Aerospace Projects Overview

Draft, version 1.2

Project Based Learning, cross-curricular (English Language Arts, Math, Science, Social Studies, Tech, Arts) using Colorado State Grade Standards embedded and assessed within the project*

As with all PBL, projects will develop with the nuances of each learning community and not all content areas are covered in each project

**Colorado Science Standards and alignments may shift once these standards are made available in final form--as of July 2018 they are currently in approved draft status and this scope and sequence aligns to the draft form.*

Aerospace Projects Overview	6th Grade Topics	7th Grade Topics	8th Grade Topics
	• **A Geological Exploration of Mars and Earth** • **Aviation Weather** • **High Altitude Balloon Launch, Because Learning** • **Astronomy through NASA Earth Science Aircraft, SOFIA**	• **DreamUp to Space** • **Genes in Space, through MiniPCR** • **Moon and Mars Colonization: Life in Space** • **Birds, Flight, and Ecosystems**	• **We Have Liftoff! Rocketry Concepts** • **DreamCoder, Engineering Design** • **Soar Up!** • **sUAV Challenge**

***A note about assessments**: both formative and summative in nature using a combination of rubrics, guides, traditional assessments and reflective check-ins throughout project to support learner growth and success.*

***A note about differentiation**: Results from NWEA MAP testing provides targeted growth in English Language Arts and Math for effective scaffolding of content, process and products for learner growth and success.*

6th Grade Projects Scope and Sequence

Project: A Geological Exploration of Mars and Earth
Driving Questions:
How can we understand distant planets through the geology of our planet? How do geologists and engineers collaborate to explore planets?
Standards:
Asking Questions and Defining Problems, Developing and Using Models, Planning and Carrying Out Investigations, Analyzing and Interpreting Data, Using Mathematics and Computational Thinking, Constructing Explanations and Designing Solutions, Engaging in Argument from Evidence, Obtaining, Evaluating and Communicating Information, Solar System, Rock Strata, Water Cycle, Complex Patterns and Weather, Human Interaction and Effect on Earth's Resources, Mapping of Natural Hazards, Human Activities Effect Global Warming, Formulate, represent, and use algorithms with rational numbers flexibly, accurately, and efficiently, Visual displays and summary statistics of one-variable data condense the information in data sets into usable knowledge, Direct and indirect measurement can be used to describe and make comparisons, Linear functions model situations with a constant rate of change and can be represented numerically, algebraically, and graphically, Linear measure, angle measure, area, and volume are fundamentally different and require different units of measure, Speak and use multimedia to present claims and findings to an audience, Explain and interpret information, Identify supported and unsupported claims, Read, comprehend, and analyze literary, informational, and persuasive texts from a variety of authors, Use technology to shape, produce and publish grammatically correct writing in a variety of genres, Conduct research projects to answer a question, Gathering evidence from several sources, Evaluate arguments and specific claims, Analyze and interpret historical source

Activities
- Interactive Project Journal development for notes, artifacts, diagrams using google docs
- Explore Mars through the lens of a geologist
- Research, identify and classify geologic substances, history and processes using learner demonstrations and presentations
- NASA Journey of a Lifetime Interact with current Mars missions, research and oral presentation
- Build models and make predictions about structures on Mars through structures on the surface of Earth
- Giant Mars Map activities to develop an understanding of the planet

Assessments
- Journal checks for accuracy, completion and timeliness
- Vocabulary quizzes
- Geologic substances, history and processes guide and rubric
- Mars missions, research and oral presentation guide and rubric
- Model building guide and rubric
- Participation in Giant Mars Map group event
- Written Reflections on the process and debrief at the end of project
- iLEAD PBL Academic Rigor and Social Emotional Learning rubrics to develop learning mindsets
- Peer feedback, Critical Friends Protocol

Differentiation
- Options for teaming
- Mind-maps and diagrams, hand drawn or computer based
- Model development, physical or using technology
- Videos for content delivery and review
- Vocabulary assessment, choice for written or oral; option for re-challenging an assessment after further study to show growth and mastery
- Writing rubrics individualized to support writing development using MAP data results
- Facilitator checks-ins on progress and support, flexible frequency for individual need
- Online learning tools, such as Quizlet and ProProfs, to support several methods for learning complex content and vocabulary
- Kid-friendly rubrics with scaffolded self monitoring timelines for due dates
- iLEAD Academic Rigor and Social Emotional Learning assessment tool for individual goal setting and focus throughout project

Project: Weather to Fly...or Not!
Driving Questions:
How does meteorology inform and interact with flight? How can we use weather products to develop forecasts? How are earth's structures related to global weather patterns and how are they changing? What effect does climate have on people and society? How can technology be utilized to mitigate the effects on humans on a changing planet?
Standards:
Asking Questions and Defining Problems, Developing and Using Models, Planning and Carrying Out Investigations, Analyzing and Interpreting Data, Using Mathematics and Computational Thinking, Constructing Explanations and Designing Solutions, Engaging in Argument from Evidence, Obtaining, Evaluating and Communicating Information, Water Cycle, Complex Patterns and Weather, Human Interaction and Effect on Earth's Resources, Mapping of Natural Hazards, Human Activities Effect Global Warming, analyze and explain how human and physical systems (oceans, mountains, rivers, valleys, plants) vary and interact, Speak and use multimedia to present claims and findings to an audience, Analyze and interpret historical sources (original documents, maps, artifacts) to ask and research questions about the historical eras, individuals, groups, and ideas in various regions throughout the Western Hemisphere, Use different geographic tools such as maps, globes, diagrams, charts and data to identify and present solutions to problems around the world; analyze and explain how human and physical systems (oceans, mountains, rivers, valleys, plants) vary and interact, Examine the governmental and economic connections between the United States and other nations, Explain and interpret information, Identify supported and unsupported claims, Read, comprehend, and analyze literary, informational, and persuasive texts from a variety of authors, Use technology to shape, produce and publish grammatically correct writing in a variety of genres, Conduct research projects to answer a question, Gathering evidence from several sources, Evaluate arguments and specific claims, Formulate, represent, and use algorithms with rational numbers flexibly, accurately, and efficiently, Visual displays and summary statistics of one-variable data condense the information in data sets into usable knowledge, Direct and indirect

measurement can be used to describe and make comparisons, Linear functions model situations with a constant rate of change and can be represented numerically, algebraically, and graphically, Linear measure, angle measure, area, and volume are fundamentally different and require different units of measure

Activities	Assessments	Differentiation
• Interactive Project Journal development for notes, artifacts, diagrams using google docs • FAA Jetstream Online Weather and NASA Climate Change, Explore weather through the lens of a meteorologist and aviator • Creative Learning Systems, Build and use weather instruments for a weather station • Introduction to arduinos and sensors through Because Learning • Collect and analyze data using arduinos through Because Learning • FAA Forecast, Utilize technology based weather products used in the aviation industry including global and local maps • Predict weather through understanding global and local weather patterns and changes	• Journal checks for accuracy, completion and timeliness • Vocabulary quizzes • Weather Instrument guide and rubric • Oral presentation guide and rubric • Demonstrate proficiency using sensors and arduinos • Demonstrate usage of aviation weather products, "pull weather" for a proposed flight • Severe weather research and presentation rubric • Written Reflections on the process and debrief at the end of project • Final assessment, weather • iLEAD PBL Academic Rigor and Social Emotional Learning rubrics to develop learning mindsets • Peer feedback, Critical Friends Protocol	• Options for teaming • Mind-maps and diagrams, hand drawn or computer based • Model development, physical or using technology • Videos for content delivery and review • Vocabulary assessment, choice for written or oral; option for re-challenging an assessment to show growth and mastery • Writing rubrics individualized to support writing development using MAP data results • Facilitator checks-ins on progress and support, flexible frequency for individual need • Online learning tools, such as Quizlet and ProProfs, to support several methods for learning complex content and vocabulary • Kid-friendly rubrics with scaffolded self monitoring timelines for due dates • Optional: Severe Weather video research and presentation • iLEAD Academic Rigor and Social Emotional Learning assessment tool for individual goal setting and focus throughout project

Project: High Altitude Balloon Launch, Because Learning
Driving Questions:
How is technology developed and used in high altitude balloon launches? How can mapping the air space connected to control towers ensure safe air travel? How do meteorologists interact with aviators?
Standards:
Asking Questions and Defining Problems, Developing and Using Models, Planning and Carrying Out Investigations, Analyzing and Interpreting Data, Using Mathematics and Computational Thinking, Constructing Explanations and Designing Solutions, Engaging in Argument from Evidence, Obtaining, Evaluating and Communicating Information,, Water Cycle, Complex Patterns and Weather, Use different geographic tools such as maps, globes, diagrams, charts and data to identify and present solutions to problems around the world; analyze and explain how human and physical systems (oceans, mountains, rivers, valleys, plants) vary and interact, Formulate, represent, and use algorithms with rational numbers flexibly, accurately, and efficiently, Visual displays and summary statistics of one-variable data condense the information in data sets into usable knowledge, Direct and indirect measurement can be used to describe and make comparisons, Linear functions model situations with a constant rate of change and can be represented numerically, algebraically, and graphically, Linear measure, angle measure, area, and volume are fundamentally different and require different units of measure, Speak and use multimedia to present claims and findings to an audience, Explain and interpret information, Identify supported and unsupported claims, Read, comprehend, and analyze literary, informational, and persuasive texts from a variety of authors, Use technology to shape, produce and publish grammatically correct writing in a variety of genres, Conduct research projects to answer a question, Gathering evidence from several sources, Evaluate arguments and specific claims

Activities:	Assessments	Differentiation
• Interactive Project Journal development for notes, artifacts, diagrams using google docs • Smithsonian, America by Air, Explore Air Space and its history by mapping activities • FAA Smart Skies, model, investigate, analyze, and resolve air traffic conflicts • Design a infographic of Aviation Alphabet and create a call sign	• Journal checks for accuracy, completion and timeliness • Vocabulary quizzes • Design a infographic of Aviation Alphabet and create a call sign guide and rubric • Air Space and Control Towers research guide and rubric • Air Space and Control Towers guide and rubric for oral presentation	• Options for teaming • Mind-maps and diagrams, hand drawn or computer based • Model development, physical or using technology • Videos for content delivery and review • Vocabulary assessment, choice for written or oral; option for re-challenging an assessment to show growth and mastery

• Design and Launch a high altitude balloon with a sensor payload Because Learning • Analyze and communicate data from high altitude balloon launch • Collaboration with NASA Meteorologists and subject matter experts	• Written Reflections on the process and debrief at the end of project • iLEAD PBL Academic Rigor and Social Emotional Learning rubrics to develop learning mindsets • Peer feedback, Critical Friends Protocol	• Writing rubrics individualized to support writing development using MAP data results • Facilitator checks-ins on progress and support, flexible frequency for individual need • Online learning tools, such as Quizlet and ProProfs, to support several methods for learning complex content and vocabulary • Kid-friendly rubrics with scaffolded self monitoring timelines for due dates • iLEAD Academic Rigor and Social Emotional Learning assessment tool for individual goal setting and focus throughout project

Project: NASA Earth Science Aircraft, SOFIA
Driving Questions:
How are aircraft designed and used to understand our Earth? How can we use different bands of light to obtain information about celestial bodies? How has technology and instrument development furthered our understanding of the Universe? How do subject matter experts collaborate to run a successful NASA mission?
Standards:
Asking Questions and Defining Problems, Developing and Using Models, Planning and Carrying Out Investigations, Analyzing and Interpreting Data, Using Mathematics and Computational Thinking, Constructing Explanations and Designing Solutions, Engaging in Argument from Evidence, Obtaining, Evaluating and Communicating Information, Solar System, Electromagnetic Spectrum, Use different geographic tools such as maps, globes, diagrams, charts and data to identify and present solutions to problems around the world; analyze and explain how human and physical systems (oceans, mountains, rivers, valleys, plants) vary and interact, Examine the governmental and economic connections between the United States and other nations, Speak and use multimedia to present claims and findings to an audience, Explain and interpret information, Identify supported and unsupported claims, Formulate, represent, and use algorithms with rational numbers flexibly, accurately, and efficiently, Visual displays and summary statistics of one-variable data condense the information in data sets into usable knowledge, Direct and indirect measurement can be used to describe and make comparisons, Linear functions model situations with a constant rate of change and can be represented numerically, algebraically, and graphically, Linear measure, angle measure, area, and volume are fundamentally different and require different units of measure, Read, comprehend, and analyze literary, informational, and persuasive texts from a variety of authors, Use technology to shape, produce and publish grammatically correct writing in a variety of genres, Conduct research projects to answer a question, Gathering evidence from several sources, Evaluate arguments and specific claims, A simple wave model has a repeating pattern with specific wavelength, frequency, and amplitude and mechanical waves need a medium through which they are transmitted. This model can explain many phenomena which include light and sound, A wave model of light is useful to explain how light interacts with objects through a variety of properties, Designed technologies can transmit digital information as wave pulses

Activities: • Interactive Project Journal development for notes, artifacts, diagrams using google docs • Research the mission of NASA's SOFIA through a webquest • Explore the Electromagnetic Spectrum through learner developed demonstrations and presentations • Complete SOFIA "Active Astronomy" education activities in order to examine infrared light https://www.sofia.usra.edu/sites/default/files/section1.pdf • Develop and execute a plan to interact with SOFIA crew • Design a simple, modified aircraft • Participate in lab activities about lenses and their applications, including the construction of a basic telescope • Explore the history of astrophysics and tools/experiments used to examine the universe through NASA's "Cosmic Times" activities	**Assessments** • Journal checks for accuracy, completion and timeliness • Vocabulary quizzes • Writing, Webquest rubric • Diagram of EM Spectrum • Rubric-based assessment for lens and telescope activity, along with the SOFIA "Active Astronomy" activities • History of Astrophysics guide and rubric • Modified aircraft guide and rubric • Written Reflections on the process and debrief at the end of project • iLEAD PBL Academic Rigor and Social Emotional Learning rubrics to develop learning mindsets • Peer feedback, Critical Friends Protocol	**Differentiation** • Options for teaming • Mind-maps and diagrams, hand drawn or computer based • Model development, physical or using technology • Videos for content delivery and review • Vocabulary assessment, choice for written or oral; option for re-challenging an assessment to show growth and mastery • Writing rubrics individualized to support writing development using MAP data results • Facilitator checks-ins on progress and support, flexible frequency for individual need • Online learning tools, such as Quizlet and ProProfs, to support several methods for learning complex content and vocabulary • Kid-friendly rubrics with scaffolded self monitoring timelines for due dates

7th Grade Projects Scope and Sequence

Project: Moon and Mars Colonization

How can long term space exploration impact us as people and as a space-faring society? How can we justify space exploration given the global challenges we face on Earth? What is the impact of privatized space exploration on the industry and society? What energy and power needs will we have on the Moon and Mars? How can we best acquire, develop, and utilize the technology necessary to create an ecosystem that can successfully operate a Moon and Mars colony?

Standards:

Asking Questions and Defining Problems, Developing and Using Models, Planning and Carrying Out Investigations, Analyzing and Interpreting Data, Using Mathematics and Computational Thinking, Constructing Explanations and Designing Solutions, Engaging in Argument from Evidence, Obtaining, Evaluating and Communicating Information, All living things are made up of cells, Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring, Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with nonliving, Ecosystems are sustained by the continuous flow of energy, originating primarily from the sun, and the recycling of matter and nutrients within the system. Heredity explains why offspring resemble, but are not identical to, their parents and is a unifying biological principle, Genetic variations among individuals in a population give some individuals an advantage in surviving and reproducing in their environment, Use different geographic tools such as maps, globes, diagrams, charts and data to identify and present solutions to problems around the world; analyze and explain how human and physical systems (oceans, mountains, rivers, valleys, plants) vary and interact, Examine the governmental and economic connections between the United States and other nations, Formulate, represent, and use algorithms with rational numbers flexibly, accurately, and efficiently, Visual displays and summary statistics of one-variable data condense the information in data sets into usable knowledge, Direct and indirect measurement can be used to describe and make comparisons, Linear functions model situations with a constant rate of change and can be represented numerically, algebraically, and graphically, Linear measure, angle measure, area, and volume are fundamentally different and require different units of measure, Analyze and interpret historical source, Speak and use multimedia to present claims and findings, Analyze a speaker's main ideas and supporting details, Read, comprehend, and analyze literary, informational, and persuasive texts from a variety of authors, Use technology to shape, produce and publish grammatically correct writing in a variety of genres, follow a standard format for citation, evaluate the soundness of reasoning and the relevance/sufficiency of evidence

Activities

- Interactive Project Journal development for notes, artifacts, diagrams using google docs
- Read, discuss, and complete activities based on *The Martian* by Andy Weir (classroom edition)
- Complete the NASA "You Can't Take It With You" Martian settlement building activities
- Energy activities including solar panel activity, wind turbine design using KidWind lessons and materials, mathematical computations exercise, multimeter usage/basic electricity activities
- Design and test a bottle biology ecosystem project that showcase a variety of ecosystem cycles (nitrogen cycle, water cycle, etc.)
- Compare plant growth utilizing space-exposed tomato seeds and Earth-based seeds via Tomatosphere; built a plant growth chamber
- Research current plant-growth and animal projects on the ISS
- Participate in an online exploration of including an examination of the model systems and an opportunity to connect with one of the researchers there http://biosphere2.org

Assessments

- Journal checks for accuracy, completion and timeliness
- Vocabulary quizzes
- *The Martian*: embedded quizzes and informal comprehension assessments; final presentation; formal writing activity
- Guide and Rubric-driven assessment, project, and presentation for "You Can't Take It With You"
- Kidwind guide and rubric
- Water cycle guide and rubric
- Guide, including charts, and rubric for Tomatosphere
- iLEAD PBL Academic Rigor and Social Emotional Learning rubrics to develop learning mindsets
- Peer feedback, Critical Friends Protocol

Differentiation

- Audio-book versions of *The Martian* are available, as well as differentiated comprehension questions and writing prompts/assignments
- Embedded differentiation in the "You Can't Take It With You" activity guide
- Options for teaming
- Mind-maps and diagrams, hand drawn or computer based
- Model development, physical or using technology
- Videos for content delivery and review
- Vocabulary assessment, choice for written or oral; option for re-challenging an assessment to show growth and mastery
- Writing rubrics individualized to support writing development using MAP data results
- Facilitator checks-ins on progress and support, flexible frequency for individual need
- Online learning tools, such as Quizlet and ProProfs, to support several methods for learning complex content and vocabulary
- Kid-friendly rubrics with scaffolded self monitoring timelines for due dates
- iLEAD Academic Rigor and Social Emotional Learning assessment tool for individual goal setting and focus throughout project

Project: DreamUp to Space

Driving questions:
What are living things? How can living things adapt and survive in Microgravity? How does Space adaptation compare to heredity and adaptation on Earth? What does collaboration on the International Space Station tell us about possible future initiatives? What does collaborating with experts entail?

Standards:
Asking Questions and Defining Problems, Developing and Using Models, Planning and Carrying Out Investigations, Analyzing and Interpreting Data, Using Mathematics and Computational Thinking, Constructing Explanations and Designing Solutions, Engaging in Argument from Evidence, Obtaining, Evaluating and Communicating Information, Formulate hypotheses and predict results, Compare results to predictions and draw conclusions based on hypotheses, Use observation to inform predictions, Present data in graphical form, Scientific method, Animal and plant biology, parts and function, Gravity vs Microgravity, Measurement and Conversion, Experimental Design and constraints, Formulate, represent, and use algorithms with rational numbers flexibly, accurately, and efficiently, Visual displays and summary statistics of one-variable data condense the information in data sets into usable knowledge, Direct and indirect measurement can be used to describe and make comparisons, Linear functions model situations with a constant rate of change and can be represented numerically, algebraically, and graphically, Linear measure, angle measure, area, and volume are fundamentally different and require different units of measure, Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes., Oral presentation, Video communication, Analyze and interpret historical source, Speak and use multimedia to present claims and findings, Analyze a speaker's main ideas and supporting details, Read, comprehend, and analyze literary, informational, and persuasive texts from a variety of authors, Use technology to shape, produce and publish grammatically correct writing in a variety of genres, follow a standard format for citation, evaluate the soundness of reasoning and the relevance/sufficiency of evidence

Activities

- Interactive Project Journal development for notes, artifacts, diagrams using google docs
- Diagram and model cells including parts and functions
- Complete online HHMI Biointeractive activities relating to the biology of cells as well as genetics and heredity
- Create a Model of the International Space Station
- NASA "Build the Space Station"
- identify the international partnerships involved in the development and operation of the International Space Station (ISS).
- Optional: NASA Mass vs Weight Educator guide, Demonstrate the difference between mass and weight
- Investigate careers in space exploration
- Design mind maps representing Scientific Method and Engineering Design Process
- Writing: POE (Predict, Observe, Explain) method to explore Microgravity and Gravity including building and conducting demonstrations, videos and discussion
- Develop an idea for an experiment to be run on International Space Station using a NanoRacks MixStix
- Create an "elevator pitch" video explaining the experiment
- Collaborate with experts using guided steps on email, phone conversations, Skype and face-to-face meetings

Assessments:

- Journal checks for accuracy, completion and timeliness
- Oral group presentations on parts and partners of ISS using rubric
- Vocabulary quizzes
- BioInteractive activities completion
- Design mind maps representing Scientific Method and Engineering Design Process guide and rubric
- Formal Writing, Experiment Design Proposal using rubric
- Video/Oral presentation on Experiment Proposal using rubric
- Written Reflections on the process and debrief at the end of project
- Documentation of expert interaction and collaboration
- Gravity vs Microgravity formal assessment
- Documentation of interaction with subject matter experts, blog
- iLEAD PBL Academic Rigor and Social Emotional Learning rubrics to develop learning mindsets
- Peer feedback, Critical Friends Protocol

Differentiation

- Options for teaming
- Mind-maps and diagrams, hand drawn or computer based
- Model development, physical or using technology
- Videos for content delivery and review
- Vocabulary assessment, choice for written or oral; option for re-challenging an assessment to show growth and mastery
- Writing rubrics individualized to support writing development using MAP data results
- Facilitator checks-ins on progress and support, flexible frequency for individual need
- Online learning tools, such as Quizlet and ProProfs, to support several methods for learning complex content and vocabulary
- Kid-friendly rubrics with scaffolded self monitoring timelines for due dates
- iLEAD Academic Rigor and Social Emotional Learning assessment tool for individual goal setting and focus throughout project

Project: Genes in Space, through MiniPCR
Driving Questions:
How can we explore heredity in Microgravity? How does heredity differ in microbiology versus on Earth? What are the current ideas about epigenetics? What processes are involved in microbiology?

Standards:
Asking Questions and Defining Problems, Developing and Using Models, Planning and Carrying Out Investigations, Analyzing and Interpreting Data, Using Mathematics and Computational Thinking, Constructing Explanations and Designing Solutions, Engaging in Argument from Evidence, Obtaining, Evaluating and Communicating Information, Formulate hypotheses and predict results, Compare results to predictions and draw conclusions based on hypotheses, All living things are made up of cells, Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring, Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with nonliving, Ecosystems are sustained by the continuous flow of energy, originating primarily from the sun, and the recycling of matter and nutrients within the system. Heredity explains why offspring resemble, but are not identical to, their parents and is a unifying biological principle, Genetic variations among individuals in a population give some individuals an advantage in surviving and reproducing in their environment,Use observation to inform predictions about unknown samples, Present data in graphical form, Formulate, represent, and use algorithms with rational numbers flexibly, accurately, and efficiently, Visual displays and summary statistics of one-variable data condense the information in data sets into usable knowledge, Direct and indirect measurement can be used to describe and make comparisons, Linear functions model situations with a constant rate of change and can be represented numerically, algebraically, and graphically, Linear measure, angle measure, area, and volume are fundamentally different and require different units of measure, Microbiology skills: Micropipetting, Preparation of agarose gels, Agarose gel DNA electrophoresis , Visualization of dyes, Paper chromatography, Heredity, DNA, develop models, technical writing, literature, Speak and use multimedia to present claims and findings, Analyze a speaker's main ideas and supporting details, Read, comprehend, and analyze literary, informational, and persuasive texts from a variety of authors, Use technology to shape, produce and publish grammatically correct writing in a variety of genres, follow a standard format for citation, evaluate the soundness of reasoning and the relevance/sufficiency of evidence

Activities	Assessments	Differentiation
• Interactive Project Journal development for notes, artifacts, diagrams using google docs • Develop a "kid friendly" DNA Model Science Kit Challenge to be "marketed and sold" to children • Teach Genetics, Observable human characteristics and introduction to genetics • The Friendship Experiment, by Erin Teagan, guided reading • NASA Space Bioscience research and mini report on biological experiments that have been or are presently on ISS • MiniPCR Glow Lab, Investigate DNA base pairing and the conditions that will cause the DNA double helix to separate into single strands (denaturation), and then come together again (annealing) • Develop and propose an experiment using PCR that can be run on International Space Station through Genes in Space	• Journal checks for accuracy, completion and timeliness • Vocabulary quizzes • DNA Model Science Kit, rubric • Technical writing, DNA guide rubric • Literature circle guides • Mini presentation rubric on ISS Bioscience guide and rubric • Introduction to genetics diagrams and labs completion • MiniPCR Lab instructions and completion • Genes in Space proposal, rubric and presentation • Written Reflections on the process and debrief at the end of project • iLEAD PBL Academic Rigor and Social Emotional Learning rubrics to develop learning mindsets • Peer feedback, Critical Friends Protocol	• Options for teaming • Mind-maps and diagrams, hand drawn or computer based • Model development, physical or using technology • Videos for content delivery and review • Vocabulary assessment, choice for written or oral; option for re-challenging an assessment to show growth and mastery • Writing rubrics individualized to support writing development using MAP data results • Facilitator checks-ins on progress and support, flexible frequency for individual need • Online learning tools, such as Quizlet and ProProfs, to support several methods for learning complex content and vocabulary • Kid-friendly rubrics with scaffolded self monitoring timelines for due dates • iLEAD Academic Rigor and Social Emotional Learning assessment tool for individual goal setting and focus throughout project

Project: Birds and Flight
Driving Questions: How does a bird fly? How has human-powered flight been influenced by bird flight? How do innovations in technology allow humans to better mimic bird flight? How does wing design affect flight?
Standards:
Asking Questions and Defining Problems, Developing and Using Models, Planning and Carrying Out Investigations, Analyzing and Interpreting Data, Using Mathematics and Computational Thinking, Constructing Explanations and Designing Solutions, Engaging in Argument from Evidence, Obtaining, Evaluating and Communicating Information, Speak and use multimedia to present claims and findings, Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions, Biodiversity is the wide range of existing life forms that have adapted to the variety of conditions on Earth, from terrestrial to marine ecosystems**,** Analyze a speaker's main ideas and supporting details,Formulate, represent, and use algorithms with rational numbers flexibly, accurately, and efficiently, Visual displays and summary statistics of one-variable data condense the information in data sets into usable knowledge, Direct and indirect measurement can be used to describe and make comparisons, Linear functions model situations with a constant rate of change and can be represented numerically, algebraically, and graphically, Linear measure, angle measure, area, and volume are fundamentally different and require different units of measure, Read, comprehend, and analyze literary, informational, and persuasive texts from a variety of authors, Use technology to shape, produce and publish grammatically correct writing in a variety of genres, follow a standard format for citation, evaluate the soundness of reasoning and the relevance/sufficiency of evidence

Activities	Assessments	Differentiation

• Interactive project journal development for notes, artifacts, diagrams using google docs • Utilize computer-based wind tunnel programs and a classroom wind tunnel to develop and test an aerodynamic wing and/or aircraft based on bird biology • Participate in composite materials construction lab • Participate in a bird-watching field observation experience • Connect with NASA subject-matter experts at Armstrong Flight Research Center who are developing new aircraft designs based on bird structures, Prandtl Wing • Complete biomimicry activities: "Birdflight Adaptations: Inspirations for Aeronautical Engineering" through and "Amazing Birds" through Cornell Lab of Ornithology • Complete online bird adaptation simulation challenge, "Flap to the	• Journal checks for accuracy, completion and timeliness • Vocabulary quizzes • Written Reflections on the process and debrief at the end of project • Wind tunnel guide and rubric • Composite lab completion • Written Reflection on bird observation experience • Completion and rubrics from Bird Flight Adaptations, • iLEAD PBL Academic Rigor and Social Emotional Learning rubrics to develop learning mindsets • Peer feedback, Critical Friends Protocol	• Options for teaming • Mind-maps and diagrams, hand drawn or computer based • Model development, physical or using technology • Videos for content delivery and review • Vocabulary assessment, choice for written or oral; option for re-challenging an assessment to show growth and mastery • Writing rubrics individualized to support writing development using MAP data results • Facilitator checks-ins on progress and support, flexible frequency for individual need • Online learning tools, such as Quizlet and ProProfs, to support several methods for learning complex content and vocabulary • Kid-friendly rubrics with scaffolded self monitoring timelines for due dates • iLEAD Academic Rigor and Social Emotional Learning assessment tool for individual goal setting and focus throughout project

8th Grade Projects Scope and Sequence

Project: We Have Liftoff! Rocketry Concepts
Driving Questions:
What energy and forces are utilized and overcome in order to launch rockets? What challenges have humans faced in the history of rocketry? How will these challenges change in the future?
Standards:
Asking Questions and Defining Problems, Developing and Using Models, Planning and Carrying Out Investigations, Analyzing and Interpreting Data, Using Mathematics and Computational Thinking, Constructing Explanations and Designing Solutions, Engaging in Argument from Evidence, Obtaining, Evaluating and Communicating Information, Analyze and interpret historical source, Newton's Laws, Matter is composed of atoms and molecules can be used to explain the properties of substances, diversity of materials, states of matter and phases changes, Reacting substances rearrange to form different molecules, but the number of atoms is conserved. Some reactions release energy and others absorb energy, Reacting substances rearrange to form different molecules, but the number of atoms is conserved. Some reactions release energy and others absorb energy, Motion is described relative to a reference frame that must be shared with others and is determined by the sum of the forces acting on it. The greater the mass of the object, the greater the force needed to achieve the same change in motion, Forces that act a distance (gravitational, electric, and magnetic) can be explained by force fields that extend through space and can be mapped by their effect on a test object, Kinetic energy can be distinguished from the various forms of potential energy, Energy changes to and from each type can be tracked through physical or chemical interaction , When two objects interact, each on exerts a force on the other that can cause energy to be transferred to and from the object, Speak and use multimedia to clarify information, strengthen claims, and add interest, Analyze a speaker's purpose, Read, analyze, and evaluate a variety of literary and nonfiction texts, Analyze key ideas, people, events, and claims in nonfiction, Use technology to shape, produce, and publish grammatically correct writing that makes an argument or analyzes a topic, Conduct short research projects to answer a question and generate additional focus questions, Follow a standard format for citation, Evaluate the soundness of reasoning and the relevance/sufficiency of evidence.

Activities	**Assessments**	**Differentiation**
• Interactive Project Journal development for notes, artifacts, diagrams using google docs • Phase Change and Chemical Reactions, Research and develop demonstrations, NASA States of Matter • Design, build, and test a model rocket utilizing RockSim simulation software, a classroom vertical wind tunnel, and an actual model rocket launch	• Journal checks for accuracy, completion and timeliness • Vocabulary quizzes • Phase Change and Chemical Reactions, Research and develop demonstrations • Rocket model guide and rubric • Oral presentation rubric • SpaceMath@NASA formal assessments • Written Reflections on the process and debrief at the end of project	• Options for teaming • Mind-maps and diagrams, hand drawn or computer based • Model development, physical or using technology • Videos for content delivery and review • Vocabulary assessment, choice for written or oral; option for re-challenging an assessment to show growth and mastery • Writing rubrics individualized to

(actual rocket launch completed in partnership with local rocketry club) ● Utilize the Teachengineer.org lessons and activities, "Rockets" which asks students to make engineering choices, create free-body diagrams, and relate rocket motion to Newton's laws. ● Calculate rocket launch trajectories, altitudes, and orbits through SpaceMath@NASA lessons and activities	● Written Reflections on the process and debrief at the end of project ● iLEAD PBL Academic Rigor and Social Emotional Learning rubrics to develop learning mindsets ● Peer feedback, Critical Friends Protocol	support writing development using MAP data results ● Facilitator checks-ins on progress and support, flexible frequency for individual need ● Online learning tools, such as Quizlet and ProProfs, to support several methods for learning complex content and vocabulary ● Kid-friendly rubrics with scaffolded self monitoring timelines for due dates ● iLEAD Academic Rigor and Social Emotional Learning assessment tool for individual goal setting and focus throughout project

Project: UAV Challenge
Driving Questions: What are the current and future roles of the UAS in society? How do sUAVs operate both on Earth and on off-Earth locations? What does it take to create a UAS that can perform a specific task? How do we ensure UAS are safely utilized in society?
Standards:
Asking Questions and Defining Problems, Developing and Using Models, Planning and Carrying Out Investigations, Analyzing and Interpreting Data, Using Mathematics and Computational Thinking, Constructing Explanations and Designing Solutions, Engaging in Argument from Evidence, Obtaining, Evaluating and Communicating Information, Newton's Laws, Some reactions release energy and others absorb energy, Motion is described relative to a reference frame that must be shared with others and is determined by the sum of the forces acting on it. The greater the mass of the object, the greater the force needed to achieve the same change in motion, Forces that act a distance (gravitational, electric, and magnetic) can be explained by force fields that extend through space and can be mapped by their effect on a test object, Kinetic energy can be distinguished from the various forms of potential energy, Energy changes to and from each type can be tracked through physical or chemical interaction , When two objects interact, each on exerts a force on the other that can cause energy to be transferred to and from the object, Formulate, represent, and use algorithms with rational numbers flexibly, accurately, and efficiently, Visual displays and summary statistics of one-variable data condense the information in data sets into usable knowledge, Direct and indirect measurement can be used to describe and make comparisons, Linear functions model situations with a constant rate of change and can be represented numerically, algebraically, and graphically, Linear measure, angle measure, area, and volume are fundamentally different and require different units of measure, Speak and use multimedia to clarify information, strengthen claims, and add interest, Analyze a speaker's purpose, Read, analyze, and evaluate a variety of literary and nonfiction texts, Analyze key ideas, people, events, and claims in nonfiction, Use technology to shape, produce, and publish grammatically correct writing that makes an argument or analyzes a topic, Conduct short research projects to answer a question and generate additional focus questions, Follow a standard format for citation, Evaluate the soundness of reasoning and the relevance/sufficiency of evidence

Activities	**Assessments**	**Differentiation**
● Interactive Project Journal development for notes, artifacts, diagrams using google docs ● Create a safety poster for the safe and ethical use of UAVs ● Complete safety training for UAVs flight both on RealFlight simulators and with a UAS in a flight cage ● Design, build, and test a small UAV ● Explore the roles, benefits, and limitations of UAS in society ● Research off-Earth applications of UAS, referencing the work of NASA JPL, particularly the development of Mars UAS	● Journal checks for accuracy, completion and timeliness ● Vocabulary quizzes ● Rubric-based assessment on the design, build, and test of a sUAV ● Completion of pilot safety testing ● Explore the roles, benefits, and limitations of UAVs in society guide and rubric, oral presentation ● iLEAD PBL Academic Rigor and Social Emotional Learning rubrics to develop learning mindsets ● Peer feedback, Critical Friends Protocol	● Options for teaming ● Mind-maps and diagrams, hand drawn or computer based ● Model development, physical or using technology ● Videos for content delivery and review ● Vocabulary assessment, choice for written or oral; option for re-challenging an assessment to show growth and mastery ● Writing rubrics individualized to support writing development using MAP data results ● Facilitator checks-ins on progress and support, flexible frequency for individual need ● Online learning tools, such as Quizlet and ProProfs, to support several methods for learning complex content and vocabulary ● Kid-friendly rubrics with scaffolded self monitoring timelines for due dates ● iLEAD Academic Rigor and Social Emotional Learning assessment tool for individual goal setting and focus

		throughout project • Optional, begin study in preparation for FAA Part 107 UAV rating.

Project: Soar Up!
Driving Questions:
How can I design and build a model glider to meet specific flight challenges?
How can I understand and explain forces through the model I create and launch? How can I use bird flight, historic and current aircraft to understand the dynamics of flight? In what ways has our ability to fly changed the world?
How have past aerospace challenges shaped present and future aerospace?
Standards:
Asking Questions and Defining Problems, Developing and Using Models, Planning and Carrying Out Investigations, Analyzing and Interpreting Data, Using Mathematics and Computational Thinking, Constructing Explanations and Designing Solutions, Engaging in Argument from Evidence, Obtaining, Evaluating and Communicating Information, Speak and use multimedia to clarify information, strengthen claims, and add interest, Analyze a speaker's purpose, Motion is described relative to a reference frame that must be shared with others and is determined by the sum of the forces acting on it. The greater the mass of the object, the greater the force needed to achieve the same change in motion, Kinetic energy can be distinguished from the various forms of potential energy, Energy changes to and from each type can be tracked through physical or chemical interactions. The relationship between the temperature and the total energy of a system depends on the types, states and amounts of matter, When two objects interact, each on exerts a force on the other that can cause energy to be transferred to and from the object, Designed technologies can transmit digital information as wave pulses,Formulate, represent, and use algorithms with rational numbers flexibly, accurately, and efficiently, Visual displays and summary statistics of one-variable data condense the information in data sets into usable knowledge, Direct and indirect measurement can be used to describe and make comparisons, Linear functions model situations with a constant rate of change and can be represented numerically, algebraically, and graphically, Linear measure, angle measure, area, and volume are fundamentally different and require different units of measure, Read, analyze, and evaluate a variety of literary and nonfiction texts, Analyze key ideas, people, events, and claims in nonfiction, Use technology to shape, produce, and publish grammatically correct writing that makes an argument or analyzes a topic, Conduct short research projects to answer a question and generate additional focus questions, Follow a standard format for citation, Evaluate the soundness of reasoning and the relevance/sufficiency of evidence

Activities	Assessments:	Differentiation
• Interactive Project Journal development for notes, artifacts, diagrams using google docs • Control services of aircraft • Design and construct a model aircraft in a Design Challenge • Essay (argument): to fund NASA or not • History of flight, timeline, NASA Reliving the Wright way • Wanted! Famous Aviator Essay and Product • Pilot interaction with full scale aircraft • Optional, Air Traffic Control Research and experience • Optional, Private Pilot written exam prep • RedBird Simulator, fight practice • First instruction flight	• Journal checks for accuracy and completion • Vocabulary quizzes • Design Challenge, Model Aircraft, using rubric • Formal Writing, Essay Writing (2), using rubric • Aviation artifact, using rubric with oral presentation • Written Reflections on the process and debrief at the end of project • Logbook, ground school, simulator time and first flight • iLEAD PBL Academic Rigor and Social Emotional Learning rubrics to develop learning mindsets • Peer feedback, Critical Friends Protocol	• Options for teaming • Mind-maps and diagrams, hand drawn or computer based • Model development, physical or using technology • Videos for content delivery and review • Vocabulary assessment, choice for written or oral; option for re-challenging an assessment to show growth and mastery • Writing rubrics individualized to support writing development using MAP data results • Facilitator checks-ins on progress and support, flexible frequency for individual need • Online learning tools, such as Quizlet and ProProfs, to support several methods for learning complex content and vocabulary • Kid-friendly rubrics with scaffolded self monitoring timelines for due dates • iLEAD Academic Rigor and Social Emotional Learning assessment tool for individual goal setting and focus throughout project

Project: Engineering Design, DreamCoder through DreamUp
Driving Questions:
How can we understand the impact of space travel through data collection and analysis? What does coding mean and how does it work? What kinds of data can be obtained through a platform housed within the International Space Station?
Standards:
Asking Questions and Defining Problems, Developing and Using Models, Planning and Carrying Out Investigations, Analyzing and Interpreting Data, Using Mathematics and Computational Thinking, Constructing Explanations and Designing Solutions, Engaging in Argument from Evidence, Obtaining, Evaluating and Communicating Information, Speak and use multimedia to clarify information, strengthen claims, and add interest, Analyze a speaker's purpose,Motion is described relative to a reference frame that must be shared with others and is determined by the sum of the forces acting on it. The

greater the mass of the object, the greater the force needed to achieve the same change in motion, Kinetic energy can be distinguished from the various forms of potential energy, Energy changes to and from each type can be tracked through physical or chemical interactions. The relationship between the temperature and the total energy of a system depends on the types, states and amounts of matter, When two objects interact, each on exerts a force on the other that can cause energy to be transferred to and from the object, Designed technologies can transmit digital information as wave pulses, Formulate, represent, and use algorithms with rational numbers flexibly, accurately, and efficiently, Visual displays and summary statistics of one-variable data condense the information in data sets into usable knowledge, Direct and indirect measurement can be used to describe and make comparisons, Linear functions model situations with a constant rate of change and can be represented numerically, algebraically, and graphically, Linear measure, angle measure, area, and volume are fundamentally different and require different units of measure, Read, analyze, and evaluate a variety of literary and nonfiction texts, Analyze key ideas, people, events, and claims in nonfiction, Use technology to shape, produce, and publish grammatically correct writing that makes an argument or analyzes a topic, Conduct short research projects to answer a question and generate additional focus questions, Follow a standard format for citation, Evaluate the soundness of reasoning and the relevance/sufficiency of evidence		
Activities ● Interactive Project Journal development for notes, artifacts, diagrams using google docs ● Space Program Phases, online platform, learner paced through DreamCoder ● Codecademy, Coding 101, basics of Python ● Explore and change code to operate sensors on a Raspberry Pi ● Develop an idea to gather data to be run on International Space Station ● Analyze and report on data	**Assessments** ● Journal checks for accuracy and completion ● Vocabulary quizzes ● Demonstrate introductory Python skills through manipulating sensors ● Written group debriefs ● Experiment development rubric ● Analysis of data in written and oral form, rubric ● Written Reflections on the process and debrief at the end of project ● Forces of Motion Exam ● iLEAD PBL Academic Rigor and Social Emotional Learning rubrics to develop learning mindsets ● Peer feedback, groups	**Differentiation** ● Options for teaming ● Mind-maps and diagrams, hand drawn or computer based ● Model development, physical or using technology ● Videos for content delivery and review ● Vocabulary assessment, choice for written or oral; option for re-challenging an assessment to show growth and mastery ● Writing rubrics individualized to support writing development using MAP data results ● Facilitator checks-ins on progress and support, flexible frequency for individual need ● Online learning tools, such as Quizlet and ProProfs, to support several methods for learning complex content and vocabulary ● Kid-friendly rubrics with scaffolded self monitoring timelines for due dates ● iLEAD Academic Rigor and Social Emotional Learning assessment tool for individual goal setting and focus throughout project

STEAM

Design Tech Short Course

Required coursework offered in grades 6-8 in the “Exploratorium” and “Makery” spaces

using Creative Learning Systems curriculum with SCA aerospace emphasis

STEAM
Design Tech Short Courses

All grades

Three week mini courses developed to expose learners to a wide array of hands-on, minds-on projects in STEAM, digital communications, applied technology, and engineering design. Project activities link technology concepts to core academic content

Creative Learning Systems' (CLS) curriculum forms the foundation for "Exploratorium" and "Makery" learning and will be experienced in grades 6-8. **Potentiel tools** listed in the units belows can be utilized by learners for any unit or project once the skill is obtained by a learner. All learners will develop an ePortfolio using google products to record and communicate skills, knowledge, and experiences gained from projects, resulting in a digital journal of learning. Note: *Units below provide a sample of when or how they would be used.*

Documenting History: The exploration of space has led to some amazing scientific achievements while also providing significant historical moments that can inform and inspire future explorers.

- Review significant media events that were focused on space. Consider the Arrival at the Moon of Apollo II (and the Eagle lander specifically) and its effect on the larger population of Earth.
- Identify the limitations of 1960s television and broadcast technology.
- How would the Moon Landing have been different if Neil Armstrong and Buzz Aldrin had had smart-phones and selfie-sticks?
- Develop a web site to promote the event.
- Build a social media "identity" for the event, focusing on branding concepts.
- Work with NASA or other agencies to promote the event on a larger scale and increase awareness of student work and the growing potential for new media.

Potential tools for this unit include:

- **Digital Communications include methods to create any variety of entertainment, graphic design, and artistic productions including software such as**
  - **Camtasia -Video Production**
  - **CrazyTalk & CrazyTalk Animator - 2D animator**
  - **Dreamweaver - Web Design**
  - **Frames - Stop Motion Animation**
  - **GarageBand - Sound Engineering**
  - **InDesign - Print and Digital Design**
  - **Storyboarding & Video Production**

Engineering Space Solutions: Space is a famously hostile environment and its exploration demands some very clever engineering solutions to make sure that astronauts and their equipment can survive and endure on planets besides Earth.

- Compare Earth to other planets in our Solar system and define the specific challenges of living and working on those worlds.
- Develop specific solutions for the environments of the rocky terrestrial planets (Mercury, Venus, and Mars). For example, the heat and pressure of Venus make it a very challenging environment while its apparent similarity to Earth suggests the presence of valuable metals. Other examples include a Solar observatory on Mercury and an underground colony on Mars.
- Build a physical model of a mining colony for Venus, focusing on methods for reducing the heat inside and resisting the crushing pressure of that environment. Explore materials, construction processes, and methods by which materials could be transported from Earth to Venus and vice-versa.
-

Potential tools for this unit include:

- **Mechanics and Structures support the development of Engineering practices and mindsets**
  - **fischertechnik Mechanic -Engineering Skills including Simple and Complex Machines**
  - **IQ Key - design, build, and test gear combinations for speed**
  - **K'Nex - simple machines**
  - **Zometool - bridge, tower and structure building**

Engineering Space Solutions 2: In addition to the risks and challenges of space exploration, humans are also faced with the daunting task of covering the great distances between planets, especially planets beyond the Asteroid Belt.

- Make a scale model of the Solar System, using a large gymnasium or play-field.
- Research current discoveries regarding the outer planets and their satellites. Many people are surprised to learn that both Saturn and Jupiter have more than sixty natural satellites. How many can you name?
- Compare the weather of Earth with the weather of other planets with complex atmospheres. Research the storms of

Mars, Jupiter, Saturn, and Uranus.
- Using software, chart the location and progress of storms on Earth and on other planets.
- Discuss space weather and its effects on exploration hardware and human physiology.
- Build models of potential vehicles for long-range space travel, focusing on practical issues such as food, life-support, fuel, and whether or not the craft will return to Earth.
- Research extra-Solar planets and provide ideas on how humans might someday cross the mind-bending distances between stars.

Potential tools for this unit include:

- **Scientific Data and Analysis include systems to obtain and interact with data**
  - **ArcGIS Online - Geographic Information Systems**
  - **Astronomy with MicroObservatory**
  - **Extreme Weather and Monster Storms**
  - **Geographic Information Systems (GIS) - GIS Websites**
  - **Google Earth**
  - **Lasers**
  - **Vernier Scientific Sensors & Structures Tester**

<u>The Power of Simulation:</u> Space exploration depends on concrete knowledge that comes from testing, experimentation, and a willingness to push the envelope. Sometimes, however, scientists and engineers develop simulations and other tools to develop and test hypotheses, especially in those examples where a physical presence would be challenging.

- Research the classic arcade game 'Lunar Lander' and watch the video clip of Neil Armstrong's descent to Tranquility Base.
- Using simple programming tools like Scratch, develop your own version of Lunar Lander, focusing on a simulation of gravity, limited fuel, and the dangers of uneven, unfamiliar terrain.
- Transfer the program from Scratch (.sb or .sb2) to an Android app format (APK) using App Inventor or similar tools. Try to connect the functional game or application to the established social media presence for promotion and sharing.
- Choose another target and identify one of the dangers to humans that exist within that environment. Develop a simulation that shows the dangers and a method for circumventing it. Consider radiation, the vacuum of space, uncatalogued meteors, asteroids, and comets, as well as other factors, such as fuel, cost, and the number of humans required, or if the mission is wholly robotic.

Potential tools for this unit include:

- **Software Engineering**
  - **App Inventor 2 - program apps for Android smartphones**
  - **Scratch v2 - Computer Programming**
  - **Stencyl - Game Design**
  - **TouchDevelop - Computer Coding**

<u>When STEM becomes STEAM</u>: The development of knowledge within Science, Technology, Engineering, and Math is a critical part of our society and helps produced future workers with skills that help us move forward as a civilization. STEM can be made more powerful, however, with the addition of an 'A', which stands for 'Art'.

- Develop a blueprint for an extra-terrestrial vehicle.Examples include a transport vehicle for Mercury, an aerostat (balloon) for exploring the upper atmosphere of Venus, an airplane for the thin atmosphere of Mars, or submarine for exploring the subsurface oceans of Europa or Enceladus.
- Blueprints often use a three-view design.
- Start with traditional tools like blue-pencils and graph paper, but move towards the goal of preparing a formal graphic using graphics software like PhotoShop or Illustrator.
- Develop their design into a 3D model in .OBJ format and, print it out as a prototype using TinkerCAD.

Potential tools for this unit include:

- **Computer Graphics**
  - **Illustrator - Design, Marketing, Services, Publications**
  - **Photoshop - Enhancing Photos**
  - **Tinkercad - Drawing and Painting with Software, 3D Printing**

<u>Wired for Flight</u>: We take our wired devices for granted but the design and engineering of electrical systems and electronics for flight and space travel represents its own category of fabrication and planning. A basic understanding of electrical theory is beneficial for everyone but critical to pilots, astronauts and the engineers who support them.

- Work through the basic arduino challenges, such as programming a blinking light and adjusting the rate at which it blinks.
- Develop an interface using Arduino or Makey Makey to control a Scratch program. This could be as simple as developing a controller for the program the students had created earlier, or it may be an entirely original product.

- Research pneumatic motors and their benefits. Modern robotics has seen a great deal of development in the fields of artificial muscle and using pneumatics to simulate more lifelike human movement. What would you use them for?

Potential tools for this unit include:

- **Circuitry**
  - **Arduino - Programmable Circuits**
  - **MaKey MaKey - Programmable Circuits**
  - **Pneumatics - Air Powered Circuits**
  -

<u>Rise of the Robots</u>: One long-promised aspect of technology that will benefit space exploration is the development of increasingly capable and autonomous robots. Beyond their advantages in terms of navigating the hostile environment of space, robots can be engineered for specific dangers and to provide specific responses.

- Research current robots in space like Robonaut or DEXTRE. Examine the history and try to identify the specific challenges the robots were designed to meet.
- Develop rovers that can move forwards, backwards, and turn (left and right) while also picking up a sample, storing it on board, and then picking up another sample.
- Use the on-board accelerometer and gyroscope to generate charts and plots of how the Sphero robot moves.
- Use the VEX kit to build a faster, more capable rover. Experiment with gearing to improve speed or torque, or its ability to lift and store greater weights. Experiment with the built-in autonomous modes and develop scenarios to take advantage of them.

Potential tools for this unit include:

- **Robotics and Control Technology**
  - **Lego Mindstorms Robotics**
  - **Sphero - Programmable Robotic Sphere**
  - **VEX Robotics Design System**

<u>To Infinity and Beyond</u>: In all examples, humans are bound to a final ticking clock; the ultimate expansion of the Sun will eventually consume the planet Earth. And while this may not take place for three billion years, it's important that humans do more to consider the future and the ways by which we can responsibly maintain and extend our presence in the Universe.

- Research previous solutions humans have come up with for providing energy to moving vehicles.
- Design a fuel-cell car for an imagined city of the future.
- Discuss how the design would change for different environments like the Moon, Mars, and even distant dwarf-planets like Pluto.
- Research the role of solar power in space exploration.
- Discuss why spacecraft like Cassini and the Curiosity rover use RTGs (Radioisotope Thermoelectric Generators) to generate electricity. What are the advantages and disadvantages of both?
- Use a solar panel to modify an existing device, as an augmentation or even a full-fledged conversion.
- Consider the role of wind power on Earth and discuss methods for developing this resource on other planets, while also improving the reliability and efficiency of wind-turbines we use here.
- Develop scenarios for applying sustainable technologies to space exploration, focusing on novel categories and "out-of-the-box" thinking.

Potential tools for this unit include:

- **Sustainability**
  - **Hydrogen Fuel Cells**
  - **Solar Energy**
  - **Wind Power**

Wings Over the Rockies **Boeing Exploration of Flight** Blue Skies Gallery	**Wings Over the Rockies** **<u>Exploration of Flight</u>** **<u>Boeing Blue Sky Aviation Gallery</u>** Simulators, Static displays, Virtual Reality and Flight opportunities, airport tours, access to subject matter experts, and educational resources to enhance and extend aerospace curriculum **Utilized in conjunction with projects pertaining to Space** ● ShareSpace Foundation's Mars Map (https://sharespace.org/about/mars-maps/) ● Challenger Learning Center e-missions ● Collaboration with subject matter experts connected to Wings Over the Rockies **Utilized in conjunction with projects pertaining to Aviation** ● Flight training using FAA approved simulators ○ FLYTHISSIM TOUCHTRAINER® FM210 ○ REDBIRD XWIND ○ REDBIRD FMX ● Interactive displays ○ Weather ○ Wing design ○ Aerodynamics ○ Lift ● Acrobatic Elliptical experience to understand g-forces, spin, loops, steep turns ● Collaboration with Subject Matter Experts connected to Wings Over the Rockies

<u>Essential Standards to be Covered and Assessed through Projects and Direction Instruction</u>

Reading, Writing and Commun-ication **Core Content Standards to be Covered and Assessed**	**6th**	**7th**	**8th**
	Reading, Writing, and Communicating Learning Expectations for Sixth Grade **Oral Expression and Listening** Speak and use multimedia to present claims and findings to an audience, placing ideas in a logical order and supporting the main idea/theme with strong details and facts; actively listen to speakers in order to explain and interpret information and to identify supported and unsupported claims that may be made; work collaboratively in a variety of group settings by being prepared, listening actively, and sharing ideas. **Reading for All Purposes** Read literary, informational, and persuasive texts from a variety of authors; summarize, analyze, and evaluate themes, characters, and plot in literature or key ideas, claims, events in nonfiction; examine how text structure, point of view, and word choice affect the text's meaning—being sure to use textual evidence to support explanations. **Writing and Composition** Use technology to shape, produce and publish grammatically correct writing that makes an argument, explains or analyzes a topic, and includes an introduction, logical development, and a thoughtful and relevant concluding statement; write narratives that develop real or imagined experiences by starting with an interesting opening, using narrative techniques such as	**Reading, Writing, and Communicating Learning Expectations for Seventh Grade** **Oral Expression and Listening** Speak and use multimedia to present claims and findings while emphasizing major points in a focused, clear manner with strong descriptions, facts, details, and examples; analyze a speaker's main ideas and supporting details and explain how the ideas clarify a topic, text, or issue under study; collaborate in discussions, listen actively, and pose questions. **Reading for All Purposes** Read literary, informational, and persuasive texts from a variety of sources and authors; summarize, analyze, and evaluate different themes, characters, key ideas/events, points of view and claims; analyze multimedia adaptations and fictional vs. historical accounts of an event; analyze the impact word choice and text structure have on meaning; cite several pieces of textual evidence in support of all analyses. **Writing and Composition** Use technology to shape, produce, and publish grammatically correct writing that that makes an argument or explains the analysis of a topic; craft writing that includes an introduction, logical development, and a concluding statement; write narratives that develop real or imagined experiences through the use of an engaging opening, narrative techniques that capture the action, and a conclusion that effectively ends the piece.	**Reading, Writing, and Communicating Learning Expectations for Eighth Grade** **Oral Expression and Listening** Speak and use multimedia to clarify information, strengthen claims, and add interest while emphasizing significant points in a focused and clear manner; use relevant evidence, sound reasoning, and well-chosen details; analyze a speaker's purpose as it relates to the information provided; identify when irrelevant evidence is introduced; collaborate in discussions, listen actively to group members' contributions, and pose relevant and thoughtful questions. **Reading for All Purposes** Read a variety of literary and nonfiction texts; summarize, analyze, and evaluate themes and the relationship between characters, plot, and setting in literature; analyze key ideas, people, events, and claims in nonfiction; analyze the impact of word choice on meaning and tone; explain how authors use different points of view to create mystery, humor, or conflict and use different structures to organize texts; recognize the extent to which filmed, staged, or multimedia versions stay true to an original text; cite evidence to strongly support an analysis. **Writing and Composition** Use technology to shape, produce, and publish grammatically correct writing that makes an argument or analyzes a topic; craft writing that introduces what is to follow, provides information that is meaningfully organized, and offers a

	description and dialogue while demonstrating command over different stages of writing (planning, revising, and editing). **Research and Reasoning** Conduct short research projects to answer a question, gathering evidence from several sources and refocusing the question when needed; evaluate arguments and specific claims that are made in order to figure out which claims are supported by evidence and which are not.	**Research and Reasoning** Conduct short research projects to answer a question and generate additional focus questions; gather information from several sources; use search terms effectively; assess the credibility of sources; follow a standard format for citation; evaluate the soundness of reasoning and the relevance/sufficiency of evidence.	concluding statement that logically follows from the information presented; write narratives of real or imagined experiences by establishing a setting/context, a point of view, and by using narrative techniques such as dialogue, imagery, pacing for effect. **Research and Reasoning** Conduct short research projects to answer a question and generate additional focus questions; gather information from several sources; use search terms effectively; assess the credibility of sources; follow a standard format for citation; evaluate the soundness of reasoning and the relevance/sufficiency of evidence.

Math	**6th**	**7th**	**8th**
Core Content Standards to be Covered and Assessed **Mathematical practices:** *-Make sense of problems and persevere in solving them* *-Reason abstractly and quantitatively* *-Construct viable arguments and critique the reasoning of others* *- Model with mathematics* *- Use appropriate tools strategically* *-Attend to precision* *-Look for and make use of structure* *-Look for and express regularity in repeated reasoning*	**Math Learning Expectations for Sixth Grade** **Number Sense, Properties and Operations** 1. Quantities can be expressed and compared using ratios and rates 2. Formulate, represent, and use algorithms with positive rational numbers with flexibility, accuracy, and efficiency 3. In the real number system, rational numbers have a unique location on the number line and in space **Patterns, Functions, and Algebraic Structures** 1. Algebraic expressions can be used to generalize properties of arithmetic 2. Variables are used to represent unknown quantities within equations and inequalities **Data Analysis, Statistics, and Probability** 1. Visual displays and summary statistics of one-variable data condense the information in data sets into usable knowledge **Shape, Dimension, and Geometric Relationships** 1. Objects in space and their parts and attributes can be measured and analyzed	**Math Learning Expectations for Seventh Grade** **Number Sense, Properties and Operations** 1. Proportional reasoning involves comparisons and multiplicative relationships among ratios 2. Formulate, represent, and use algorithms with rational numbers flexibly, accurately, and efficiently **Patterns, Functions, and Algebraic Structures** 1. Properties of arithmetic can be used to generate equivalent expressions 2. Equations and expressions model quantitative relationships and phenomena **Data Analysis, Statistics, and Probability** 1. Statistics can be used to gain information about populations by examining samples 2. Mathematical models are used to determine probability **Shape, Dimension, and Geometric Relationships** 1. Modeling geometric figures and relationships leads to informal spatial reasoning and proof 2. Linear measure, angle measure, area, and volume are fundamentally different and require different units of measure	**Math Learning Expectations for Eighth Grade** **Number Sense, Properties and Operations** 1. In the real number system, rational and irrational numbers are in one to one correspondence to points on the number line **Patterns, Functions, and Algebraic Structures** 1. Linear functions model situations with a constant rate of change and can be represented numerically, algebraically, and graphically 2. Properties of algebra and equality are used to solve linear equations and systems of equations 3. Graphs, tables and equations can be used to distinguish between linear and nonlinear functions **Data Analysis, Statistics, and Probability** 1. Visual displays and summary statistics of two-variable data condense the information in data sets into usable knowledge **Shape, Dimension, and Geometric Relationships** 1. Transformations of objects can be used to define the concepts of congruence and similarity 2. Direct and indirect measurement can be used to describe and make comparisons

Social Science	**6th**	**7th**	**8th**
Core Content Standards to be Covered and Assessed	**Social Studies Learning Expectations for Sixth Grade** **History** Analyze and interpret historical sources (original documents, maps, artifacts) to ask and research questions about the historical eras, individuals, groups, and	**Social Studies Learning Expectations for Seventh Grade** **History** Locate and evaluate multiple historical sources with different points of view to investigate a historical question and to formulate and defend an argument;	**Social Studies Learning Expectations for Eighth Grade** **History** Examine and interpret a variety of primary and secondary sources, from different perspectives, to formulate a hypothesis and construct a written historical argument

	ideas in various regions throughout the Western Hemisphere. **Geography** Use different geographic tools such as maps, globes, diagrams, charts and data to identify and present solutions to problems around the world; analyze and explain how human and physical systems (oceans, mountains, rivers, valleys, plants) vary and interact. **Economics** Identify and explain different types of economic systems including market, command and mixed economies; recognize and talk about the ways in which saving and investing are key contributors to financial well-being. **Civics** Examine the governmental and economic connections between the United States and other nations of the Western Hemisphere; compare multiple governmental systems such as democracy, monarchy and authoritarian.	examine the historical eras, individuals, groups, ideas and themes in regions of the Eastern Hemisphere and their relationships with one another. **Geography** Use different types of geographic tools such as maps, globes, diagrams, charts, and geographic data and technologies to make inferences and predictions about the differing perspectives and issues within regions in the Eastern Hemisphere. **Economics** Explain how supply and demand influences price and profit in a market economy; determine and describe how individual choices can influence the distribution of resources and economic production. **Civics** Compare how the different forms of government and organizations influence the world community; discuss the rights, roles, and responsibilities of citizens under various forms of government.	about a topic in American history (origins of the American Revolution through Reconstruction). **Geography** Use different geographic tools and data such as maps, globes, diagrams, charts, geospatial technologies (geographic information systems, Google Earth, global positioning systems) to analyze human and physical systems; explain both conflict and cooperation over space and resources in the United States from the origins of the American Revolution through Reconstruction. **Economics** Provide examples of how economic freedom and free trade are important for economic growth; explain why it is important to manage personal credit and debt. **Civics** Analyze the elements of continuity and change in the United States' constitutional system; summarize the role of law and the rights, roles, and responsibilities of citizens in a democracy.

Science	**Physical Science**	**Life Science**	**Earth and Space Science**
Science and Engineering Practices *-Asking Questions and Defining Problems.* *-Developing and Using Models.* *-Planning and Carrying Out Investigations* *-Analyzing and Interpreting Data* *-Using Mathematics and Computational Thinking* *-Constructing Explanations and Designing Solutions* *-Engaging in Argument from Evidence* *-Obtaining, Evaluating and Communicating Information*	1.) The fact that matter is composed of atoms and molecules can be used to explain the properties of substances, diversity of materials, states of matter and phases changes. 2.) Reacting substances rearrange to form different molecules, but the number of atoms is conserved. Some reactions release energy and others absorb energy. 3.) Motion is described relative to a reference frame that must be shared with others and is determined by the sum of the forces acting on it. The greater the mass of the object, the greater the force needed to achieve the same change in motion. 4.) Forces that act a distance (gravitational, electric, and magnetic) can be explained by force fields that extend through space and can be mapped by their effect on a test object. 5.) Kinetic energy can be distinguished from the various forms of potential energy. 6.) Energy changes to and from each type can be tracked through physical or chemical interactions. The relationship between the temperature and the total energy of a system depends on the types, states and	1.) All living things are made up of cells, which is the smallest unit that can be said to be alive. 2.) Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. 3.) Sustaining life requires substantial energy and matter inputs. 4.) Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. 5.) Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with nonliving. 6.) Ecosystems are sustained by the continuous flow of energy, originating primarily from the sun, and the recycling of matter and nutrients within the system. 7.) Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem. 8.) Heredity explains why offspring resemble, but are not identical to, their parents and is a unifying biological principle. Fossils are mineral replacements, preserved remains, or traces of organisms	1.) Motion is predictable in both solar systems and galaxies. 2.) The solar system contains many varied objects held together by gravity. Solar system models explain and predict eclipses, lunar phases, and seasons. 3.) Rock strata and the fossil record can be used as evidence to organize the relative occurrence of major historical events in Earth's history. 4.) Energy flows and matter cycles within and among Earth's systems, including the sun and Earth's interior as primary energy sources. Plate tectonics is one result of these processes. 5.) Plate tectonics is the unifying theory that explains movements of rocks at Earth's surface and geological history. 6.) Water cycles among land, ocean, and atmosphere, and is propelled by sunlight and gravity. Density variations of sea water drive interconnected ocean currents. Water movement causes weathering and erosion, changing landscape features. 7.) Complex interactions determine local weather patterns and influence climate, including the role of the ocean. 8.) Humans depend on Earth's land, ocean, atmosphere, and biosphere for different resources, many of which are limited or not renewable.

	amounts of matter. 7.) When two objects interact, each on exerts a force on the other that can cause energy to be transferred to and from the object. 8.) A simple wave model has a repeating pattern with specific wavelength, frequency, and amplitude and mechanical waves need a medium through which they are transmitted. This model can explain many phenomena which include light and sound. 9.) A wave model of light is useful to explain how light interacts with objects through a variety of properties. 10.) Designed technologies can transmit digital information as wave pulses.	that lived in the past. 9.) Genetic variations among individuals in a population give some individuals an advantage in surviving and reproducing in their environment. 10.) Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. **11.)** Biodiversity is the wide range of existing life forms that have adapted to the variety of conditions on Earth, from terrestrial to marine ecosystems**.**	Resources are distributed unevenly around the planet as a result of past geologic processes. 9.) Mapping the history of natural hazards in a region and understanding related geological forces. 10.) Human activities affect global warming. Decisions to reduce the impact of global warming depend on understanding climate science, engineering capabilities, and social dynamics.