AOPA 10th Grade Aviation STEM Curriculum Standard Alignment

In the Aircraft Systems and Performance course, students in the pilot and UAS tracks will take an in-depth look at the systems that make manned and unmanned aircraft work. Beginning with aircraft propulsion, students will learn about the different types of engines that produce thrust to propel an aircraft or UAS. They will go on to explore other key aircraft systems, including fuel, electrical, landing gear, and environmental. In order to fly an aircraft safely, students must also learn about the flight instruments associated with each system and how to identify and troubleshoot common problems. This unit also covers airplane flight manuals, the pilot's operating handbook, and required aircraft documents. Finally, students will complete a project of designing their own airplane, and will explore the benefits of mentorship and work-based learning experiences.

Aircraft Systems and Performance, Semester 2

Unit 7 Propulsion

Description:
To begin their exploration of primary systems found on most manned and unmanned aircraft, students will first learn about the variety of powerplants used in manned and unmanned aircraft, including piston and turbine combustion engines, and electric motors. They will learn how aircraft powerplants are classified and the fundamentals of how different types of powerplants operate.

Next Generation Science Standards

Three-dimensional Learning

- **HS-ETS1-2** - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering
- Science and Engineering Practices
    - Asking Questions and Defining Problems
    - Constructing Explanations and Designing Solutions
  - Disciplinary Core Ideas
    - ETS1.A: Defining and Delimiting Engineering Problems
  - Crosscutting Concepts
    - None

- **HS-ETS1-3** - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
  - Science and Engineering Practices
    - Constructing Explanations and Designing Solutions
  - Disciplinary Core Ideas

■ ETS1.B: Developing Possible Solutions ○ Crosscutting Concepts ■ None
• **HS-PS1-4** - Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. ○ Science and Engineering Practices ■ Developing and Using Models ○ Disciplinary Core Ideas ■ PS1.B Chemical Reactions ○ Crosscutting Concepts ■ Energy and Matter
• **HS-PS3-2 -** Develop and use models to illustrate that energy at the microscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative positions of particles (objects). ○ Science and Engineering Practices ■ Developing and Using Models ○ Disciplinary Core Ideas ■ PS3.A Definitions of Energy ○ Crosscutting Concepts ■ Energy and Matter
• **HS-PS3-3** - Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. ○ Science and Engineering Practices ■ Developing and Using Models ■ Constructing Explanations and Designing Solutions ○ Disciplinary Core Ideas ■ PS3.A Definitions of Energy ■ PS3.B Conservation of Energy and Energy Transfer ○ Crosscutting Concepts ■ Cause and Effect ■ System and System Models ■ Energy and Matter
• **HS-PS3-5 -** Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction. ○ Science and Engineering Practices ■ Developing and Using Models ○ Disciplinary Core Ideas ■ PS3.C Relationship Between Energy and Forces ○ Crosscutting Concepts ■ Systems and System Models ■ Cause and Effect

STANDARDS LIST

Common Core State Standards
HSN.Q.A.1 - Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
RST.9-10.2 - Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
RST.9-10.4 - 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 9-10 texts and topics.
W.9-10.1.D - Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
W.9-10.2.D - Use precise language and domain-specific vocabulary to manage the complexity of the topic.
W.9-10.4 - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
WHST.9-10.6 - Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
WHST.9-10.8 - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
WHST.9-10.9 - Draw evidence from informational texts to support analysis, reflection, and research.

Unit 8 Airframe Systems

Description:

The type of powerplant and the performance requirements determine the type of fuel used in an aircraft. Students will learn about the variety of fuel sources used in aircraft, including JetA, avgas, diesel, and electricity. They also will learn how aircraft fuel systems are designed to accommodate each of these fuel types, the types of instrumentation used to monitor aircraft fuel systems, and how to identify and troubleshoot fuel system issues. In addition, students learn the basics of aircraft electricity, including how it is generated and stored. Heating, hydraulics, landing gear, environmental control systems, and anti/de-ice systems will also be covered.

Next Generation Science Standards

Three-dimensional Learning

STANDARDS LIST

- **HS-ETS1** - Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
    - Science and Engineering Practices
        - Asking Questions and Defining Problems
        - Constructing Explanations and Designing Solutions
    - Disciplinary Core Ideas
        - ETS1.A: Defining and Delimiting Engineering Problems
        - ETS1.B: Developing Possible Solutions
    - Crosscutting Concepts
        - Systems and System Models
- **HS-ETS1-2** - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering
    - Science and Engineering Practices
        - Asking Questions and Defining Problems
        - Constructing Explanations and Designing Solutions
    - Disciplinary Core Ideas
        - ETS1.A: Defining and Delimiting Engineering Problems
        - ETS1.C: Optimizing the Design Solution
    - Crosscutting Concepts
        - None
- **HS-ETS1-3** - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
    - Science and Engineering Practices
        - Constructing Explanations and Designing Solutions
    - Disciplinary Core Ideas
        - ETS1.B: Developing Possible Solutions
    - Crosscutting Concepts
        - None
- **HS-PS2-6** - Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.
    - Science and Engineering Practices
        - Obtaining, Evaluating, and Communicating Information
    - Disciplinary Core Ideas
        - PS1.A: Structure and Properties of Matter
        - PS2.B: Types of Interactions
    - Crosscutting Concepts
        - Cause and Effect
- **HS-PS3-3** - Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy

- Science and Engineering Practices
  - Constructing Explanations and Designing Solutions
- Disciplinary Core Ideas
  - PS3.A: Definitions of Energy
  - ETS1.A: Defining and Delimiting Engineering Problems
- Crosscutting Concepts
  - Cause and Effect
  - Systems and System Models
  - Energy and Matter

- **HS-PS3-5 -** Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
  - Science and Engineering Practices
    - Developing and Using Models
  - Disciplinary Core Ideas
    - PS3.C: Relationship Between Energy and Forces
  - Crosscutting Concepts
    - Systems and System Models
    - Cause and Effect

Common Core State Standards

RST.9-10.2 - Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

RST.9-10.3 - Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

RST.9-10.4 - 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 9-10 texts and topics.

WHST.9-10.1 - Write arguments focused on discipline-specific content.

WHST.9-10.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

WHST.9-10.6 - Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

WHST.9-10.7 - Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

WHST.9-10.8 - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

WHST.9-10.9 - Draw evidence from informational texts to support analysis, reflection, and research.

Unit 9 Avionics and Flight Instructments

Description:

In the first semester, students learned about the importance of air pressure in making aircraft fly. Now they will expand their understanding of air pressure by examining pitot-static systems used to supply key information about airspeed and altitude. Students will learn how pitot-static systems are designed, how they function, the types of instrumentation they supply, and how to troubleshoot common problems. In some aircraft, gyroscopic instruments such as heading indicators, attitude indicators, and turn coordinators may be driven by a vacuum system. Students will learn how vacuum systems function, the types of instruments they drive, and how to troubleshoot common problems. Even in today's world of electronic navigation, the magnetic compass is an essential tool for pilots. Students will learn about the cardinal directions, principles of magnetism, errors associated with magnetic compasses in aircraft, and how to determine a flight course using a magnetic compass.

Next Generation Science Standards

Three-dimensional Learning

- **HS-ETS1-3** - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
    - Science and Engineering Practices
        - Constructing Explanations and Designing Solutions
    - Disciplinary Core Ideas
        - PS2.A: Forces and Motion
        - ETS1.B: Developing Possible Solutions
    - Crosscutting Concepts
        - Structure and Function
        - Interdependence of Science, Engineering, and Technology
- **HS-ETS1-4** - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
    - Science and Engineering Practices
        - Using Mathematics and Computational Thinking
    - Disciplinary Core Ideas
        - ETS1.B: Developing Possible Solutions
    - Crosscutting Concepts
        - Systems and System Models

STANDARDS LIST

- **HS-PS1-5** - Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
    - Science and Engineering Practices
        - Using Mathematics and Computational Thinking
        - Constructing Explanations and Designing Solutions
    - Disciplinary Core Ideas
        - None
    - Crosscutting Concepts
        - Patterns
        - Energy and Matter
        - Stability and Change
- **HS-PS3-2** - Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative positions of particles (objects).
    - Science and Engineering Practices
        - Developing and Using Models
    - Disciplinary Core Ideas
        - PS3.A: Definitions of Energy
    - Crosscutting Concepts
        - Energy and Matter
- **HS-PS3-5** - Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
    - Science and Engineering Practices
        - Developing and Using Models
        - Constructing Explanations and Designing Solutions
    - Disciplinary Core Ideas
        - PS3.C: Relationship Between Energy and Forces
    - Crosscutting Concepts
        - Cause and Effect
        - Systems and System Models
- **HS-PS4-2** - Evaluate questions about the advantages of using a digital transmission and storage of information.
    - Science and Engineering Practices
        - Asking Questions and Defining Problems
        - Engaging in Argument from Evidence
        - Obtaining, Evaluating, and Communicating Information
    - Disciplinary Core Ideas
        - PS4.C: Information Technologies and Instrumentation
    - Crosscutting Concepts
        - Systems and System Models
        - Interdependence of Science, Engineering, and Technology

Common Core State Standards
RST.9-10.2 - Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
RST.9-10.3 - Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
RST.9-10.4 - 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 9-10 texts and topics.
RST.9-10.5 - Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
RST.9-10.8 - Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
MP.1 - Make sense of problems and persevere in solving them.
MP.2 - Reason abstractly and quantitatively.
MP.6 - Attend to precision.
MP.8 - Look for and express regularity in repeated reasoning.
WHST.9-10.1 - Write arguments focused on discipline-specific content.
WHST.9-10.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
WHST.9-10.6 - Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
WHST.9-10.8 - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
WHST.9-10.9 - Draw evidence from informational texts to support analysis, reflection, and research.

Unit 10 Required Documentation

Description:

Knowledge of required documents and manuals is essential for a pilot to conduct a safe flight. In this unit, students will become familiar with required documents pertaining to aircraft ownership, airworthiness, maintenance and operations with inoperative equipment. Students will also learn how to use airplane flight manuals and pilot operating handbooks. By understanding the operations, limitations, and performance characteristics of a particular aircraft, the pilot can make educated flight decisions.

STANDARDS LIST

YOU CAN FLY
AOPA FOUNDATION
HIGH SCHOOLS

Next Generation Science Standards

Three-dimensional Learning

- **HS-ETS1-3** - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
    - Science and Engineering Practices
        - Constructing Explanations and Designing Solutions
    - Disciplinary Core Ideas
        - ETS1.B: Developing Possible Solutions
    - Crosscutting Concepts
        - None

Common Core State Standards

RST.9-10.1 - Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

RST.9-10.2 - Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

RST.9-10.3 - Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

RST.9-10.4 - 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 9-10 texts and topics.

RST.9-10.7 - Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

RST.9-10.9 - Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

WHST.9-10.1 - Write arguments focused on discipline-specific content.

WHST.9-10.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

WHST.9-10.4 - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

WHST.9-10.6 - Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

WHST.9-10.8 - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

WHST.9-10.9 - Draw evidence from informational texts to support analysis, reflection, and research.

Unit 11 End of Semester Project and Career Development

Description:

The tenth grade year culminates in a review of aircraft components and design, a final project, and continued planning for a career in aviation and aerospace. Students will individually answer Private Pilot Knowledge Test questions from previous lessons to jog their memories and begin thinking about how the various aircraft components work together in particular designs to complete missions. Then they will work in pairs to create and present a poster that explains how a particular aircraft system and its components operate for different kinds of aircraft and missions. Students will then divide into teams of 3 or 4, with each team imagining it is launching a new aircraft company that will build a particular type of aircraft to serve a specific purpose or function. In the final lesson, students will explore the value of mentorships and work-based learning experiences.

Next Generation Science Standards

Three-dimensional Learning

- **HS-ETS1-2** - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
    - Science and Engineering Practices
        - Asking Questions and Defining Problems
        - Constructing Explanations and Designing Solutions
    - Disciplinary Core Ideas
        - ETS1.A: Defining and Delimiting Engineering Problems
        - ETS1.B: Developing Possible Solutions
        - ETS1.C: Optimizing the Design Solution
    - Crosscutting Concepts
        - Systems and System Models
- **HS-ETS1-3** - Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
    - Science and Engineering Practices
        - Asking Questions and Defining Problems
        - Constructing Explanations and Designing Solutions
    - Disciplinary Core Ideas
        - ETS1.A: Defining and Delimiting Engineering Problems
        - ETS1.B: Developing Possible Solutions
        - ETS1.C: Optimizing the Design Solution
    - Crosscutting Concepts
        - Systems and System Models

Common Core State Standards

STANDARDS LIST

RST.9-10.2 - Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
RST.9-10.7 - Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
WHST.9-10.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
WHST.9-10.4 - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
WHST.9-10.6 - Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
WHST.9-10.8 - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
WHST.9-10.9 - Draw evidence from informational texts to support analysis, reflection, and research.