

## Aerospace Engineering

Curriculum/Content Area: Applied Technology & Engineering (ATE)	Course Length: 2 Terms
Course Title: Aerospace Engineering (AE)	Date last reviewed: October 21, 2015
Prerequisites: <i>Geometry</i> and either <i>Principles of Engineering</i> or <i>Physics</i>	Board approval date: November 17, 2015

### Desired Results

#### Course description and purpose:

The major focus of this course is to expose students to the world of aeronautics, flight and engineering through the fields of aeronautics, aerospace engineering and related areas of study. Students work in teams utilizing hands-on activities, projects and problems and are exposed to various situations faced by aerospace engineers. In addition, students use 3D design software to help design solutions to proposed problems. Students design intelligent vehicles to learn about documenting their project, solving problems and communicating their solutions to their peers and members of the professional community.

#### Enduring Understandings (EUs):

1. Engineering is an ongoing process. The development of every new invention and innovation is grounded in the work of people from previous generations.
2. Engineering is the profession in which the knowledge of the mathematics and natural sciences, gained by study, experience, and practice, is applied with judgment, to develop ways to utilize, the materials and forces of nature for the benefit of mankind.
3. Ideas can be communicated in many different ways and the match between the selection of the form of communication and the audience determines the effectiveness of the presentation.
4. A system is a group of related elements that work together for a specific outcome.
5. Frequently problems are too complex for a single person to solve. Teams are formed and duties shared. It is important to have a diversified team to help discover solutions that someone might miss.
6. Testing before, during, and after design & fabrication is essential to guaranteeing the reliability of a product.
7. Reliability is the ability of a product to perform its designed function, within an acceptable tolerance, for a given length of time under specific operating conditions.

#### Essential Questions (EQs):

1. Why is a design process, and the documentation of said process, so important to follow when creating a solution to a problem?
2. How can an existing product be changed to incorporate different processes to make it less expensive and provide better performance?
3. What emerging technologies are or may be on the horizon that will provide energy more efficiently?
4. Why would an engineer use theory-based vs. experiment-based data interpretation in the decision-making process?
5. Why are programmable logic devices used to control machines versus monitoring and adjusting processes manually?
6. Why do teams use consensus to make decisions?
7. Why are engineers concerned about material properties?
8. Why do engineers and designers use scientific principles when creating solutions.
9. Why is it crucial for designers and engineers to utilize statistics throughout the design process?

8. Laws of physics exist, allowing for the prediction of actions between items within a system. These predictions are key elements in the overall design of a solution.

### Assessment Evidence

Performance assessments:

1. Major projects consisting of full project documentation, complete system design with modifications and fabrication of a functioning system prototype.
2. Project presentations targeted at either informing or persuading audiences about a design solution.

Other assessments may include:

- Formative activities including group work used to introduce content and provide feedback to students.
- Summative quizzes used to determine content mastery.

### Course-Long Standards

#### Wisconsin Standards for Technology and Engineering:

ENG1: Students will analyze and demonstrate the attributes of design.

ENG2: Students will analyze and demonstrate engineering design.

ENG3: Students will demonstrate and analyze the role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.

ENG4: Students will develop abilities to apply the design process.

ENG5: Students will develop the abilities to use and maintain technological products and systems.

ENG6: Students will develop the abilities to assess the impact of products and systems.

### Unit #1: Introduction to Aerospace

#### Major Topics:

1. Evolution of Flight
2. Physics of Flight
3. Flight Planning and Navigation

#### Standards

##### Wisconsin Technology and Engineering Standards

ENG1.a.1.e: Design is a creative process.

ENG1.a.2.e: Everyone can design solutions to a problem.

ENG1.a.9.h: Examine how the design needs to continually be evaluated and the ideas of the design must be redefined and improved.

ENG2.a.2.e: Explore when designing an object, it is important to be creative and consider all ideas.

ENG2.b.3.m: Modeling, testing, evaluating and modifying are used to transform ideas into practical solutions.

ENG2.b.4.h: A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.

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.

**CCSS**

CCSS.ELA-Literacy.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.

CCSS.ELA-Literacy.WHST.11-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

**Learning Targets:**

**I can...**

- Understand the evolution of flight instills an appreciation of past engineering accomplishments.
- Work in teams to design smaller components of a larger system. The success of the entire system relies on each component to function correctly and to interact correctly with each other.
- Apply appropriate design principles to create design solutions.
- Develop and fabricate aeronautical systems accounting for surface forces, center of gravity, fluid flow and airfoil properties.
- Determine the proper mechanical/electrical system to use in an aerodynamic design.
- Develop a navigation plan utilizing GPS and navigational tools.

**Unit #2: Aerospace Design**

**Major Topics:**

1. Materials and Structures
2. Propulsion
3. Flight Physiology

**Standards**

**Wisconsin Technology and Engineering Standards**

ENG2.b.2.e: Discuss how models are used to communicate and test design ideas and processes.  
ENG2.b.3.m: Modeling, testing, evaluating and modifying are used to transform ideas into practical solutions.  
ENG3.b.2.e: Describe that the process of experimentation, which is common in science, can also be used to solve technological problems.  
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.b.2.e: Use computers and technology to access and organize information.  
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.

**CCSS**

CCSS.ELA-Literacy.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.

CCSS.ELA-Literacy.WHST.11-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

**Learning Targets:****I can...**

- Apply concurrent engineering practices to solve problems.
- Understand that aerospace material selection is based upon many factors including mechanical, thermal, electromagnetic, and chemical properties.
- Apply Newton's Three Laws of Motion as part of a propulsion system design.
- Prove that the capabilities and limitations of the human body need to be understood by pilots, crews, and aerospace engineer.
- Utilize statics, mathematically analyze a system to determine the types and magnitude of forces within.
- Explain the effects that stress has on a material and explain how the material will react.

**Unit #3: Space****Major Topics:**

1. Space Travel
2. Orbital Mechanics

**Standards:****Wisconsin Technology and Engineering Standards**

ENG2.b.4.h: A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.

ENG3.a.3.e: Explain troubleshooting is a way of finding out why something does not work so that it can be improved.

ENG3.b.5.h: Describe how many technological problems require a multidisciplinary approach.

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.3.e: Recognize and use everyday symbols such as numbers and symbols to communicate key ideas.

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.

**CCSS**

CCSS.ELA-Literacy.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.

CCSS.ELA-Literacy.WHST.11-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

### Learning Targets:

#### I can...

- Apply concurrent engineering practices to solve problems.
- Work effectively in teams and apply the design process to develop acceptable solutions to problems and case studies.
- Analyze space law based on international agreements designed to promote the use of space for the good of all humankind.
- Apply the laws that govern satellite orbits which also govern celestial body (e.g. comets, planets and moons) orbits.

## Unit #4: Alternative Applications

### Major Topics:

1. Alternative Applications
2. Remote Systems
3. Aerospace Careers

### Standards

#### Wisconsin Technology and Engineering Standards

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.

ENG4.c.3.e: Improve the design solutions.

ENG5.a.6.h: Diagnose a system that is malfunctioning and use tools, materials, or machines to repair it.

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.

#### CCSS

CCSS.ELA-Literacy.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.

CCSS.ELA-Literacy.WHST.11-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

### Learning Targets:

#### I can . . .

- Apply concurrent engineering practices to solve problems.
- Work effectively in teams and apply the design process to develop acceptable solutions to problems and case studies.

- Utilize aerospace concepts traditionally considered applicable to flight and apply them in a variety of applications and industries.
- Understand that remote system design is based upon the integrated system design of mechanical, electrical, and software systems.
- Consider the wide variety of career paths available to students which require careful consideration for future professional success.