

AOPA FOUNDATION HIGH SCHOOL AVIATION STEM CURRICULUM  
STANDARDS LIST



## AOPA 9<sup>th</sup> Grade Aviation STEM Curriculum Standard Alignment

Overview: The ninth-grade course will provide the foundation for advanced exploration in the areas of flying, aerospace engineering, and unmanned aircraft systems. Students will learn about engineering practices, problem solving, and the innovations and technological developments that have made today's aviation and aerospace industries possible. Students will also learn about the wide variety of exciting and rewarding careers available to them. The ninth-grade course will inspire students to consider aviation and aerospace careers while laying the foundation for continued study in grades 10 through 12 and beyond.

### Launching Into Aviation, Semester 1

Unit 1 Aviation 101
<b>Description:</b> Students will explore the different types of aviation at work in the modern world. They'll learn the uses and benefits of various forms of aviation, including commercial, military, private, and drone flying, as well as space exploration. Students will also learn about different types of aircraft, from drones and rockets to airliners and general aviation airplanes. This unit will give students a taste of the exciting and varied career possibilities in these fields.
<b>Next Generation Science Standards</b>
<b>Three-dimensional Learning</b>
HS-ETS1-1 - Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. <ul style="list-style-type: none"><li>• Science and Engineering Practices<ul style="list-style-type: none"><li>○ Asking Questions and Defining Problems</li><li>○ Constructing Explanations and Designing Solutions</li></ul></li><li>• Disciplinary Core Ideas<ul style="list-style-type: none"><li>○ ETS1.A: Defining and Delimiting Engineering Problems</li></ul></li><li>• Crosscutting Concepts<ul style="list-style-type: none"><li>○ Systems and System Models</li><li>○ Influence of Science, Engineering, and Technology on Society and the Natural World</li></ul></li></ul>

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
  - Constructing Explanations and Designing Solutions
- Disciplinary Core Ideas
  - ETS1.C: Optimizing the Design Solution

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
  - Influence of Science, Engineering, and Technology on Society and the Natural World

## Unit 2 Taking Flight—Early Aviation Innovations

### Description:

Students will follow the path of aviation from its primitive beginnings to the dawn of powered flight. They will consider how observing birds influenced the earliest human attempts at flight before moving on to explore the first successful flight technologies, including lighter-than-air aircraft and gliders. The unit will culminate with an understanding of the technologies, innovative engineering, and design processes developed by the Wright Brothers. They'll also examine how the Wright Brothers' approach to problem solving is helping today's engineers address new challenges as they strive to break boundaries in aviation and aerospace.

### Next Generation Science Standards

#### Three-dimensional Learning

HS-ETS1-1 - Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

- 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
  - Systems and System Models
  - Influence of Science, Engineering, and Technology on Society and the Natural World

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
  - Constructing Explanations and Designing Solutions
- Disciplinary Core Ideas
  - ETS1.C: Optimizing the Design Solution

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
  - Influence of Science, Engineering, and Technology on Society and the Natural World

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

HS-LS 1-2 - Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

- Science and Engineering Practices
  - Developing and Using Models
- Disciplinary Core Ideas
  - LS1.A: Structure and Function
- Crosscutting Concepts
  - Systems and System Models

HS-PS2-2 - Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. (NOTE: This standard is not explicitly used as math is not required to complete the exercise).

- Science and Engineering Practices
  - Using Mathematics and Computational Thinking
- Disciplinary Core Ideas
  - PS2.A: Forces and Motion
  - PS2.B: Types of Interactions
- Crosscutting Concepts
  - Systems and System Models

**Common Core State Standards Mathematics**

HSG.MG.A.1 - Use geometric shapes, their measures and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

HSN-Q.A.2 - Define appropriate quantities for the purpose of descriptive modeling.

HSN-Q.A.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

## Unit 3 From Theory to Practical Reality - Rapid Developments in Powered Flight

### Description:

Tracing the dramatic growth in aviation from its first practical applications through its use as an essential military tool, students will learn about the innovations that changed the way aircraft were made and flown. Topics will include the technological developments that led to the first commercial airline service, a transcontinental airmail system, and ultimately the fighters, long-range bombers, and transport aircraft of World War II. Students will learn how engineers, designers, and pilots solved the problems presented by aircraft that could fly further, faster, and higher than ever before.

### Next Generation Science Standards

#### Three-dimensional Learning

HS-ESS3-2 - Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

- Science and Engineering Practices
  - Engaging in Argument from Evidence
- Disciplinary Core Ideas
  - ESS3.A: Natural Resources
  - ETS1.B: Developing Possible Solutions
- Crosscutting Concepts
  - Influence of Science, Engineering, and Technology on Society and the Natural World

HS-ETS1-1 - Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

- 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
  - Systems and System Models
  - Influence of Science, Engineering, and Technology on Society and the Natural World

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
  - Constructing Explanations and Designing Solutions
- Disciplinary Core Ideas
  - ETS1.C: Optimizing the Design Solution

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
  - Influence of Science, Engineering, and Technology on Society and the Natural World

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

## Unit 4 To the Stars - Making Jet and Space Travel Possible

### Description:

Students will learn about the innovations that led to the jet age and consider how the expansion of military technology into the commercial sector led to widespread social changes. They will learn about the space race and the intense political competition that led scientists and engineers to overcome seemingly insurmountable obstacles to take machines and people into space, to the moon, and beyond. They'll look at the problem-solving processes and innovative leaps that took space exploration from the unimaginable to the common in a single generation.

### Next Generation Science Standards

### Three-dimensional Learning

HS-ETS1-1 - Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

- Science and Engineering Practices

<ul style="list-style-type: none"> <li>○ Asking Questions and Defining Problems</li> <li>○ Constructing Explanations and Designing Solutions</li> <li>● Disciplinary Core Ideas <ul style="list-style-type: none"> <li>○ ETS1.A: Defining and Delimiting Engineering Problems</li> </ul> </li> <li>● Crosscutting Concepts <ul style="list-style-type: none"> <li>○ Systems and System Models</li> <li>○ Influence of Science, Engineering, and Technology on Society and the Natural World</li> </ul> </li> </ul>
<p>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.</p> <ul style="list-style-type: none"> <li>● Science and Engineering Practices <ul style="list-style-type: none"> <li>○ Constructing Explanations and Designing Solutions</li> </ul> </li> <li>● Disciplinary Core Ideas <ul style="list-style-type: none"> <li>○ ETS1.C: Optimizing the Design Solution</li> </ul> </li> </ul>
<p>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.</p> <ul style="list-style-type: none"> <li>● Science and Engineering Practices <ul style="list-style-type: none"> <li>○ Constructing Explanations and Designing Solutions</li> </ul> </li> <li>● Disciplinary Core Ideas <ul style="list-style-type: none"> <li>○ ETS1.B: Developing Possible Solutions</li> </ul> </li> <li>● Crosscutting Concepts <ul style="list-style-type: none"> <li>○ Influence of Science, Engineering, and Technology on Society and the Natural World</li> </ul> </li> </ul>
<p>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.</p> <ul style="list-style-type: none"> <li>● Science and Engineering Practices <ul style="list-style-type: none"> <li>○ Using Mathematics and Computational Thinking</li> </ul> </li> <li>● Disciplinary Core Ideas <ul style="list-style-type: none"> <li>○ ETS1.B: Developing Possible Solutions</li> </ul> </li> <li>● Crosscutting Concepts <ul style="list-style-type: none"> <li>○ Systems and System Models</li> </ul> </li> </ul>
<p><b>Common Core State Standards Mathematics</b></p>
<p>HSA-REI.B.3 - Solve equations and inequalities in one variable.</p>
<p>HSG.MG.A.1 - Use geometric shapes, their measures and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).</p>
<p>HSN-Q.A.1 - Reason quantitatively and use units to solve problems.</p>

## Unit 5 Creating the Future - What's New and Next in Aviation and Aerospace

### Description:

Modern aircraft navigation, fly-by-wire, “glass” cockpits, and composite structural materials are among the key innovations that students will explore as they consider how aviation continues to advance. Students will also look at how space exploration has changed as commercial enterprises have moved into that arena. The unit and the semester will culminate in a project in which students use their new understanding of aviation technology to design, build, and defend a museum exhibit based on the topics discussed during the semester.

### Next Generation Science Standards

#### Three-dimensional Learning

HS-ETS1-1 - Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

- 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
  - Systems and System Models
  - Influence of Science, Engineering, and Technology on Society and the Natural World

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
  - Constructing Explanations and Designing Solutions
- Disciplinary Core Ideas
  - ETS1.C: Optimizing the Design Solution

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
  - Influence of Science, Engineering, and Technology on Society and the Natural World

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

### **Common Core State Standards Mathematics**

HSA-REI.B.3 - Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

HSN.Q.A.2 - Define appropriate quantities for the purpose of descriptive modeling.

### **Standards for Mathematical Practice**

CCSS.MATH.CONTENT.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.

CCSS.MATH.CONTENT.HSN.Q.A.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

CCSS.MATH.PRACTICE.MP4 - Model with mathematics