Curriculum Framework – Aerospace Engineering (2015-2016)
Unit 1 Introduction to Aerospace – Lesson 1.1 Evolution of Flight

Desired Results *(stage 1)*

ESTABLISHED GOALS
It is expected that students will…

- G1 – Demonstrate an ability to identify, formulate, and solve engineering problems.
- G2 – Demonstrate an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- G3 – Demonstrate an ability to design and conduct experiments, as well as to analyze and interpret data.
- G4 – Demonstrate an ability to apply knowledge of mathematics, science, and engineering.
- G5 – Demonstrate an ability to use the techniques, skills, and modern engineering tools

Transfer

TRANSFER: *Students will be able to independently use their learning to …*

- T1 – Research topics according to accepted academic standards and become a resource to others on a selected topic. (NGSS Engineering Practice 6)
- T2 – Develop and deliver an informative presentation for peers. (NGSS Engineering Practice 8 and ABET 2014-2015, criterion 3g)

Meaning

UNDERSTANDINGS: *Students will understand that …*

- U1 – The evolution of flight instills an appreciation of past engineering accomplishments.
- U2 –Aerospace history provides insight to future challenges involving travel through the atmosphere and space.
- U3 – Aerospace engineers typically work in teams to design smaller components of a larger system. The success of the entire system relies on each component to function correctly and to interact correctly with each other.
- U4 – Success often comes from learning from failures which is demonstrated throughout the history of aerospace development.

ESSENTIAL QUESTIONS: *Students will keep considering …*

- Q1 – What motivates an individual and a country to improve current aerospace performance?
- Q2 – How can failure affect progress?
- Q3 – What role has society played in the evolution of flight?
- Q4 – How does knowledge of aerospace history provide insight to future innovation?

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necessary for engineering practice. • G6 – Pursue the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. • G7 – Demonstrate an understanding of professional and ethical responsibility. • G8 – Demonstrate an ability to function on multidisciplinary teams. • G9 – Demonstrate an ability to communicate effectively. • G10 – Gain knowledge of contemporary issues. • G11 – Recognize the need for, and develop an ability to engage in life-long learning.	Acquisition ***KNOWLEDGE:*** *Students will…* • K1 – Identify major Aerospace Engineering accomplishments. U1, U2 • K2 – Describe trends in Aerospace Engineering. U2, U3, U4	***SKILLS:*** *Students will…* • S1 – Analyze how Aerospace Engineering achievements were made. U1, U2 • S2 – Predict how Aerospace Engineering achievements will impact future accomplishments. U1, U2, U3, U4 • S3 – Synthesize discrete facts into a coherent sequence of events. U1, U2, U4 • S4 – Deliver organized oral presentations of work tailored to the audience. U1, U2

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Evidence *(stage 2)*		
Activities (A) Projects (P) Problems(B)	Assessment FOR Learning	Assessment OF Learning
1.1.1.P Aerospace Evolution Video	• Essential questions • Research notes • Responses to prompts in procedure • List of achievements • Group discussion • Peer review	• Research documentation • Presentation of research

Learning Plan *(stage 3)*	
Activities (A) Projects (P) Problems(B)	Knowledge and Skills
P.1.1.1	K1, K2, S1, S2, K3, K4

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Curriculum Framework – Aerospace Engineering (2015-2016)
Unit 1 Introduction to Aerospace – Lesson 1.2 Physics of Flight

Desired Results *(stage 1)*

ESTABLISHED GOALS
It is expected that students will…

- G1 – Demonstrate an ability to identify, formulate, and solve engineering problems.
- G2 – Demonstrate an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- G3 – Demonstrate an ability to design and conduct experiments, as well as to analyze and interpret data.
- G4 – Demonstrate an ability to apply knowledge of mathematics, science, and engineering.
- G5 – Demonstrate an ability to use the techniques, skills, and

Transfer

TRANSFER: *Students will be able to independently use their learning to …*

- T1 – Develop a computational model to generate data to solve a problem. (NGSS Engineering Practice 2)
- T2 – Design, build, and test a model to improve performance (NGSS Engineering Practice 2,5, and 8)

Meaning

UNDERSTANDINGS: *Students will understand that …*

- U1 – Aircraft have fixed and moveable surfaces to control forces and change flight direction.
- U2 – The center of gravity of an object is where its weight is concentrated.
- U3 – Four major forces act on an aircraft flying in the Earth's atmosphere.
- U4 – Lift and drag are generated by fluid flow around an airfoil.
- U5 – Atmospheric conditions impact aircraft performance.
- U6 – Aircraft performance can be simulated in a safe and cost effective environment.
- U7 – Wind tunnels allow the performance of shapes to be tested in real fluid flow.
- U8 – Gliders are designed to fly long distances without a system to produce thrust.

ESSENTIAL QUESTIONS: *Students will keep considering …*

- Q1 – How does data analysis affect a design process?
- Q2 – How do aircraft use the thin fluid of air to sustain flight?
- Q3 – How are aircraft safely controlled?
- Q4 – How does using a design process iterate to an optimal solution?

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	Acquisition	
modern engineering tools necessary for engineering practice. • G6 – Pursue the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. • G7 – Demonstrate an understanding of professional and ethical responsibility. • G8 – Demonstrate an ability to function on multidisciplinary teams. • G9 – Demonstrate an ability to communicate effectively. • G10 – Gain knowledge of contemporary issues. • G11 – Recognize the need for, and develop an ability to engage in life-long learning.	***KNOWLEDGE:*** *Students will…* • K1 – Identify major components of an aircraft. U1 • K2 – Approximate the center of gravity of geometric shapes. U2 • K3 – Identify the three axis of an aircraft. U2, U3 • K4 – Label the motions about the three axis of an aircraft. U2, U3 • K5 – Describe the four major forces which act on an aircraft. U2, U3 • K6 – Describe the four ways that lift is generated by an airfoil. U2, U3, U4 • K7 – Label the components of an airfoil. U3, U4 • K8 – Describe the Earth's atmosphere composition and layers. U5 • K9 – Describe the relationship of altitude, temperature and pressure within the Earth's atmosphere. U5 • K10 – Describe the factors that impact lift and drag. U3, U4, U5 • K11 – Explain factors which improve aircraft stability. U1,U2,U3,U8	***SKILLS:*** *Students will…* • S1 – Describe how the motions about the three axis of an aircraft are stabilized and controlled by aircraft components. U2, U3 • S2 – Calculate the center of gravity of an aircraft. U2 • S3 – Revise the weight and location of masses onboard an aircraft for safe flight balance. U2 • S4 – Demonstrate how lift may be created with an airfoil. U3, U4 • S5 – Calculate the values of Earth's atmosphere altitude, temperature and pressure relative to each other. U5 • S6 – Calculate the values of lift, drag and Reynolds Number. U1, U3, U4, U6 • S7 – Predict how aircraft characteristics affect lift, drag, and Reynolds Number. U1, U3, U4, U6 • S8 – Design an airfoil to meet or exceed desired performance. U1, U2, U3, U4, U5, U6, U7 • S9 – Design a glider to meet or exceed desired performance. U1, U2, U3, U4, U8 • S10 – Summarize test data to evaluate glider performance against design criteria. U1, U2, U3, U4, U8 • S11 – Revise a glider to meet or exceed desired performance. U1, U2, U3, U4, U8 • S12 – Analyze the factors that contribute to a successful glider design. U1, U2, U3, U4, U8 • S13 – Accurately construct a glider that represents a design. U1, U2, U3, U4, U8 • S14 – Predict glider performance. U1, U2, U3, U4, U8 • S15 – Compare glider performance to predicted

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		performance. U1, U2, U3, U4, U8 • S16 – Optimize glider performance to improve performance. U1, U2, U3, U4, U8

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Evidence *(stage 2)*			Learning Plan *(stage 3)*	
Activities (A) Projects (P) Problems(B)	Assessment FOR Learning	Assessment OF Learning	Activities (A) Projects (P) Problems(B)	Knowledge and Skills
1.2.1.A Aircraft Control Surface	• Essential questions • Responses to the prompts in the procedure	• Conclusion questions	1.2.1.A Aircraft Control Surface	K1, K2, K3, K4, S1
1.2.2.A Center Gravity	• Essential questions • Use of correct formula • Correct calculation steps	• Correct responses to balance questions • Conclusion questions	1.2.2.A Center Gravity	K2, K4, K5, S2, S3
1.2.3.A Airfoil	• Essential questions • Observations recorded in the engineering notebook	• Observations recorded in the engineering notebook • Conclusion questions	1.2.3.A Airfoil	K5, K6, S4
1.2.4.A Atmosphere	• Essential questions • Use of correct formula • Correct calculation steps Construction of an spreadsheet to calculate values	• Correct calculations • Conclusion questions	1.2.4.A Atmosphere	K8, K9, S5
1.2.5.A Aerodynamic Forces	• Essential questions • Use of correct formula • Correct calculation steps	• Correct responses to balance questions • Conclusion questions	1.2.5.A Aerodynamic Forces	K5, K6, K7, K10, S6, S7
1.2.6.A Airfoil Simulation	• Essential questions • Correctly recorded Airfoil performance indications	• Conclusion questions	1.2.6.A Airfoil Simulation	K5, K6, K7, K10, S8
1.2.7.A Airfoil Construction (OPTIONAL)	• Essential questions • Accurate entry of airfoil geometry into spreadsheet • Accurate creation of an airfoil	• Accurate creation of an airfoil physical model • Conclusion	1.2.7.A Airfoil Construction (OPTIONAL)	n/a

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	CAD model • Accurate creation of an airfoil physical template • Accurate creation of an airfoil physical model	questions		
1.2.8.A Airfoil Test (OPTIONAL)	• Essential questions • Accurate lift and drag data	• Activity report • Conclusion questions	1.2.8.A Airfoil Test (OPTIONAL)	n/a
1.2.9.A Glider Using AERY	• Essential questions • Engineering design process iterations • A stable glider design	• A stable glider design • Conclusion questions	1.2.9.A Glider Using AERY	K1, K3, K4, K5, K6, K7, K11, S9
1.2.10.P Glider Design 1	• Essential questions • Engineering design process iterations • A stable glider design that meets constraints	• Project report • Conclusion questions	1.2.10.P Glider Design 1	K1, K3, K4, K5, K6, K7, K11, S9
1.2.11.P Glider Design 2	• Essential questions • Engineering design process iterations • A stable glider design that meets constraints	• Project report • Conclusion questions	1.2.11.P Glider Design 2	K1, K3, K4, K5, K6, K7, K11, S9, S10, S11
1.2.12.P Glider Long Distance	• Essential questions • Engineering design process iterations • A stable glider design that meets constraints	• Project report • Conclusion questions	1.2.12.P Glider Long Distance	K1, K3, K4, K5, K6, K7, K11, S9, S10, S11, S12
1.2.13.P Glider Design Flight Data	• Essential questions • Engineering design process iterations	• Flight data results • Conclusion questions	1.2.13.P Glider Design Flight Data	K1, K3, K4, K5, K6, K7, K11, S9, S10, S11, S12, S13, S14, S15, S16

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	• A stable glider design that meets constraints	
1.2.14.P Glider Design Flights	• Essential questions • Engineering design process iterations • A stable glider design that meets constraints	• Flight data results • Conclusion questions
1.2.15.P GliderDesignPhase2	• Essential questions • Engineering design process iterations • A stable glider design that meets constraints	• Flight data results • Conclusion questions

1.2.14.P Glider Design Flights	K1, K3, K4, K5, K6, K7, K11, S9, S10, S11, S12, S13, S14, S15, S16
1.2.15.P GliderDesignPhase2	K1, K3, K4, K5, K6, K7, K11, S9, S10, S11, S12, S13, S14, S15, S16

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Curriculum Framework – Aerospace Engineering (2015-2016)
Unit 1 Introduction to Aerospace – Lesson 1.3 Flight Planning and Navigation

Desired Results *(stage 1)*

ESTABLISHED GOALS
It is expected that students will…

- G1 – Demonstrate an ability to identify, formulate, and solve engineering problems.
- G2 – Demonstrate an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- G3 – Demonstrate an ability to design and conduct experiments, as well as to analyze and interpret data.
- G4 – Demonstrate an ability to apply knowledge of mathematics, science, and engineering.
- G5 – Demonstrate an ability to use the techniques, skills, and

Transfer

TRANSFER: *Students will be able to independently use their learning to …*

- T1 – Develop a model to describe an environment. (NGSS Engineering Practice 2)
- T2 – Use a computational model to generate data to solve a problem. (NGSS Engineering Practice 5)

Meaning

UNDERSTANDINGS: *Students will understand that …*

- U1 – The history of navigation is intertwined with technology development.
- U2 – Pilots then apply the principles of navigation to safely travel to their destinations.
- U3 – Each flight should be planned in advance of the actual flight.
- U4 – The Global Positioning System, GPS, is a complex system designed to provide accurate location information to many users.
- U5 – Simulations are widely used in the aerospace industry to develop skills which can be effectively applied to the actual device.
- U6 – Air traffic is coordinated within a complex system to improve safety and efficiency.

ESSENTIAL QUESTIONS: *Students will keep considering…*

- Q1 – How can a simulation be used to develop a skill?
- Q2 – How can a system maintain safety in a complex environment?
- Q3 – How can an environment be modeled accurately?

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	Acquisition	
modern engineering tools necessary for engineering practice. • G6 – Pursue the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. • G7 – Demonstrate an understanding of professional and ethical responsibility. • G8 – Demonstrate an ability to function on multidisciplinary teams. • G9 – Demonstrate an ability to communicate effectively. • G10 – Gain knowledge of contemporary issues. • G11 – Recognize the need for, and develop an ability to engage in life-long learning.	***KNOWLEDGE:*** *Students will…* • K1 – Describe major advances in navigation technology. U1, U2, U3, U4 • K2 – Identify components of common aviation navigation aids. U2, U3 • K3 – Describe how an aircraft reacts to flight control inputs. U2, U3, U5 • K4 – Describe purpose of air traffic control system how it functions. U2, U6 • K5 – Explain how Global Positioning System, GPS, functions. U4 • K6 – Identify the functions of a typical Global Positioning System, GPS, unit functions. U4 • K7 – Describe the relationship of Tsiolkovsky rocket equation variables. U3, U5 • K8 – Identify characteristics which contribute to a successful team. U5	***SKILLS:*** *Students will…* • S1 – Interpret an indication shown on a navigation aid. U2, U3, U5 • S2 – Illustrate navigation aid indication on a map. U2, U3 • S3 – Operate an aircraft in a simulated environment. U2, U3, U5 • S4 – Plan a flight route. U2, U3, U5 • S5 – Use a navigation aid to fly an aircraft to a destination in a simulated environment. U2, U3, U5 • S6 – Predict an aircraft collision based on aircraft vectors. U2, U3, U5, U6 • S7 – Calculate an alternate aircraft vector for safe separation. U2, U3, U5, U6 • S8 – Create route consisting of latitude and longitude waypoints using a Global Positioning System, GPS, unit. U2, U4 • S9 – Interpret a route from latitude and longitude waypoints. U2, U4 • S10 – Select team members for a project based on characteristics. U5 • S11 – Select propulsion system based on characteristics of each. U5

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Evidence *(stage 2)*		
Activities (A) Projects (P) Problems(B)	Assessment FOR Learning	Assessment OF Learning
1.3.1.A Intro Radio Navigation	• Essential questions • Plot of aircraft positions • Sketch of navigation aid	• Plot of aircraft positions • Sketch of navigation aid • Conclusion questions
1.3.AS Radio Nav Assessment	• Essential questions • Completion of the flight tutorial	• Completion of the flight tutorial • Conclusion questions
1.3.2.A Flight Simulator Intro	• Essential questions • Completion of the flight tutorial	• Completion of the flight tutorial • Conclusion questions
1.3.3.A Cross Country Solo	• Essential questions	• Map of route flown • Flight analysis • Conclusion questions
1.3.4.A Air Traffic Control	• Essential questions • Calculate aircraft velocity iterations	• Successful aircraft separation screen shot • Conclusion questions
1.3.5.A GPS Nav Chart Creation	• Essential questions • Sketch of navigation area • Waypoint recordings • Track recording	• Print navigation map • Conclusion questions
1.3.6.A GPS Route Planning	• Essential questions • Completed waypoint organizer	• Completed navigation map • Conclusion questions
1.3.7.A GPS Route Execution	• Essential questions • Complete peer produced navigation	• Activity report • Conclusion questions

Learning Plan *(stage 3)*	
Activities (A) Projects (P) Problems(B)	Knowledge and Skills
1.3.1.A Intro Radio Navigation	K1, K2, S1, S2
1.3.AS Radio Nav Assessment	K2, S1, S2
1.3.2.A Flight Simulator Intro	K3, S3
1.3.3.A Cross Country Solo	K2, K3, S2, S3, S4, S5
1.3.4.A Air Traffic Control	K4, S2, S6, S7
1.3.5.A GPS Nav Chart Creation	K6, S1, S2, S8
1.3.6.A GPS Route Planning	K6, S1, S2, S8
1.3.7.A GPS Route Execution	K6, S1, S2, S9

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	instructions	
1.3.8.P Race to Mars Module 1: Propulsion	• Essential questions • Selection of vehicle propulsion system	• Completion of homework questions • Completion of the module game

1.3.8.P Race to Mars Module 1: Propulsion	K7, K8, S10, S11

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Curriculum Framework – Aerospace Engineering (2015-2016)
Unit 2 – Lesson 2.1 Materials and Navigation

Desired Results *(stage 1)*

ESTABLISHED GOALS
It is expected that students will…

- G1 – Demonstrate an ability to identify, formulate, and solve engineering problems.
- G2 – Demonstrate an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- G3 – Demonstrate an ability to design and conduct experiments, as well as to analyze and interpret data.
- G4 – Demonstrate an ability to apply knowledge of mathematics, science, and engineering.
- G5 – Demonstrate an ability to use the techniques, skills, and

Transfer

TRANSFER: *Students will be able to independently use their learning to …*

- T1 – Create a computational model to optimize a design. (NGSS Engineering Practice 4)
- T2 – Analyze data to make design decisions. (NGSS Engineering Practice 4)

Meaning

UNDERSTANDINGS: *Students will understand that …*

- U1 – Aerospace material selection is based upon many factors including mechanical, thermal, electromagnetic, and chemical properties.
- U2 – Composites combine different materials to create a material with properties superior to that of the individual materials.
- U3 – Material testing provides a reproducible evaluation of material properties.
- U4 – Structural design, including centroid location, moment of inertia, and a material's modulus of elasticity, are important considerations for an aircraft.
- U5 – Static equilibrium occurs when the sum of all forces acting on a body is equal to zero.

ESSENTIAL QUESTIONS: *Students will keep considering …*

- Q1 – How do material properties affect an aircraft design?
- Q2 – How can a simulation improve aircraft design?
- Q3 – Why is it important for a material test procedure to follow strict standards?
- Q4 – How does an engineer predict the performance and safety of a selected material?
- Q5 – Why do engineers calculate forces acting on structures?

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	Acquisition	
modern engineering tools necessary for engineering practice. • G6 – Pursue the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. • G7 – Demonstrate an understanding of professional and ethical responsibility. • G8 – Demonstrate an ability to function on multidisciplinary teams. • G9 – Demonstrate an ability to communicate effectively. • G10 – Gain knowledge of contemporary issues. • G11 – Recognize the need for, and develop an ability to engage in life-long learning.	***KNOWLEDGE:*** *Students will…* • K1 – Describe common aerospace materials and their properties. U1, U2, U3 • K2 – Identify moment of inertia and Young's Modulus equations. U1, U4 • K3 – Recognize the impact of loading conditions on a structure. U1, U3, U4, U5	***SKILLS:*** *Students will…* • S1 – Classify materials for aerospace applications. U1, U2, U3, U4 • S2 – Model a structure using a 3D modeling software. U1, U3, U4 • S3 – Analyze deformation of a structure as a result of force application. U1, U3, U4, U5 • S4 – Design a structure that meets a given criteria. U1, U3, U4, U5 • S5 – Construct a composite structure. U2 • S6 – Measure mechanical properties of material. K1, K3, U1, U2, U3, U4 • S7 – Interpret measurements of a tensile tester. K1, K3, U1, U2, U3, U4 • S8 – Calculate moment of inertia and Young's Modulus equations. K1, K2, K3, U1, U2, U3, U4

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Evidence *(stage 2)*			Learning Plan *(stage 3)*	
Activities (A) Projects (P) Problems(B)	Assessment FOR Learning	Assessment OF Learning	Activities (A) Projects (P) Problems(B)	Knowledge and Skills
2.1.1.A Aerospace Materials Investigation	• Essential questions • Completed material organizers in procedure	• Completed material organizers in procedure • Conclusion questions	2.1.1.A Aerospace Materials Investigation	K1, S1
2.1.2.A Frame Generator Intro	• Essential questions • Completed tutorial	• Completed tutorial • Conclusion questions	2.1.2.A Frame Generator Intro	K3, S2
2.1.3.A Frame Generator Analysis	• Essential questions • Completed tutorial	• Completed tutorial • Conclusion questions	2.1.3.A Frame Generator Analysis	K3, S2, S3
2.1.4.P Frame Design Engine	• Essential questions • Load simulation that meets the established criteria	• Load simulation that meets the established criteria • Presentation of design • Conclusion questions	2.1.4.P Frame Design Engine	K3, S2, S3, S4
2.1.4.P Frame Design Fuselage	• Essential questions • Sketch of structural design • Load simulation that meets the established criteria	• Load simulation that meets the established criteria • Presentation of design • Conclusion questions	2.1.4.P Frame Design Fuselage	K3, S2, S3, S4
2.1.5.A Prepare Composite Sample	• Essential questions • Composite sample rubric	• Completed composite sample that meet the required specifications • Composite sample rubric • Conclusion questions	2.1.5.A Prepare Composite Sample	K1, S5
2.1.6.A Composite Fabrication	• Essential questions • Composite sample rubric	• Completed composite sample that meet the required specifications • Composite sample	2.1.6.A Composite Fabrication	K1, S5

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		rubric • Conclusion questions		
2.1.7.A Demolding Finishing Composite Sample	• Essential questions • Composite sample rubric	• Completed composite sample that meet the required specifications • Composite sample rubric • Conclusion questions	2.1.7.A Demolding Finishing Composite Sample	K1, S5
2.1.8.A Test Composite Sample	• Essential questions • Moment of Inertia calculation • Test data recording • Test data analysis • Modulus of Elasticity calculation	• Moment of Inertia calculation • Test data recording • Test data analysis • Modulus of Elasticity calculation • Conclusion questions	2.1.8.A Test Composite Sample	K1, K2, S6, S7, S8

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Curriculum Framework – Aerospace Engineering (2015-2016)
Unit 2 Aerospace Design – Lesson 2.2 Propulsion

Desired Results *(stage 1)*

ESTABLISHED GOALS
It is expected that students will…

- G1 – Demonstrate an ability to identify, formulate, and solve engineering problems.
- G2 – Demonstrate an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- G3 – Demonstrate an ability to design and conduct experiments, as well as to analyze and interpret data.
- G4 – Demonstrate an ability to apply knowledge of mathematics, science, and engineering.
- G5 – Demonstrate an ability

Transfer

TRANSFER: *Students will be able to independently use their learning to …*

- T2 – Design, build, and test a model to improve performance. (NGSS Engineering Practice 2,5, and 8)
- T2 – Analyze data to make design decisions. (NGSS Engineering Practice 4)

Meaning

UNDERSTANDINGS: *Students will understand that …*

- U1 – Energy transformed between forms of energy produces propulsion.
- U2 – Newton's Three Laws of Motion are central to the idea of propulsion.
- U3 – Engines vary in terms of efficiency, speed, and altitude.
- U4 – Air and fuel are used for combustion.
- U5 – Engine configuration impacts flight performance.
- U6 – Rocket engines produce thrust through rapid expansion of gases.

ESSENTIAL QUESTIONS: *Students will keep considering …*

- Q1 – How do a propeller and a jet propulsion system appear similar yet both are quite different?
- Q2 – How do the characteristics of a propulsion system affect the design of an aircraft or spacecraft?
- Q3 – How does test data affect the design process?

Acquisition

KNOWLEDGE: *Students will…*

- K1 – Describe the four primary forces acting on an aircraft. U1
- K2 – Explain how Newton's Third Law applies to aerodynamic forces. U2
- K3 – Describe the characteristics of the four types of propulsion systems. U1, U2, U3, U4, U5

SKILLS: *Students will…*

- S1 – Construct a physical model of a system. U1, U2
- S2 – Measure mechanical properties of material. U1, U2
- S3 – Interpret measurements of a test system. U1, U2
- S4 – Simulate performance of propulsion systems. U1, U2, U3, U4, U5
- S5 – Design an aircraft propulsion system to meet a given

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to use the techniques, skills, and modern engineering tools necessary for engineering practice. • G6 – Pursue the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. • G7 – Demonstrate an understanding of professional and ethical responsibility. • G8 – Demonstrate an ability to function on multidisciplinary teams. • G9 – Demonstrate an ability to communicate effectively. • G10 – Gain knowledge of contemporary issues. • G11 – Recognize the need for, and develop an ability to engage in life-long learning.	• K4 – Classify rocket engine systems. U1, U2, U6 • K5 – Identify the thrust and impulse equations. U1, U2, U6 • K6 – Describe parts and functions of a typical model rocket engine. U1, U2, U6 • K7 – Outline model rocket safety suggestions. U1, U2, U6 • K8 – Label model rocket components and functions. U1, U2, U6 • K9 – Recognize the equation of center of gravity and center of pressure. U1, U2, U5, U6 • K10 – Identify common space propulsion systems. U1, U2, U5, U6 • K11 – Identify basic criteria to consider when designing a spacecraft. U1, U2, U5, U6	objective such as maximum efficiency, maximum thrust to weight ratio. U1, U2, U3, U4, U5 • S6 – Infer how changes in propulsion system parameters affect performance. U1, U2, U3, U4, U5 • S7 – Interpret measurements of a model rocket engine thrust. U1, U2, U6 • S8 – Design a stable model rocket. U1, U2, U5, U6 • S9 – Construct a stable model rocket. U1, U2, U5, U6 • S10 – Gather performance data associated model rocket launch such as maximum height of flight. U1, U2, U5, U6 • S11 – Construct a stable model rocket. U1, U2, U6 • S12 – Calculate maximum height using rocket engine test data and indirect height measurements. U1, U2, U5, U6 • S13 – Organize and express thoughts and information in a clear and concise manner. U1, U2, U5, U6 • S14 – Select spacecraft components based on characteristics of each component. U1, U2, U5, U6 • S15 – Select spacecraft landing system based on characteristics of each component. U1, U2, U5, U6

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Evidence *(stage 2)*			Learning Plan *(stage 3)*	
Activities (A) Projects (P) Problems(B)	Assessment FOR Learning	Assessment OF Learning	Activities (A) Projects (P) Problems(B)	Knowledge and Skills
2.2.1.A Action Reaction	• Essential questions • Accurately constructed test stand • Test data recording • Test data analysis	• Test data recording • Test data analysis • Conclusion questions	2.2.1.A Action Reaction	K1, K2, S1, S2, S3
2.2.2.A Engine Simulator	• Essential questions • Responses to procedure prompts	• Responses to procedure prompts • Conclusion questions	2.2.2.A Engine Simulator	K1, K2, K3, S4, S5
2.2.3.P Turbine Design	• Essential questions • Design iterations documented in the engineering notebook • Completed Turbine Engine Design Template	• Print screen of final design iterations • Completed Turbine Engine Design Template • Conclusion questions	2.2.3.P Turbine Design	K1, K2, K3, S4, S5
2.2.4.A Rocket Engine Test	• Essential questions • Test data recording • Test data analysis	• Test data recording • Test data analysis • Conclusion questions	2.2.4.A Rocket Engine Test	K4, K5, K6, K7, S8
2.2.5.P Rocket Design Build	• Essential questions • Design iterations documented in the engineering notebook • Rocket stability test • Rocket Design and Build Rubric	• Rocket design iterations documented with screen captures • Rocket physical construction • Rocket stability test • Rocket Design and Build Rubric • Conclusion questions	2.2.5.P Rocket Design Build	K8, K9, S8, S9
2.2.6.P Rocket Launch	• Essential questions • Sketch of launch	• Conclusion questions	2.2.6.P Rocket Launch	K4, K5, K6, K7, K8, S8

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	configuration • Data recording of parameters related to rocket maximum altitude			
2.2.7.P Rocket Performance Analysis	• Essential questions • Calculation of maximum rocket altitude • Rocket Performance Analysis Rubric	• Rocket maximum rocket altitude • Project report • Rocket Performance Analysis Rubric • Conclusion questions	2.2.7.P Rocket Performance Analysis	K4, K5, K6, K8, S12
2.2.8.P Space Propulsion	• Essential questions • Research documentation in engineering notebook	• Presentation of research • Conclusion questions	2.2.8.P Space Propulsion	K10, S13
2.2.9.P Race To Mars Module 2: Vehicle Design	• Essential questions • Decision making during the game	• Completion of homework questions • Completion of the module game	2.2.9.P Race To Mars Module 2: Vehicle Design	K11, S14
2.2.10.P Race To Mars Module 3: Landing Systems	• Essential questions • Selection of efficient system	• Completion of homework questions • Completion of the module game	2.2.10.P Race To Mars Module 3: Landing Systems	K11, S15

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Curriculum Framework – Aerospace Engineering (2015-2016)
Unit 2 Aerospace Design– Lesson 2.3 Flight Physiology

Desired Results *(stage 1)*

ESTABLISHED GOALS
It is expected that students will…

- G1 – Demonstrate an ability to identify, formulate, and solve engineering problems.
- G2 – Demonstrate an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- G3 – Demonstrate an ability to design and conduct experiments, as well as to analyze and interpret data.
- G4 – Demonstrate an ability to apply knowledge of mathematics, science, and engineering.
- G5 – Demonstrate an ability

Transfer

TRANSFER: *Students will be able to independently use their learning to …*

- T1 – Use mathematical models to predict performance. (NGSS Engineering Practice 5)
- T2 – Critically read technical literature to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. (NGSS Engineering Practice 8)

Meaning

UNDERSTANDINGS: *Students will understand that …*

- U1 – The capabilities and limitations of the human body need to be understood by pilots, crews, and aerospace engineers.
- U2 – The human body consists of systems that work together to ensure functionality and life.
- U3 – An aerospace engineer considers the human interaction with the machine for more effective designs.
- U4 – Extreme environments and forces can harm or kill a human.

ESSENTIAL QUESTIONS: *Students will keep considering …*

- Q1 – How human factors affect aerospace engineering design?
- Q2 – How communications between humans affect aerospace engineering design?
- Q3 – How can the risk of aviation accidents be minimized?

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	Acquisition	
to use the techniques, skills, and modern engineering tools necessary for engineering practice. • G6 – Pursue the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. • G7 – Demonstrate an understanding of professional and ethical responsibility. • G8 – Demonstrate an ability to function on multidisciplinary teams. • G9 – Demonstrate an ability to communicate effectively. • G10 – Gain knowledge of contemporary issues. • G11 – Recognize the need for, and develop an ability to engage in life-long learning.	***KNOWLEDGE:*** *Students will…* • K1 – Describe common human body systems and their functions. U1, U2, U3 • K2 – Recognize the formula for distance with respect to time and acceleration. U1 • K3 – List common factors contribute to an aircraft accident. U1, U2, U3, U4	***SKILLS:*** *Students will…* • S1 – Measure human vision quality such as acuity, astigmatism, color vision perception, depth perception and peripheral vision field. U1, U2, U3 • S2 – Analyze how human factors affect aerospace system design. U1, U2, U3 • S3 – Infer reaction time through indirect measurements. U1, U3 • S4 – Analyze an aircraft accident to determine likely causes. U1, U2, U3, U4

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Evidence *(stage 2)*		
Activities (A) Projects (P) Problems(B)	Assessment FOR Learning	Assessment OF Learning
2.3.1.A Visual Perception	• Essential questions • Student response sheet • Conclusion questions	• Student response sheet • Conclusion questions
2.3.2.A Reaction Time	• Essential questions • Accurate data collection • Reaction time calculations	• Reaction time calculations • Conclusion questions
2.3.3.A Flight Control Design	• Essential questions • Flight simulation performance • Recorded observations	• Recorded observations • Conclusion questions
2.3.4.A Build A Block	• Essential questions • Discussion of observations	• Conclusion questions
2.3.5.A NTSB Reports	• Essential questions • Research notes in engineering notebook • Accident analysis	• Presentation of research • Conclusion questions

Learning Plan *(stage 3)*	
Activities (A) Projects (P) Problems(B)	Knowledge and Skills
2.3.1.A Visual Perception	K1, S1, S2
2.3.2.A Reaction Time	K2, S3
2.3.3.A Flight Control Design	K1, S2
2.3.4.A Build A Block	K1, S2
2.3.5.A NTSB Reports	K3, S4

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Curriculum Framework – Aerospace Engineering (2015-2016)
Unit 3 Space – Lesson 3.1 Space Travel

Desired Results *(stage 1)*

ESTABLISHED GOALS
It is expected that students will…

- G1 – Demonstrate an ability to identify, formulate, and solve engineering problems.
- G2 – Demonstrate an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- G3 – Demonstrate an ability to design and conduct experiments, as well as to analyze and interpret data.
- G4 – Demonstrate an ability to apply knowledge of mathematics, science, and engineering.

Transfer

TRANSFER: *Students will be able to independently use their learning to …*

- T1 – Research topics according to accepted academic standards and become a resource to others on a selected topic. (NGSS Engineering Practice 6)
- T2 – Develop and deliver an informative presentation for peers. (NGSS Engineering Practice 8 and ABET 2014-2015, criterion 3g)
- T3 – Develop a model or mockup to evaluate a design solution. (NGSS Engineering Practice 2)

Meaning

UNDERSTANDINGS: *Students will understand that …*

- U1 – The universe exists in a scale that is difficult to conceptualize.
- U2 – Space law is a system based on international agreements designed to promote the use of space for the good of all humankind.
- U3 – The exploration of space is successful through learning from previous missions and the development of technology and systems.

ESSENTIAL QUESTIONS: *Students will keep considering …*

- Q1 – Why is creating a model of the universe challenging?
- Q2 – How does space junk affect our future?
- Q3 – How does a model or mockup enhance a presentation of a design?
- Q4 – What laws govern space?
- Q4 – How commercial space flight affects the role of government organizations in space activities?

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	Acquisition	
• G5 – Demonstrate an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. • G6 – Pursue the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. • G7 – Demonstrate an understanding of professional and ethical responsibility. • G8 – Demonstrate an ability to function on multidisciplinary teams. • G9 – Demonstrate an ability to communicate effectively. • G10 – Gain knowledge of contemporary issues. • G11 – Recognize the need for, and develop an ability to engage in life-long learning.	***KNOWLEDGE:*** *Students will…* • K1 – Recognize common celestial groups such as galaxy, star and planet. U1, U3 • K2 – Describe the relative sizes of celestial bodies. U1, U3 • K3 – Explain how global governance applies to space issues. U2 • K4 – Outline how past space faring achievements contributed to subsequent achievements. U3 • K5 – Describe how commercial organizations contribute to space related activities. U2, U3 • K6 – Identify the impact that space junk has on space based activities. U1, U2, U3	***SKILLS:*** *Students will…* • S1 – Analyze an issue to which space applies. U2 • S2 – Organize and express thoughts and information in a clear and concise manner. U2 • S3 – Design a system to mitigate space junk. U1, U2, U3 • S4 – Construct a prototype to demonstrate a design solution. U3

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Evidence *(stage 2)*		
Activities (A) Projects (P) Problems(B)	Assessment FOR Learning	Assessment OF Learning
3.1.1.A Sizing Up the Universe	• Essential questions • Student responses to prompts	• Student responses to prompts • Print screen of results • Conclusion questions
3.1.2.P Space Law	• Essential questions • Research notes in engineering notebook	• Presentation of research • Conclusion questions
3.1.3.P Space Junk Mitigation	• Essential questions • Research notes in engineering notebook	• Presentation of research • Mock-up • Conclusion questions

Learning Plan *(stage 3)*	
Activities (A) Projects (P) Problems(B)	Knowledge and Skills
3.1.1.A Sizing Up the Universe	K1, K2
3.1.2.P Space Law	K3, S1, S2
3.1.3.P Space Junk Mitigation	K3, K4, S2, S3, S4

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Curriculum Framework – Aerospace Engineering (2015-2016)
Unit 3 Space – Lesson 3.2 Orbital Mechanics

Desired Results *(stage 1)*

ESTABLISHED GOALS
It is expected that students will…

- G1 – Demonstrate an ability to identify, formulate, and solve engineering problems.
- G2 – Demonstrate an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- G3 – Demonstrate an ability to design and conduct experiments, as well as to analyze and interpret data.
- G4 – Demonstrate an ability to apply knowledge of mathematics, science, and engineering.

Transfer

TRANSFER: *Students will be able to independently use their learning to…*

- T1 – Research topics according to accepted academic standards and become a resource to others on a selected topic. (NGSS Engineering Practice 6)
- T2 – Use mathematical models to predict performance. (NGSS Engineering Practice 5)
- T3 – Develop a computational model to generate data used to solve a problem. (NGSS Engineering Practice 2)

Meaning

UNDERSTANDINGS: *Students will understand that …*

- K1 – Orbital mechanics provides a means for describing orbital behavior of bodies.
- K2 – The same laws that govern satellite orbits also govern celestial body (e.g. comets, planets and moons) orbits.
- K3 – Objects in orbit are continuously falling toward the body about around which they orbit.
- K4– Objects orbit other objects in a pattern governed by forces exerted on each other.
- K5 – All objects exert an attraction force to each other.
- K6 – Orbital elements can be used to fully define a satellite's orbit, allowing the accurate prediction of the precise location of the satellite at a given time.
- K7 – A satellite's mission is a major factor when designing its orbit.

ESSENTIAL QUESTIONS: *Students will keep considering …*

- Q1 – How do satellites impact our daily lives?
- Q2 – How a satellite orbit is described?
- Q3 – How an obit of a satellite orbit is designed?
- Q4 – How modeling software improves design process efficiency?
- Q5 – How an orbital pattern affects the success of a satellite mission?

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	Acquisition	
• G5 – Demonstrate an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. • G6 – Pursue the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. • G7 – Demonstrate an understanding of professional and ethical responsibility. • G8 – Demonstrate an ability to function on multidisciplinary teams. • G9 – Demonstrate an ability to communicate effectively. • G10 – Gain knowledge of contemporary issues. • G11 – Recognize the need for, and develop an ability to engage in life-long learning.	***KNOWLEDGE:*** *Students will…* • K1 – List major contributions made by people studying orbital mechanics. U1, U2, U3 • K2 – Describe common satellite orbital pattern shapes and applications. U1, U2, U3, U4, U5, U6, U7 • K3 – Name and describe the six Keplerian elements. U1, U2, U3, U4, U5, U6, U7 • K4 – Explain Kepler's Laws. U1, U2, U3, U4, U5, U6, U7 • K5 – Recognize the equations for orbital period, orbital gravitational potential energy, orbital kinetic energy, and total orbital energy. U1, U2, U3, U4, U5, U6, U7 • K6 – Describe how an orbital mechanics modeling software can be applied design a satellite system. U1, U2, U3, U4, U5, U6, U7 • K7 – Explain how financial factors impact a project. U7	***SKILLS:*** *Students will…* • S1 – Analyze how an orbital mechanics theory can describe satellite motion. U1, U2, U3, U4, U5, U6, U7 • S2 – Organize and express thoughts and information in a clear and concise manner. U1, U2 • S3 – Identify the most appropriate orbital pattern for an application. U1, U2, U3, U4, U5, U6, U7 • S4 – Calculate an orbiting body's orbital period, orbital gravitational potential energy, orbital kinetic energy, and total orbital energy. U1, U2, U3, U4, U5, U6, U7 • S5 – Model a satellite system using a modeling software. U1, U2, U3, U4, U5, U6, U7 • S5 – Formulate a financial proposal for a project. U7

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Evidence *(stage 2)*		
Activities (A) Projects (P) Problems(B)	Assessment FOR Learning	Assessment OF Learning
3.2.1.A Orbital Mechanics Historical Figures	• Essential questions • Research notes in engineering notebook	• Presentation of research • Poster of research • Conclusion questions
3.2.2.AS Orbit Types	• Essential questions	• Responses to assessment
3.2.3.AS Orbital Descriptions	• Essential questions	• Responses to assessment
3.2.4.AS Special Orbits	• Essential questions	• Responses to assessment
3.2.5.A Orbital Mechanics Modeling	• Essential questions • Mission requirement description • Orbit Tuner model	• Orbit Tuner model • Conclusion questions
3.2.6.A Orbital Physics	• Essential questions • Use of correct formula • Correct calculation steps	• Correct responses to balance questions • Conclusion questions
3.2.7.A Systems Tool Kit	• Essential questions • Completed tutorial	• Completed tutorial • Conclusion questions
3.2.8.P Where Is ISS	• Essential questions • Completed scenarios	• Completed scenarios • Conclusion questions
3.2.9.P Race To Mars Module 4: Bidding	• Essential questions • Completed module	• Completed module • Conclusion questions

Learning Plan *(stage 3)*	
Activities (A) Projects (P) Problems(B)	Knowledge and Skills
3.2.1.A Orbital Mechanics Historical Figures	K1, S1, S2
3.2.2.AS Orbit Types	K2, S3
3.2.3.AS Orbital Descriptions	K2, S3
3.2.4.AS Special Orbits	K2, S3
3.2.5.A Orbital Mechanics Modeling	K2, S3
3.2.6.A Orbital Physics	K5, S4
3.2.7.A Systems Tool Kit	K6, S5
3.2.8.P Where Is ISS	K6, S5
3.2.9.P Race To Mars Module 4: Bidding	K7, S5

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Curriculum Framework – Aerospace Engineering (2015-2016)
Unit 4 Alternative Applications – Lesson 4.1 Alternative Applications

Desired Results *(stage 1)*

ESTABLISHED GOALS
It is expected that students will…

- G1 – Demonstrate an ability to identify, formulate, and solve engineering problems.
- G2 – Demonstrate an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- G3 – Demonstrate an ability to design and conduct experiments, as well as to analyze and interpret data.
- G4 – Demonstrate an ability to apply knowledge of mathematics, science, and engineering.
- G5 – Demonstrate an ability

Transfer

TRANSFER: *Students will be able to independently use their learning to …*

- T1 – Gather and analyze data to optimize a design solution. (NGSS Engineering Practice 4)
- T2 – Adapt solutions to other fields of engineering. (ABET 2014-2015, criterion 3a)

Meaning

UNDERSTANDINGS: *Students will understand that …*

- U1 – Aerospace concepts traditionally considered applicable to flight can be used in a variety of applications and industries.
- U2 – Fluid movement is an important consideration in the design of many products.
- U3 – Air travel impacts society and the environment in many ways.
- U4 – Efficiency is major criteria for aircraft design.

ESSENTIAL QUESTIONS: *Students will keep considering …*

- Q1 – How can aerospace engineering concepts be applied to solve problems that are not directly related to aircraft?
- Q2 – How does aerospace engineering affect the environment?
- Q3 – How does aerospace engineering affect the global economy?
- Q4 – How air movement can be transferred into useable electrical energy?

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	Acquisition	
to use the techniques, skills, and modern engineering tools necessary for engineering practice. • G6 – Pursue the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. • G7 – Demonstrate an understanding of professional and ethical responsibility. • G8 – Demonstrate an ability to function on multidisciplinary teams. • G9 – Demonstrate an ability to communicate effectively. • G10 – Gain knowledge of contemporary issues. • G11 – Recognize the need for, and develop an ability to engage in life-long learning.	***KNOWLEDGE:*** *Students will…* • K1 – List alternative applications than aircraft for aerospace engineering concepts. U1, U2 • K2 – Describe the parts and functions of a wind turbine. U1, U2 • K3 – Identify factors that impact aircraft efficiency. U3, U4 • K4 – Recognize the drag equation. U2	***SKILLS:*** *Students will…* • S1 – Design aerospace system as an alternate to an aircraft which use aerospace engineering concepts. Examples include a wind turbine and a parachute. U1, U2 • S2 – Construct an alternate aerospace system. U2 • S3 – Measure output of an alternate aerospace system. U1, U2 • S4 – Optimize an alternate aerospace system. U1, U2 • S5 – Explain aircraft efficiency affects aircraft design. U3, U4

Evidence *(stage 2)*		
Activities (A) Projects (P) Problems(B)	Assessment FOR Learning	Assessment OF Learning
4.1.1.P Wind Turbine Design	• Essential questions • Accurately constructed	• Graph of data • Conclusion questions

Learning Plan *(stage 3)*	
Activities (A) Projects (P) Problems(B)	Knowledge and Skills
4.1.1.P Wind Turbine Design	K2, S1, S2, S3, S4

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	model • Accurate data documentation in engineering notebook • Graph of data			
4.1.2.B Aircraft Efficiency	• Essential questions • Research documentation in engineering notebook • Calculations of fuel efficiency • Graph of data	• Calculations of fuel efficiency • Graph of data • Conclusion questions	4.1.2.B Aircraft Efficiency	K3, S5
4.1.3.B Parachute Design	• Essential questions • Research documentation in engineering notebook • Design documentation in engineering notebook • Drag equation computation • Data documentation	• Project report • Conclusion questions	4.1.3.B Parachute Design	K4, S1, S2, S3, S4

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Curriculum Framework – Aerospace Engineering (2015-2016)
Unit 4 Alternative Applications – Lesson 4.2

Desired Results *(stage 1)*

ESTABLISHED GOALS
It is expected that students will…

- G1 – Demonstrate an ability to identify, formulate, and solve engineering problems.
- G2 – Demonstrate an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- G3 – Demonstrate an ability to design and conduct experiments, as well as to analyze and interpret data.
- G4 – Demonstrate an ability to apply knowledge of mathematics, science, and engineering.
- G5 – Demonstrate an ability to use the techniques, skills, and modern engineering tools necessary for engineering

Transfer

TRANSFER: *Students will be able to independently use their learning to …*

- T1 – Create a computational model to control a complex system. (NGSS Engineering Practice 5)
- T2 – Function effectively within a diverse team. (ABET 2014-2015, criterion 3d)
- T3 – Develop a complex model to manipulate and test a proposed process. (NGSS Engineering Practice 2)

Meaning

UNDERSTANDINGS: *Students will understand that …*

- U1 – Remote system designs are used in air, ground, maritime, and space environments.
- U2 – Remote systems can be designed to perform an extended operation with little human input or impact.
- U3 – Operator input is established through the use of an operator interface and a means to communicate with the remote system.
- U4 – Remote system design is based upon the integrated system design of mechanical, electrical, and software systems.
- U5 – Remote systems use sensor feedback to modify behavior.

ESSENTIAL QUESTIONS: *Students will keep considering…*

- Q1 – How can mechanical, electrical and software systems be integrated to solve a problem?
- Q2 – How can a tool such as pseudocode be adapted to design logical solution to a problem?
- Q3 – How can a team be diversified to enhance a design process?
- Q4 – How does a design process optimize a solution to a problem?
- Q5 – How does the effectiveness of a presentation affect the acceptability of a solution?
- Q6 – What modern-day applications for remote systems go beyond current uses?

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	Acquisition	
practice. • G6 – Pursue the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. • G7 – Demonstrate an understanding of professional and ethical responsibility. • G8 – Demonstrate an ability to function on multidisciplinary teams. • G9 – Demonstrate an ability to communicate effectively. • G10 – Gain knowledge of contemporary issues. • G11 – Recognize the need for, and develop an ability to engage in life-long learning.	***KNOWLEDGE:*** *Students will…* • K1 – Explain how unmanned systems can be integrated into aerospace systems. U1, U2, U4 • K2 – Recognize factors that affect communication with equipment in space. U1, U2, U3 • K3 – Describe how input and output devices function. U4, U5 • K4 – Explain the purpose of a flowchart or pseudocode. U4 • K5 – Describe functions of a computer program. U4, U5 • K6 – Identify how functions of a computer program can be applied to perform a task. U4, U5 • K7 – Outline how a satellite data is gathered and used to create a map. U1, U2, U4 • K8 – Describe how human factors impact space travel. U2, U3, U4, U5 • K9 – Describe how spacecraft systems function. U2, U3, U4, U5	***SKILLS:*** *Students will…* • S1 – Analyze how aerospace unmanned systems function. U1, U2, U3, U4 • S2 – Synthesize a discrete knowledge into a coherent sequent of events. U1, U2, U3, U4 • S3 – Deliver organized oral presentations of work tailored to the audience. U1, U2, U3, U4 • S4 – Describe the impact of a communication delay on the success of a mission. U2 • S5 – Operate output devices to perform a function. U2, U3, U4, U5 • S6 – Relate sensor input to the environment being measured. U5 • S7 – Create a flowchart or pseudocode to perform a task. U2, U3, U4, U5 • S8 – Construct a control program to accomplish a specified goal. U4, U5 • S9 – Operate a remote system through a series of performance tasks including autonomous navigation. U1, U2, U3, U4, U5 • S10 – Gather data using robot control software. U4 • S11 – Arrange data using spreadsheet software. U4 • S12 – Operate a simulated spaceflight. U1, U2, U3, U4

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Evidence *(stage 2)*			Learning Plan *(stage 3)*	
Activities (A) Projects (P) Problems(B)	Assessment FOR Learning	Assessment OF Learning	Activities (A) Projects (P) Problems(B)	Knowledge and Skills
4.2.1.P Unmanned Systems Video	• Essential questions • Research notes • Responses to prompts in procedure • List of achievements • Group discussion • Peer review	• Research documentation • Presentation of research	4.2.1.P Unmanned Systems Video	K1, S1, S2, S3
4.2.1.P Unmanned Systems PPT	• Essential questions • Research notes • Responses to prompts in procedure • List of achievements • Group discussion • Peer review	• Research documentation • Presentation of research	4.2.1.P Unmanned Systems PPT	K1, S1, S2, S3
4.2.2.A Human Robot Exploration	• Essential questions • Accuracy of instructions	• Accuracy of instructions • Conclusion questions	4.2.2.A Human Robot Exploration	K2, S4
4.2.3.A Inputs Outputs	• Essential questions • Responses to informal questions during teacher verifications within procedure • Student responses to questions in procedure	• Accuracy of testbed construction • Responses to questions in procedure • Conclusion questions	4.2.3.A Inputs Outputs	K3, S5, S6
4.2.4.A Basic Output Programming	• Essential questions • Responses to informal questions • Output responses	• Output responses • Program psedocode • Completed programs • Conclusion questions	4.2.4.A Basic Output Programming	K3, K4, K5, K6, S5, S6, S7, S8

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	• Program psedocode			
4.2.5.A Basic Input Programming	• Essential questions • Responses to informal questions • Input and output responses • Program psedocode	• Input and output responses • Program psedocode • Completed programs • Conclusion questions	4.2.5.A Basic Input Programming	K3, K4, K5, K6, S5, S6, S7, S8
4.2.6.A While If Else Loop	• Essential questions • Input and output responses • Program psedocode	• Input and output responses • Program psedocode • Completed programs • Conclusion questions	4.2.6.A While If Else Loop	K3, K4, K5, K6, S5, S6, S7, S8
4.2.7.A Variable Function	• Essential Questions • Responses to informal questions • Input and output responses • Program psedocode	• Input and output responses • Program psedocode • Completed programs • Conclusion questions	4.2.7.A Variable Function	K3, K4, K5, K6, S5, S6, S7, S8
4.2.8.A Satellite Flight	• Essential Questions • Construction and analysis of the data gathered • Quality control decisions related to quality of data gathered	• System physical construction • Accuracy of data to represent the terrain • Conclusion questions	4.2.8.A Satellite Flight	K3, K4, K5, K6, K7, S5, S6, S7, S8, S9
4.2.9.A Create Topographical Map	• Essential Questions • Analysis of the data gathered • Quality control decisions related to quality of data gathered	• Accuracy of data to represent the terrain • Conclusion questions	4.2.9.A Create Topographical Map	K7, S10
4.2.10.P Path Finder	• Essential questions • Engineering design process iterations	• System physical construction • Number of sensors	4.2.10.P Path Finder	K3, K4, K5, K6, , K7, S5, S6, S7, S8, S9

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	• Program development documentation in engineering notebook • Project rubric	effectively used • Program psedocode • Program code • Performance of system to complete the objective • Time to complete the objective • Project report • Project rubric		
4.2.11.P Rover Navigation	• Essential questions • Engineering design process iterations • Program development documentation in engineering notebook • Project rubric	• System physical construction • Number of sensors effectively used • Program psedocode • Program code • Performance of system to complete the objective • Time to complete the objective • Project report • Project rubric	4.2.11.P Rover Navigation	K1, K2, K3, K4, K5, K6, , K7, S5, S6, S7, S8, S9
4.2.12.P Fly By Wire Autopilot	• Essential questions • Engineering design process iterations • Program development documentation in engineering notebook • Testing procedure development	• System physical construction • Program psedocode • Program code • Performance of system to complete the objective • Project report	4.2.12.P Fly By Wire Autopilot	K3, K4, K5, K6, S5, S6, S7, S8, S10, S11

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	• Use of a spreadsheet to organize and analyze data • Project rubric	• Project rubric • Conclusion questions
P.4.2.13 Race To Mars Module 5: Taking on Roles & Flight	• Essential questions • Management of inflight resources	• Completion of homework quesitons • Completion of the module game

P.4.2.13 Race To Mars Module 5: Taking on Roles & Flight	K8, K9

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Curriculum Framework – Aerospace Engineering (2015-2016)
Unit 4 Alternative Applications – Lesson 4.3 Aerospace Careers

Desired Results *(stage 1)*

ESTABLISHED GOALS
It is expected that students will…

- G1 – Demonstrate an ability to identify, formulate, and solve engineering problems.
- G2 – Demonstrate an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- G3 – Demonstrate an ability to design and conduct experiments, as well as to analyze and interpret data.
- G4 – Demonstrate an ability to apply knowledge of mathematics, science, and engineering.
- G5 – Demonstrate an ability to use the techniques, skills, and

Transfer

TRANSFER: *Students will be able to independently use their learning to …*

- T1 – Self analyze current skills and knowledge. (ABET 2014-2015, criterion 3i)
- T2 – Develop a career plan. (ABET 2014-2015, criterion 3f and i)

Meaning

UNDERSTANDINGS: *Students will understand that …*

- U1 – The wide variety of career paths available to students requires careful consideration for future professional success.
- U2 – Career planning should consider many factors.
- U3 – Career planning should begin by exploring one's own interests and understanding possible options.

ESSENTIAL QUESTIONS: *Students will keep considering …*

- Q1 – Who are reliable sources for career advice?
- Q2 – When should a career plan be started?
- Q3 – How often should a career plan be updated?
- Q4 – What are resources that can be used to develop a career plan?

Acquisition

KNOWLEDGE: *Students will…*

- K1 – Describe factors that a student should consider when planning a career. U1, U2, U3
- K2 – Outline questions as preparation to interview a professional. U2, U3

SKILLS: *Students will…*

- S1 – Collect information related to a future career. U1, U2, U3
- S2 – Interview a professional. U2, U3
- S3 – Assemble career information into a coherent plan. U1, U2, U3
- S4 – Deliver organized presentations of work tailored to the audience. U1, U2, U3, U4
- S5 – Criticize the work of a peer. U1, U2, U3, U4

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modern engineering tools necessary for engineering practice. • G6 – Pursue the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. • G7 – Demonstrate an understanding of professional and ethical responsibility. • G8 – Demonstrate an ability to function on multidisciplinary teams. • G9 – Demonstrate an ability to communicate effectively. • G10 – Gain knowledge of contemporary issues. • G11 – Recognize the need for, and develop an ability to engage in life-long learning.		

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Evidence *(stage 2)*		
Activities (A) Projects (P) Problems(B)	Assessment FOR Learning	Assessment OF Learning
4.3.1.P Future Professional Video	• Essential questions • Project rubric • Research notes in engineering notebook	• Presentation of research • Project rubric • Conclusion questions
4.3.1.P Future Professional PPT	• Essential questions • Project rubric • Research notes in engineering notebook	• Presentation of research • Project rubric • Conclusion questions

Learning Plan *(stage 3)*	
Activities (A) Projects (P) Problems(B)	Knowledge and Skills
4.3.1.P Future Professional Video	K1, K2, S1, S2, S3, S4, S5
4.3.1.P Future Professional PPT	K1, K2, S1, S2, S3, S4, S5

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