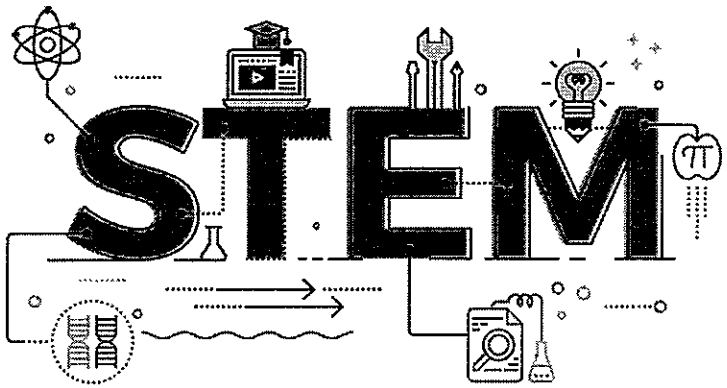
Secaucus Board of Education

STEM Course 1

Course Codes: 5610, 5710, 5810

STEM Department



Born on January 2017

Aligned to the NJSLS for Science (2016), Mathematics (2016), Technology (2014), & English Language Arts Literacy (2016)

Adopted by the Secaucus Board of Education on: January 19, 2017

District Equity Statement

The Board of Education directs that all students enrolled in the schools of this district shall be afforded equal educational opportunities in strict accordance with the law. No students shall be denied access to or benefit from any educational program or activity or from a co-curricular or athletic activity on the basis of the student's race, color, creed, religion, national origin, ancestry, age, marital status, affectional or sexual orientation, gender, gender identity or expression, socioeconomic status, or disability. The Board directs the Superintendent to allocate faculty, administrators, support staff members, curriculum materials, and instructional equipment supplies among and between the schools and classes of this district in a manner that ensures equivalency of educational opportunity throughout this district. The school district's curricula in the following areas will eliminate discrimination, promote mutual acceptance and respect among students, and enable students to interact effectively with others, regardless of race, color, creed, religion, national origin, ancestry, age, marital status, affectional or sexual orientation, gender, gender identity or expression, socioeconomic status, or disability:

1. School climate/learning environment
2. Courses of study, including Physical Education
3. Instructional materials and strategies
4. Library materials
5. Software and audio-visual materials
6. Guidance and counseling
7. Extra-curricular programs and activities
8. Testing and other assessments.

Excerpt from Secaucus Board of Education, Policy 5750, Edited September 2016.

Course Description

STEM 1 is an introduction to the engineering and design process. Student learning experiences integrate interdisciplinary content knowledge with a focus on defining problems and identifying goals, data collection, and evidence-based reasoning to inform and iterate on the design solution. Students learn and apply foundational computer language skills with an introduction to programming.

Primary Interdisciplinary Connections

Science
Math
Business
ELA
Arts

Course Modifications (ELLs, Special Education, Gifted and Talented)

The teacher will determine, with the assistance of guidance counselors, teacher assistant/aides, educational specialists and/or special education teachers, what modifications will be made for his/her students. Such examples of modifications can include, but not be limited to:

- Extended time as needed
- Modification of tests and quizzes
- Preferential seating
- Alternative/Formative assessment (projects)
- Effective teacher questioning (ranging from simple recall to higher order critical thinking questions)
- Supplemental materials
- Cooperative learning
- Teacher tutoring
- Peer tutoring
- Differentiated Instruction

Unit 1: What Is Engineering?	Students are introduced to the Engineering/Design Process **Big Ideas:** • Engineering is problem solving or improving a product or process. • The Engineering/Design (Innovation) Process includes the following phases: 1. Define the Problem 2. Identify Goals 3. Research 4. Generate Ideas (Develop a Possible Solution) 5. Design 6. Create a prototype 7. Test 8. Evaluate 9a. Redesign >> Test >> Re-Evaluate or 9b. Share
Timing:	1 week
Standards:	*NJSLS for Technology* **8.2.8.C.4:** Identify the steps in the design process that would be used to solve a designated problem. **8.2.8.C.1:** Explain how different teams/groups can contribute to the overall design of a product. *NJSLS for Science* **MS-ETS1-2, MS-ETS1-3**: There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. **MS-ETS1-4:** A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. **MS- ETS1-4**: The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. *NJSLS for Mathematics*

	MP 1. Make sense of problems and persevere in solving them. *NJSLS for English Language Arts Literacy* **SL.6.1.A** Come to discussions prepared, having read or studied required material; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion. **SL.6.1.B** Follow rules for collegial discussions, set specific goals and deadlines, and define individual roles as needed. **SL.6.1.C** Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion.	
Essential Questions:	**Objectives:**	**Suggested Activities, Investigation, and Student Experiences:**
• What is engineering? • What is the engineering/design process? • How do engineers communicate to solve a problem?	Students will: • Know engineering is problem solving or improving a process/product (life hacking). • Reflect on process used in an engineering/design challenge. • Identify steps in the engineering/design process. • Communicate with others to improve the solution design process.	• Cooperative Group Investigations and Hands-on Activities. • Partner collaboration. • Index Card Challenge • Paper Chain Challenge • Nametag Challenge • Marshmallow Challenge • Scrum
Assessments:	**Materials:**	**Resources:**
• Student discussion, participation, and feedback	• Interactive Whiteboard	• Department Created Resources & Assessments

• Oral Questioning • Homework Assignments • Classwork • Projects	• Whiteboard • Dry Erase Markers • Paper • Masking Tape • Scissors • Pens/Pencils/Markers • Index Cards • Paper Cups • Fishing Line • Paper Clips • Marbles • Paper Plates	• Video: What's an Engineer? Crash Course Kids #12.1 • Video: The Engineering Process: Crash Course Kids #12.2 • Engineering/Design Process Steps Visual Aids

Unit 2: Defining a Problem & Identifying Goals	Students define problems and identify goals, evaluate solutions against criteria and constraints, and iterate on a design solution. **Big Ideas:** • Deeper knowledge/understanding of (science) content can be applied to come up with better solutions to problems. • Goals may be defined in any problem by taking different factors into account (specificity/generality, criteria/constraints, time, available resources, immediacy of need, etc.) • The way a problem is defined and solution goals identified impact the problem's solution.
Timing:	3 Weeks
Standards:	*NJSLS for Technology* **8.2.8.C.4** Identify the steps in the design process that would be used to solve a designated problem **8.2.8.C.5.a** Create a technical sketch of a product with materials and measurements labeled. **8.2.8.C.8** Develop a proposal for a chosen solution that include models (physical, graphical or mathematical) to communicate the solution to peers. **8.2.8.D.3** Build a prototype that meets a STEM-based design challenge using science, engineering, and math principles that validate a solution. **8.2.8.C.2** Explain the need for optimization in a design process. *NJSLS for Science* **MS-ETS1-2, MS-ETS1-3:** There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.

	MS- ETS1-4: A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. **MS- ETS1-4:** The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. *NJSLS for Mathematics* **MP 1.**Make sense of problems and persevere in solving them. *NJSLS for English Language Arts Literacy* **RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts. **RST.6-8.7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). **RST.6-8.9** Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. **WHST.6-8.9** Draw evidence from informational texts to support analysis, reflection, and research **WHST.6-8.1.B** Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.

Essential Questions:	**Objectives:**	**Suggested Activities, Investigation, and Student Experiences:**
• How do I Identify goals? • How are goals defined when solving a problem?	Students will be able to: • Understand that engineers are people who solve problems. • Integrate previous experience and knowledge/understanding of (science)	• Practice identifying problems and suggesting possible solutions. • Testing Shapes Challenge: What is the strongest Shape?

• How does the way problems/goals are defined and setting goals affect the solution to a problem? • How can science content knowledge and previous experience contribute to the ability to solve a problem? • How can finding the point of failure make a design solution stronger? • What types of shapes have the most structural integrity and why? • How do I write an effective proposal?	content to come up with better solutions to problems as well as their rationale. • Practice defining problems by taking different factors into account (specificity/generality, criteria/constraints, time, available resources, immediacy of need, etc.) • Experience solving design problems with both general and specific goals to compare and contrast how the way a problem is defined and goals identified impact its solution. • Understand the importance of teamwork and failure in science and engineering. • Understand that even weak materials can be made stronger with good design techniques. • Understand that some shapes are stronger than others. • Compare models to understand why some models are stronger than others. • Understand the term "structural integrity" is a building's ability to hold itself up and keep its shape and that several factors including distribution	Construct a free-standing structure using only 12 x 24 paper & 3 yd masking tape. (tools include scissors and rulers) to see how much weight it can hold. The load must be off the ground. Only triangular, circular, and rectangular shapes may be used. Students build, test, and reiterate on solutions. • Write a proposal that identifies the problem, project goals (what is to be accomplished), how the problem is to be solved, and support suggested solutions with evidence-based reasoning. • Define testing and evaluation criteria (How will you know when the solution is successful?) • Set goals for purposes of testing/evaluation/iteration

	of mass, force, and gravity affect a building's structural integrity. • Develop a proposal for a chosen solution that include models and sketches with materials and measurements labeled to communicate the solution to an audience. • Set goals as a way to test and evaluate prototypes and use this information to improve/iterate on the design solution.	
Assessments:	**Materials:**	**Resources:**
• Student discussion, participation, and feedback • Quizzes • Proposal • Peer Evaluations • Homework assignments • Classwork • Projects	• Paper - 12 x 24 for each build round • Masking Tape • Rulers • Scissors • Pencils/Pens/Sharpies • Paper to write Design Proposal • Measuring Tape • Scale • Incremental weights (3lb, 25 lb) • Devices to type Proposals, research and access content reading • (Teacher) Interactive Whiteboard	• Department Created Resources & Assessments

Unit 3: Evidence & Data Collection for Solution Design	Students learn how to collect data and evidence and use this to inform the design solution. **Big Ideas:** • Not all problems have one solution, a clear solution, or a solution that will be discovered within our lifetime. • There are various ways to collect data and generate evidence in order to better solve problems and iterate on the design solution. • Engineers use a specific format to document the design process.
Timing:	9 weeks, ongoing
Standards:	*NJSLS for Technology* **8.2.8.A.2:** Examine a system, consider how each part relates to other parts, and discuss a part to redesign to improve the system. **8.2.8.B.6:** Compare and contrast the different types of intellectual property including copyrights, patents and trademarks. **8.2.8.C.2**: Explain the need for optimization in a design process. **8.2.8.C.4:** Identify the steps in the design process that would be used to solve a designated problem. **8.2.8.C.6**: Create a technical sketch of a product with materials and measurements labeled. **8.2.8.C.8:** Collaborate with peers and experts in the field to research and develop a product using the design process, data analysis and trends, and maintain a design log with annotated sketches to record the developmental cycle. **8.2.8.D.2:** Identify the design constraints and trade-offs involved in designing a prototype (e.g., how the prototype might fail and how it might be improved) by completing a design problem and reporting results in a multimedia presentation, design portfolio or engineering notebook. **8.2.8.D.3:** Build a prototype that meets a STEM-based design challenge using science, engineering, and math principles that validate a solution.

	NJSLS for Science: **MS-ETS1-1:** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. **MS-ETS1-2:** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. **MS-ETS1-3**: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. **MS-ETS1-4:** Develop a model to generate data for iterative testing and modification of a proposed *NJSLS for Mathematics* **MP 1.** Make sense of problems and persevere in solving them. **MP 2.** Reason abstractly and quantitatively. **MP 3.** Construct viable arguments and critique the reasoning of others. **MP 4.** Model with mathematics. **MP 5.** Use appropriate tools strategically. **MP 6.** Attend to precision. **MP 7.** Look for and make use of structure. **MP 8.** Look for and express regularity in repeated reasoning. *NJSLS for English Language Arts Literacy* **RST.6-8.7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

	WHST.6-8.1.A Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically. **WHST.6-8.1.B** Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources. **SL.6.1** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. **SL.6.2** Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study. **SL.6.3** Delineate a speaker's argument and specific claims, distinguishing claims that are supported by reasons and evidence from claims that are not.	
Essential Questions:	**Objectives:**	**Suggested Activities, Investigation, and Student Experiences:**
• Do all problems have a solution? • How can I collect/use evidence to solve a problem? • Why is it important to collect data and document the design process? • What are the benefits and shortcomings of reverse engineering? • How can previous experience be used to solve a problem or improve a solution going forward?	Students will: • Know engineering is problem solving or improving a process/product (life hacking). • Understand the difference between an observation and an inference. • Make observations to generate evidence in order to form a theory. (Evidence-based reasoning)	• Cooperative Group Investigations and Hands-on Activities. • The Mystery Tube • Reverse Engineering • Paper Airplane Design • Building Ramps from Recycled Materials • Quarter Drop • Earthquakes & Volcanos • Bottle Toss Challenge • Testing and redesign • Maintaining an engineering

	• Use Real-Time data to solve a problem. • Engage in evidentiary argumentation to convince others that their theory is correct. • Communicate with others to improve the solution design process. • Reverse engineer (build a model) to better understand how something works and generate evidence to support a theory. • Collect data and document the design process. • Understand why and how Engineers keep detailed records and data. • Become familiar with Engineering Notebook format and maintain an Engineering Notebook. • Build and test prototypes to evaluate the effects of different variables. • Consider data and evidence to iterate on and optimize the design solution.	notebook • Quantitative & Qualitative Data Collection • Generating Evidence to support a theory • Evidentiary Argumentation
Assessments:	**Materials:**	**Resources:**
• Student discussion, participation, and feedback • Homework assignments • Classwork	• Paper • Tape - Masking & Scotch • Pencils/Pens • Sharpies	• Department Created Resources & Assessments

• Projects	• Rulers • Scissors • Protractors • Whiteboard • Whiteboard markers • Devices with Internet access • "Mystery Tubes" • Engineering (Composition) Notebooks • String or Yarn	

Unit 5:	Introduction to Programming
Timing:	4 Weeks
Standards:	*NJSLS for Technology* **8.2.8.E.3** Develop an algorithm to solve an assigned problem using a specified set of commands and use peer review to critique the solution. **8.2.8.A.2** Examine a system, consider how each part relates to other parts, and discuss a part to redesign to improve the system. **8.2.8.A.3** Investigate a malfunction in any part of a system and identify its impacts. **8.2.8.C.7** Collaborate to examine a malfunctioning system and identify the step-by-step process used to troubleshoot, evaluate and test options to repair the product, presenting the better solution. *NJSLS for Mathematics* **MP 1.** Make sense of problems and persevere in solving them. **MP 2.** Reason abstractly and quantitatively. **MP 3.** Construct viable arguments and critique the reasoning of others. **MP 4.** Model with mathematics. **MP 5.** Use appropriate tools strategically. **MP 6.** Attend to precision. **MP 7.** Look for and make use of structure. **MP 8.** Look for and express regularity in repeated reasoning. *NJSLS for English Language Arts Literacy* **WHST.6-8.2** Write informative/explanatory texts, including the narration of historical

<table>
<tr><td></td><td colspan="2">events, scientific procedures/ experiments, or technical processes.</td></tr>
<tr><td>Essential Questions:</td><td>Objectives:</td><td>Suggested Activities, Investigation, and Student Experiences:</td></tr>
<tr><td>What is a computer program?
What are the core features of most programming languages?
How does programming enable creativity and individual expression?
What practices and strategies are effective for writing programs?</td><td>Students will be able to:
Define and create an algorithm.
Understand variables, loops, booleans, and conditionals
Brainstorm ideas.
Storyboard their idea.
Write a step-by-step plan for how they will use your time to create the program.
Create the program, testing each part to make sure it works.
Troubleshoot – make small adjustments to fix things that don't work.
Complete a project evaluation.
Complete a Peer Evaluation on Google Classroom.</td><td>Cooperative group investigations.
Hands-on activities.
Partner collaborations.
Scratch Tutorials
Scratch Project
Working with constraints.
Testing.</td></tr>
<tr><td>Assessments:</td><td>Materials:</td><td>Resources:</td></tr>
<tr><td>Student Participation
Oral Questioning
Homework Assignments
Classwork
Projects</td><td>Paper
Pencil
Whiteboard
Whiteboard markers
Erasers
Computers with internet access.</td><td>Scratch.com
Code.org
Codeacademy.com</td></tr>
</table>

Unit 6: Generating Ideas	Bridge Design	
Timing:	3 Weeks	
Standards:	**National Core Arts Standards** (MA:Cr1.1.6) Formulate variations of goals and solutions for media artworks by practicing chosen creative processes, such as sketching, improvisation and brainstorming. **Technology (2014)** 8.2.8.C.4 Identify the steps in the design process that would be used to solve a designated problem. **Technology (2014)** 8.2.8.C.6 Create a technical sketch of a product with materials and measurements labeled. **Technology (2014)** 8.2.8.C.8 Collaborate with peers and experts in the field to research and develop a product using the design process, data analysis and trends, and maintain a design log with annotated sketches to record the developmental cycle.	
Essential Questions:	**Objectives:**	**Activities, Investigation, and Student Experiences:**
• What type of bridge can we build that will hold the most weight? • How do we build the bridge?	Students will be able to: • Construct a bridge using a limited amount of materials. • Take into account a budget when purchasing more materials. • Keep a balance sheet for their expenses. • Write checks to buy materials.	• Cooperative group investigations. • Hands-on activities. • Partner collaborations. • Working with constraints. • Testing. • Redesign.

	• Test structural integrity of their bridges.	
Assessments:	**Materials:**	**Resources:**
• Student Participation • Oral Questioning • Homework Assignments • Classwork • Projects	• Paper • Pencil • Whiteboard • Whiteboard markers • Erasers • Graph paper. • Toothpicks. • String. • Gum drops. • Manilla envelopes.	• Math project series: Building toothpick bridges.