STEAM – Unit 1 (AEROSPACE ENGINEERING)

Content Area: **ENGINEERING (Gifted and Talented Grade 3/4)**
Course(s):
Time Period: **Ongoing**
Length: **Ongoing**
Status: **Published**

Big Idea

Gifted and talented students should be exposed to the career possibilities in intellectually challenging, high demand areas such as aerospace engineering. The aerospace industry has an insatiable demand for engineers. (EGFI, 2018) Aerospace engineers design and build jet fighters, spaceships, rockets, planes, satellites --- essentially any craft that soars through or above the atmosphere. (EGFI, 2018) Aerospace engineers also write computer code and programs to control rovers and satellites all over the solar system. Over the next decade, aerospace engineers will be challenged to do amazing things such as design personal air taxis, build privately funded spacecraft, successfully send passenger rockets to Mars, and plan the first human settlement on Mars.

To fully explore the subject of aerospace engineering, students should research the history of aerospace engineering and space exploration. Mimicking aerospace engineers, students should design models of airplanes, rockets, satellites, rovers, space stations, and Mars colonies. Students should practice the scientific method by posing a question, identifying variables, conducting tests, collecting data, graphing data, and interpreting data. Students should follow the engineering design process by identifying a need or problem, designing a solution, building a prototype, testing it, identifying problems, and fixing them. This way of working is called iteration.

If finances allow, students would benefit from an outside field trip to an aerospace museum, flight museum, or interactive camp...such as be an astronaut for a day. If possible, students should also have the opportunity to participate in simulation activities such as domestic flight and space shuttle lift off. Students should keep a journal/portfolio of their research, experiences, experiments, data analysis, and conclusions. Students should use technology to analyze their data and present it at the end of the semester.

TENTATIVE LESSONS (Curriculum provided by NASA and the U.S. AIR FORCE AUXILIARY - CIVIL AIR PATROL AEROSPACE CONNECTIONS IN EDUCATION (ACE) and AEROSPACE EDUCATION EXCELLENCE (AEX))

LESSON	MATERIALS	TRAINING	COST
FLIGHT SIMULATOR FROM CIVIL AIR PATROL https://www.gocivilairpatrol.com/programs/aerospace-education/for-educators/	• 2 free simulators borrowed from CIVIL AIR PATROL UNTIL JAN. 2019 • Microsoft Flight Simulator software free • 2 desktop computers with good video graphics card and more than 512 mb RAM	• self trained • possibly get a pilot parent to show us how it works	• computers (@$1500 each - we could probably use these on the 3D printers too) • An APP or HDMI cord to reflect the screen onto the SMART Board

CIVIL AIR PATROL STEM LESSONS ● AEROSPACE CONNECTIONS IN EDUCATION PROGRAM (ACE) ● AEROSPACE EDUCATION EXCELLENCE PROGRAM (AEX) - possible if field trip conducted https://www.gocivilairpatrol.com/programs/aerospace-education/for-educators/	● basic STEAM building materials	● self trained ● teacher registers students for the ACE and/or AEX programs online	● no additional cost ● students receive a certificate after completing the curriculum
NASA STEM LESSONS https://www.nasa.gov/audience/foreducators/index.html	● basic STEAM building materials	● self trained	● no additional cost
FUTURE ENGINEERS/NASA 3D DESIGN CHALLENGE (sep 21 for last year)	● 3D printer	● self trained ● teacher registers students	● no additional cost
FIELD TRIP TO BUEHLER CHALLENGER & SCIENCE CENTER (ASTRONAUT FOR A DAY), PARAMUS, NJ http://www.bcsc.org/b-l-a-s-t/	● Up to 28 students can attend the field trip	● camp run by certified teachers	● $620 for 28 students
ETTC INFLATABLE PLANETARIUM STARLAB (DELIVERED ON SITE BY STOCKTON UNIVERSITY) http://www.ettc.net/ava/acava/starLab.html	● Up to 25 students plus teacher	● 1 teacher at Northfield must attend free training. Next training is July 18th 9-12am.	● Free to borrow from Atlantic County AVA

- Paper airplanes - analyze and graph data
- Flight simulator (Civil Air Patrol STEM kit) (if funds available)
- ETTC STAR LAB to view constellations, solar system, and night sky (sponsored by Atlantic County AVA Media Center)
- Field trip to Buehler Challenger & Science Center (Astronaut for a day) (if funds available)
- Space Discovery Guides Book Set for research
- Straw rockets - analyze and graph data
- Zip line - land on a target - analyze and graph data
- Alka Seltzer rockets - analyze and graph data
- Design a Soft Landing for a rocket or rocket booster
- Design a Soft Landing for a rover
- Design an energy independent space station or human settlement on Mars
- Research and present information about an important historical figure in aerospace engineering.

- Research and present findings about a planet in our solar system.

- Teachengineering.org
    - Spaced Out — Lesson
      Grade Level: 4 (3-5)
      Engineering Category: Partial design
      Total Time: 15 minutes
      Students are introduced to the space environment, learning about the major differences between the environment on Earth and that of outer space (atmosphere, radiation, microgravity)— and the engineering challenges that arise because of these...
    - Strawkets and Control — Activity
      Grade Level: 3 (3-5)
      Engineering Category: Relating science and/or math concepts to engineering
      Total Time: 50 minutes
      Students investigate the effect that fins have on rocket flight. They construct two paper rockets that they launch themselves by blowing through a straw (see Figure 1). One "strawket" has wings and the other has fins. Students observe how these two...
    - Destination Outer Space — Lesson
      Grade Level: 4 (3-5)
      Engineering Category: Relating science and/or math concepts to engineering
      Total Time: 20 minutes
      Students acquire a basic understanding of the science and engineering of space travel as well as a brief history of space exploration. They learn about the scientists and engineers who made space travel possible and briefly examine some famous space...
    - Space Shelter — Activity
      Grade Level: 4 (3-5)
      Engineering Category: Relating science and/or math concepts to engineering
      Total Time: 100 minutes
      Students are given the following engineering challenge: "The invasion has taken place and we need to find a new home. To ensure your survival beyond Earth's occupation you must design a shelter that can be built on another planet." Then students...
    - Using Thrust, Weight & Control: Rocket Me into Space — Lesson
      Grade Level: 4 (3-5)
      Engineering Category: Relating science and/or math concepts to engineering
      Total Time: 15 minutes
      One exciting challenge for engineers is the idea of exploration. Through the continuing storyline of the Rockets unit, this lesson looks more closely at Spaceman Rohan, Spacewoman Tess, their daughter Maya, and their challenges with getting to space,...
    - Beyond the Milky Way — Lesson
      Grade Level: 4 (3-5)
      Engineering Category: Relating science and/or math concepts to engineering
      Total Time: 20 minutes
      When we look at the night sky, we see stars and the nearby planets of our own solar system. Many of those stars are actually distant galaxies and glowing clouds of dust and gases called nebulae. The universe is an immense space with distances...
    - Blast Off: Generating Rocket Thrust with Propellants — Lesson
      Grade Level: 4 (3-5)
      Engineering Category: Relating science and/or math concepts to engineering
      Total Time: 15 minutes
      Rockets need a lot of thrust to get into space. Students learn how rocket thrust is generated with propellant. The two types of propellants are discussed—liquid and solid—and their relation to their use on rockets is investigated. Students learn why...
    - Rockets — Curricular Unit

Grade Level: 4 (3-5)
Engineering Category: Relating science and/or math concepts to engineering
Total Time: 590 minutes
Students learn how and why engineers design satellites to benefit life on Earth, as well as explore motion, rockets and rocket motion. Through six lessons and 10 associated hands-on activities, students discover that the motion of all...

- Spacecraft Design: Beat the Heat — Activity
  Grade Level: 4 (3-5)
  Engineering Category: Partial design
  Total Time: 50 minutes
  To understand the challenges of satellite construction, student teams design and create model spacecraft to protect vital components from the harsh conditions found on Mercury and Venus. They use slices of butter in plastic eggs to represent the...
- Airplane Tails & Wings: Are You in Control? — Lesson
  Grade Level: 6 (5-7)
  Engineering Category: Relating science and/or math concepts to engineering
  Total Time: 50 minutes
  Students learn about airplane control surfaces on tails and wings, and engineering testing wherein one variable is changed while others are held constant. Through the associated activity, they compare the performance of a single paper airplane design...

Enduring Understanding

SWBAT understand the career possibilities in aerospace engineering. SWBAT to identify the scientific method. SWBAT to understand the engineering design process. SWBAT identify the importance of using models and iteration in design. SWBAT empathize with stakeholders to improve design outcomes. SWBAT make connections between scientific concepts (such as chemistry, physics, and circuitry) and effective aerospace engineering practices. SWBAT make connections between experiments conducted in the laboratory and real world experiences.

Skills

- Research aerospace engineering.
- Use presentation technology to write a presentation about findings.
- Practice the scientific method.
- Use spreadsheet technology to graph data and findings.
- Practice the engineering design process. Use tools to build a prototype.
- Use technology to present information about historical figures in the aerospace industry and information about the characteristics of a planet in our solar system.

Standards

8.2.5.C.1 Collaborate with peers to illustrate components of a designed system.
8.2.5.C.2 Explain how specifications and limitations can be used to direct a product's development.
8.2.5.C.3 Research how design modifications have lead to new products.
8.2.5.C.4 Collaborate and brainstorm with peers to solve a problem evaluating all solutions to provide the best results with supporting sketches or models.
8.2.5.C.5 Explain the functions of a system and subsystems.
8.2.5.C.6 Examine a malfunctioning tool and identify the process to troubleshoot and present options to repair the tool.

8.2.5.D.1 Identify and collect information about a problem that can be solved by technology, generate ideas to solve the problem, and identify constraints and trade-offs to be considered.
8.2.5.D.2 Evaluate and test alternative solutions to a problem using the constraints and trade-offs identified in the design

process to evaluate potential solutions.
8.2.5.D.3 Follow step by step directions to assemble a product or solve a problem.
8.2.5.D.4 Explain why human-designed systems, products, and environments need to be constantly monitored, maintained, and improved.
8.2.5.D.5 Describe how resources such as material, energy, information, time, tools, people and capital are used in products or systems.
8.2.5.D.6 Explain the positive and negative effect of products and systems on humans, other species and the environment, and when the product or system should be used.
8.2.5.D.7 Explain the impact that resources such as energy and materials used in a process to produce products or system.

Assessments

- Teacher observation
- Successful completion of project
- Successful completion of portfolio
- Successful presentation of project to the class

Resources/Instructional Materials

- Teachengineering.org (space series)
- NASA
- CIVIL AIR PATROL - ACE and AEX PROGRAM (AEROSPACE STEM CURRICULUM)
- Buehler Challenger & Science Center's programs, Paramus, NJ
- Library Series Space Discovery Guides Book Set
- EGFI
- Future Engineers
- Engineering is Elementary
- Science buddies
- Foss
- Smithsonian
- Design Squad PBS
- Discovery Education - Energy
- Mystery Science Curriculum
- South Carolina Science Curriculum
- Steve Spangler
- Science Bob
- Exploratorium Science Snacks
- Imagination Station Toledo.org
- http://globaldayofdesign.com/
- http://worlds-of-learning.com/
- Pbs learning media nj
- Siemens Lesson Plans
- Lesson Planet

Modifications

Individual accommodations

• Additional support

• Adapting lessons to meet various learning styles

Integration of 21st Century Skills

Focus on the development of 21st Century Content Skills:

- Global awareness
- Civic literacy
- Health and wellness awareness
- Environmental literacy

Focus on the Development of Learning and Thinking Skills:

- Critical Thinking and Problem Solving Skills
- Communication Skills
- Creativity and Innovation Skills
- Collaboration Skills
- Information and Media Literacy Skills
- Contextual Learning Skills

Focus on the Development of Life Skills:

- Leadership
- Ethics
- Accountability
- Adaptability
- Personal Productivity
- Personal Responsibility
- People Skills
- Self Direction
- Social Responsibility

Interdisciplinary Connections

- Academic and Technical Rigor - Projects are designed to address key learning standards identified by the school or district.
- Authenticity - Projects use a real world context (e.g., community problems) and address issues that matter to the students.
- Applied Learning - Projects engage students in solving problems calling for competencies expected in high-performance work organizations (e.g.,teamwork, problem-solving, communication, etc.).
- Active Exploration - Projects extend beyond the classroom by connecting to community explorations.
- Adult Connections - Projects connect students with the wider community.
- Assessment Practices - Projects involve students in regular, performance-based exhibitions and assessments of their work; evaluation criteria reflect personal, school, and real-world standards of performance.