School District of South Orange-Maplewood

STEM

The School District of
SOUTH ORANGE & MAPLEWOOD
525 Academy Street • Maplewood, NJ 07040

SOMSD

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THE SCHOOL DISTRICT OF SOUTH ORANGE-MAPLEWOOD

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TABLE OF CONTENT

RATIONALE.....4
PURPOSE 4
ENGINEERING CONNECTION.....4-5
DESCRIPTION.....6
OVERVIEW 6-7
LESSON PLANS AND ACTIVITIES.....8-

I. Rationale

The South Orange Maplewood School District believes students should be engaged in the use of STEM (Science, Technology, Engineering and Mathematics) to excel in various areas of their lives including academics, civic duties, the work place, and within an ever-changing global society. As technology becomes increasingly important in today's world, it is invaluable to not only learn how to use technology, but also to understand how to create it. Students must recognize the importance of how STEM and how the four subject areas of Science, Technology, Engineering and Math cross and can be used to design and or invent answers for the 21st Century and beyond.

II. Purpose

Students follow the steps of the engineering design process (EDP) while learning about assistive devices and biomedical engineering. They first go through a design-build-test activity to learn the steps of the cyclical engineering design process. Then, during the three main activities (7 x 55 minutes each) student teams are given a fictional client statement and follow the EDP steps to design products—an off-road wheelchair, a portable wheelchair ramp, and an automatic floor sweeper computer program. Students brainstorm ideas, identify suitable materials and demonstrate different methods of representing solutions to their design problems—scale drawings or programming descriptions, and simple models or classroom prototypes.

III. Engineering Connection

The field of engineering is all encompassing in its subject matter and real-world challenges. Yet, engineers of all disciplines have in common certain approaches—teamwork, brainstorming, problem defining with requirements and constraints, the iterative steps of the design process, testing and analysis, prototyping, production and communication. All engineers use some form of the steps of the engineering design process to organize their ideas, and test and refine potential solutions to real-life challenges. Engineers must gain an understanding of all the contextual factors of a particular design challenge—need for the project, relevant social, ethical, environmental and economic conditions of the target population, system integration, and project needs and limitations. Working through all the technical and non-technical issues helps engineers generate useful, appropriate and successful design solutions.

Engineers improve the quality of life for people around the world and they follow the steps of the engineering design process as a widely accepted way of arriving at desirable solutions to identified problems. The activities in this unit guide students through the engineering design process as they apply basic engineering concepts to real-world design problems. Through the development of assistive devices, students are exposed to the humanitarian aspects of engineering. Examples of advanced technology applications abound, for example, cutting edge prostheses such as Dean Kamen's "Luke Arm" or the redesign of traditional prosthesis to improve comfort and user interface.

This course will prepare students for success in life, future education, and work in an economy driven by information, knowledge, and innovation requires a public education system where teaching and learning are aligned with 21st century learning outcomes. These outcomes move beyond a focus on basic competency in core subjects and foster a deeper understanding of academic content at much higher levels by promoting critical thinking, problem solving, and creativity.

The US Bureau of Labor Statistics predicts one in every two STEM jobs in the country will be in computing occupations, with more than 150,000 job openings annually making it one of the fastest growing occupations in the United States. And these jobs pay 75 percent more than the national median annual salary. Finally the breadth of industries requiring computing professionals is diverse — two-thirds of computing jobs are in sectors other than information technology, including manufacturing, defense, health care, finance, and government.

Furthermore, The NJDOE's Technological Literacy Standards 6A:8-1.1 states that the purpose of this curriculum should be:

Through this curriculum, South Orange Maplewood School District will provide students with an increased knowledge of how to utilize technology to:

- *Enhance problem solving skills*
- *Compile data to formulate solutions to real world problems*
- *Build/engineer a program to assist with everyday activities*
- *Discuss social and ethical responsibilities in the use of technology*
- *Develop products/models that address societal issues*
- *Examine the relationship that exist between software functions and daily activity*
- *Build logical thinking*
- *Develop innovation and creativity*
- *Increase teamwork skills*
- *Provides a visual grasp of math and science*
- *Analyze how technology can be used to improve the design and functionality of the environment*

IV. Description

This curriculum is an introduction to STEM with a particular interest in the field of engineering. Students are introduced to the major steps of the engineering design process (EDP) and some of the roles engineers play in our world. After introducing the EDP, students are teamed up with one or two other students. Each student team spends approximately seven days working on each module—an engineering project focused on the humanitarian side of engineering. After the seven days, groups move onto their next engineering design project. This pattern repeats until students have completed all three modules. While each learning module focuses on a different field of engineering, all share the common theme of biomedical engineering through the design of assistive devices.

The Goals set forth to achieve this vision are:

GOAL 1: All students will be prepared to excel in the community, work place and in our global society using 21st century skills.

GOAL 2: All educators, including administrators, will attain the 21st century skills and knowledge necessary to effectively integrate educational technology in order to enable students to achieve the goals of the core curriculum content standards and experience success in a global society.

GOAL 3: Educational technology will be accessible by students, teachers and administrators and utilized for instructional and administrative purposes in all learning environments, including classrooms, library media centers, and other educational settings such as community centers and libraries.

GOAL 4: New Jersey school districts will establish and maintain the technology infrastructure necessary for all students, administrators and staff to safely access digital information on demand and to communicate virtually.

V. Overview:

Course Title: STEM

Unit Schedule Section I Building Towards the Future

- **Day 1: Engineering Design Quiz and Class set up**
- **Day 2: Review**
- **Day 3: The Next Dimension lesson**
- **Day 4: A Place in Space activity**
- **Day 5-6: Skyscrapers: Engineering Up! lesson**
- **Day 7-8: Newspaper Tower activity**
- **Day 8-9: Balsa Towers activity**

Assessment

After this unit, students should be able to:

- **Locate a point in space, given its coordinates and an origin.**
- **Use coordinates to describe the location of a given point in space relative to some origin.**
- **Explain why they built their towers the way they did, using the concepts and terms they learned in the history of skyscraper presentation.**

  Explain how their towers resisted the wind load (for example, which tower parts supported the bulk of the load, or making the tower really slender so the wind has less area to act on, etc.).

Day 10-11: Start with the five-minute engineer illustration; introduce students to the field of engineering and the engineering design process. Begin Super Slinger Engineering Challenge.
Day 12: Entire-class engineering challenge continued.
Day 13-14: Design Step 1, Identify the need
Day 14-15: Design Step 2, Research the Problem
Day 15-16: Brainstorm Possible Solutions
Day 17: Engineering Analysis
Day 18-20: Construct a Prototype
Day 21: Test, evaluate and reflect on engineering challenge design solutions. Show students a movie or film that shows people overcoming disabilities through the help of engineered technology; see suggestions in the activity write-up.
Days 22-30: Begin Off-Road Wheelchair Challenge
Days 31-40: Begin Portable Wheelchair Ramp Challenge
Days 41-50: Begin Automatic Floor Cleaner Computer Program Challenge
Day 51: Show students the PBS Frontline episode titled, *Vietnam: Wheels of Change* (10 minutes); available at http://www.pbs.org/frontlineworld/stories/vietnam804/video/video_index.html); conclude with a round table discussion.
Day 52-54: Presentations

APPENDIX