

STEAM

(Science, Technology, Engineering, Arts, Math)

Grades: 4-7

Allamuchy Township School District

Curriculum Framework

2016-2017

Rationale:

STEAM will motivate our most promising students into fields that will continue to keep the United States as a global leader. Science has been identified as a national priority. Our students are not stacking up with other developed countries. A statement made by Representative George Miller of California, "We all know the statistics - we've fallen to 21st in math achievement, 25th in science, and 24th in problem solving. Our goal at Allamuchy is to spark interest in STEAM fields as our students are preparing for high school, college and beyond. We need to encourage our students to be creators, so they can thrive in a complex, fast-moving and rapidly changing technical world.

Lesson Framework:

STEAM will meet once in the Specials class rotation. This will allow the students to engage in STEAM lessons, put into practice the Engineering Design, Create, Model, and share what they have learned. Students will:

- Use chromebooks to complete research
- Use chromebooks to be introduced to basic coding
- Ask questions and define problems
- Develop using models
- Plan and carry out investigations
- Analyze and interpret data
- Using mathematics and computational thinking
- Construct explanations and design solutions
- Engage in argument from evidence
- Obtain, evaluate, and communicate information

Sample Activity 1 Grades 4-7: Team Building Skills using STEAM

Straw Tower: to construct a building that meets the necessary requirements and costs the least amount of money to build. Students will be placed in groups of 3-4 and given a set of rules/requirements along with the cost of items used. They will be required to record their expenses on an expense log. Students will be given one class to brainstorm, plan construction and purchase initial supplies. The second class will be dedicated to construction. Teams will be scored on their projects. Scoring is based on how many requirements each team meets and least amount in cost.

Resource: NASA (received activities through Space Camp training)

Sample Activity 2 Grades 4-7:

K'nex

K'Nex can provide a wide variety of ways for teachers to teach technology, math and literacy skills. It can also be an effective way to help pupils to become successful learners, confident individuals, responsible citizens and effective contributors. It is also a particularly good way to encourage cooperative learning and to involve pupils with learning difficulties in a whole class activity. K'Nex can be used as a standalone activity, or groups activity. It can be a valued resource in the classroom because of its versatility. It can be incorporated into virtually any topic. Some examples could include building a skeleton, towers (look-out towers, towers that can withstand earthquakes), models with gears, pulleys and motors, rockets powered by balloons, fairground and play park models, sports equipment, Roman roads etc. Almost anything can be built from K'Nex. Pupils work together through the following process to design and build their model, using one of the following kits: Levers and Pulleys; Wheels & Axles and Inclined Planes; or Renewable Energy. Examples of some of the objectives in using K'nex are as follows:

- Design product
- Build prototype
- Test prototype
- Improve prototype
- Product completion
- Analysis of process

NGSS PRACTICE STANDARDS

1. Asking questions (science) and defining problems (engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (science) and designing solutions (engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Students are engaged in problem solving, creative thinking, and collaboration through invention-based learning. With K'nex students are encouraged to be creators.

Students need to be able to identify a problem and work to solve it. Students are challenged with invention-based learning by moving through the invention cycle

Resource Link: https://ubibliorum.ubi.pt/bitstream/10400.6/5563/58/3484_6997.pdf
<https://www.basicfun.com/knex/>

Sample Activity Grade 4:

Catching the Wind: Designing Windmills: Unit overview: Mechanical Engineering involves the design of anything with moving parts. In this unit, students will think like mechanical engineers - and also use their understanding of air as wind - to design and create wind-powered machines. Students will study how common machines such as mechanical pencils and egg beaters work, then use their mechanical engineering skills to design sailboats and windmills that catch the wind. There will be a read-a-load: *Leif Catches the Wind*. The story introduces a tale of a child somewhere around the world who solves a problem through engineering. The book integrates social studies into the unit and illustrate for students the relevance of STEM subjects.

Resource Link: *Engineering is Elementary (eie.org)*

Sample Activity Grade 5:

Designing and Building Walls: Unit Overview: This activity will guide students to discover and discuss the connection between earth material such as clay and soil and their uses in design. Students will be introduced to Frank Lloyd Wright: Falling Waters. The famous home was built over waterfalls and the falls became part of the home. Students explore the imaginative and inspiring engineering feat of the Great Wall of China.

Resource Links: *Fallingwaters.org*
Engineering is Elementary (eie.org)

Sample Activity Grade 5 or 6:

LEGO® Education SPIKE™ Essential gets students excited about hands-on STEAM learning. This playful, narrative-based learning experience is part of the LEGO Learning System and encourages students to investigate STEAM concepts while contributing to literacy, math, and social-emotional development. SPIKE set (s) allow students to configure 4 minifigures with their own personalities, who act as storytellers to make problem-solving relatable to all students. Students begin to use their skills in coding.

Resource Link (s):

<https://www.lego.com/en-us/product/lego-education-spike-essential-set-45345>

Sample Activity Grade 7:

Phabulous Physics: Students will discover physics and types of energy with hands-on activities: Junior Solar Sprints, Mousetrap cars, and Roller Coasters are a sample of activities students will discover with. With Junior Solar Sprints (JSS) students design, build and race solar-powered cars using hands-on engineering skills and principles of science and math. Students develop teamwork and problem solving abilities, investigate environmental issues, and gain hands-on science, technology, engineering, and mathematics (STEM) skills to create the fastest, most interesting, and best crafted vehicle possible. The top team(s) will go on to participate in county-wide competition. Students will receive information on materials and vehicle specification as well as expected conduct on race day. Teams awards are presented in the following areas: speed, craftsmanship, engineering, progress journal, and best use of recycled materials.

Resource Link (s): transoptions.org

teachingengineering.org

docfizzix.com

www-tc.pbskids.org

Connecting Activities to Next Generation Science Standards & Common Core Curriculum Standards

Engineering Design Standards

Composed of three main phases:

- Defining and Delimiting Engineering Problems - involves stating the problem to be solved as clearly as possible in terms of criteria for success, and constrains or limits
- Designing Solutions to Engineering Problems - begins with generating a number of different possible solutions, then evaluating potential solutions to see which ones best meet the criteria and constraints of the problem
- Optimizing the Design Solution - involves a process in which solutions are systematically tested and refined and the final design is improved by trading off less important for those that are more important

Science

- Make observations and/or measurements of an object to provide evidence that a pattern can be used
- Use evidence to construct an explanation
- Ask questions and predict outcomes about changes that occur
- Support arguments
- Define a simple design problem that can be solved by applying scientific ideas
- Define the criteria and constraints of a design problem taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions
- Evaluate design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem
- Apply scientific principles for design
- Unify concepts and processes

Technology

- Empowers students real-world data, tools, experts and global outreach to actively engage in solving meaningful problems

Mathematics

- Use appropriate tools strategically
- Reason abstractly and quantitatively
- Solve multi-step real-life problems
- Use appropriate tools strategically
- Number and Operations
- Reasoning and Proof
- Measurement
- Data Analysis and Probability

21st Century Life and Careers

- Enable students to make informed decisions that prepare them to engage as active citizens in a dynamic global society and successfully meet the challenges and opportunities of the 21st century global workplace

English Language Arts, Writing and Communications

- Document, explain, and express ideas, processes and findings
- Students are encouraged to communicate for comprehension and express ideas addressing the standards for speaking and listening. Includes multimedia components and visual displays in presentations to clarify understanding and information

STEM students will...

- Learn and apply rigorous content within science, technology, engineering, and mathematics disciplines to answer complex questions, to investigate global issues, and to develop solutions for challenges, and real world problems
- Integrate content from science, technology, engineering, and mathematics disciplines to answer complex questions, to investigate global issues, to develop solutions for challenges, and real world problems
- Interpret and communicate information from science, technology, engineering, and mathematics
- Engage in inquiry to investigate global issues, challenges, and real-world problems
- Engage logical reasoning to answer complex questions to investigate global issues, and to develop solutions for challenges and real world problems
- Collaborate as a STEM team to answer complex questions to investigate global issues, and to develop solutions for challenges and real world problems
- Apply technology appropriately to answer complex questions to investigate global issues and to develop solutions for challenges and real world problems

Resource Links:

www.state.nj.us/education/cccs

www.nasa.gov

www.nextgenscience.org

<https://education.lego.com/en-us/>

https://ubibliorum.ubi.pt/bitstream/10400.6/5563/58/3484_6997.pdf

<https://www.basicfun.com/knex/>

<https://www.lego.com/en-us/product/lego-education-spike-essential-set-45345>

Mdk12.msde.maryland.gov

US Space and Rocket Center