AOPA FOUNDATION HIGH SCHOOL AVIATION STEM CURRICULUM

PACING GUIDE

YOU CAN FLY
AOPA FOUNDATION
HIGH SCHOOLS

STEM REVIEWED
STEM ACCREDITED

NINTH GRADE CURRICULUM

LAUNCHING INTO AVIATION
SEMESTER ONE

Unit 1: Aviation 101

		No. of Sessions Per Lesson	Day of Semester
Pre-Course Exam		1	1
Section A – Introduction to Aviation and Aerospace			
Lesson 1	Introduction to Aerospace Studies	1	2
Lesson 2	Engineering Practices in Action	3	5
Lesson 3	Aviation Careers Are For You!	1	6
Section B – Overview of Commercial, Military, and General Aviation			
Lesson 1	Introduction to Commercial Aviation	1	7
Lesson 2	Introduction to Military Aviation	1	8
Lesson 3	Introduction to General Aviation	1	9
Section C – Introduction to Unmanned Aircraft Systems			
Lesson 1	UAS Fundamentals	2	11
Lesson 2	UAS Operation and Safety	1	12
Section D – Introduction to Space Exploration			
Lesson 1	Current and Future Space Exploration	3	15
Unit 1 Exam		1	16

Total Sessions Unit 1 **16**
Semester Total **16**

*If the course is off pace for your school/schedule, we recommended that lessons denoted by an asterisk could be shortened or skipped.

updated 7.20.21

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Unit 2: Taking Flight—Early Aviation Innovations

		No. of Sessions Per Lesson	Day of Semester
Section A – Aviation's Primitive Beginnings			
Lesson 1	Flight in Greek Mythology	1	17
Lesson 2	Da Vinci and His Flying Machines	2	19
Section B – Lighter Than Air			
Lesson 1	Hot Air and Gas Ballooning	4	23
Section C – Gliders			
Lesson 1	From Birds to Gliders	1	24
Lesson 2	Glider Flight and Early Innovators	3	27
Section D – Powered, Controlled Flight			
Lesson 1	The "Wright" Approach	2	29
Lesson 2	Build and Test a Wind Tunnel	6	35
Lesson 3	The "Wright" Attitude	1	36
Unit 2 Exam		1	37

Total Sessions Unit 2 **21**
Semester Total **37**

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Unit 3: From Theory to Practical Reality—Rapid Developments in Powered Flight

		No. of Sessions Per Lesson	Day of Semester
Section A – First Practical Applications of Airplanes, Commercial and Military			
Lesson 1	Beginnings of U.S. Commercial Airline Service	1	38
Lesson 2	Aviation and World War I	2	40
Lesson 3	Airmail and the Transcontinental Airway System	1	41
Section B – Women in Early Aviation			
Lesson 1	Women in Early Aviation	2	43
Section C – World War II			
Lesson 1	Aviation Innovation and World War II	3	46
Lesson 2	One For All, All For One	2	48
Unit 3 Exam		1	49

Total Sessions Unit 3 **12**
Semester Total **49**

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Unit 4: To the Stars—Making Jet and Space Travel Possible

		No. of Sessions Per Lesson	Day of Semester
Section A – The Jet Age			
Lesson 1	Development of the Jet Engine	3	52
Lesson 2	Commercial Air Travel	2	54
Section B – The Space Race			
Lesson 1	The Space Race Begins	1	55
Lesson 2	To the Moon	3	58
Lesson 3	The Space Race Winds Down	1	59
Lesson 4	The Shuttle Program	2	61
Unit 4 Exam		1	62

Total Sessions Unit 4 **13**
Semester Total **62**

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Unit 5: Creating the Future—What's New and Next in Aviation and Aerospace

		No. of Sessions Per Lesson	Day of Semester
Section A – Modern Aircraft Design			
Lesson 1	Fly-by-Wire and "Glass" Cockpits*	1	63
Lesson 2	Aircraft Navigation	1	64
Lesson 3	Composites and Structures	1	65
Section B – Government and Commercial Space			
Lesson 1	Government and Commercial Space	1	66
Section C – End of Semester Project			
Lesson 1	End of Semester Project	5	71
Unit 5 Exam		1	72
Post-Course Exam		1	73

Total Sessions Unit 5 11
Semester Total 73

*If the course is off pace for your school/schedule, we recommended that lessons denoted by an asterisk could be shortened or skipped.

updated 7.20.21

AOPA FOUNDATION HIGH SCHOOL AVIATION STEM CURRICULUM

STANDARDS LIST

AOPA 9th 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
Description: 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.
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
  o Asking Questions and Defining Problems
  o Constructing Explanations and Designing Solutions
• Disciplinary Core Ideas
  o ETS1.A: Defining and Delimiting Engineering Problems
• Crosscutting Concepts
  o Systems and System Models
  o 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

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

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- 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 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

- Asking Questions and Defining Problems
- Constructing Explanations and Designing Solutions

- Disciplinary Core Ideas
  - ETS1.A: Defining and Delimiting Engineering Problems
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  - 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 equations and inequalities in one variable.

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.1 - Reason quantitatively and use units to solve problems.

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
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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
  o Using Mathematics and Computational Thinking
• Disciplinary Core Ideas
  o ETS1.B: Developing Possible Solutions
• Crosscutting Concepts
  o 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