Verona Public School District
Curriculum Overview

8th Grade TED

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

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

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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:

This is a beginning course in robotics. Students will learn basic programming as well as problem solving strategies. Students will work through various design challenges that lead to the construction of several types of robots, including teleoperated, pre-programmed, and autonomous. In addition, the course will discuss topics heavily debated in the field.

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 **X** 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 **X** K. Information Technology L. Law, Public, Safety, Corrections & Security M. Manufacturing **X** N. Marketing 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.*
• https://www.vexrobotics.com/vexiq	• Various Teacher Constructed Materials

H.B. Whitehorne Grade 8 TED (Technology, Engineering, and Design)

Unit Title / Topic: Robotics	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:

- robotics play a major role in society (e.g. manufacturing, space exploration, and biomedical research).
- robot systems require troubleshooting and maintenance to ensure safe and proper function.
- engineering design is an interactive process with a defined cycle of steps.
- robots can be controlled in different ways.
- sensors allow robots to interact with the world.
- energy can be converted from one form to another.
- components of a robot can be changed to produce motion, speed, torque and acceleration.
- design and programming are processes that must consider all the systems within a robot and the required task.
- “there is no free lunch”- technology can result in positive and negative effects.

Essential Questions:

- How have developments in robotics affected careers and society? How is the field changing our modern life?
- What is the relationship between robot and human?
- Does robotics have an important place in our world?

Students will know:

- robotics is the specialized type of engineering that deals with the design, construction, operation, and application of robots.
- robots can be operated by remote control (known as teleoperated robots), automatically by themselves (known as autonomous robots), or a combination of teleoperated and autonomous operation (known as hybrid robots).
- a robot is any man-made machine that can perform work or other actions normally performed by humans.
- actuators are used to act upon an environment, usually for moving or controlling a mechanism or system.
- DC motors convert electrical energy into mechanical energy through the use of electromagnetic fields and rotating wire coils.
- When a voltage is applied to a motor, it outputs a fixed amount of mechanical power (usually to a shaft, gear, and/or wheel), spinning at some speed with some amount of torque.
- motor loading happens when there is any opposing force (such as friction or a heavy mass) acting as a load and requiring the motor to output torque to overcome it. If you keep increasing the load on a motor it eventually stops spinning or stalls.
- gear ratio expresses the relationship between a driving gear (the gear connected to the input power source, such as a motor) and a driven gear (the gear connected to the output, such as a wheel or mechanism) in a system.
- a simple gear train is a connected set of rotating gears that transmits power from an input.
- a drivetrain is the robotic subsystem that provides the ability to move.
- an object manipulator is a mechanism that allows a robot to interact with objects in its environment. There are three basic categories of object manipulators: plows, scoops, and friction grabbers.
- a degree of freedom refers to an object’s ability to move in a single independent direction of motion.
- a lifting mechanism is any mechanism designed to move to perform tasks and/or lift objects.
- a sensor is a device that detects and responds to some type of input from the physical environment.
- programming is the process of providing a computer or other machine, such as a robot and its components, with coded instructions for the automatic performance of a particular task.
- ultrasonic sound waves are sounds that are too high of a frequency to be heard by humans.
- a gyroscope (or gyro) is a sensor that can detect and measure rotation or turning of an object.
- degrees of turn describes how far an object, like a robot, has turned.
- an encoder senses mechanical motion and translates the information (velocity, position, acceleration) into useful data.
- control is defined as the ability to direct the actions or function of something.
- open-loop control systems are also called non-feedback control systems. This type of control system is generally more simplistic and easier to implement. It cannot correct for errors or disturbances along the way.
- systems that utilize feedback are called closed-loop control systems.

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.
- classify the different types of robots and and the variety of jobs they perform..
- design robots to perform specific tasks.
- construct computer-controlled robot models to demonstrate how computers control robots.
- utilize different types of robotic sensors and their applications.
- create a computer program to direct the robot to perform a specific task.
- explore career opportunities in the field of robotics.
- 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.
- organize and present research findings effectively.
- define requirements of a design as criteria and constraints.
- use ratios and proportions to represent quantitative relationships.
- model, test, evaluate, and modify ideas into practical solutions.
- analyze solutions in terms of common components, basic system design, safety, simple controls, and system performance.
- solve problems involving scale factors, using ratio and proportion.
- compare technological decisions about products or systems that have had both desirable and undesirable consequences.
- analyze the impacts that robotic technology has on humans, society, and the environment.

Stage 2: Acceptable Evidence

Transfer Task

High Rise Programming Challenge- (Possible Space Exploration Focus) - Students use the steps of the Engineering Design Process to design and build a challenge-ready autonomous robot.

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: What is a Robot?
Students will explore key concepts and terminology and how robotics relates to the world. Students will be introduced to the VEX IQ platform hardware, Controller, Robot Brain, and understand each item's function.

Week 2: Your First Robot
Students complete a documented robot build, following the Clawbot IQ instructions. Students will be able to build a functional VEX IQ robot, utilize the design process, and be able to troubleshoot and solve problems to improve their design.

Week 3: Simple Machines & Motion
Students review and recall simple machines, pendulums, and corresponding terminology (Grade 7). They then apply that knowledge through build and design activities.

Week 4: Key Concepts
Students learn about and apply knowledge of key concepts related to mechanical design (friction, center of gravity, speed, torque, power, and mechanical advantage).

Week 5: Mechanisms
Students learn about robotic mechanisms, their design, and the corresponding math and science concepts. Students build and test drivetrains, object manipulators, and/or lifting mechanisms according to activity specifications.

Week 6: Smart Machines
Students become familiar with VEX IQ Sensors and their default functionality. Students utilize the design process through various programming exercises.

Week 7: Chain Reaction Programming
Students use their knowledge of simple machines, sensors and programming to build and test autonomous Chain Reaction Devices.

Week 8: Smarter Machines
Students increase proficiency with VEX IQ Sensors and increase robot programming capabilities. Students complete various programming challenges.

Week 9: High Rise Programming Challenge
Using their knowledge of the VEX IQ platform and all they've learned in previous lessons, students design and build a challenge-ready autonomous robot.