

CAREER CLUSTER:
CAREER PATHWAY:
COURSE TITLE: 28.01910 Flight Science

Government & Public Administration
JROTC – Air Force
Air Force Junior ROTC Curriculum

Course Description:

Flight Science focuses on how airplanes fly, how weather conditions affect flight, flight and the human body, and flight navigation. The course is designed to complement materials taught in math, physics, and other science related courses and support a Science, Technology, Engineering, and Mathematics (STEM) education. It is aligned with the *National Science Education Standards*, the national *Math Standards and Expectations*, and *ISTE National Educational Technology Standards for Students*. Throughout the course there are individual and group activities, technology enrichment, *Microsoft Flight Simulator* activities, readings, review questions, video segments, and assessments to guide in the reinforcement of the materials. A CD with the *Classroom Performance System (CPS)* by *eInstruction* files and other electronic files is located inside the instructor guide (IG).

CHAPTER ONE, LESSON ONE
<p>Lesson Title: Principles of Flight</p> <p>Learning Outcome: Outline the principles of flight</p> <p>Linked Course Outcome: Analyze the elements of flight</p>
<p>Learning Objectives:</p> <p>Students will learn the following knowledge, concepts, principles, and processes in this lesson:</p> <ol style="list-style-type: none">1. Describe the theory of flight2. Describe airfoils and flight3. Explain how Newton's Laws of Motion relate to aircraft design4. Relate the Bernoulli Principle to airfoils and flight5. Describe the effects of relative wind on flight6. Describe the characteristics of angle of attack on flight
<p>Linked <i>National Science Education Standards</i></p> <ol style="list-style-type: none">1. <u>Unifying Concepts and Processes In Science</u><ol style="list-style-type: none">1.a. Systems, order, and organization1.b. Evidence, models, and explanation1.c. Change, constancy, and measurement1.d. Evolution and equilibrium1.e. Form and function2. <u>Science as Inquiry</u><ol style="list-style-type: none">2.a. Abilities necessary to do scientific inquiry2.b. Understanding about scientific inquiry3. <u>Physical Science</u><ol style="list-style-type: none">3.d. Motions and forces5. <u>Earth and Space Science</u><ol style="list-style-type: none">5.a. Energy in the earth system6. <u>Science and Technology</u><ol style="list-style-type: none">6.a. Abilities of technological design6.b. Understanding about science and technology8. <u>History and Nature of Science</u>

- 8.a. Science as a human endeavor
- 8.b. Nature of scientific knowledge
- 8.c. Historical perspectives

Linked Math Standards and Expectations

Numbers and Operations

- 1. Understand numbers, ways of representing numbers, relationships among numbers, and number systems
 - 1.b. Compare and contrast the properties of numbers and number systems, including the rational and real numbers, and understand complex numbers as solutions to quadratic equations that do not have real solutions;
- 2. Understand meanings of operations and how they relate to one another
 - 2.a. Judge the effects of such operations as multiplication, division, and computing powers and roots on the magnitudes of quantities
 - 2.b. Develop an understanding of properties of, and representations for, the addition and multiplication of vectors and matrices
- 3. Compute fluently and make reasonable estimates
 - 3.a. Develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more-complicated cases

Geometry

- 1. Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships
 - 1.a. Analyze properties and determine attributes of two- and three-dimensional objects
- 4. Use visualization, spatial reasoning, and geometric modeling to solve problems
 - 4.a. Draw and construct representations of two- and three-dimensional geometric objects using a variety of tools
 - 4.b. Visualize three-dimensional objects and spaces from different perspectives and analyze their cross sections
 - 4.d. Use geometric models to gain insights into, and answer questions in, other areas of mathematics

Measurement

- 1. Understand measurable attributes of objects and the units, systems, and processes of measurement
 - 1.a. Make decisions about units and scales that are appropriate for problem situations involving measurement
- 2. Apply appropriate techniques, tools, and formulas to determine measurements.
 - 2.b. Understand and use formulas for the area, surface area, and volume of geometric figures, including cones, spheres, and cylinders

Process

- 1. Problem Solving
 - 1.a. Build new mathematical knowledge through problem solving
 - 1.b. Solve problems that arise in mathematics and in other contexts
 - 1.c. Apply and adapt a variety of appropriate strategies to solve problems
- 4. Connections
 - 4.a. Recognize and use connections among mathematical ideas
 - 4.b. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
 - 4.c. Recognize and apply mathematics in contexts outside of mathematics

CHAPTER ONE, LESSON TWO

Lesson Title: The Physics of Flight

Learning Outcome: Determine the relationship between the four forces of flight and flight stability

Linked Course Outcome: Analyze the Elements of Flight

Learning Objectives:

Students will learn the following knowledge, concepts, principles, and processes in this lesson:

1. Explain how lift is generated
2. Determine how weight affects flight
3. Explain how thrust affects an aircraft's movement
4. Explain how drag slows an aircraft
5. Explain how the four forces of flight interact with each other

Linked *National Science Education Standards*

1. Unifying Concepts and Processes In Science
 - 1.a. Systems, order, and organization
 - 1.b. Evidence, models, and explanation
 - 1.c. Change, constancy, and measurement
 - 1.d. Evolution and equilibrium
 - 1.e. Form and function
2. Science as Inquiry
 - 2.a. Abilities necessary to do scientific inquiry
 - 2.b. Understanding about scientific inquiry
3. Physical Science
 - 3.d. Motions and forces
 - 3.f. Interactions of energy and matter
6. Science and Technology
 - 6.a. Abilities of technological design
 - 6.b. Understanding about science and technology

Linked *Math Standards and Expectations*Numbers and Operations

1. Understand numbers, ways of representing numbers, relationships among numbers, and number systems
 - 1.b. Compare and contrast the properties of numbers and number systems, including the rational and real numbers, and understand complex numbers as solutions to quadratic equations that do not have real solutions;
 - 1.d. Use number-theory arguments to justify relationships involving whole numbers
2. Understand meanings of operations and how they relate to one another
 - 2.a. Judge the effects of such operations as multiplication, division, and computing powers and roots on the magnitudes of quantities;
 - 2.b. Develop an understanding of properties of, and representations for, the addition and multiplication of vectors and matrices;
3. Compute fluently and make reasonable estimates
 3. a. Develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more-complicated cases.

Process

1. Problem Solving
 - 1.a. Build new mathematical knowledge through problem solving
 - 1.b. Solve problems that arise in mathematics and in other contexts
 - 1.c. Apply and adapt a variety of appropriate strategies to solve problems
4. Connections
 - 4.a Recognize and use connections among mathematical ideas
 - 4.b. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
 - 4.c. Recognize and apply mathematics in contexts outside of mathematics

Linked *National Educational Technology Standards for Students (NETS•S)*

1. Creativity and Innovation: Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students:
 1. c. Use models and simulations to explore complex systems and issues.
 1. d. Identify trends and forecast possibilities.
2. Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students:
 2. b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
 2. d. Contribute to project teams to produce original works or solve problems.
3. Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information. Students:
 3. a. Plan strategies to guide inquiry.
 3. c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.
 3. d. Process data and report results.
4. Critical Thinking, Problem Solving, and Decision Making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students:
 4. a. Identify and define authentic problems and significant questions for investigation.
 4. b. Plan and manage activities to develop a solution or complete a project.
 4. c. Collect and analyze data to identify solutions and/or make informed decisions.
6. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems, and operations. Students:
 6. b. Select and use applications effectively and productively.
 6. d. Transfer current knowledge to learning of new technologies.

CHAPTER ONE, LESSON THREE

Lesson Title: The Purpose and Function of Airplane Parts

Learning Outcome: Relate the parts of the airplane to their function in flight

Linked Course Outcome: Analyze the elements of flight

Learning Objectives:

Students will learn the following knowledge, concepts, principles, and processes in this lesson:

7. Relate how the fuselage and wing shape correspond to an aircraft's mission
8. Explain the types, purpose, and function of airfoil design
9. Analyze the role of stabilizers and rudders
10. Analyze the positions of flaps, spoilers, and slats on an aircraft
11. Explain how the airflow and airfoil affect flight movement
12. Differentiate between the purpose and function of propellers, turbines, ramjets, and rocket propulsion systems

Linked *National Science Education Standards*

1. Unifying Concepts and Processes In Science
 - 1.a. Systems, order, and organization
 - 1.b. Evidence, models, and explanation
 - 1.c. Change, constancy, and measurement
 - 1.d. Evolution and equilibrium
 - 1.e. Form and function
2. Science as Inquiry
 - 2.a. Abilities necessary to do scientific inquiry
 - 2.b. Understanding about scientific inquiry

3. Physical Science

3.d. Motions and forces

3.f. Interactions of energy and matter

6. Science and Technology

6.a. Abilities of technological design

6.b. Understanding about science and technology

Linked Math Standards and Expectations

Geometry

1. Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships

1.a. Analyze properties and determine attributes of two- and three-dimensional objects;

1.b. Explore relationships (including congruence and similarity) among classes of two- and three-dimensional geometric objects, make and test conjectures about them, and solve problems involving them;

4. Use visualization, spatial reasoning, and geometric modeling to solve problems

4.a. Draw and construct representations of two- and three-dimensional geometric objects using a variety of tools

4.b. Visualize three-dimensional objects and spaces from different perspectives and analyze their cross sections;

4.d. Use geometric models to gain insights into, and answer questions in, other areas of mathematics;

Measurement

1. Understand measurable attributes of objects and the units, systems, and processes of measurement

1.a. Make decisions about units and scales that are appropriate for problem situations involving measurement

2. Apply appropriate techniques, tools, and formulas to determine measurements

2.b. Understand and use formulas for the area, surface area, and volume of geometric figures, including cones, spheres, and cylinders;

Process

1. Problem Solving

1.a. Build new mathematical knowledge through problem solving

1.b. Solve problems that arise in mathematics and in other contexts

1.c. Apply and adapt a variety of appropriate strategies to solve problems

4. Connections

4.a. Recognize and use connections among mathematical ideas

4.b. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole

4.c. Recognize and apply mathematics in contexts outside of mathematics

Linked National Educational Technology Standards for Students (NETS•S)

1. Creativity and Innovation: Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students:

1. c. Use models and simulations to explore complex systems and issues.

2. Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students:

2. b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.

2. d. Contribute to project teams to produce original works or solve problems.

3. Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information. Students:

3. c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.

3. d. Process data and report results.

4. Critical Thinking, Problem Solving, and Decision Making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students:

- 4. a. Identify and define authentic problems and significant questions for investigation.
- 4. b. Plan and manage activities to develop a solution or complete a project.
- 4. c. Collect and analyze data to identify solutions and/or make informed decisions.
- 6. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems, and operations. Students:
 - 6. a. Understand and use technology systems.
 - 6. b. Select and use applications effectively and productively.
 - 6. d. Transfer current knowledge to learning of new technologies.

CHAPTER ONE, LESSON FOUR

Lesson Title: Aircraft Motion and Control

Learning Outcome: Analyze aircraft motion and control

Linked Course Outcome: Analyze the elements of flight

Learning Objectives:

Students will learn the following knowledge, concepts, principles, and processes in this lesson:

- 13. Explain the axes of rotation and how the primary flight controls work
- 14. Explain the effects of flaps on flight
- 15. Determine the effects of slats on flight
- 16. Determine the effects of spoilers on flight
- 17. Determine the elements of controlled flight

Linked *National Science Education Standards*

- 1. Unifying Concepts and Processes In Science
 - 1.a. Systems, order, and organization
 - 1.b. Evidence, models, and explanation
 - 1.c. Change, constancy, and measurement
 - 1.e. Form and function
- 2. Science as Inquiry
 - 2.a. Abilities necessary to do scientific inquiry
 - 2.b. Understanding about scientific inquiry
- 3. Physical Science
 - 3.c. Chemical reactions
 - 3.d. Motions and forces
 - 3.e. Conservation of energy and increase in disorder
 - 3.f. Interactions of energy and matter
- 6. Science and Technology
 - 6.a. Abilities of technological design
 - 6.b. Understanding about science and technology
- 8. History and Nature of Science
 - 8.a. Science as a human endeavor
 - 8.b. Nature of scientific knowledge

Linked *National Educational Technology Standards for Students (NETS•S)*

- 2. Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students:
 - 2. b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
 - 2. d. Contribute to project teams to produce original works or solve problems.
- 6. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems, and operations. Students:
 - 6. b. Select and use applications effectively and productively.
 - 6. d. Transfer current knowledge to learning of new technologies.

CHAPTER ONE, LESSON FIVE

Lesson Title: Flight Power

Learning Outcome: Compare and contrast the types of airplane engines

Linked Course Outcome: Analyze the elements of flight

Learning Objectives:

Students will learn the following knowledge, concepts, principles, and processes in this lesson:

18. Compare the principles of Boyle's Law, Charles's Law, and Gay-Lussac's Law
19. Differentiate among the characteristics of internal combustion engines
20. Describe the mechanical, cooling, and ignition systems of reciprocating engines
21. Explain how the different types of jet engines work
22. Describe the role of reversers and suppressors used in jet aircraft
23. Distinguish among reaction engines
24. Investigate the development of new engine technology

Linked *National Science Education Standards*

1. Unifying Concepts and Processes In Science
 - 1.a. Systems, order, and organization
 - 1.b. Evidence, models, and explanation
 - 1.c. Change, constancy, and measurement
 - 1.e. Form and function
2. Science as Inquiry
 - 2.a. Abilities necessary to do scientific inquiry
 - 2.b. Understanding about scientific inquiry
3. Physical Science
 - 3.c. Chemical reactions
 - 3.d. Motions and forces
 - 3.e. Conservation of energy and increase in disorder
6. Science and Technology
 - 6.a. Abilities of technological design
 - 6.b. Understanding about science and technology
7. Science in Personal and Social Perspectives
 - 7.d. Environmental quality

Linked *Math Standards and Expectations*

Process

1. Problem Solving
 - 1.a. Build new mathematical knowledge through problem solving
 - 1.b. Solve problems that arise in mathematics and in other contexts
4. Connections
 - 4.a. Recognize and use connections among mathematical ideas
 - 4.b. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
 - 4.c. Recognize and apply mathematics in contexts outside of mathematics

Linked *National Educational Technology Standards for Students (NETS-S)*

1. Creativity and Innovation: Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students:
 1. c. Use models and simulations to explore complex systems and issues.

- 2. Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students:
 - 2. b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
 - 2. d. Contribute to project teams to produce original works or solve problems.
- 3. Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information. Students:
 - 3. c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.
 - 3. d. Process data and report results.
- 6. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems, and operations. Students:
 - 6. b. Select and use applications effectively and productively.
 - 6. d. Transfer current knowledge to learning of new technologies.

CHAPTER ONE, LESSON SIX

Lesson Title: Aviation Innovation

Learning Outcome: Identify the forces that drive the development of aerospace technology

Linked Course Outcome: Analyze the elements of flight

Learning Objectives:

Students will learn the following knowledge, concepts, principles, and processes in this lesson:

- 25. Recognize the latest topics of aviation research
- 26. Explain the use of remotely piloted vehicles
- 27. Investigate the most recent innovations in aircraft design

Linked *National Science Education Standards*

- 1. Unifying Concepts and Processes In Science
 - 1.a. Systems, order, and organization
 - 1.b. Evidence, models, and explanation
 - 1.e. Form and function
- 2. Science as Inquiry
 - 2.a. Abilities necessary to do scientific inquiry
 - 2.b. Understanding about scientific inquiry
- 3. Physical Science
 - 3.c. Chemical reactions
 - 3.d. Motions and forces
 - 3.e. Conservation of energy and increase in disorder
 - 3.f. Interactions of energy and matter
- 6. Science and Technology
 - 6.a. Abilities of technological design
 - 6.b. Understanding about science and technology
- 7. Science in Personal and Social Perspectives
 - 7.d. Environmental quality
 - 7.f. Science and technology in local, national, and global challenges
- 8. History and Nature of Science
 - 8.a. Science as a human endeavor
 - 8.b. Nature of scientific knowledge
 - 8.c. Historical perspectives

Linked *National Educational Technology Standards for Students (NETS•S)*

2. Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students:
2. b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
3. Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information. Students:
3. c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.
6. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems, and operations. Students:
6. a. Understand and use technology systems.
6. b. Select and use applications effectively and productively.

CHAPTER TWO, LESSON ONE

Lesson Title: The Atmosphere

Learning Outcome: Analyze the atmosphere's makeup

Linked Course Outcome: Evaluate how atmospheric conditions affect flight

Learning Objectives:

Students will learn the following knowledge, concepts, principles, and processes in this lesson:

1. Characterize the atmosphere's regions
2. Describe the roles of water and particulate matter in the atmosphere
3. Analyze the primary causes of atmospheric motion
4. Distinguish among the types of clouds
5. Analyze how the atmospheric layers impact flight

Linked *National Science Education Standards*

1. Unifying Concepts and Processes In Science
 - 1.a. Systems, order, and organization
 - 1.c. Change, constancy, and measurement
2. Science as Inquiry
 - 2.a. Abilities necessary to do scientific inquiry
 - 2.b. Understanding about scientific inquiry
6. Science and Technology
 - 6.a. Abilities of technological design
 - 6.b. Understanding about science and technology
8. History and Nature of Science
 - 8.a. Science as a human endeavor
 - 8.b. Nature of scientific knowledge
 - 8.c. Historical perspectives

Linked *National Educational Technology Standards for Students (NETS•S)*

3. Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information. Students:
 3. c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.
 3. d. Process data and report results.

CHAPTER TWO, LESSON TWO

<p>Lesson Title: Weather Elements</p> <p>Learning Outcome: Analyze atmospheric components and their effect on weather</p> <p>Linked Course Outcome: Evaluate how atmospheric conditions affect flight</p>
<p>Learning Objectives:</p> <p>Students will learn the following knowledge, concepts, principles, and processes in this lesson:</p> <ol style="list-style-type: none"> 28. Explain types of air masses and fronts 29. Determine factors that impact air mass 30. Assess how high- and low-pressure systems are key factors in wind and atmospheric motion 31. Explain how fronts are boundaries between air masses 32. Describe terrain factors that affect weather
<p>Linked <i>National Science Education Standards</i></p> <ol style="list-style-type: none"> 5. <u>Earth and Space Science</u> <ol style="list-style-type: none"> 5.a. Energy in the Earth system 8. <u>History and Nature of Science</u> <ol style="list-style-type: none"> 8.a. Science as a human endeavor 8.b. Nature of scientific knowledge
<p>Linked <i>National Educational Technology Standards for Students (NETS•S)</i></p> <ol style="list-style-type: none"> 2. <u>Communication and Collaboration:</u> Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students: <ol style="list-style-type: none"> 2. b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats. 3. <u>Research and Information Fluency:</u> Students apply digital tools to gather, evaluate, and use information. Students: <ol style="list-style-type: none"> 3. c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks. 6. <u>Technology Operations and Concepts:</u> Students demonstrate a sound understanding of technology concepts, systems, and operations. Students: <ol style="list-style-type: none"> 6. a. Understand and use technology systems. 6. b. Select and use applications effectively and productively.
<p>CHAPTER TWO, LESSON THREE</p>
<p>Lesson Title: Aviation Weather</p> <p>Learning Outcome: Evaluate the role of weather on air flight</p> <p>Linked Course Outcome: Evaluate how atmospheric conditions affect flight</p>
<p>Learning Objectives:</p> <p>Students will learn the following knowledge, concepts, principles, and processes in this lesson:</p> <ol style="list-style-type: none"> 1. Explain causes of atmospheric instability 2. Describe types and causes of turbulence 3. Characterize how types of severe weather affect aviation
<p>Linked <i>National Science Education Standards</i></p> <ol style="list-style-type: none"> 1. <u>Unifying Concepts and Processes in Science</u> <ol style="list-style-type: none"> 1.b. Evidence, models, and explanation 1.c. Change, constancy, and measurement 2. <u>Science as Inquiry</u> <ol style="list-style-type: none"> 2.a. Abilities necessary to do scientific inquiry 2.b. Understanding about scientific inquiry
<p>Linked <i>Math Standards and Expectations</i></p> <p><u>Numbers and Operations</u></p> <ol style="list-style-type: none"> 2. Understand meanings of operations and how they relate to one another

2.b. Develop an understanding of properties of, and representations for, the addition and multiplication of vectors and matrices

3. Compute fluently and make reasonable estimates

3a. Develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more-complicated cases

Data Analysis and Probability

4. Understand and apply basic concepts of probability

4.a. Understand the concepts of sample space and probability distribution and construct sample spaces and distributions in simple cases

Process

1. Problem Solving

1.a. Build new mathematical knowledge through problem solving

1.b. Solve problems that arise in mathematics and in other contexts

1.c. Apply and adapt a variety of appropriate strategies to solve problems

3. Communication

3.a. Organize and consolidate their mathematical thinking through communication

3.b. Communicate their mathematical thinking coherently and clearly to peers, teachers, and others

4. Connections

4.a. Recognize and use connections among mathematical ideas

4.b. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole

4.c. Recognize and apply mathematics in contexts outside of mathematics

Linked *National Educational Technology Standards for Students (NETS•S)*

2. Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students:

2b. communicate information and ideas effectively to multiple audiences using a variety of media and formats.

3. Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information. Students:

3a. plan strategies to guide inquiry.

3b. locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.

3c. evaluate and select information sources and digital tools based on the appropriateness to specific tasks.

3d. process data and report results.

4. Critical Thinking, Problem Solving, and Decision Making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students:

4a. identify and define authentic problems and significant questions for investigation.

4c. collect and analyze data to identify solutions and/or make informed decisions.

6. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems, and operations. Students:

6a. understand and use technology systems.

6b. select and use applications effectively and productively.

CHAPTER TWO, LESSON FOUR

Lesson Title: Weather Forecasting

Learning Outcome: Forecast stable and unstable conditions for air flight

Linked Course Outcome: Evaluate how atmospheric conditions affect flight

Learning Objectives:

Students will learn the following knowledge, concepts, principles, and processes in this lesson:

- 33. Outline the history of weather forecasting
- 34. Identify the types of instruments used in weather forecasting
- 35. Analyze the various types of communication methods used to provide weather information

Linked *National Science Education Standards*

- 2. Science as Inquiry
 - 2.a. Abilities necessary to do scientific inquiry
 - 2.b. Understanding about scientific inquiry
- 6. Science and Technology
 - 6.a. Abilities of technological design
 - 6.b. Understanding about science and technology
- 8. History and Nature of Science
 - 8.a. Science as a human endeavor
 - 8.b. Nature of scientific knowledge
 - 8.c. Historical perspectives

Linked *National Educational Technology Standards for Students (NETS•S)*

- 2. Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students:
 - 2. a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.
 - 2. b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
- 3. Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information. Students:
 - 3. d. Process data and report results.
- 4. Critical Thinking, Problem Solving, and Decision Making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students:
 - 4.c. Collect and analyze data to identify solutions and/or make informed decisions

CHAPTER TWO, LESSON FIVE

Lesson Title: The Effects of Weather on Aircraft

Learning Outcome: Assess the role of meteorology in aviation

Linked Course Outcome: Evaluate how atmospheric conditions affect flight

Learning Objectives:

Students will learn the following knowledge, concepts, principles, and processes in this lesson:

- 36. Determine how ice impacts flight
- 37. Explain how a microburst can induce wind shear on an aircraft
- 38. Examine how sandstorms can be hazardous to air flight
- 39. Analyze how wake turbulence affects air flight

Linked *National Science Education Standards*

- 1. Unifying Concepts and Processes in Science
 - 1.b. Evidence, models, and explanation
 - 1.c. Change, constancy, and measurement
- 2. Science as Inquiry
 - 2.a. Abilities necessary to do scientific inquiry
 - 2.b. Understanding about scientific inquiry
- 8. History and Nature of Science
 - 8.a. Science as a human endeavor

- 8.b. Nature of scientific knowledge
- 8.c. Historical perspectives

Linked National Educational Technology Standards for Students (NETS•S)

2. Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students
- 2. a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.
3. Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information. Students:
- 3. b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
 - 3. d. Process data and report results.

CHAPTER THREE, LESSON ONE

Lesson Title: Human Physiology and Air Flight

Learning Outcome: Relate the flight environment to the human body

Linked Course Outcome: Evaluate how flight affects the human body

Learning Objectives:

Students will learn the following knowledge, concepts, principles, and processes in this lesson:

1. Describe the four zones of the flight environment
2. Differentiate between the physical laws of gases according to Boyle's law, Dalton's law, and Henry's law
3. Describe the respiration and circulation processes
4. Identify the effects on the human body of reduced pressure at high altitude
5. Distinguish among the effects on the human body of acceleration and deceleration or increased g-forces
6. Define spatial disorientation and motion sickness
7. Describe other stresses of flight operations

Linked National Science Education Standards

1. Unifying Concepts and Processes In Science
 - 1.a. Systems, order, and organization
 - 1.c. Change, constancy, and measurement
2. Science as Inquiry
 - 2.a. Abilities necessary to do scientific inquiry
3. Physical Science
 - 3.c. Chemical reactions
 - 3.d. Motions and forces
4. Life Science
 - 4.e. Matter, energy, and organization in living systems
8. History and Nature of Science
 - 8.a. Science as a human endeavor

Linked Math Standards and Expectations

Process

1. Problem Solving
 - 1.a. Build new mathematical knowledge through problem solving

- 1.b. Solve problems that arise in mathematics and in other contexts
- 1.c. Apply and adapt a variety of appropriate strategies to solve problems
- 4. Connections
- 4.c. Recognize and apply mathematics in contexts outside of mathematics

Linked National Educational Technology Standards for Students (NETS•S)

- 2. Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students:
 - 2. b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
- 3. Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information. Students:
 - 3. c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.
- 6. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems, and operations. Students:
 - 6. a. Understand and use technology systems.
 - 6. b. Select and use applications effectively and productively.

CHAPTER THREE, LESSON TWO

Lesson Title: Protective Equipment and Aircrew Training

Learning Outcome: Analyze the purpose and function of personal protective equipment

Linked Course Outcome: Evaluate how flight affects the human body

Learning Objectives:

Students will learn the following knowledge, concepts, principles, and processes in this lesson:

- 8. Describe the protective equipment used by pilots and astronauts
- 9. Explain the function and use of flight simulators

Linked National Science Education Standards

- 1. Unifying Concepts and Processes In Science
 - 1.a. Systems, order, and organization
 - 1.b. Evidence, models, and explanation
 - 1.d. Evolution and equilibrium
 - 1.e. Form and function
- 3. Physical Science
 - 3.b. Structure and properties of matter
 - 3.d. Motions and forces
 - 3.f. Interactions of energy and matter
- 4. Life Science
 - 4.e. Matter, energy, and organization in living systems
- 6. Science and Technology Education
 - 6.b. Understanding about science and technology

Linked National Educational Technology Standards for Students (NETS•S)

- 2. Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students:
 - 2. b. communicate information and ideas effectively to multiple audiences using a variety of media and formats.
- 3. Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information. Students:
 - 3. b. locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.

6. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems, and operations. Students:
6a. understand and use technology systems.
6b. select and use applications effectively and productively.

CHAPTER FOUR, LESSON ONE

Lesson Title: Navigational Elements

Learning Outcome: Analyze the four elements of navigation

Linked Course Outcome: Analyze flight navigation and the purpose of aerial navigation aids

Learning Objectives:

Students will learn the following knowledge, concepts, principles, and processes in this lesson:

6. Explain the history of navigation and navigation instruments
7. Relate the Earth's size and shape to navigation
8. Correlate latitude and longitude to flight position
9. Explain how to determine navigational direction
10. Describe chart projection characteristics
11. Explain how chart projections are used in navigation
12. Explain the problems associated with projections

Linked *National Science Education Standards*

1. Unifying Concepts and Processes In Science
 - 1.c. Change, constancy, and measurement
5. Earth and Space Science
 - 5.a. Energy in the earth system
6. Science and Technology
 - 6.a. Abilities of technological design
 - 6.b. Understanding about science and technology

Linked *Math Standards and Expectations*

Geometry

2. Specify locations and describe spatial relationships using coordinate geometry and other representational systems
 - 2.a. Use Cartesian coordinates and other coordinate systems, such as navigational, polar, or spherical systems, to analyze geometric situations

Measurement

1. Understand measurable attributes of objects and the units, systems, and processes of measurement
 - 1.a. Make decisions about units and scales that are appropriate for problem situations involving measurement

Process

1. Problem Solving
 - 1.b. Solve problems that arise in mathematics and in other contexts
 - 1.c. Apply and adapt a variety of appropriate strategies to solve problems
4. Connections
 - 4.c. Recognize and apply mathematics in contexts outside of mathematics
5. Representation
 - 5.a. Create and use representations to organize, record, and communicate mathematical ideas
 - 5.b. Select, apply, and translate among mathematical representations to solve problems
 - 5.c. Use representations to model and interpret physical, social, and mathematical phenomena

Linked National Educational Technology Standards for Students (NETS•S)

- 2. Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students:
 - 2. b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
- 3. Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information. Students:
 - 3. b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
- 6. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems, and operations. Students:
 - 6. a. Understand and use technology systems.
 - 6. b. Select and use applications effectively and productively.

CHAPTER FOUR, LESSON TWO

Lesson Title: Navigational Aids

Learning Outcome: Assess the purpose and function of navigational aids

Linked Course Outcome: Analyze flight navigation and the purpose of aerial navigation aids

Learning Objectives:

Students will learn the following knowledge, concepts, principles, and processes in this lesson:

- 1. Describe the functions of the clock and compass
- 2. Distinguish among the elements of a map
- 3. Describe how to use air navigation charts
- 4. Explain the purpose of flight planning
- 5. Describe how to draft a preflight plan
- 6. Outline the procedures to perform when lost

Linked National Science Education Standards

- 1. Unifying Concepts and Processes in Science
 - 1.c. Change, constancy, and measurement
- 5. Earth and Space Science
 - 5.a. Energy in the Earth system
- 6. Science and Technology
 - 6.a. Abilities of technological design
 - 6.b. Understanding about science and technology

Linked Math Standards and Expectations

Geometry

- 2. Specify locations and describe spatial relationships using coordinate geometry and other representational systems
 - 2.a. Use Cartesian coordinates and other coordinate systems, such as navigational, polar, or spherical systems, to analyze geometric situations

Measurement

- 1. Understand measurable attributes of objects and the units, systems, and processes of measurement
 - 1.a. Make decisions about units and scales that are appropriate for problem situations involving measurement

2. Apply appropriate techniques, tools, and formulas to determine measurements.
- 2.a. Analyze precision, accuracy, and approximate error in measurement situations

Process

1. Problem solving
 - 1.b. Solve problems that arise in mathematics and in other contexts
4. Connections
 - 4.c. Recognize and apply mathematics in contexts outside of mathematics

Linked *National Educational Technology Standards for Students (NETS•S)*

3. Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information. Students:
 3. b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
6. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems, and operations. Students:
 6. a. Understand and use technology systems.
 6. b. Select and use applications effectively and productively.

CHAPTER FOUR, LESSON THREE

Lesson Title: Dead Reckoning and Wind

Learning Outcome: Relate the role of dead reckoning to navigation

Linked Course Outcome: Analyze flight navigation and the purpose of aerial navigation aids

Learning Objectives:

Students will learn the following knowledge, concepts, principles, and processes in this lesson:

1. Explain the basic principles of dead reckoning
2. Describe the wind triangle and its application in air navigation
3. Explain how the principles of dead reckoning relate to inertial navigation systems

Linked *National Science Education Standards*

1. Unifying Concepts and Processes in Science
 - 1.b. Evidence, models, and explanation
3. Physical Science
 - 3.d. Motions and forces
5. Earth and Space Science
 - 5.a. Energy in the Earth system
6. Science and Technology
 - 6.a. Abilities of technological design
 - 6.b. Understanding about science and technology
7. Science in Personal and Social Perspectives
 - 7.f. Science and technology in local, national, and global challenges

Linked *Math Standards and Expectations*

Numbers and Operations

1. Understand numbers, ways of representing numbers, relationships among numbers, and number systems
 - 1.c. Understand vectors and matrices as systems that have some of the properties of the real-number system
2. Understand meanings of operations and how they relate to one another

2.b. Develop an understanding of properties of, and representations for, the addition and multiplication of vectors and matrices

3. Compute fluently and make reasonable estimates

3.a. Develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more-complicated cases

Algebra

3. Use mathematical models to represent and understand quantitative relationships

3.c. Draw reasonable conclusions about a situation being modeled

Geometry

1. Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships

1.d. Use trigonometric relationships to determine lengths and angle measures

4. Use visualization, spatial reasoning, and geometric modeling to solve problems

4.e. Use geometric ideas to solve problems in, and gain insights into, other disciplines and other areas of interest such as art and architecture

Measurement

1. Understand measurable attributes of objects and the units, systems, and processes of measurement

1.a. Make decisions about units and scales that are appropriate for problem situations involving measurement

2. Apply appropriate techniques, tools, and formulas to determine measurements

2.a. Analyze precision, accuracy, and approximate error in measurement situations

Process

1. Problem solving

1.a. Build new mathematical knowledge through problem solving

1.b. Solve problems that arise in mathematics and in other contexts

1.c. Apply and adapt a variety of appropriate strategies to solve problems

4. Connections

4.c. Recognize and apply mathematics in contexts outside of mathematics

CHAPTER FOUR, LESSON FOUR

Lesson Title: Flight Instrumentation

Learning Outcome: Distinguish among the primary flight instruments

Linked Course Outcome: Analyze flight navigation and the purpose of aerial navigation aids

Learning Objectives:

Students will learn the following knowledge, concepts, principles, and processes in this lesson:

1. Describe the functions of airspeed indicators
2. Describe the functions of the altimeter
3. Describe the functions of a horizontal situation indicator
4. Describe the functions of attitude indicators

Linked National Science Education Standards

3. Physical Science

3.d. Motions and forces

5. Earth and Space Science

5.a. Energy in the earth system

6. Science and Technology

6.b. Understanding about science and technology

Linked Math Standards and Expectations

Numbers and Operations

1. Understand numbers, ways of representing numbers, relationships among numbers, and number systems

- 1.a. Develop a deeper understanding of very large and very small numbers and of various representations of them
- 2. Understand meanings of operations and how they relate to one another
- 2.a. Judge the effects of such operations as multiplication, division, and computing powers and roots on the magnitudes of quantities

Algebra

- 1. Understand patterns, relations, and functions
- 1.b. Understand relations and functions and select, convert flexibly among, and use various representations for them

Process

- 1. Problem solving
- 1.a. Build new mathematical knowledge through problem solving
- 1.b. Solve problems that arise in mathematics and in other contexts
- 4. Connections
- 4.a. Recognize and use connections among mathematical ideas
- 4.c. Recognize and apply mathematics in contexts outside of mathematics
- 5. Representation
- 5.b. Select, apply, and translate among mathematical representations to solve problems

Linked *National Educational Technology Standards for Students (NETS•S)*

- 6. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems, and operations. Students:
 - 6. a. Understand and use technology systems.
 - 6. b. Select and use applications effectively and productively.

CHAPTER FOUR, LESSON FIVE

Lesson Title: Navigation Technology

Learning Outcome: Analyze the developments of navigational technology

Linked Course Outcome: Analyze flight navigation and the purpose of aerial navigation aids

Learning Objectives:

Students will learn the following knowledge, concepts, principles, and processes in this lesson:

- 1. Describe the uses of the plotter
- 2. Describe the uses of the dead reckoning computer
- 3. Determine how and when to use radio aids to navigation
- 4. Investigate current developments in navigation technology
- 5. Analyze how the Air Force uses GPS and inertial navigation in air operations
- 6. Describe the purpose of computer flight-planning tools

Linked *National Science Education Standards*

- 1. Unifying Concepts and Processes in Science
 - 1.c. Change, constancy, and measurement
- 3. Physical Science
 - 3.d. Motions and forces
- 5. Earth and Space Science
 - 5.a. Energy in the earth system
- 6. Science and Technology
 - 6.b. Understanding about science and technology
- 7. Science in Personal and Social Perspectives
 - 7.f. Science and technology in local, national, and global challenges
- 8. History and Nature of Science

8.a. Science as a human endeavor

Linked *National Educational Technology Standards for Students (NETS•S)*

2. Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students:

2. b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.

3. Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information. Students:

3. b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.

6. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems, and operations. Students:

6. a. Understand and use technology systems.

6. b. Select and use applications effectively and productively.