Fair Lawn

Public Schools

Fair Lawn, NJ

Innovation & Invention

August

2015

Revised From Tech & Design I / CADD 1 August 2015
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 intermediate course in which students will study and apply the innovation process.

Engineering & Technology Education

Learn. Innovation.

Fair Lawn School District

Committee Credits

Written By

Ellie Barkin & Steve Mondadori

Ronald Durso, Supervisor

Innovation & Invention

I. Course Synopsis

Innovation & Invention is an intermediate course in which students will study and apply the invention process to develop an original design.

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.

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

Innovation & Invention serves as an intermediate course in which students will develop and apply their skills of design using CADD to electronics, modeling, fabrication, product development and basic robotics.

Unit 1: Engineering Safely (September)

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

Unit 2: Design and Invention Process (September- October)

- The design loop can be applied to continually improve upon their designs and ideas.
- The patents process protects an engineer's ideas.

Unit 3: Developing Engineering Skills (October - December)

- Engineers use detailed computer programs to create accurate schematics.
- Engineers must read schematics drawn in different perspectives.
- The collaborative thought processes allows for more creative solutions.

Unit 4: Simple Machines (January - February)

- A simple machine decreases the amount of force needed to accomplish a goal.
- Multiple simple machines working together create a device.

Unit 5: Reverse Engineering (February - April)

- Many subsystems make whole working machine.
- Differences in design affect the quality of the product.

Unit 6: Marketing and Presentation (May - June)

- Research is an essential component to good engineering.
- Engineering is driven by cost effectiveness and market needs.

IV. Unit Descriptions

Unit 1: Engineering Safely (September)

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. Compare and contrast the concepts of "engineering design" with "design".
5. Apply techniques such as product poling, research, ergonomics, material selection, measurement, CADD, mechanical drawing, and/or 3D modeling to the design process. (8.2.12.C.3; 8.2.12.C.5.8.2.12.D.2, 8.2.12.D.3)

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: Design and Invention Process (September- October)

Enduring Understandings

1. The design loop can be applied to continually improve upon their designs and ideas.
2. The patents process protects an engineer's ideas.

Essential Questions:

1. How do engineers in each field apply the design loop to solve different types of problems?
2. How do patents protect an engineer's ideas?

Learning Objectives:

1. Apply the design loop to design, build, test, collect data, and redesign, solutions to problems. (8.2.12.C.1)
2. Describe the process to obtain a patent for a new design, product or idea. (8.2.12.A.2, 8.2.12.C.4, 8.2.12.D.1, 8.2.12.A.3)
3. Analyze the effects of an engineering world without patents. (8.2.12.B.3)

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

1. Develop and design their own logo, research logo usage, and register logo with a patent.
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.

Unit 3: Developing Engineering Skills (October - December)

Enduring Understandings

1. Engineers use detailed computer programs to create accurate schematics.
2. Engineers must read schematics drawn in different perspectives.
3. The collaborative thought processes allows for more creative solutions

Essential Questions:

1. How are schematics read and explained? (8.2.12.C.5)
2. How does collaboration affect the design process?

Learning Objectives:

1. Apply technical skills to create a schematic drawing. (8.2.12.C.5)

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

1. Exploring robotics
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) – 9 Engineering Designs

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 4: Simple Machines (January - February)

Enduring Understandings

1. A simple machine decreases the amount of force needed to accomplish a goal.
2. Multiple simple machines working together create a device.

Essential Questions:

1. How can simple machines be utilized in engineering to accomplish a goal?
2. How can multiple simple machines be used together to accomplish a goal?

Learning Objectives:

1. Define types of simple machines and relate their use to force, work, energy, and engineering. (8.2.12.D.1)
2. Use simple machines to accomplish a goal.
3. Combine simple machines to accomplish a goal.

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

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

Cross-Content Connections:

Standards for Technology Literacy (9-12) – 8 Attributes of Design, 11 Applying the Design Process

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

Real world applications of technology (HS-ETS).

Energy (HS-PS), Forces (HS-PS)

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 5: Reverse Engineering (February - April)

Enduring Understanding

1. Many subsystems make whole working machine.
2. Differences in design affect the quality of the product.

Essential Questions:

1. How can engineering be applied to improve a local issue?

Learning Objectives:

1. Explain interdependent systems and their functions such as in electrical engineering. (8.2.12.C.4)

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

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

Cross-Content Connections:

Standards for Technology Literacy (9-12) – 9 Engineering Designs

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 6: Marketing and Presentation (May - June)

Enduring Understanding

1. Research is an essential component to good engineering.
2. Engineering is driven by cost effectiveness and market.

Essential Questions:

1. How can engineering be applied to improve a local issue?

Learning Objectives:

1. Apply the design, engineering and invention process to a real world issue to improve the situation. (8.2.12.C.7)
2. Propose an innovation to meet future demands supported by an analysis of potential costs, benefits, and trade-offs, risks related to the innovation. (8.2.12.A.1)
3. Analyze the technology and resources used to identify risks and trade-offs in terms of availability, cost, desirability and waste. (8.2.12.A.2)
4. Create a prototype to solve a real world problem using the design process. (8.2.12.D.1)
5. Create scaled drawings. (8.2.12.C.5)
6. Analyze the produce for safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance, repair, and human factors. (8.2.12.C.5)
7. Research design constraints for the product. (8.2.12.B.1)
8. Evaluate ethical considerations regarding sustainability. (8.2.12.B.2)
9. Analyze ethical and unethical practices around intellecutual property rights. (8.2.12.B.3)

Suggested Activities & Suggested Modifications for Special Education Students, ELL Students,

Cross-Content Connections:

Standards for Technology Literacy (9-12) – 4: Cultural, Social & Economic Connections

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.

V. Course Materials

Core (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.

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 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.