

Fair Lawn Public Schools

Fair Lawn, NJ

S.T.E.M.

Science. Technology. Engineering. Math.

Honors

August

2015

Revised From Senior Seminar in Technology
Developed August 2015

The focus of the Engineering and Technology Department is to promote the development of **innovation** skills in all students. This is an advanced course in which students will explore applications of science, technology and math to in the field of engineering which they have developed throughout their studies in the STEM fields, address real-world problems, and conduct career exploration.

**Engineering &
Technology
Education**

Learn. Innovation.

Fair Lawn School District

Committee Credits

Written By

Ellie Barkin, Steve Mondadori, Vicki Velasco

Ronald Durso, Supervisor

STEM Honors

I. Course Synopsis

STEM Honors is an advanced, 1 credit, course in which students will explore opportunities to apply content which they have learned in science, technology, and math classes to real-world, engineering applications. They will apply the design loop to explore various career fields within engineering. They will be introduced to real-world problems and applications of the engineering to address those problems.

II. Philosophy & Rationale

This course has been aligned to and developed with the [NJCCCS for Technology](#) as it's major focus, with a supplemental focus on the [Standards for Technological Literacy for the Content Study of Technology](#) (ITEA). In addition, the Next Generation Science Standards, particularly in [physical science](#) and [engineering and design](#) have been addressed along with the CCCS for [literacy in science and technical](#) subjects and [math](#). This demonstrates the integral nature of engineering into "STEM" education.

"Innovation" is defined as *the act or process of introducing new ideas, devices, or methods*". The philosophy of the Engineering and Technology Department to focus on the development of innovation in all students through the application of true, STEM education.

The purpose of this class is to provide students in AP Chemistry and/or AP Physics and/or AP Calculus with an opportunity to engage in hands-on, authentic, application of the content which they are learning in these largely theoretical courses.

Differentiated instruction for students at different levels of achievement and specific learning needs (e.g. special education, English Language Learners (ELL), at-risk, and Gifted & Talented) is embedded in targeted scaffolding based on knowledge of each student's interests, needs, and assessment data, including, but not limited to, in class formative and summative assessments. Students in these courses are provided with clear, concise rubrics which describe and define expectations for project based, authentic assessment which involves written and/or performance based requirements.

When deemed appropriate, department teachers will engage students in purposeful paired discussions to share information more effectively, such as the "turn and talk" (Harvey & Daniels, 2009). "Text annotation" could be used, for example to optimize reading comprehension (Daniels & Steineke, 2010).

III. Scope & Sequence

Engineering & Design serves as an introductory course in which each unit will focus on a key component of the fields of engineering with a consistent focus on the design loop throughout the course. This course meets one day per week.

Unit 1: Engineering Safely (September)

- The safe use of tools, equipment and machines is essential for effectively applying the engineering process.

Unit 2: What is the Engineering Process? (September-December)

- Engineering is the application of math and science to solve real world problems.
- The design loop can be applied to continually improve upon their designs and ideas.

Unit 3: Reverse Engineering (January-March)

- The form and function of engineered products are related.

Unit 4: Independent Research Project (April - June)

- Engineering can be used to positively or negatively affect society.
- Technology causes culture and society to change.

IV. Unit Descriptions

Unit 1: Engineering Safely (1 Month)

Enduring Understandings

1. The safe use of tools, equipment and machines is essential for effectively applying the engineering process.

Essential Questions:

1. How are tools, equipment and machines used safely?

Learning Objectives:

1. Identify tools, equipment, machines and their uses.
2. Identify and demonstrate how to safely use tools, equipment, and machines.

Suggested Activities & Suggested Modifications for Special Education Students, ELL Students, Students at Risk, and Gifted Students:

1. Practical exam on proper use of key tools, equipment and machines.
2. Modifications may include providing students with a template, diagrams, and additional resources for special education and ELL students.
3. Gifted students may be asked to assist their classmates in tool, equipment and machine identification.

Cross-Content Connections:

[Standards for Technology Literacy \(9-12\)](#)– 8H-K: Applying the Design Loop; 9I-K: Prototyping

Common Core Standards for English & Technical Subjects: [9-10](#); [11-12](#):

A focus in this unit will be following multistep processes.

[*Safety will be stressed and monitored throughout the course.](#)

Unit 2: What is the Engineering Process? (4 Months)

Enduring Understandings

1. Engineering is the application of math and science to solve real world problems.
2. The design loop can be applied to continually improve upon their designs and ideas.

Essential Questions:

1. How can math and science be applied to solve real world problems?
2. How does the function of the design loop aid engineers in the design process?

Learning Objectives:

1. Define engineering as the application of math and science to solve real world problems.
2. Describe and apply the steps of the design loop to complete the design of a usable finished product. (8.2.12.C.1)
3. Analyze a product and describe how it has changed over time to meet human needs and wants, such as a sneaker. (8.2.12.C.2)
4. Apply science and mathematical concepts and content to the practice of engineering.

Suggested Activities & Suggested Modifications for Special Education Students, ELL Students, Students at Risk, and Gifted Students:

1. Engineering Activity
2. Modifications may include providing students with a template to support the process.
3. Gifted students may be asked to present their product to an official representative or enter a contest.

Cross-Content Connections:

[Standards for Technology Literacy \(9-12\)](#) – 8H-K: Applying the Design Loop; 9I-K: Prototyping

Next Generation Science Standards - A focus in this unit will be on the

[real world applications of technology](#) (HS-ETS).

Common Core Standards for English & Technical Subjects: [9-10](#); [11-12](#):

A focus in this unit will be following multistep processes, key idea development and craft/structure.

Common Core Standards for Math:

A focus in this unit will be on [geometry](#), particularly the use of right triangles.

A focus in this unit will be on [numbers and quantities](#), particularly for the use of measurement.

Unit 3: Reverse Engineering (3 Months)

Enduring Understandings

1. The form and function of products are related.

Essential Questions:

1. How are form and function related in manufactured products.

Learning Objectives:

1. Determine the connection between form and function of a manufactured product.
2. Apply technical fields of mechanical engineering to a design challenge such as Rube Goldberg.
3. Apply math and science content to the process of engineering.

Suggested Activities & Suggested Modifications for Special Education Students, ELL Students, Students at Risk, and Gifted Students:

1. See #2 Above
2. Modifications may include providing students with a template or to support the process and/or design specifications with reduced variables.
3. Gifted students may be asked to complete additional steps or address additional variables.

Cross-Content Connections:

[Standards for Technology Literacy \(9-12\)](#)– 8H-K: Applying the Design Loop; 9I-K: Prototyping; 10I-L: Other Problem Solving Approaches

Next Generation Science Standards - A focus in this unit will be on the [real world applications of technology](#) (HS-ETS).

Common Core Standards for English & Technical Subjects: [9-10](#); [11-12](#):

A focus in this unit will be following multistep processes, key idea development and craft/structure.

Common Core Standards for Math:

A focus in this unit will be on [geometry](#), particularly the use of right triangles.

A focus in this unit will be on [numbers and quantities](#), particularly for the use of measurement.

Career Readiness Practices: A key idea in this unit is the focus on [career exploration](#) (NJCCCS 9.2).

Unit 4: Independent Research Project (3 Months)

Enduring Understandings

1. Applying engineering to solve problems also may result in environmental concerns.
2. Technology causes culture and society to change.

Essential Questions:

1. How does new technology affect the environment?
2. How can engineers develop technology in an environmentally friendly manner?
3. How does technology affect culture and society?

Learning Objectives:

1. Apply the technical skills of each field of engineering to solve a real-world problem, such as:
 - a. Electrical: Mag-Lev & Self-Propelled Vehicles
 - b. Civil: Structure Building
 - c. Bio-Medical: 3D Printed Joint (8.2.12.D.1)
 - d. Chemical: Oil Spill Project
2. Apply the design loop to design, build, test, collect data, and redesign, solutions to problems.
3. Explain interdependent systems and their functions such as in electrical engineering. (8.2.12.C.4)
4. Observe the cause and effect relationship between specific technologies and the environment over time. (8.2.12.B.1)
5. Compare and contrast two technological devices and their impact on the environment. (8.2.12.B.2)
6. Apply their understanding of the design loop and technologies impact on humans to create a device that impacts culture and society in a positive manner. (8.2.12.B.3)
7. Justify and explain their individual device discussing the positive and negative impacts it may have on society. (8.2.12.B.3)

Suggested Activities & Suggested Modifications for Special Education Students, ELL Students, Students at Risk, and Gifted Students:

1. Bio-technology, robotics, alternative energy
2. Modifications may include providing students with a template or to support the process and/or design specifications with reduced variables.
3. Gifted students may be asked to complete additional steps or address additional variables.

Cross-Content Connections:

[Standards for Technology Literacy \(9-12\)](#)– 15 Agricultural & Related bio-technologies, 16 Energy & Power Technologies; 4 Cultural, Social, Economic, and Political Effects of Technology; 5 Effects of Technology on Environment; 6 Role of Society

Next Generation Science Standards - A focus in this unit will be on the [real world applications of technology](#) (HS-ETS)

Common Core Standards for English & Technical Subjects: [9-10](#); [11-12](#):

A focus in this unit will be following multistep processes, key idea development and craft/structure.

Common Core Standards for Math:

A focus in this unit will be on [geometry](#), particularly the use of right triangles.

A focus in this unit will be on [numbers and quantities](#), particularly for the use of measurement.

Career Readiness Practices: A key idea in this unit is the focus on [career exploration](#) (NJCCCS 9.2).

V. Course MaterialsCore (Required) Texts

Technology Engineering & Design (2008) Pearson

Will be used as a classroom reference book.

Understanding Technology (1993) Goodheart-Wilcox

Will be used as a classroom reference book.

VI. Assessments

Classroom assessments are included to primarily guide instruction (formative assessment) and to support decisions made beyond the classroom (summative assessment).

Summative assessment will be authentic in nature. Students will be asked to complete design challenges and other performance based assessments. These assignments will typically involve a design, build, test, and redesign competent. Assessment will be rubric based.

VII. Interdisciplinary Connections and Alignment to Technology Standards

Interdisciplinary connections have been noted within each unit in the previous pages.

Careful attention will be paid in this course to form meaningful connections between the application of literacy for technical subjects, math skills and standards, career exploration, and the Next Generation Science Standards.

Engineering & Technology Education classes in the Fair Lawn Public schools promote career-readiness skills related to Personal Financial Literacy (9.1) and Career Awareness, Exploration, and Presentation (9.2). Some course concepts from the Career and Technical Education Standards (9.3), but these are not directly correlated since our district is not a CTE program.

The Fair Lawn Public Schools District fosters an environment that promotes career-readiness skills in all content areas. Whereas [Career Ready Practices](#) are explored consistently, specific alignment to [Personal Finance Literacy \(9.1\)](#) and [Career Awareness, Exploration, and Presentation Standards \(9.2\)](#) are included in the district level STEM Honors (2015)

document (below). When appropriate, the [Career and Technical Education Standards \(9.3\)](#) have been reviewed and aligned as well.

Examples: 9.2B: Career exploration in each unit of study.

In addition, every effort is made to integrate technology and engineering into our science classes. [Educational Technology \(8.1\)](#) and [Technology Education, Engineering, Design, and Computational Thinking – Programming \(8.2\)](#) standards are cross connected throughout our science programs.

Examples: 8.1A: Use spreadsheets to analyze & interpret data from laboratories, 6-12.
Use the internet to increase productivity and efficiency, 9-12.
8.1B,C: Use data to solve real-world problems, 6-12.
Use online platforms to collaborate & address global issues, 9-12.
8.1F: Collect and analyze data using internet and data simulations, 6-12.
8.2A: Become aware of the invention process, 3-5.
8.2B: Become aware of the global impacts on technology, 6-12.
8.2C: Apply the design process to pushes & pulls, K-2.
8.2D: Use tools to reduce work, K-2.

For additional detail on how these standards are integrated throughout the Fair Lawn Schools curriculum, review the Fair Lawn Public Schools District Alignment to Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix.