applied to a physical aircraft?	Learn to control an aircraft with a flight simulator	Launch Fly To Learn Powered by X-Plane software

UNIT 2: Aerospace Design		
The goal of this unit is for students to learn about factors which affect aircraft design. Students develop knowledge and skills in this unit through the use of software design, simulation tools, and hands-on construction of composites.		
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.
What strategies and processes can I use to become a more effective creator, thinker and problem solver?		CTE standards-based Rubric: Throughout the course, students and teachers use the rubric for communication of success criteria, reflection, goal setting, and feedback.
Why is communication and collaboration important? How do positive work behaviors and personal qualities impact communication and collaboration?		
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.**		Students will design an aircraft structural component in computer aided design (CAD) simulation software. Students will create and test composite samples which represent structural components used in aircraft construction. Students design, build, and test their own model rockets. After learning how the human body is affected by flight conditions and its impact on aircraft design, students will measure various parameters of their vision, reaction time, and communication effectiveness. Then, students research and present aircraft accident investigation resources. -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?
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.	
	4C2.a.15.h: I can determine the best resolution for a problem, decision or opportunity based on given criteria.	
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.	
	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.	
	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.	
	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.	
PRIORITY CONTENT STANDARDS & Learning Targets		
Standard: ENG1: Students will analyze and demonstrate the attributes of design.	I can apply concurrent engineering practies to solve problems.	
Standard: ENG3: Students will demonstrate and analyze the role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.	I can apply concurrent engineering practies to solve problems.	

Standard: ICT1: Students will analyze, select and use information and communication technologies.	I can understand that aerospace matieral selection is based upon many factors including mechanical, thermal, electromagnetic, and chemical properties.	
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 must designers and engineers calculate forces acting on bodies and structures?	Use CAD software to design, model, and test suitabilty of materials.	Autodesk Inventor
How does an airplane use the thin fluid of air to propel itself?	Design a turbine engine using simulator software.	Ideal Cycle Gas Turbine Analysis software
How do human factors affect aerospace engineering design?	Collaborate with a team to design a Mars mission survival plan.	

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<tr><td colspan="3">The goal of this unit is for students to focus on space related-concepts defined in aerospace engineering. Students will learn about the governance of space and the impact of exploration of space. Students learn orbital mechanics and apply these concepts to modeling orbiting systems with software used by aerospace engineers.</td></tr>
<tr><td colspan="2">STAGE 1: Desired Unit Results
What will students understand as a result of the unit? Students will learn about the foverance of space, the impact of space exploration, and orbital mechanics.</td><td>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?</td></tr>
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What thought-provoking questions will foster inquiry, understanding, and transfer of learning?</td><td>Success Criteria with Standards
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<tr><td colspan="2">What strategies and processes can I use to become a more effective creator, thinker and problem solver?</td><td rowspan="2">CTE standards-based Rubric: Throughout the course, students and teachers use the rubric for communication of success criteria, reflection, goal setting, and feedback.</td></tr>
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Students may be given options to show their learning in varied ways.</td></tr>
<tr><td colspan="2">Creativity, Critical Thinking, Communication and Collaboration
4C2: Students will formulate and defend judgments and decisions by employing critical thinking skills.</td><td rowspan="11">After learning a basic understanding of laws governing and describing satellite orbits and the Keplerian Element Set and Kepler's Laws of Motion, students apply what they learned by creating a model of the International Space Station orbit using Systems Tool Kit (STK).

-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?</td></tr>
<tr><td rowspan="2">a: I develop effective resolutions for a given problem, decision or opportunity using available information.</td><td>4C2.a.11.h: I can determine the information needed to address an identified problem.</td></tr>
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Standard: ICT1: Students will analyze, select and use information and communication technologies.	*I can understand that aerospace matieral selection is based upon many factors including mechanical, thermal, electromagnetic, and chemical properties.*	
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 space law necessary?	Select and research a space law case an prepare a 5 minute presentation/video to share with the class.	
What keeps an object in orbit?	Investigate orbital mechanics and model with software	AGI STK 11 software

UNIT 4: Alternative Applications

The goal of this unit is for students to consider applications of aerospace concepts beyond the design of aircraft and spacecraft and to explore career opportunities in the field of aerospace engineering. Students simulate a progression of operations to explore a planet. Students build and operate a remote sensing model to measure a physical terrain similar to the satellite overflight of an unexplored planet. Students transform the data into a topographical map that students will use to plan an autonomous planetary rover mission.

STAGE 1: Desired Unit Results

What will students understand as a result of the unit? Students will learn about the foverance of space, the impact of space exploration, and orbital mechanics.

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?

- Why is creativity and innovation important? How is creativity and innovation used in [name of career pathway]?
- 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?
- What strategies and processes can I use to become a more effective creator, thinker and problem solver?
- Why is communication and collaboration important? How do positive work behaviors and personal qualities impact communication and collaboration?

Success Criteria with Standards

The criteria for evaluating performance on standards is constant.

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.

PRIORITY CAREER & TECHNICAL STANDARDS & Learning Targets

Creativity, Critical Thinking, Communication and Collaboration **4C2: Students will formulate and defend judgments and decisions by employing critical thinking skills.**	
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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.

After learning how aerospace engineering concepts can be applied beyond the design of aircraft and spacecraft, students apply concepts related to airfoils and wind turbines to determine efficiency. Students apply the airfoil drag equation to design a parachute which they build and test.

After learning to integrate mechanical, electrical, and software systems, students design, create, and test using a robot modeling system which includes input sensors and output devices. Students create a satellite model to gather elevation data of a terrain. Students use the modeling system to design, build, program, and test an autonomous vehicle which simulate a rover sent to explore a remote location such as a planet or a moon. An optional project is available for differentiated instruction to meet needs of a diverse level of student knowledge and skill. Students use the modeling system to create a physical simulation of an autopilot system. Students create a program to use an accelerometer input to control the output of an aircraft control surface.

After investigating the aerospace professional career, students write a potential academic and career plan.

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Standard: ICT1: Students will analyze, select and use information and communication technologies.	I can understand that aerospace matieral selection is based upon many factors including mechanical, thermal, electromagnetic, and chemical properties.

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 space law necessary?	Select and research a space law case an prepare a 5 minute presentation/video to share with the class.	
What keeps an object in orbit?	Investigate orbital mechanics and model with software	AGI STK 11 software