Verona Public School District
Curriculum Overview

7th Grade TED

Curriculum Committee Members:
Julia Harth

Supervisor:
Glen Stevenson

Curriculum Developed:
Fall/Winter 2015
Revised Summer 2016
Revised Summer 2017

Board Approval Date:
March 24, 2015
August 30, 2016
August 29, 2017

Verona Public Schools
121 Fairview Ave., Verona, NJ 07044
www.veronaschools.org

Verona Public Schools Mission Statement:

The mission of the Verona Public Schools, the center of an engaged and supportive community, is to empower students to achieve their potential as active learners and productive citizens through rigorous curricula and meaningful, enriching experiences.

Course Description:

Grade 7 will further explore the processes and techniques used in the design and construction of our engineered world. The first half of the year will focus on Future City. Students involved in the Future City Competition spend time creating cities that could exist at least 100 years in the future. Each city must incorporate a solution to a design challenge that changes each year. For the second half of the year, the class will focus on mechanics and structural engineering. Emphasis is placed on compound machines and the effects of individual parts on the whole. The course culminates in students developing a Rube Goldberg machine. The construction of these machines will test students' abilities to troubleshoot and refine their designs.

Prerequisite(s):

None

Standard 8: Technology Standards

8.1: Educational Technology: *All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.*	**8.2: Technology Education, Engineering, Design, and Computational Thinking - Programming:** *All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.*
X A. Technology Operations and Concepts **X** B. Creativity and Innovation **X** C. Communication and Collaboration D. Digital Citizenship **X** E. Research and Information Fluency **X** F. Critical thinking, problem solving, and decision making	**X** A. The Nature of Technology: Creativity and Innovation **X** B. Technology and Society **X** C. Design **X** D. Abilities for a Technological World E. Computational Thinking: Programming

SEL Competencies and Career Ready Practices

Social and Emotional Learning Core Competencies: *These competencies are identified as five interrelated sets of cognitive, affective, and behavioral capabilities*	**Career Ready Practices:** *These practices outline the skills that all individuals need to have to truly be adaptable, reflective, and proactive in life and careers. These are researched practices that are essential to career readiness.*
Self-awareness: The ability to accurately recognize one's emotions and thoughts and their influence on behavior. This includes accurately assessing one's strengths and limitations and possessing a well-grounded sense of confidence and optimism.	**X** CRP2. Apply appropriate academic and technical skills. CRP9. Model integrity, ethical leadership, and effective management. CRP10. Plan education and career paths aligned to personal goals.
Self-management: The ability to regulate one's emotions, thoughts, and behaviors effectively in different situations. This includes managing stress, controlling impulses, motivating oneself, and setting and working toward achieving personal and academic goals.	CRP3. Attend to personal health and financial well-being. **X** CRP6. Demonstrate creativity and innovation. **X** CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. CRP11. Use technology to enhance productivity.
Social awareness: The ability to take the perspective of and empathize with others from diverse backgrounds and cultures, to understand social and ethical norms for behavior, and to recognize family, school, and community resources and supports.	CRP1. Act as a responsible and contributing citizen and employee. CRP9. Model integrity, ethical leadership, and effective management.
Relationship skills: The ability to establish and maintain healthy and rewarding relationships with diverse individuals and groups. This includes communicating clearly, listening actively, cooperating, resisting inappropriate social pressure, negotiating conflict constructively, and seeking and offering help when needed.	**X** CRP4. Communicate clearly and effectively and with reason. CRP9. Model integrity, ethical leadership, and effective management. CRP12. Work productively in teams while using cultural global competence.
Responsible decision making: The ability to make constructive and respectful choices about personal behavior and social interactions based on consideration of ethical standards, safety concerns, social norms, the realistic evaluation of consequences of various actions, and the well-being of self and others.	**X** CRP5. Consider the environmental, social, and economic impact of decisions. CRP7. Employ valid and reliable research strategies. **X** CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. CRP9. Model integrity, ethical leadership, and effective management.

Standard 9: 21st Century Life and Careers

9.1: Personal Financial Literacy: *This standard outlines the important fiscal knowledge, habits, and skills that must be mastered in order for students to make informed decisions about personal finance. Financial literacy is an integral component of a student's college and career readiness, enabling students to achieve fulfilling, financially-secure, and successful careers.*	**9.2: Career Awareness, Exploration & Preparation:** *This standard outlines the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements.*	**9.3: Career and Technical Education:** *This standard outlines what students should know and be able to do upon completion of a CTE Program of Study.*
X A. Income and Careers B. Money Management C. Credit and Debt Management D. Planning, Saving, and Investing **X** E. Becoming a Critical Consumer F. Civic Financial Responsibility G. Insuring and Protecting	A. Career Awareness (K-4) **X** B. Career Exploration (5-8) C. Career Preparation (9-12)	A. Agriculture, Food & Natural Res. **X** B. Architecture & Construction C. Arts, A/V Technology & Comm. D. Business Management & Admin. E. Education & Training F. Finance G. Government & Public Admin. H. Health Science I. Hospital & Tourism J. Human Services K. Information Technology L. Law, Public, Safety, Corrections & Security **X** M. Manufacturing **X** N. Marketing **X** O. Science, Technology, Engineering & Math P. Transportation, Distribution & Log.

Course Materials

Core Instructional Materials: *These are the board adopted and approved materials to support the curriculum, instruction, and assessment of this course.*	**Differentiated Resources**: *These are teacher and department found materials, and also approved support materials that facilitate differentiation of curriculum, instruction, and assessment of this course.*
•	• Various Teacher Constructed Materials • https://www.rubegoldberg.com/ •

Unit Title / Topic: Future City	Unit Duration: 9 weeks (46 Days)

Stage 1: Desired Results

Established Goals:

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 object, tool, or process such that an optimal design can be achieved.

Transfer Goal:

Students will be able to independently use their learning to design solutions to real-world problems by applying a design process that includes defining a problem, generating ideas, selecting a solution, and using simple modeling tools or techniques to test and revise a design.

Students will understand:

- The engineering design process is a method that is used to solve technological challenges to change and improve products for the way we live.
- Teamwork is essential to the engineering design process. Engineers have to be able to communicate accurately and work well with colleagues and clients in order to be effective members of a team.
- Technology changes constantly due to the continuing effort to improve products and systems; good is not good enough if better is possible.

Essential Questions:

- How can we make the world a better place?
- What age-related challenges exist in today's urban environments?
- How does collaboration impact (affect) the design process?
- What is the relationship between math, science, and engineering?

Students will know:

- the engineering design process includes defining a problem, generating ideas, selecting a solution, testing the solution(s), making the item, evaluating it, and presenting the results.
- project management is a professional organizing system that focuses on keeping projects and teams coordinated and moving forward.
- there are four main stages of project management: Define, Plan, Do, and Review. Each step of the engineering design process aligns with a different stage of the project management cycle.
- in engineering, the success of a project often hinges on proper management of the goals, budget, timeline, and resources.
- inquiry is a process that people use to study to the natural world and develop knowledge and understanding of scientific ideas.
- universal design is the design of products and environments to be usable by all people, to the greatest extent possible, without adaptation or specialized design.
- "Infrastructure" is a term for the structures, systems, and facilities that make a city inhabitable—that is, a place that has what people need in order to live there.
- zoning refers to the way in which land in a city gets divided up and categorized. Zoning regulations and laws help ensure that a city can grow and change in a manageable, safe, and attractive way.
- city planning requires an understanding of all the systems and features that make up a city. City planners are always thinking about how to improve the quality of life in a city by fixing problems and planning how the city can grow and change.
- human factors engineers consider human strengths and weaknesses, both physical and cognitive, when designing new technology.
- "Scale" is the ratio between two sets of measurements.
- "Scale drawing" is a drawing that uses scale to make an object smaller or larger than the real object.
- "Scale model" is a proportional model of a three- dimensional object.
- the use of symbols, measurements, and drawings promotes clear communication by providing a common language to express ideas.

Students will be able to:

- apply a design process that includes defining a problem, brainstorming a solution, generating ideas, identifying criteria, exploring possibilities, selecting an approach, making a model or prototype, testing and evaluating a design, and refining a design to solve a problem.
- formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.
- contribute to a group endeavor by offering useful ideas, supporting the efforts of others, and focusing on the task.
- work safely and accurately with a variety of tools, machines, and materials.
- examine and select the resources necessary to manufacture a design that will successfully achieve its desired goal(s).
- sketch a design solution before production to ensure the integrity of the original design and truest representation as humanly possible.
- test and critique design solutions.
- find solutions through use of experimentation to solve technological problems.
- use symbols, measurements, and drawings to clearly communicate ideas.
- develop the criteria and constraints for a given design solution..
- test and evaluate designs in relation to pre-established requirements, such as criteria and constraints, and refine as needed.
- clearly describe and exemplify the benefits and challenges of a design.

Stage 2: Acceptable Evidence

Transfer Task

Students involved in the Future City Competition spend time creating cities that could exist at least 100 years in the future. Each city must incorporate a solution to a design challenge that changes each year. This year's challenge, The Age-Friendly City, asks students to identify an issue older people have and engineer two innovative solutions so they can remain active and independent. In January, students will present their cities before a panel of judges at Regional Competitions throughout the United States, Canada, China, and Egypt. Teams that win their regional competition (United States only) receive airfare and hotel accommodations for five members of their team to attend the Finals held in Washington, DC, in February.

Other Evidence of Learning

Project Plan Notebooks- Throughout instruction, students record observations, data, notes, and ideas. This information is used by students to form conclusions and support reasoning with evidence. The body of student work is reviewed by the teacher in order to assess both content and procedural knowledge. Notebooks will also be used to help students create a schedule and complete the project on time.
Performance Assessments- Students design, construct, and test solutions to various aspects of the challenge. Student work cooperatively to complete design activities and deliver presentations. Students are evaluated using performance and process rubrics.
Summative Assessments- Students complete pre/post content knowledge tests that consist of selected response items. Students also complete brief constructed response assignments that require a written response to a question or statement.

Stage 3: Activities to Foster Learning

Learning Activities

Week 1: What is a City?
In order to create cities of the future, students need to understand what a city is. What makes a city a city? What are its underpinnings? Who designs, builds, and maintains cities? Build students' background knowledge so they can approach the work more like professional engineers, with an informed perspective.

Week 2: Engineering and Design
Introduce students to the engineering design process. Build on what students already know about engineers and the different fields of engineering.

Week 3: Project Management

Week 4: Define
Students gather all of the pertinent information about the project. Students complete a Project Plan to help them plan and organize the project. They use it throughout the marking period.

Week 5: Plan
Students research solutions, decide on the unique attributes of their city, and provide a solution to this year's challenge: Identify an issue that senior citizens have and engineer two innovative solutions so they can remain active and independent.

Week 6: Plan
Students design a Virtual City using SimCity software and present their city's progress via a slideshow presentation.

Week 7: Do
Students finalize city essay and start building city model.

Week 8: Do
Students build a physical model of a section of their city using recycled materials. In addition to highlighting their city of the future, the City Model must also show the solution to this year's challenge and include at least one moving part.

Week 9: Review
Students create City Presentation and reflect on project.

Regional Competition: January 2018

Unit Title / Topic: Mechanisms & Machines	Unit Duration: 9 weeks (46 Days)

Stage 1: Desired Results

Established Goals:
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 object, tool, or process such that an optimal design can be achieved.

Transfer Goal:
Students will be able to <u>independently</u> use their learning to design solutions to real-world problems by applying a design process that includes defining a problem, generating ideas, selecting a solution, and using simple modeling tools or techniques to test and revise a design.

Students will understand:
- simple machines and how they provide mechanical advantage.
- systems thinking: how a whole is expressed in terms of its parts and how the parts relate to each other and to the whole.
- "the whole is only as good as the sum of its parts"- the quality of technology is often a result of the integrity of the system and the resources used in the process.

Essential Questions:
- How do machines help us live our lives?
- How does collaboration impact (affect) the design process?
- What is the relationship between math, science, and engineering?

Students will know:
- technology is often produced in teams because collective ideas have more options and variety.
- simple machines make work easier by multiplying, reducing or changing the direction of force.
- each part of a closed loop system is necessary to ensure that the technology performs its desired goal and/or function.
- a system is a set of related parts - together they form a whole designed to achieve a desired goal.
- technological systems include input, processes, output, and, at times, feedback.
- an input is something put into a system, such as resources, in order to achieve a goal
- a process is a systematic sequence of actions that combine resources to produce an output.
- an output is the result of the operation of any system.
- feedback is using all or a portion of the information from the output of a system to regulate or control the processes or inputs in order to modify the output.
- forces are pushes or pulls on objects.
- there are different kinds of forces, and each has unique properties.
- work is the product of force and distance.
- machines make doing work easier by reducing the effort force needed to do a given amount of work.
- the effort force to lift a load using a pulley system depends on the number of pulleys and how they are connected to the load.
- levers balance when the product of a weight and its distance from the fulcrum on one arm are equal to the product of another weight and its distance from the fulcrum on the other arm.
- mechanical advantage describes how much machines multiply effort force.
- unbalanced forces change the motion of objects.
- average speed is distance traveled divided by time of travel.
- friction can act against the motion of an object and decrease its speed.
- the Law of Conservation of Energy.
- kinetic energy is energy of motion.
- friction works to reduce the kinetic energy of moving objects.
- gravitational potential energy is energy associated with the position of an object.
- gravitational potential energy and kinetic energy can interchange forms as an object changes its height. Energy is conserved.
- the essence of problem solving is in the creative and carefully documented design of the best solution using the Engineering Design Process.
- engineers, architects, and others who engage in design and technology use scientific knowledge to solve practical problems, they also have to take human values and limitations into account as well.
- design usually requires taking constraints into account- some constraints are unavoidable, others limit choices.
- developing technology based on design solutions must be continuously monitored to ensure that the best outcomes are a result of its production.

Students will be able to:
- apply a design process that includes defining a problem, brainstorming a solution, generating ideas, identifying criteria, exploring possibilities, selecting an approach, making a model or prototype, testing and evaluating a design, and refining a design to solve a problem.
- formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.
- demonstrate how each part of a closed loop system is necessary to ensure that the technology performs its desired goal and/or function.
- contribute to a group endeavor by offering useful ideas, supporting the efforts of others, and focusing on the task.
- work safely and accurately with a variety of tools, machines, and materials.
- examine and select the resources necessary to manufacture a design that will successfully achieve its desired goal(s).
- categorize functions of a system according to the universal systems model (inputs, process, outputs, feedback).
- sketch a design solution before production to ensure the integrity of the original design and truest representation as humanly possible.
- test and critique design solutions.
- find solutions through use of experimentation to solve technological problems.
- use symbols, measurements, and drawings to clearly communicate ideas.
- develop the criteria and constraints for a given design solution..
- test and evaluate designs in relation to pre-established requirements, such as criteria and constraints, and refine as needed.
- clearly describe and exemplify the benefits and challenges of a design.

Stage 2: Acceptable Evidence

Transfer Task
Rube Goldberg Inc.Challenge- Students design, refine, and redesign a Rube Goldberg Machine that solve the Rube Goldberg Inc. Challenge. Students will demonstrate their understanding of content knowledge and science and engineering skills not only through the planning and construction process but also through a detailed analysis of their finished machine.

Cross-Curricular Connection - STC's Energy, Forces, and Motion Unit (Grade 6)

Other Evidence of Learning
<u>Engineering Journals</u>- Throughout instruction, students record observations, data, notes, and ideas. This information is used by students to form conclusions and support reasoning with evidence. The body of student work is reviewed by the teacher in order to assess both content and procedural knowledge.
<u>Performance Assessments</u>- Students design, construct, and test solutions to various technological challenges. Student work cooperatively to complete design activities and deliver presentations. Students are evaluated using performance and process rubrics.
<u>Summative Assessments</u>- Students complete pre/post content knowledge tests that consist of selected response items. Students also complete brief constructed response assignments that require a written response to a question or statement.

Stage 3: Activities to Foster Learning

Learning Activities

Week 1: Who is Rube Goldberg?
Students will explore key concepts and terminology related to Rube Goldberg and his devices.

Week 2: Energy, Forces, and Motion
Students will review their knowledge of Energy, Forces, and Motion and apply it to building their own Rube Goldberg Device.

Week 3: Simple Machines
Students investigate each of the six simple machines. How do they work? What function could they serve in their machine?

Week 4: Rube Goldberg Device Design
Students complete a project proposal that includes at least two diagrams and a materials list. Students may not begin construction until their proposal is approved.

Week 5: Rube Goldberg Device Construction
Students follow the steps of the engineering design process to construct their device.

Week 6: Device Construction
Students follow the steps of the engineering design process to construct their device.

Week 7: Device Testing
Students will conduct several test runs to ensure that their machine is reliable.

Week 8: Design Evaluation and Revisions
Students will determine how much force is needed to start the machine, how much force exits the machine, and describe the types of energy transferred in the device.

Week 9: Project Report
Students will share their completed reports & machine designs. All machines will be presented at H.B.W.'s Rube Goldberg Exhibit.