# PLTW Aerospace Engineering Course Framework

## PLTW Framework - Overview

PLTW Frameworks are representations of the knowledge, skills, and understandings that empower students to thrive in an evolving world. The PLTW Frameworks define the scope of learning and instruction within the PLTW curricula. The framework structure is organized by four levels of understanding that build upon each other: Knowledge and Skills, Objectives, Domains, and Competencies.

The most fundamental level of learning is defined by course Knowledge and Skills statements. Each Knowledge and Skills statement reflects specifically what students will know and be able to do after they've had the opportunity to learn the course content. Students apply Knowledge and Skills to achieve learning Objectives, which are skills that directly relate to the workplace or applied academic settings. Objectives are organized by higher-level Domains.

Domains are areas of in-demand expertise that an employer in a specific field may seek; they are key understandings and long-term takeaways that go beyond factual knowledge into broader, conceptual comprehension.

At the highest level, Competencies are general characterizations of the transportable skills that benefit students in various professional and academic pursuits. As a whole, the PLTW Frameworks illustrate the deep and relevant learning opportunities students experience from PLTW courses and demonstrate how the courses prepare students for life, not just the next grade level.

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

## Essential Questions

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|---|---|
| 1.1 - 1 | What role has technology played in the evolution of flight? |
| 1.1 - 2 | What role has society played in the evolution of flight? |
| 1.1 - 3 | What role has the evolution of flight played in the culture of the society? |
| 1.1 - 4 | How does knowledge of aerospace history provide insight to future innovation? |
| 1.2 - 1 | How are aircraft controlled in flight? |
| 1.2 - 2 | How do aircraft use the thin fluid of air to sustain flight? |
| 1.2 - 3 | What is essential for aircraft to fly? |
| 1.2 - 4 | How does using a design process iterate to an optimal solution? |
| 1.3 - 1 | How can skills and knowledge learned from a simulator be applied to a physical aircraft? |
| 1.3 - 2 | How can a system maintain safety in a complex environment? |
| 1.3 - 3 | How can an environment be modeled accurately? |
| 2.1 - 1 | How do material properties affect an aircraft design? |
| 2.1 - 2 | Why must designers and engineers calculate forces acting on bodies and structures? |
| 2.1 - 3 | How does an engineer predict the performance and safety of a selected material? |

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|---|---|
| 2.2 - 1 | How does an airplane produce thrust? |
| 2.2 - 2 | How does an airplane use the thin fluid of air to propel itself? |
| 2.2 - 3 | How do a propeller and a jet propulsion system appear similar, yet both are quite different? |
| 2.3 - 1 | How do human factors affect aerospace engineering design? |
| 2.3 - 2 | How does communication between humans affect aerospace engineering design? |
| 2.3 - 3 | How can the risk of aviation accidents be minimized? |
| 3.1 - 1 | What is the universe? |
| 3.1 - 2 | Why is space law necessary? |
| 3.1 - 3 | How does space junk affect our future? |
| 3.2 - 1 | How do satellites impact our daily lives? |
| 3.2 - 2 | What is an orbit and how is it described? |
| 3.2 - 3 | What keeps an object in orbit? |
| 3.2 - 4 | How does modeling software improve a design process? |
| 3.2 - 5 | How does an orbital pattern affect the success of a satellite mission? |
| 4.1 - 1 | How can aerospace engineering concepts be applied to solve problems that are not directly related to aircraft? |
| 4.1 - 2 | How does aerospace engineering affect the global economy? |
| 4.1 - 3 | How can air movement be transferred into usable electrical energy? |
| 4.2 - 1 | How can mechanical, electrical, and software systems be integrated to solve a problem? |
| 4.2 - 2 | How can a team be diversified to enhance a design process? |
| 4.2 - 3 | What future applications for remote systems do you predict? |
| 4.3 - 1 | How do you want to be remembered as a professional? |
| 4.3 - 2 | What and who are reliable sources for career advice? |
| 4.3 - 3 | What resources can be used to develop a career plan? |

## Competencies, Domains, Objectives, Knowledge and Skills

### Transportable Knowledge and Skills

Core workplace skills that students and workers need to acquire, that can be used across all stages of a career, and that, because of their universal utility, are transportable from job to job, from employer to employer, across the economy.

Career Readiness (CAR):

Engineers use professional skills and knowledge to pursue opportunities and create sustainable solutions to improve and enhance the quality of life of individuals and society.

CAR-A. Describe and distinguish among the different disciplines of engineering.

CAR-A.1 Explain that engineering disciplines continue to evolve and emerge as new interdisciplinary fields or sub-disciplines to better meet the needs of society. Examples include: Aerospace Engineering, Biomedical Engineering, Environmental Engineering, Computer Engineering, Structural Engineering, and Water Resource Engineering.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ |

CAR-B. Strive to create sustainable solutions to meet the needs of society, without compromising the ability of future society to meet their needs.

CAR-B.1 Identify principles that help guide development of sustainable solutions. Considerations for sustainable development include people, planet, and profit.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
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Communication (COM):

Engineering practice requires effective communication with a variety of audiences using multiple modalities.

COM-A. Communicate effectively with an audience based on audience characteristics.

COM-A.1 Adhere to established conventions of written, oral, and electronic communications (grammar, spelling, usage, and mechanics).

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☑ | ☑ | ☐ | ☐ | ☐ | ☑ | ☑ | ☑ | ☐ | ☑ | ☑ |

COM-A.2 Follow acceptable formats for technical writing and professional presentations.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☑ | ☐ | ☐ | ☐ | ☐ | ☑ | ☑ | ☑ | ☐ | ☑ | ☑ |

COM-A.3 Properly cite references for all communication in an accepted format.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

COM-A.4 Clearly label tables and figures with units and explain the information presented in context.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☑ | ☑ | ☐ | ☐ | ☐ | ☑ | ☑ | ☑ | ☐ | ☑ | ☑ |

## Competencies, Domains, Objectives, Knowledge and Skills

Collaboration (COL):

Demonstrate an ability to function on multidisciplinary teams.

COL-A. Facilitate an effective team environment to promote successful goal attainment.

COL-A.1 Contribute individually to overall collaborative efforts.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
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Critical and Creative Problem-Solving (CCP):

The skills necessary for students to generate ideas and solutions to problems.

CCP-A. Explain and justify an engineering design process.

CCP-A.1 Describe major steps of a design process and identify tasks involved in each step.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☑ | ☐ | ☑ | ☐ | ☑ | ☐ | ☐ |

CCP-A.2 Document a design process in an engineering notebook according to best practices.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☐ | ☑ | ☐ | ☑ | ☑ | ☑ | ☐ |

CCP-B. Collect, analyze, and interpret information relevant to the problem or opportunity at hand to support engineering decisions.

CCP-B.1 Find relevant data in credible sources such as literature, databases, and policy documents.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☑ | ☐ | ☐ | ☐ | ☐ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ |

CCP-C. Synthesize an ill-formed problem into a meaningful, well-defined problem.

CCP-C.1 Identify and define visual, functional, and structural design requirements with realistic constraints, against which solution alternatives can be evaluated.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☐ | ☑ | ☐ | ☑ | ☑ | ☑ | ☐ |

CCP-C.2 List potential constraints that may impact the success of a design solution. Examples include economic (cost), environmental, social, political, ethical, health and safety, manufacturability, technical feasibility, and sustainability.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☐ | ☑ | ☐ | ☑ | ☑ | ☑ | ☐ |

CCP-D. Generate multiple potential solution concepts.

CCP-D.1 Represent concepts using a variety of visual tools, such as sketches, graphs, and charts, to communicate details of an idea.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☑ | ☑ | ☑ | ☑ | ☐ | ☑ | ☐ | ☑ | ☐ |

CCP-E. Develop models to represent design alternatives and generate data to inform decision making, test alternatives, and demonstrate solutions.

CCP-E.1 Use a model to accurately represent the key aspects of an object, system or process.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☑ | ☑ | ☐ | ☐ | ☑ | ☐ | ☑ | ☐ |

CCP-E.2 Produce a physical model using hand tools and simple construction techniques.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

CCP-F. Select a solution path from many options to successfully address a problem or opportunity.

CCP-F.1 Explain that there are often multiple viable solutions and no obvious best solution. Tradeoffs must be considered and evaluated consistently throughout an engineering design process.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☐ | ☑ | ☐ | ☑ | ☑ | ☑ | ☐ |

CCP-G. Make judgments and decisions based on evidence.

CCP-G.1 Evaluate evidence and arguments to identify deficiencies, limitations, and biases or appropriate next steps in the pursuit of a better solution.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☑ | ☐ |

CCP-H. Demonstrate independent thinking and self-direction in pursuit of accomplishing a goal.

CCP-H.1 Plan and use time in pursuit of accomplishing a goal without direct oversight.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☑ | ☑ | ☐ | ☑ | ☑ | ☑ | ☑ | ☐ | ☑ | ☑ | ☐ |

CCP-H.2 Plan how to gain additional knowledge and learning to accomplish a goal.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ |

CCP-I. Demonstrate flexibility and adaptability to change.

CCP-I.1 Adapt to varied roles, job responsibilities, schedules, and contexts.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☑ | ☑ | ☐ | ☐ | ☐ | ☑ | ☐ | ☑ | ☐ | ☑ | ☑ |

CCP-I.2 Use praise, setbacks, and feedback to positively influence one's professional development.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☑ | ☑ |

CCP-J. Persevere to solve a problem or achieve a goal.

CCP-J.1 Reflect critically on past experiences to inform future progress.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☑ | ☑ | ☐ |

## Competencies, Domains, Objectives, Knowledge and Skills

### Technical Knowledge and Skills

Every career field requires technical literacy and career-specific knowledge and skills to support professional practice.

Aerospace Industry Knowledge (AIK):

The aerospace industry evolved through building upon the research and testing of previous aerospace accomplishments and failures.

AIK-A. Analyze the cause and effect of an aerospace engineering event.

AIK-A.1 Identify the correct sequence and approximate dates of major events in aerospace engineering.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

AIK-A.2 Describe the cause-and-effect relationship that led to aerospace developments.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

AIK-B. Predict future aerospace engineering developments.

AIK-B.1 Describe major development trends in Aerospace Engineering.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

AIK-B.2 Describe future aerospace engineering needs.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ |

AIK-B.3 Relate past aerospace engineering cause-and-effect relationships to future events.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

Algorithms and Programming (AAP):

A remote system integrates mechanical, electrical, and software elements into a single system that is operated remotely or autonomously.

AAP-A. Design an unmanned system.

AAP-A.1 Describe applications of an unmanned system.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ |

AAP-A.2 Describe the application of a control system in an unmanned system.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ |

AAP-A.3 Describe the application of a mechanical design in an unmanned system.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ |

AAP-B. Construct a control program.

AAP-B.1 Explain the purpose of pseudocode to develop a control program.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ |

AAP-B.2 Create pseudocode to perform a simple task.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ |

AAP-B.3 Describe the application of inputs and outputs in the design of a system.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ |

Engineering Tools and Technology (ETT):

The practice of engineering requires the application of mathematical principles and common engineering tools, techniques, and technologies.

ETT-A. Using a variety of measuring devices, measure and report quantities accurately and to a precision appropriate for the purpose.

ETT-A.1 Explain that all measurements are an approximation of the true value of a quantity.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ |

ETT-B. Use a spreadsheet application to help identify and/or solve a problem.

ETT-B.1 Populate a spreadsheet application with data and organize the data to be useful in accomplishing a specific goal.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ |

ETT-B.2 Use the functions and tools within a spreadsheet application to manipulate, analyze, and present data in a useful way.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ |

ETT-C. Construct physical objects using hand tools and shop tools.

ETT-C.1 Identify basic hand tools and shop tools and describe their function.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ |

ETT-C.2 Describe a process to build a physical object based on a conceptual communication, such as a drawing or description.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

ETT-C.3 Demonstrate use of hand tools and shop tools.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ |

ETT-D. Apply computational thinking to generalize and solve a problem using a computer.

ETT-D.1 Interact with content-specific models and simulation to support learning and research.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

ETT-D.2 Use modeling and simulation to represent and understand natural phenomena.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☑ | ☑ | ☐ | ☐ | ☑ | ☐ | ☑ | ☐ |

ETT-D.3 Develop an algorithm (step-by-step process) for solving a problem.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ |

ETT-D.4 Identify, test, and implement possible solutions to a problem using a computer.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☑ | ☐ | ☐ | ☑ | ☐ | ☑ | ☐ |

ETT-D.5 Automate a solution using algorithmic thinking.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☑ | ☐ |

Fundamentals of Flight (FOF):

A foundation of knowledge of how aircraft and spacecraft fly is necessary to apply aerospace engineering design.

FOF-A. Analyze the interaction of the four major forces of atmospheric flight.

FOF-A.1 Identify the three axes of an aircraft.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOF-A.2 Describe the motion of an aircraft about the three axes.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOF-A.3 Describe the four forces of flight.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOF-B. Analyze aircraft stability and control.

FOF-B.1 Identify major components of an aircraft.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ |

FOF-B.2 Describe how the fixed and moveable components of an aircraft affect its stability and control.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ |

FOF-B.3 Describe how pilot inputs control the movable components of an aircraft.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ |

FOF-C. Analyze the effect of weight on an aircraft.

FOF-C.1 Explain the importance of weight and balance of an aircraft.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOF-C.2 Calculate the center of gravity of geometric shapes.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☑ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOF-C.3 Calculate the center of gravity of an aircraft.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOF-C.4 Design the weight distribution plan of an aircraft for a safe flight condition.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOF-D. Design an airfoil.

FOF-D.1 Label components of an airfoil.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOF-D.2 Describe how lift and drag are generated by fluid flow around the airfoil.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOF-D.3 Apply atmospheric calculations to airfoil design.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOF-D.4 Apply the lift equation to an airfoil.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOF-D.5 Apply the drag equation to an airfoil.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOF-E. Design an aircraft and spacecraft propulsion system.

FOF-E.1 Identify aircraft and spacecraft propulsion systems and their characteristics.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOF-E.2 Predict the effect of changing engine variables on the propulsion performance.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOF-E.3 Apply propulsion calculations to the design of a propulsion system.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOF-F. Design a rocket for stable flight.

FOF-F.1 Use a rocket engine performance chart.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOF-F.2 Describe how center of pressure and center of gravity affect rocket performance.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOF-F.3 Predict the stability of a rocket for stable flight.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOF-G. Apply aerospace concepts to non-aerospace systems.

FOF-G.1 Explain how aerospace engineering concepts can be applied to non-aerospace systems.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ |

FOF-G.2 Identify aerospace equations which can be applied to non-aerospace systems.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ |

FOF-H. Design aircraft and spacecraft for human systems.

FOF-H.1 Describe how human physiology is affected by flight.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOF-H.2 Describe aircraft systems that adapt to human physiology.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOF-H.3 Measure human reaction time and sensory acuity.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOF-H.4 Describe how human factors affect aerospace system design.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ |

Flight Operations (FOP):

Aerospace engineering design is intertwined within a complex operational system.

FOP-A. Interpret aircraft navigation systems.

FOP-A.1 Describe the function of and use of navigation systems.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOP-A.2 Interpret navigation system readings.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOP-B. Design a solution to an aircraft traffic dilemma.

FOP-B.1 Describe the purpose and function of an air traffic control system.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOP-B.2 Predict position information for aircraft.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOP-B.3 Analyze an aircraft interaction scenario.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOP-C. Analyze an aircraft accident to determine probable cause.

FOP-C.1 Describe typical factors that contribute to an aircraft accident.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ |

FOP-C.2 Explain how to research information about an aviation accident.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ |

FOP-D. Operate an aircraft in a virtual environment.

FOP-D.1 Explain how the flight controls interact with the aircraft.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☑ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOP-D.2 Demonstrate the ability to maintain control of a simulated aircraft.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

## Competencies, Domains, Objectives, Knowledge and Skills

Materials and Structures (MAS):

Products designed by aerospace engineering rely on the selection of appropriate materials and the application.

MAS-A. Analyze the mechanical properties of material.

MAS-A.1 Explain the importance of mechanical properties of materials to the structure of an aircraft.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

MAS-A.2 Describe the procedure to mechanically test material.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

MAS-A.3 Identify equations that interrelate deflection, moment of inertia, and modulus of elasticity of a structure.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

MAS-A.4 Measure mechanical properties of a material.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

MAS-B. Design an aircraft structure.

MAS-B.1 Describe common aerospace materials, properties, and applications.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

MAS-B.2 Recognize the impact of loading conditions on a structure.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

Space Flight (SFL):

An aerospace engineer needs a foundation of technical knowledge, such as orbital mechanics, and non-technical knowledge, such as global governance of space issues.

SFL-A. Analyze an issue to which space law applies.

SFL-A.1 Explain how global governance applies to space issues.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ |

SFL-A.2 Describe how commercial organizations contribute to space-related activities.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ |

SFL-A.3 Identify the effect that space junk has on space-based activities.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ |

## Competencies, Domains, Objectives, Knowledge and Skills

SFL-B. Apply orbital mechanics equations to an orbiting body.

SFL-B.1 Describe the six Keplerian elements.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ |

SFL-B.2 Identify orbital mechanics equations.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ |

SFL-B.3 Identify the energy forms within an orbital body.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ |

SFL-C. Model an orbital system.

SFL-C.1 Describe common satellite orbital patterns and applications.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ |

SFL-C.2 Describe how an orbital mechanics modeling software can be applied to design a satellite system.

| Lesson: | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 4.1 | 4.2 | 4.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ |