

HILLSBOROUGH TOWNSHIP SCHOOL DISTRICT

HILLSBOROUGH TOWNSHIP HIGH SCHOOL

STEM CURRICULUM

GRADE 8

JULY 2014

Eighth Grade STEM Course Overview

The eighth grade STEM course of study includes an overview of STEM and a deeper exploration of the engineering design process including the use of electronic tools and modern rapid-prototyping and manufacturing processes.

The Engineering Design Process is revisited and reinforced to help students expand their understanding of the iterative nature of design. The role of computer assisted design is introduced as students investigate how the engineering design practices are used to research, develop, troubleshoot, and develop a prototype to solve problems. Students explore the capabilities of a variety of Computer Numeric Control (CNC) prototyping and manufacturing devices and their uses in the modern, technological, designed world. Students deepen their understanding that technology involves many types of problems and different approaches to solve them. These include the identification of problems, research and development, invention, manufacturing, troubleshooting and subsequent innovation of their designed solution.

The eighth grade STEM curriculum meets the requirements of the New Jersey Core Curriculum Content Standards for Technology Education, the Standards for Technology Literacy, as well as 21st Century Skills development.

Unit of Study/ Pacing	Content	NJCCCS Content Statement	NJCCCS cpi	Essential Questions	Enduring Understandings	Learning Targets	Assessment – Formative Summative Common Benchmark	Interdisciplinary Connections
<p>Unit 1: Introduction to STEM</p> <p>2-3 days</p>	<p>Lesson Block 1: Intro to the course</p> <p>Intro to safety</p>	<p>Content: The designed world is the product of a design process that provides the means to convert resources into products and systems.</p>	<p>8.2.8.G.1 Explain why human designed systems, products and environments need to be constantly monitored, maintained, and improved.</p>	<p>How does STEM differ from ‘shop class’?</p> <p>What are the Rules of the class?</p>	<p>Shop class was simply about how to follow directions so that all participants will end up with essentially the same product - STEM is applying the Design Loop to a problem in order to create a solution to that problem. (Products created by the design loop are often unique).</p> <p>Basic rules should be understood.</p>	<p>Explain how STEM class is different from a shop class.</p> <p>Be able to discuss the rules and the reasons behind them.</p>	<p>Classroom rules/policy contract, Individual and class questioning</p> <p>Common Benchmark: Summative Multiple Choice (used as pre-test and post-test)</p>	<p>Technology: Standards for Technological Literacy (STL) (ITEEA, 2000/2002/2007) Understanding the characteristics and scope of technology (STL-1) Understanding the Core Concepts of Technology (STL-2) Understanding the relationships among technologies and connections with other fields of study (STL-3) Understanding the role of society in the development and use of technology (STL-6)</p> <p>Science Content: Science is a practice in which an established body of knowledge is continually revised, refined, and extended. 5.1.8.C.3: Generate new and productive questions to evaluate and refine core explanations.</p>
<p>Unit 2: Defining a Problem and Developing a Solution</p>	<p>Lesson Block 1: Problem Statement - Includes Intro engineering design and research</p>	<p>Content The use of technology and digital tools requires knowledge and appropriate use of operations and related applications.</p> <p>Content:</p>	<p>8.1.8.A.1 Create professional documents (e.g., newsletter, personalized learning plan, business letter or flyer) using advanced features of a word processing program.</p> <p>8.1.8.A.5</p>	<p>What is Engineering?</p>	<p>A way of looking at the world with a critical eye in order to see issues occurring in our Designed World, and creating solutions to those issues.</p>	<p>Define what the role of engineering is in society.</p>	<p>Discussion of video such as <i>What is Engineering?</i> https://www.youtube.com/watch?v=bipTWWHya8A&feature=vp</p> <p>Presentation</p>	<p>Technology: Standards for Technological Literacy (STL) (ITEEA, 2000/2002/2007) Understanding the attributes of design (STL-8) New products and systems can be developed to solve problems or to help to</p>

<p>2-3 Days</p>		<p>The use of technology and digital tools requires knowledge and appropriate use of operations and related applications.</p> <p>Content: The design process is a systemic approach to solving problems.</p>	<p>Select and use appropriate tools and digital resources to accomplish a variety of tasks and to solve problems.</p> <p>8.2.8.B.1 Design and create a product using the design process that addresses a real world problem with specific criteria and constraints.</p>	<p>What other possible solutions are available to fill the need put forth in the problem statement?</p>	<p>Research online to find other solutions to the given Problem Statement.</p>	<p>Present information in an electronic format.</p>	<p>Common Benchmark: Portfolio</p>	<p>do things that could not be done without the help of technology. (STL-1F) The development of technology is a human activity and is the result of individual or collective needs and the ability to be creative. (STL-1G) Technology is closely linked to creativity, which has resulted in innovation. (STL-1H) The use of inventions and innovations has led to changes in society and the creation of new needs and wants (STL-6E) Social and cultural priorities and values are reflected in technological devices. (STL-6F) Meeting societal expectations is the driving force behind the acceptance and the use of products and systems. (STL-6G) Many inventions and innovations have evolved by using slow and methodical processes of tests and refinements. (STL-7C) Design is a creative planning process that leads to useful products and systems. (STL-8E)</p> <p>Science Content: Science involves practicing productive social interactions with peers, such as partner talk, whole-group discussions, and small-group work.</p>
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								<p>estimation strategies. For example: If a woman making \$25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or \$2.50, for a new salary of \$27.50. If you want to place a towel bar $9\frac{3}{4}$ inches long in the center of a door that is $27\frac{1}{2}$ inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.</p> <p>7.G.1 Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.</p> <p>7.G.6 Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.</p>
5-7 days	<p>Lesson Block 2:</p> <p>CAD</p>	<p>Content: The use of technology and digital tools requires knowledge and appropriate use of operations and related applications.</p> <p>Content: The design process is a systemic approach to</p>	<p>8.1.8.A.5 Select and use appropriate tools and digital resources to accomplish a variety of tasks and to solve problems.</p> <p>8.2.8.B.1 Design and create a product using the design process that addresses a real world problem with specific criteria and constraints.</p>	<p>What is CAD?</p> <p>How do you use CAD to enhance the design process? 4</p>	<p>Computer Aided Drawing/Design.</p> <p>Use of CAD to draw out, share and manipulate a design in detail.</p>	<p>Be able to define CAD.</p> <p>Use CAD to draw design.</p>	<p>Constructed response questions</p> <p>Performance rubrics</p> <p>Conforming to the Design Brief</p> <p>CAD produced drawings and renderings.</p>	<p>Technology: Standards for Technological Literacy (STL) (ITEEA, 2000/2002/2007)</p> <p>The Nature of Technology</p> <p>Understanding the characteristics and scope of technology (STL-1)</p> <p>The development of technology is a human activity and is the result of individual or collective needs and the ability to be creative. (STL-1G)</p> <p>Technology and Society</p>

		<p>solving problems.</p> <p>Content: The design process is a systemic approach to solving problems.</p> <p>Content: The design process is a systemic approach to solving problems.</p> <p>Content Digital tools facilitate local and global communication and collaboration in designing products and systems.</p>	<p>8.2.8.B.2 Identify the design constraints and trade offs involved in designing a prototype, (how the prototype might fail, and how it might be improved) by completing a design problem and reporting results in a multimedia presentation.</p> <p>8.2.8.B.3 Solve a science-based design challenge and build a prototype using science and math principles throughout the design process.</p> <p>8.2.8.E.1 Develop a product using the design process, data analysis and trends and maintain a digital log with annotated sketches to record the development cycle in collaboration with peers and experts in the field.</p>	<p>What will your Solution look like in CAD?</p>	<p>The developed (brainstormed) solution will be drawn in CAD.</p>	<p>Be able to draw a solution to their Problem Statement in CAD.</p>		<p>Understanding the cultural, social, economic, and political effects of technology (STL-4) Design Understanding the Attributes of Design (STL-8) Design is a creative planning process that leads to useful products and systems. (STL-8E) There is no perfect design. (STL-8F) Requirements for a design are made up of criteria and constraints. (STL-8G) Understanding engineering design (STL-9) Design involves a set of steps, which can be performed in different sequences and repeated as needed. (STL-9F) Brainstorming is a group problem-solving design process in which each person in the group presents his or her ideas in an open forum. (STL-9G) The use of symbols, measurements, and drawings promotes clear communication by providing a common language to express ideas. (STL-17K)</p>
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<p>4-5 days</p>	<p>Lesson Block 3: Rapid Prototyping Tools</p>	<p>Content: Digital tools and environments support the learning process and foster collaboration in solving local or global issues and problems.</p> <p>Content: Knowledge and understanding of human cultural and societal values are fundamental when designing technology systems and products in the global society</p> <p>Content: Technological advancements create societal concerns regarding the practice of safe, legal</p>	<p>8.1.8.C.1 Participate in an online learning community with learners from other countries to understand their perspectives on a global problem / issue and propose possible solutions.</p> <p>8.2.8.C.1 Explain the need for a patent and process of registering one.</p> <p>8.1.8.D.2 Summarize the application of fair use and creative commons.</p> <p>8.1.8.A.3 Create a multimedia</p>	<p>How can you use rapid prototyping tools to enhance the design and creation process?</p> <p>Why is 3D manufacturing currently so widespread?</p> <p>What is an example of creative commons or fair use?</p>	<p>Use tools such as Makerbot, CNC Mills, and Epilog to produce the designs created in CAD.</p> <p>The Patent for 3D printers has run out. The technology has been introduced to a new generation of engineers.</p> <p>Manufacturers such as BMW Tesla and others hold patents for many auto safety features for which they do not enforce the patents on (used by other auto companies in their cars) so as to protect the greater good.</p>	<p>At the least be able to describe how rapid prototyping can be used to enhance the design process. At best, be able to use a production tool to produce their own design.</p> <p>Identify reasons for the spread of Rapid Prototyping in industry.</p> <p>Be able to describe an example of the use of Creative Commons or Fair Use.</p>	<p>Constructed response questions</p> <p>Performance rubrics</p> <p>Presentation</p>	<p>Technology: Standards for Technological Literacy (STL) (ITEA, 2000/2002/2007) The development and use of technology poses ethical questions. (STL-4F) Economic, political, and cultural issues are influenced by the development and use of technology. (STL-4G) Understanding the effects of technology on the environment (STL-5) Decisions to develop and use technologies often put environments and economic concerns in direct competition with one another (STL-5F) Understanding the relationships among technologies and connections with other fields of study (STL-3) Understanding of and abilities to select and use manufacturing technologies (STL-19) A product, system, or environment developed for one setting may be applied to another setting. (STL-2E)</p>

		and ethical behaviors Content: The use of technology and digital tools requires knowledge and appropriate use of operations and related applications.	digital resources to accomplish a variety of tasks and to solve problems.	What types of Rapid Prototyping tools exist and which is used for what purpose?		sound and images on the topic of a specific Rapid Prototyping Technology and how it is being used.		
20-25 days	Lesson Block 4: Creation of a Designed Product	Content: Digital tools facilitate local and global communication and collaboration in designing products and systems. Content: Technology is created through the application and appropriate use of technological resources. Content: Technology is created through the application and appropriate use of technological resources	8.2.8.E.1 Develop a product using the design process, data analysis and trends and maintain a digital log with annotated sketches to record the development cycle in collaboration with peers and experts in the field. 8.2.8.F.1 Explain the impact of resource selection and processing in the development of a common technological product or system. 8.2.8.F.2 Explain how the resources and processes used in the production of a current product can be modified to have a more positive impact on the environment (e.g., recycled metals, alternate energy sources) and the economy.	What is the procedure to create the designed product? How does the availability and choice of materials impact the design?	For example: legs for a table are created by a set of steps. So are aprons, tops and other components. We are constrained by our available materials. Materials are chosen for their cost, availability and environmental impact.	Demonstrate by creation of each component, their comprehension of the proper procedures. Choose from the available materials.	Creation of designed solution to the posed problem. Common Benchmark: Portfolio	Technology: Standards for Technological Literacy (STL) (ITEEA, 2000/2002/2007) Design a product, system or environment for a specific setting (STL-3) Design is a creative planning process that leads to useful products and systems. (STL-8E) There is no perfect design. (STL-8F) Requirements for a design are made up of criteria and constraints. (STL-8G) Understanding engineering design (STL-9) Design involves a set of steps, which can be performed in different sequences and repeated as needed. (STL-9F) Abilities to apply the design process (STL-11) Marketing a product involves informing the public about it as well as assisting in selling and distributing it. (STL-19K) Math 7.RP.1 Compute unit rates associated with ratios of fractions, including

		<p>Content: Technology systems impact every aspect of the world in which we live.</p> <p>Content: The designed world is the product of a design process that provides the means to convert resources into products and systems.</p> <p>Content: The designed world is the product of a design process that provides the means to convert resources into products and systems.</p>	<p>8.2.8.G.1 Explain why human designed systems, products and environments need to be constantly monitored, maintained, and improved.</p> <p>8.2.8.G.2 Explain the interdependence of a subsystem that operates as part of a system.</p>	<p>What materials have the least impact on the environment and are still cost effective? How has technology impacted the livelihood of the providers of raw materials?</p> <p>What machines and processes are available to use?</p> <p>How do you use the tools available to you?</p> <p>How much time is required to complete said process?</p>	<p>How our choices of materials affect not only the product itself but, the environment and the workforce.</p> <p>We are constrained by our available machines.</p> <p>Lessons will be given on each applicable tool.</p> <p>Different processes take time to complete, depending on their complexity.</p>	<p>Explain the intentional and unintentional consequences of material choices.</p> <p>Select the appropriate tools for a needed procedure.</p> <p>Demonstrate proper usage of the tools.</p> <p>Complete their project within the allotted time.</p>	<p>fraction $\frac{1}{2}$/$\frac{1}{4}$ miles per hour, equivalently 2 miles per hour. 7.NS.1.d Apply properties of operations as strategies to add and subtract rational numbers. 7.NS.2.c Apply properties of operations as strategies to multiply and divide rational numbers. 7.EE.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. For example: If a woman making \$25 an hour gets a 10% raise, she will make an additional $\frac{1}{10}$ of her salary an hour, or \$2.50, for a new salary of \$27.50. If you want to place a towel bar $9\frac{3}{4}$ inches long in the center of a door that is $27\frac{1}{2}$ inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation. 7.G.1 Solve problems involving scale drawings of geometric</p>
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								figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale. 7.G.6 Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.
1-2 Days	Lesson Block 5: Evaluation and Redesign	Content: The design process is a systemic approach to solving problems. Content: The design process is a systemic approach to solving problem.	8.2.8.B.1 Design and create a product using the design process that addresses a real world problem with specific criteria and constraints. 8.2.8.B.2 Identify the design constraints and trade offs involved in designing a prototype, (how the prototype might fail, and how it might be improved) by completing a design problem and reporting results in a multimedia presentation. 8.2.8.B.3 Solve a science-based design challenge and build a prototype using science and math principles throughout the design process. 8.2.8.F.2	H.ow closely does the completed product match the original design? What about the design could be better? What about the constructed product is done well? What about the constructed product could be done better? What would a redesigned product look like and what features would it have?	Using tools determine how closely your product is to it's original specifications. There is no 'perfect design'. Work and skill can create functional products that can be useful in everyday life. Despite our best efforts, there are inevitably flaws in the manufacture of a given product. Use of the design loop requires a constant re-evaluation of the product to improve it.	Analyze and write-up a detailed comparison of the conceived design and the final product. Analyze the design with a critical eye and an engineering mindset to determine how the design might be improved. Analyze and critique the product in order to determine what was successful in the creation of the product. Analyze and critique the product in order to determine what was NOT successful in the creation of the product. Produce a design which improves upon the original and be able to explain how it improves upon the original.	Design and redesign of product Common Benchmark: Summative Multiple Choice (post-test)	Technology: Standards for Technological Literacy (STL) (ITEEA, 2000/2002/2007) Design is a creative planning process that leads to useful products and systems. (STL-8E) There is no perfect design. (STL-8F) Requirements for a design are made up of criteria and constraints. (STL-8G) Understanding engineering design (STL-9) Design involves a set of steps, which can be performed in different sequences and repeated as needed. (STL-9F) Modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions. (STL-9H)

		<p>Content: The design process is a systemic approach to solving problem</p> <p>Content: Technology is created through the application and appropriate use of technological resources.</p> <p>Content: The designed world is the product of a design process that provides the means to convert resources into products and systems.</p>	<p>Explain how the resources and processes used in the production of a current product can be modified to have a more positive impact on the environment (e.g., recycled metals, alternate energy sources) and the economy.</p> <p>8.2.8.G.2 Explain the interdependence of a subsystem that operates as part of a system.</p>					
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Eighth Grade STEM Bibliography

What is Engineering? <https://www.youtube.com/watch?v=bipTWWHya8A&feature=kp>