S.T.E.A.M. (Enrichment)

Unit Title: Energy and the Environment

Stage 1: Desired Results

Standards & Indicators:

Computer Science & Design Thinking:

- 8.1.8.IC.1: Compare the trade-offs associated with computing technologies that affect individuals' everyday activities and career options.
- 8.1.8.IC.2: Describe issues of bias and accessibility in the design of existing technologies.
- 8.1.8.DA.5: Test, analyze, and refine computational models.
- 8.1.8.DA.6: Analyze climate change computational models and propose refinements.
- 8.2.8.ETW.3: Analyze the design of a product that negatively impacts the environment or society and develop possible solutions to lessen its impact.

International Society for Technology Education**:**

- Empowered Learner
  - 1a- Students articulate and set personal learning goals, develop strategies leveraging technology to achieve them and reflect on the learning process itself to improve learning outcomes.
- Knowledge Constructor
  - 3a- Students plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.
- Innovative Designer
  - 4a- Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
  - 4b- Students select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.
  - 4c- Students develop, test and refine prototypes as part of a cyclical design process.
- Computational Thinking
  - 5c- Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
- Creative Communicator
  - 6b- Students create original works or responsibly repurpose or remix digital resources into new creations.
  - 6c- Students communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations
- Global Collaborator
  - 7c- Students contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.

Standards for Technological and Engineering Literacy:

- Nature and Characteristics of Technology and Engineering
  - STEL-1M: Apply creative problem-solving strategies to the improvement of existing devices or processes or the development of new approaches.
- Core Concepts of Technology and Engineering
  - STEL-2S: Defend decisions related to a design problem.
- Design in Technology and Engineering Education
  - STEL-7Q: Apply the technology and engineering design process.
  - STEL-7R: Refine design solutions to address criteria and constraints.
  - STEL-7U: Evaluate the strengths and weaknesses of different design solutions.
  - STEL-7V: Improve essential skills necessary to successfully design.

Computer Science and Design Thinking

Standard	Performance Expectations	Core Ideas
8.1.8.IC.1	Compare the trade-offs associated with computing	Advancements in computing

S.T.E.A.M. (Enrichment)

	technologies that affect individual's everyday activities and career options	technology can change individuals' behaviors. Society is faced with trade-offs due to the increasing globalization and automation that computing brings.
8.1.8.IC.2	Describe issues of bias and accessibility in the design of existing technologies.	
8.1.8.DA.5	Test, analyze, and refine computational models Computer models can be used to simulate events, examine theories and inferences, or make predictions.	Computer models can be used to simulate events, examine theories and inferences, or make predictions.
8.1.8.DA.6	Analyze climate change computational models and propose refinements.	
8.2.8.ETW.3	Analyze the design of a product that negatively impacts the environment or society and develop possible solutions to lessen its impact.	Resources need to be utilized wisely to have positive effects on the environment and society. Some technological decisions involve tradeoffs between environmental and economic needs, while others have positive effects for both the economy and environment.

Career Readiness, Life Literacies and Key Skills		
Standard	**Performance Expectations**	**Core Ideas**
9.4.8.CI.1	Assess data gathered on varying perspectives on causes of climate change (e.g., crosscultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions	Gathering and evaluating knowledge and information from a variety of sources, including global perspectives, fosters creativity and innovative thinking.
9.4.8.CI.4	Explore the role of creativity and innovation in career pathways and industries	
9.4.8.IML.12	Use relevant tools to produce, publish, and deliver information supported with evidence for an authentic audience.	There is a need to produce and publish media that has information supported with quality evidence and is intended for authentic audiences.

Central Idea/Enduring Understanding:

Students will understand that …

- Two types of energy exist: potential (stored energy) and kinetic (energy in motion).
- Energy sources can be renewable, exhaustible, or inexhaustible. There are advantages and disadvantages to each.
- The six main forms of energy include solar or light radiation, thermal, electrical, mechanical, chemical, and nuclear.
- Energy efficiency and conservation are necessary in order to minimize pollution, improve business/economy, reduce dependence on

Essential/Guiding Question:

- What is energy?
- What causes an energy crisis?
- What would be the results if humans used only renewable and inexhaustible forms of energy?
- How do we educate the community about the need for sustainable energy sources?
- If the sun provides 1000 times the amount of energy we need, why doesn't the United States rely more on solar power?
- What factors are challenging governments to meet energy needs in the future?
- How will a smart grid affect our lives in the future?
- Are we running out of water?

S.T.E.A.M. (Enrichment)

foreign sources, and reduce our carbon footprint to create a sustainable world. ● Energy can be transferred, or moved, from one object to another. ● Energy can be transformed, or changed, from one form to another. ● The second law of thermodynamics states that not all energy is 100 percent efficient when it is converted from one form to another. ● Work is measured in Joules and is defined as force acting over a distance. Power is measured in Watts and is defined by how fast work is done. ● Engineers, designers, and engineering technologists are high demand for the development of future technology to meet societal needs and wants. ● There are events and issues that challenge us to use energy wisely and to develop alternate forms of energy, including economic and population growth, natural disasters, and conflicts with countries that provide the United States with oil. ● Fossil fuel use and greenhouse gas emissions can be reduced by using innovative means to implement renewable and inexhaustible energy sources. ● Energy sources can be used to produce electricity and hydrogen, energy carriers that provide the greatest diversity and lowest impact on the environment. ● Decisions regarding the implementation of alternative energy sources involve the weighing of tradeoffs between predicted positive and negative effects on the environment and financial burden. ● Careers in sustainable engineering will be created because our planet needs environmentally sustainable solutions to support population growth and preserve our limited natural resources. ● Water plays a critical role in our daily lives; it should be used wisely and users should be conscientious about conserving water. ● Environmental engineering focuses on developing a sustainable future, preventing pollution, and assessing the environmental impact of integrated waste management systems. ● The seven steps of integrated waste management include reduce, reuse, recycle, compost, incineration that creates usable energy, landfills, and incineration with no usable energy created.	● How does an individual person make an impact on the environment? ● Is the climate changing? If the climate were to change, how would it affect you?

S.T.E.A.M. (Enrichment)

● Engineers must consider a product's life cycle when designing because every product has an impact on the environment. ● Every individual impacts the environment through the choices they make in energy consumption and garbage disposal. ● Using energy efficiently will reduce the need for new power plants and utility infrastructure and will reduce the need to burn fossil fuels to produce energy, thereby reducing greenhouse gas emissions that contribute to climate change. ● Heat transfer occurs through conduction, convection, and radiation.	
Content: ● Lesson 1: Investigating Energy ○ 1.1: Energy Comes in Many Forms ○ 1.2: Energy Crossroads ○ 1.3: Using Energy Efficiently ○ 1.4a: Wind Energy ○ 1.4: Measuring Energy ● Lesson 2: Sustainable Energy ○ 2.1: Why are We Concerned? ○ 2.2: Energy Expo ○ 2.3: Energy for Our Future ● Lesson 3: Making an Impact ○ 3.1: Water Audit ○ 3.2: Product Life Cycle ○ 3.3: I Made a Difference ○ 3.4: Recycle City ○ 3.5: Heat Transfer Pre-Assessment ○ 3.6: Heat Transfer ○ 3.7: Penguin Dwelling ○ 3.8: Heat Transfer Post-Assessment	**Skills(Objectives):** ● Demonstrate an ability to identify, formulate, and solve engineering problems. ● 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. ● Demonstrate an ability to design and conduct experiments, as well as to analyze and interpret data. ● Demonstrate an ability to apply knowledge of mathematics, science, and engineering. ● Demonstrate an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. ● Pursue the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. ● Demonstrate an understanding of professional and ethical responsibility. ● Demonstrate an ability to function on multidisciplinary teams. ● Demonstrate an ability to communicate effectively. ● Gain knowledge of contemporary issues. ● Recognize the need for, and develop an ability to engage in life-long learning. ● Design and conduct experiments, as well as to analyze and interpret data to make improvements on blade designs for a wind turbine. ● Function on multidisciplinary teams. ● Understand the impact of energy related engineering solutions in a global, economic, environmental, and societal context. ● Describe the differences between, and the advantages and disadvantages of exhaustible, inexhaustible, renewable, and non-renewable energy sources.

S.T.E.A.M. (Enrichment)

	● Describe the six main forms of energy; including solar or light radiation, thermal, electrical, mechanical, chemical, and nuclear. ● Describe the roles and responsibilities of STEM professionals for high demand technological careers. ● Differentiate between potential and kinetic energy. ● Identify global energy uses and explain trends toward future demands. ● Demonstrate ways to increase the efficiency of energy used in homes and at school. ● Calculate financial savings and explain effects of our carbon footprint as a result of using energy efficiently. ● Use the design process to design, model, and test a wind turbine for efficiency. ● Calculate power and work by measuring force, distance, and time using the wind turbine model. ● Formulate, and solve engineering problems to make our world sustainable. ● Communicate effectively through oral, written and multi-media presentations about alternative energy options. ● Understand the impact of alternative energy solutions in a global, economic, environmental, and societal context. ● Recognize that alternative energies are not always available in every location. ● Recognize that the solution to our energy needs now and in the future will include conservation and wise use of resources as well as a wide variety of sources. ● Describe the roles and responsibilities of STEM careers that help solve environmental problems. ● Graph data that represents energy consumption, energy imports, and energy production. ● Identify alternative forms of energy, explain why they are alternative, and identify the advantages and disadvantages of each. ● Identify challenges in transferring alternative energies from where they are produced to where they are consumed. ● Research an alternative energy solution used for a specific purpose that will reduce the nation's dependency on fossil fuels.

Interdisciplinary Connections:

Science:

- MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential environmental impacts.
- MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

S.T.E.A.M. (Enrichment)

- MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution.
- MS-PS3-3: Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
- MS-PS3-4: Plan an investigation to determine the relationships among energy transferred, type of matter, its mass, and the change in particle kinetic energy as measured by temperature.

Mathematics:

- 7.EE.B.4: Use variables to represent quantities and write expressions and equations based on real-world phenomena.
- 7.RP.A.2: Recognize and represent proportional relationships, e.g., greenhouse gas emissions over time.
- 8.SP.A.1–2: Construct and interpret scatter plots with environmental variables and describe distributions.

Visual and Performing Arts:

- 1.1.8.Cn10b: Use research-informed processes to create original dance or performance pieces about climate change.
- 1.2.8.Re7b: Analyze how different forms of media artworks convey messages about environmental issues.
- 1.4.8.Cn11a: Research play/drama elements and discuss production choices in climate-themed theater.
- 1.5.8.Cn11b: Explore why people create art about different issues, including climate and sustainability.

Language Arts:

- L.VL.7.3. Determine or clarify the meaning of unknown and multiple-meaning words or phrases based on grade 8 reading and content, including technical meanings, choosing flexibly from a range of strategies.
  A. Use context (e.g., the overall meaning of a sentence or paragraph; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.
  B. Analyze the impact of specific word choices on meaning and tone.
- W.IW.7.2. Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
  A. Introduce a topic clearly, previewing what is to follow; and organize ideas, concepts, and information, using text structures (e.g., definition, classification, comparison/contrast, cause/effect, etc.) and text features (e.g., headings, graphics, and multimedia) when useful to aid in comprehension.
  B. Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples.
- W.WR.7.5. Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation.
- L.KL.7.2. Use knowledge of language and its conventions when writing, speaking, reading, or listening.
- SL.UM.7.5. Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.

Stage 2: Assessment Evidence

Performance Task(s):

- 1.4 - Measuring Energy
- 2.2 - Energy Expo
- 2.3 - Energy for Our Future
- 3.7 - Penguin Dwellings
- 3.8 - Heat Transfer Post-Assessment

Other Evidence:

- Online assignments
- Exit Tickets
- Worksheets
- Do Nows
- Conclusion Questions
- Summaries

Stage 3: Learning Plan

Learning Opportunities/Strategies:

- **Lesson 1: Investigating Energy**- Investigate the various forms of energy and examples of each form within their own environment.
  - **1.1: Energy Comes in Many Forms**- Explore the energy sources that they

Resources:

- Project Lead the Way (PLTW)
- Lesson Presentations
- Google Docs
- Google Forms
- Google Classroom

S.T.E.A.M. (Enrichment)

use every day and the form of each energy source. ○ **1.2: Energy Crossroads**- Explore our current energy consumption and its damaging effects on our environment and the economy. ○ **1.3: Using Energy Efficiently**- Research their household energy consumption and compare that to energy usage across the country and discuss ways to improve energy efficiency. ○ **1.4a: Wind Energy**- Learn how wind energy is generated and how a wind turbine works. ○ **1.4: Measuring Energy**- Explore powering a city with wind power by designing an efficient wind turbine. ● **Lesson 2: Sustainable Energy**- Research and discuss the historical uses of energy and how energy is used today. ○ **2.1: Why are We Concerned?**- Graph the past, present, and predicted future use of energy sources. ○ **2.2: Energy Expo**- Research a type of renewable energy including designing, building, and testing a model that uses renewable energies. ○ **2.3: Energy for Our Future**- Research and determine what forms of alternative energy will help reduce the nation's dependence on fossil fuels. ● **Lesson 3: Making an Impact**- Focuses on reducing the impact of energy consumption on the environment through energy efficiency and conservation. ○ **3.1: Water Audit**- Research and determine household water usage and brainstorm ways to reduce water usage. ○ **3.2: Product Life Cycle**- Research and explain the life cycle of a product to gain understanding of the impact of items on the environment. ○ **3.3: I Made a Difference**- Learn about how engineers help reduce environmental waste and improve the environment. ○ **3.4: Recycle City**- Use a program to simulate an implementation of different programs that may encourage a city's citizens to be more energy efficient and environmentally friendly.	LGBT and Disabilities Law Resources: ● GLSEN Educator Resources ● Supporting LGBTQIA Youth Resource List ● Respect Ability: Fighting Stigmas, Advancing Opportunities DEI Resources: ● Learning for Justice ● GLSEN Educator Resources ● Supporting LGBTQIA Youth Resource List ● Respect Ability: Fighting Stigmas, Advancing Opportunities ● NJDOE Diversity, Equity & Inclusion Educational Resources ● Diversity Calendar

S.T.E.A.M. (Enrichment)

○ **3.5: Heat Transfer Pre-Assessment**- Complete a questionnaire to assess their understanding of heat transfer. ○ **3.6: Heat Transfer**- Discuss and Summarize several demonstrations of heat transfer. ○ **3.7: Penguin Dwelling**- Test available building materials before designing and building a dwelling that will keep a penguin-shaped ice cube from melting. ○ **3.8: Heat Transfer Post-Assessment**- Check understanding of heat transfer and compare to the start of the lesson.	

Differentiation *Please note: Teachers who have students with 504 plans that require curricular accommodations are to refer to Struggling and/or Special Needs Section for differentiation

High-Achieving Students	On Grade Level Students	Struggling Students	Special Needs/ELL
Higher order thinking questions Differentiation of pacing and activities Differentiation of learning strategies: visual, auditory, kinetic and cooperative Enrichment and extension	Differentiation of learning strategies: visual, auditory, kinetic and cooperative Differentiating the lesson activities Lesson tutorials	Provide a highly structured, predictable learning environment Provide organizers Lessons designed to the style of learning that matches the student Cooperative Learning Positive reinforcement Lessons presentation available on google classroom Frequent check for understanding Break down task into manageable units One-on-one instruction Pair student with a high achieving student	Any student requiring further accommodations and/or modifications will have them individually listed in their 504 Plan or IEP. These might include, but are not limited to: breaking assignments into smaller tasks, giving directions through several channels (auditory, visual, kinesthetic, model), and/or small group instruction for reading/writing ELL supports should include, but are not limited to, the following:: Extended time Provide visual aids Repeated directions Differentiate based on proficiency Provide word banks Allow for translators, dictionaries

Unit Title: Flight and Space

Stage 1: Desired Results

Standards & Indicators:

Computer Science & Design Thinking:

- 8.1.8.IC.1: Compare the trade-offs associated with computing technologies that affect individuals' everyday activities and career options.
- 8.1.8.IC.2: Describe issues of bias and accessibility in the design of existing technologies

S.T.E.A.M. (Enrichment)

- 8.1.8.DA.5: Test, analyze, and refine computational models.
- 8.1.8.DA.6: Analyze climate change computational models and propose refinements.
- 8.2.8.ETW.3: Analyze the design of a product that negatively impacts the environment or society and develop possible solutions to lessen its impact.

International Society for Technology in Education:

- Innovative Designer
  - 4a- Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
  - 4b- Students select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.
  - 4c- Students develop, test and refine prototypes as part of a cyclical design process.
- Computational Thinker
  - 5c- Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
- Global Collaborator
  - 7c- Students contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.

Standards for Technological and Engineering Literacy:

- Nature and Characteristics of Technology and Engineering
  - STEL-1M: Apply creative problem-solving strategies to the improvement of existing devices or processes or the development of new approaches.
- History of Technology
  - STEL-6C: Compare various technologies and how they have contributed to human progress.
- Design in Technology and Engineering Education
  - STEL-7Q: Apply the technology and engineering design process.
  - STEL-7R: Refine design solutions to address criteria and constraints.
  - STEL-7U: Evaluate the strengths and weaknesses of different design solutions.
  - STEL-7V: Improve essential skills necessary to successfully design.

Computer Science and Design Thinking		
Standard	**Performance Expectations**	**Core Ideas**
8.1.8.IC.1	Compare the trade-offs associated with computing technologies that affect individual's everyday activities and career options	Advancements in computing technology can change individuals' behaviors. Society is faced with trade-offs due to the increasing globalization and automation that computing brings.
8.1.8.IC.2	Describe issues of bias and accessibility in the design of existing technologies.	
8.1.8.DA.5	Test, analyze, and refine computational models	Computer models can be used to simulate events, examine theories and inferences, or make predictions.
8.1.8.DA.6	Analyze climate change computational models and propose refinements.	
8.2.8.ETW.3 .	Analyze the design of a product that negatively impacts the environment or society and develop possible solutions to lessen its impact	Resources need to be utilized wisely to have positive effects on the environment and society. Some technological decisions involve tradeoffs between environmental and economic needs, while others have positive effects for both the economy and environment.

S.T.E.A.M. (Enrichment)

Career Readiness, Life Literacies and Key Skills		
Standard	**Performance Expectations**	**Core Ideas**
9.4.8.CI.4	Explore the role of creativity and innovation in career pathways and industries	Gathering and evaluating knowledge and information from a variety of sources, including global perspectives, fosters creativity and innovative thinking.
9.4.8.IML.12	Use relevant tools to produce, publish, and deliver information supported with evidence for an authentic audience.	There is a need to produce and publish media that has information supported with quality evidence and is intended for authentic audiences.
9.4.8.TL.3	Select appropriate tools to organize and present information digitally	Some digital tools are appropriate for gathering, organizing, analyzing, and presenting information, while other types of digital tools are appropriate for creating text, visualizations, models, and communicating with others.

Central Idea/Enduring Understanding:

Students will understand …

- The variety of careers related to engineering, biomedical sciences and computer science.
- To communicate effectively for specific purposes and settings.
- To collaborate effectively on a diverse and multidisciplinary team.
- To demonstrate personal responsibility and initiative.
- To persistently apply an iterative process to solve a problem or create an opportunity that can be justified.
- To solve a problem using computational thinking, analytical, and critical thinking skills.
- To analyze and describe design functionality by observation of an artifact.
- To demonstrate the ability to manage multiple resources throughout a project.
- To design and conduct an experiment that investigates a question.
- To analyze the factors affecting flight.
- To represent data, and describe relationships and processes to make predictions and solve air traffic control problems.
- To identify potential reasons why people want to travel to space.
- To propose solutions to provide safe living conditions in space.

Essential/Guiding Question:

- What skills prepare you for diverse career opportunities?
- How can failure produce positive outcomes?
- What does it take to effectively develop a solution to a problem or need?
- What does effective teamwork look like?
- Why are teams of people more successful than an individual when solving problems?
- How do you express yourself and your creativity through engineering?
- How do past technological achievements lead to new advancements?
- How do the laws of motion affect flight in Earth's atmosphere and space?
- What is the purpose of modeling?
- What is the purpose of performing investigations?
- What do humans need to survive?

Content:

- Lesson 1: Flight
  - 1.1: Instant Design Challenge
  - 1.2: Forces of Flight
  - 1.3: Test Flight

Skills(Objectives):

- Demonstrate an ability to identify, formulate, and solve engineering problems.
- Demonstrate an ability to design a system, component, or process to meet desired needs within realistic

S.T.E.A.M. (Enrichment)

○ 1.4: Drones to the Rescue ○ 1.5: Flight Planning ○ 1.6: Flight Management ○ 1.7: Cleared for Takeoff ○ Lesson 1 Assessment ● Lesson 2: Space ○ 2.1: Explorers of the Universe ○ 2.2: 3…2…1…Liftoff ○ 2.3: All Systems Go ○ 2.4: Out of this World Food ○ 2.5: Fit for Space ○ 2.6: Stayin' Alive ○ 2.7: Take Two! ○ Lesson 2 Assessment ● Lesson 3: Destination Mars ○ 3.1: Mission to Mars ○ End-of-Unit Assessment	constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. ● Demonstrate an ability to design and conduct experiments, as well as to analyze and interpret data. ● Demonstrate an ability to apply knowledge of mathematics, science, and engineering. ● Demonstrate an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. ● Pursue the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. ● Demonstrate an understanding of professional and ethical responsibility. ● Demonstrate an ability to function on multidisciplinary teams. ● Demonstrate an ability to communicate effectively. ● Gain knowledge of contemporary issues. ● Recognize the need for, and develop an ability to engage in life-long learning. ● Design and conduct experiments, as well as to analyze and interpret data to make improvements on blade designs for a wind turbine. ● Function on multidisciplinary teams. ● Describe the roles and responsibilities of STEM professionals for high demand technological careers. ● Identify the variety of careers related to engineering, biomedical sciences, and computer science. ● Explore a variety of careers related to engineering, biomedical sciences, and computer science. ● Explore and reflect on personal interests and strengths in relation to diverse career opportunities. ● Use accurate and appropriate terminology. ● Communicate to meet the needs of the audience and be appropriate to the situation. ● Document work, including processes, research, and solutions, in an organized notebook. ● Practice active listening. ● Illustrate successful collaboration through effective communication and constructive feedback. ● Apply team norms to encourage productivity and define how a team will function and measure its success. ● Identify and evaluate positive and negative behaviors that impact the team's effectiveness. ● Describe one's individual role and expectations of performance within the team and support other team members, if needed, to meet team goals. ● Independently take initiative. ● Identify ethical considerations that must be considered when creating solutions or opportunities. ● Describe major steps of a design process and identify typical tasks involved in each step.

S.T.E.A.M. (Enrichment)

	● Define a problem and justify the pursuit of a solution to the problem. ● Identify appropriate design requirements (criteria and constraints). ● Generate ideas or build upon other ideas to innovate. ● Evaluate solution ideas against the design requirements, and justify the best solution to pursue. ● Persistently design and develop the solution. ● Develop and implement a plan to test and evaluate a potential solution to verify that it meets all design requirements. ● Devise and execute a plan to solve a problem. ● Collect, display, analyze, and interpret data (including diagrams, charts, graphs, and tables) to draw a conclusion. ● Decompose a problem into smaller parts. ● Deconstruct an artifact to gain understanding about its functionality. ● Illustrate how the context in which an artifact is used determines the correctness, usability, functionality, and suitability of the artifact. ● Create and execute a plan to manage and use resources (time, materials, tools). ● Perform necessary data calculations and draw logical conclusions from experimental data. ● Describe how the forces of lift, drag, weight, and thrust affect flight. ● Explain how Newton's laws and lift principles affect flight. ● Analyze how the shape of a wing (airfoil) affects flight. ● Describe the major parts of an aircraft or spacecraft and how they affect flight. ● Describe how orbit is affected by an object's velocity and gravitational force. ● Calculate flight time given speed and distance. ● Analyze and interpret maps to draw conclusions. ● Independently take initiative. ● Plan schedule using a graphical planning tool. ● Describe current aerospace developments. ● Explain the benefits of space exploration (past, current, and future). ● Investigate resource recycling to meet human needs within a spacecraft or space habitat. ● Analyze nutritional needs in space and ways to counteract the effects of microgravity on the body.

Interdisciplinary Connections:

Science:

- MS-PS2-2: Plan an investigation to provide evidence that the change in an object's motion depends on the sum of forces and mass.
- MS-PS3-1: Construct and interpret graphical displays of data to describe energy's relationship to the speed of an object.
- MS-ETS1-1: Define criteria and constraints for solving a problem, considering scientific principles and human impacts.

S.T.E.A.M. (Enrichment)

- MS-ETS1-2: Evaluate competing design solutions using a systematic process.
  MS-ETS1-3: Analyze data from tests to compare design solutions and select features to combine.

Mathematics:

- 7.EE: Use expressions and equations to represent real-world situations (e.g., calculating thrust, lift).
- 7.RP: Analyze proportional relationships (e.g., ratio of wing area to lift).
- 7.SP: Summarize and interpret data distributions like test-flight results.
- 8.EE & 8.SP: Interpret scatter plots and build expressions modeling aerodynamic relationships.

Visual and Performing Arts:

- 1.2.Re7: Analyze how visual media, such as satellite imagery or design diagrams, convey ideas.
- 1.4.Cn11: Understand creative choices in performance or presentation formats (e.g., flight simulation demos).
- 1.5.Cr2: Use artistic tools to create visual representations of technical ideas (e.g., aerodynamic models, vehicle mock-ups).

Language Arts:

- L.VL.8.3. Determine or clarify the meaning of unknown and multiple-meaning words or phrases based on grade 8 reading and content, including technical meanings, choosing flexibly from a range of strategies.
  C. Use context (e.g., the overall meaning of a sentence or paragraph; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.
  D. Analyze the impact of specific word choices on meaning and tone.
- W.IW.8.2. Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
  C. Introduce a topic clearly, previewing what is to follow; and organize ideas, concepts, and information, using text structures (e.g., definition, classification, comparison/contrast, cause/effect, etc.) and text features (e.g., headings, graphics, and multimedia) when useful to aid in comprehension.
  D. Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples.
- W.WR.8.5. Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
- L.KL.8.2. Use knowledge of language and its conventions when writing, speaking, reading, or listening.
- SL.UM.8.5. Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.

Stage 2: Assessment Evidence

Performance Task(s):

- 1.7: Cleared for Takeoff
- 2.7: Take Two!
- 3.1: Mission to Mars
- Lesson 1 Assessment
- Lesson 2 Assessment
- End-of-Unit Assessment

Other Evidence:

- Online assignments
- Exit Tickets
- Worksheets
- Do Nows

Stage 3: Learning Plan

Learning Opportunities/Strategies:

- **Lesson 1: Flight**- Discover the science of flight and use aerodynamic concepts to explain how aircraft fly.
  - **1.1: Instant Design Challenge**- Engage in a hands-on instant design challenge, in which they work in teams to design, build and test a paper airplane using provided materials.

Resources:

- Project Lead the Way (PLTW)
- Lesson Presentations
- Google Docs
- Google Forms
- Google Classroom

LGBT and Disabilities Law Resources:

- GLSEN Educator Resources
- Supporting LGBTQIA Youth Resource List

S.T.E.A.M. (Enrichment)

○ **1.2: Forces of Flight**- Explore the key forces that affect flight-thrust, drag, weight, and lift. ○ **1.3: Test Flight**- Learn about the different parts of an airplane and learn how adjusting the different parts changes the motion of the airplane. ○ **1.4: Drones to the Rescue**- Explore different uses for drones and the basics of flight. ○ **1.5: Flight Planning**- Examine basic information about maps and navigation. ○ **1.6: Flight Management**- Analyze and solve various scenarios related to flight, including determining which crew members can be cleared to fly based on their flight hours and the flight schedule. ○ **1.7: Cleared for Takeoff**- Apply previous learning to design and build an aircraft using various materials. ○ **Lesson 1 Assessment** ● **Lesson 2: Space**- Investigate how scientists and engineers play a vital role in space travel, space discovery, and living in space. ○ **2.1: Explorers of the Universe**- Explore the history of space travel, its purpose, and the various scientific and technological benefits resulting from it. ○ **2.2: 3…2…1…Liftoff**- Build and test balloon rockets to explore the forces of flight related to liftoff. ○ **2.3: All Systems Go**- Examine the different layers of orbit around the Earth and what objects are orbiting in each layer. ○ **2.4: Out of this World Food**- Analyze food and water requirements on Earth and in Space, explore the fundamentals of healthy eating during space flight and at a future off-Earth colony. ○ **2.5: Fit for Space**- Explore what it takes to maintain human health in space and the effects of microgravity on the human body.	● Respect Ability: Fighting Stigmas, Advancing Opportunities DEI Resources: ● Learning for Justice ● GLSEN Educator Resources ● Supporting LGBTQIA Youth Resource List ● Respect Ability: Fighting Stigmas, Advancing Opportunities ● NJDOE Diversity, Equity & Inclusion Educational Resources ● Diversity Calendar

S.T.E.A.M. (Enrichment)

<table>
<tr>
<td>

2.6: Stayin' Alive- Analyze the resources needed on a spacecraft to maintain a safe living environment, including maintaining clean water and oxygen, and how these resources are constantly recycled through the various systems of the spacecraft and the humans living on the spacecraft.
2.7: Take Two!- Apply previous learning and skills to design and build an improved balloon rocket or a water treatment system.
Lesson 2 Assessment

Lesson 3: Destination Mars- Work in teams to design and model different aspects required to complete a mission to Mars.

3.1: Mission to Mars- Teams assemble an astronaut crew for the mission to Mars, choose the vehicle to get the crew safely to Mars, schedule the astronauts' tasks for one day aboard the spacecraft, decide where to land on Mars' surface, and create a prototype for a Mars lander.
End-of-Unit Assessment

</td>
<td></td>
</tr>
<tr>
<td colspan="2">Differentiation *Please note: Teachers who have students with 504 plans that require curricular accommodations are to refer to Struggling and/or Special Needs Section for differentiation</td>
</tr>
<tr>
<td>
<table>
<tr><th>High-Achieving Students</th></tr>
<tr><td>Higher order thinking questions
Differentiation of pacing and activities
Differentiation of learning strategies: visual, auditory, kinetic and cooperative
Enrichment and extension</td></tr>
</table>
</td>
<td>
<table>
<tr><th>On Grade Level Students</th></tr>
<tr><td>Differentiation of learning strategies: visual, auditory, kinetic and cooperative
Differentiating the lesson activities
Lesson tutorials</td></tr>
</table>
</td>
<td>
<table>
<tr><th>Struggling Students</th></tr>
<tr><td>Provide a highly structured, predictable learning environment
Provide organizers
Lessons designed to the style of learning that matches the student
Cooperative Learning
Positive reinforcement
Lessons presentation available on google classroom
Frequent check for understanding
Break down task into manageable units
One-on-one instruction</td></tr>
</table>
</td>
<td>
<table>
<tr><th>Special Needs/ELL</th></tr>
<tr><td>Any student requiring further accommodations and/or modifications will have them individually listed in their 504 Plan or IEP. These might include, but are not limited to: breaking assignments into smaller tasks, giving directions through several channels (auditory, visual, kinesthetic, model), and/or small group instruction for reading/writing

ELL supports should include, but are not limited to, the following::
Extended time
Provide visual aids
Repeated directions
Differentiate based on proficiency
Provide word banks
Allow for translators, dictionaries</td></tr>
</table>
</td>
</tr>
</table>

S.T.E.A.M. (Enrichment)

		Pair student with a high achieving student	

Pacing Guide

STEAM Enrichment	PTLW Resource	Standards
Energy and the Environment (45 days)	**Lessons:** Lesson 1: Investigating Energy- 14 days Lesson 2: Sustainable Energy- 15 days Lesson 3: Making an Impact- 16 days	8.1.8.IC.1–2 8.1.8.DA.5–6 8.2.8.ETW.3
Flight and Space (45 Days)	**Lessons:** Lesson 1: Flight- 20 days Lesson 2: Space- 16 days Lesson 3: Destination Mars- 9 days	8.1.8.IC.1–2 8.1.8.DA.5–6 8.2.8.ETW.3