Township of Ocean Schools

Assistant Superintendent
Office of Teaching and Learning

SPARTAN MISSION:
Meeting the needs of all students with a proud tradition of academic excellence.

DEPARTMENT Applied Technology COURSE Robotics and Automation (PLTW)

Curriculum Development Timeline

School: Township Of Ocean Intermediate School

Course: Robotics and Automation (former 8th grade Makerspace elective)

Department: Applied Technology

Board Approval	Supervisor	Notes
August 2023	Erin Leahy	July 2023

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Township of Ocean Pacing Guide	
Week	Marking Period 1
1	Classroom Expectations/Robotics Lab Safety/Benchmark
2	Activity 1.1 Welcome Interns!
3	Activity 1.2 On the Move
4	Activity 1.3 Rescue Mission
5	Activity 1.4 Robot Shuffle
6	Activity 1.5 Looping Shuffle
7	Activity 1.6 Time to Switch Gears
8	Activity 1.7 It Is Universal
9	Activity 1.8 Bevel Up
10	Project 1.9 Design Challenge
Week	Marking Period 2
11	Project 1.9 Design Challenge
12	Project 1.9 Design Challenge
13	Lesson 1 Interim Assessment
14	Activity 2.1 Makes Sense
15	Activity 2.2 Color Coded
16	Activity 2.3 Follow Me
17	Activity 2.4 End of the Line
18	Project 2.5 Helping Hand/Final Project
19	Project 2.5 Helping Hand/Final Project
20	Final Project Presentation/Unit 2 Assessment/Benchmark

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Core Instructional & Supplemental Materials including various levels of Texts
• PLTW.org individual student accounts • VEX robotics kits (2 students per group) • Google Classroom postings of supplemental materials • NewsELA articles w/ quizzes • Empowered Schools platform access (re: energy) • Guest speakers via videos: discoverE.org "Chats with Change Makers" • Access to STEM building tools and materials (outside the VEX kits)   ○ Hot glue guns, glue sticks, cardboard, scissors, utility knives, cutting mats, safety goggles, wooden dowels, screwdrivers, allen wrenches, power drills, clamps,wood glue, plastic cups, pipe cleaners, paper plates, scissors, glue, masking tape, shoeboxes, construction paper, popsicle sticks

Time Frame	PLTW R & A Unit 1: 12 weeks
Topic	
Automating Mechanisms: Students explore how gear trains and other mechanisms transfer movement in mechanical systems and design, build, and program automated systems to meet the needs of clients. In the end-of-lesson project, students can choose to design an interactive device to keep pets physically and mentally active, a spinning street sign to warn drivers to slow down and stop, or a high-speed dragster.	
Alignment to Standards	
• **5.ETS.8.1.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. • **8.2.8.ED.2.8.ED.2** Identify the steps in the design process that could be used to solve a problem. • **8.2.8.ED.2.8.ED.3** Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch) • **8.2.8.ED.2.8.ED.5** Explain the need for optimization in a design process. • **8.2.8.ED.2.8.ED.7** Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches). • **8.2.8.ETW.2.8.ETW.3** Analyze the design of a product that negatively impacts the environment or society and develop possible solutions to lessen its impact. • **8.2.8.ITH.2.8.ITH.3** Evaluate the impact of sustainability on the development of a	

designed product or system
- **8.2.8.NT.2.8.NT.3** Examine a system, consider how each part relates to other parts, and redesign it for another purpose.

Learning Objectives and Activities

From the first activity of Unit 1, students follow a build guide to build a simple gear train with VEX parts. Having students dive right into a simple build with VEX parts is intended to get students familiar with the different VEX parts, and get them actively building and figuring out different building tips, while also establishing a hands-on approach in the unit.

SWBAT answer the following questions:
Why are teams of people more successful than an individual when solving problems?
What does effective teamwork look like?
What does it take to effectively develop a solution to a problem or need?
How can failure produce positive outcomes?
What skills prepare you for diverse career opportunities?

SWBAT understand the following concepts:
- Computational thinking practices are critical for all students to learn and form the cornerstone of the language of innovation, and will drive all future STEM discoveries and careers.
- All machines utilize potential and kinetic energy to make them go.
- The lever, wheel and axle, pulley, inclined plane, wedge and screw help us to do work with less energy.
- Everyday machines use one or more of these simple machines to make a compound machine.
- Models can help us make sense of the natural world as we observe phenomena.

SWBAT understand the following concepts (Activity 1.1):

- Build guide to build a simple gear train with VEX parts.
- Build with VEX parts as intended to get students familiar with the different VEX parts
- Actively build and figure out different building tips, while also establishing a hands-on approach in the unit.

SWBAT understand the following concepts (Activity 1.2):

- Built a simple gear train with three gears driven by a hand crank.
- Modify the build from the previous activity and replace the hand crank with a motor.

Students have to connect the motor to the VEX Brain, and configure the motor in VEXcode. When they are done with the setup, students create their first program in VEXcode, to control the motor.

<u>SWBAT understand the following concepts (Activity 1.3):</u>

- Use the motorized gear train to build a four-wheeled vehicle called Res-Q-Bot. To complete the Res-Q-Bot build.
- To complete the Res-Q-Bot build, students will add a brain and battery to the chassis and use a variety of parts to develop their building skills using VEX parts.
- Run the program they created in Activity 1.2 to make the robot move autonomously.

<u>SWBAT understand the following concepts (Activity 1.4):</u>

- Repurpose their robots from Activity 1.3 Rescue Mission by adding a button and then using programming to make the robot do a shuffle.
- As students' programs get more complex, support them using tools and processes such as flowcharting, debugging or troubleshooting, iteration, and effective teamwork.

<u>SWBAT understand the following concepts (Activity 1.5):</u>

- Extend their programming knowledge to update their programs to include loops.
- As student interns design a thank-you robot shuffle for the client, the dance can also celebrate students' progress in building and programming a vehicle.

<u>SWBAT understand the following concepts (Activity 1.6):</u>

- Analyze the speed and torque of gear trains. This enables students to design effective solutions based on predicting the desired output of a gear train.
- Observe the rotation of gears as they start to quantify the relationship between the driving (input) and driven (output) gears in a gear train. The focus is on students' conceptualization of speed (and later in the activity of torque) rather than performing calculations out of context.

<u>SWBAT understand the following concepts (Activity 1.7):</u>

- Build a universal joint—which transmits rotational motion and torque at an angle, and see how this can help have mechanical advantage with gears.

SWBAT understand the following concepts (Activity 1.8):

- Create a bevel gear, a mechanism that transmits motion and torque at a fixed 90° angle and will follow a build guide to build a bevel gear assembly. The purpose of following a build guide for this assembly is so that students set up the bevel gears correctly so that they connect properly.

SWBAT understand the following concepts (Activity 1.9):

- Read the chart of Client Summary to choose to complete this project. Client Summaries are listed in order from most straight-forward to the most complex. The design requirements provide the basics—from that foundation, any of the projects can be made as challenging as desired.

Assessments

Formative:
- At the end of each activity/build, each student will use their group build, discuss the answers to the check-out reflection questions and then individually write the answers on paper or on a google doc.
- Students will also keep an interactive notebook to take notes and keep drawings of their ideas as they develop over time. This is also a space to document the steps of the design process and will be a resource to reference throughout the course.

Summative:
- At the end of the unit, groups will use the design process to create a prototype of a solution to help someone in need. This prototype will utilize the brain, sensors, motors and switches along with the created and debugged code to have their robot perform one or multiple helpful tasks.

Benchmark:
- At the beginning and end of the course, each student will take the pre and post test.

Alternative:
- As students work through learning how to build mechanical devices as well as code, there will be group and individual quizzes to check for understanding.

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Interdisciplinary Connections
RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. Students use an instruction manual for assembly, and guided tutorials within coding software. **RST.9-10.4.** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics. Students learn to use the Mindstorm programming software and become familiar with the purpose of different coding blocks and robotic sensors. **RST.9-10.5.** Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). Students design robots to maximize pushing force and friction needed to accomplish
Career Readiness, Life Literacies, and Key Skills
• **9.2.8.CAP.2.8.CAP.12** Assess personal strengths, talents, values, and interests to appropriate jobs and careers to maximize career potential. • **9.4.8.CI.4.8.CI.4** Explore the role of creativity and innovation in career pathways and industries. • **9.4.8.DC.4.8.DC.4** Explain how information shared digitally is public and can be searched, copied, and potentially seen by public audiences. • **9.4.8.IML.4.8.IML.4** Ask insightful questions to organize different types of data and create meaningful visualizations.
Technology Integration

● Students will use VEX Programming Software to collaborate and work towards solving authentic problems.
    • 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas
 	
● Students will use Google Classroom to collaborate, work towards solving authentic problems, or participate in an online classroom discussion.
    • 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem

Career Education

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- **CRP2**. Apply appropriate academic and technical skills
- **CRP4.** Communicate clearly and effectively and with reason
- **CRP6.** Demonstrate creativity and innovation
- **CRP8.** Utilize critical thinking to make sense of problems and persevere in solving them
- **CRP10.** Plan education and career paths aligned to personal goals
- **CRP11.** Use technology to enhance productivity
- **CRP12.** Work productively in teams while using cultural global competence

Time Frame	PLTW R & A Unit 2: 8 weeks

Topic

Sensors and Systems: Students investigate the versatility of an optical sensor as a programmed input device. Students extend their knowledge of mechanisms as they design increasingly complex prototypes to serve the needs of users. In the end-of-lesson project, students connect inputs to outputs through programming to create effective solutions that help their communities.

Alignment to Standards

- **5.ETS.8.1.MS.ETS1.2** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- **5.ETS.8.1.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.
- **5.ETS.8.1.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.
- **8.2.8.ED.2.8.ED.1** Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.

Learning Objectives and Activities

SWBAT answer the following questions:
- What is the purpose of modeling?
- How does algorithmic thinking help you solve complex problems?
- Why is understanding how parts connect as a system important?
- What are some positive and negative ways that automation has changed or is changing the way people work, live, and play?

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- Why is understanding the user perspective an important part of design?
- How do you express yourself and your creativity through engineering and computer science?
-

SWBAT understand the following concepts:

- Computational thinking practices are critical for all students to learn and form the cornerstone of the language of innovation, and will drive all future STEM discoveries and careers.
- All machines utilize potential and kinetic energy to make them go.
- The lever, wheel and axle, pulley, inclined plane, wedge and screw help us to do work with less energy.
- Everyday machines use one or more of these simple machines to make a compound machine.
- Models can help us make sense of the natural world as we observe phenomena.

SWBAT understand the following concepts (Activity 2.1):

- Create a program to spin the motor 90 degrees forwards and backward to simulate the opening and closing of the hospital door.
- Use the *spin Motor forward for 90 degrees* block and the s*pin Motor reverse for 90 degrees* block to achieve this goal. This functionality is possible because the VEX Smart Motors have a built-in encoder that allows users to control the motor's direction, speed, acceleration, position, and torque.
- Students continue to grow their programming skills using conditional statements. Conditional statements evaluate a yes/no condition, also called a Boolean condition, an expression that determines whether a condition is true or false. Help students understand that an *if-then* statement and a yes/no condition are the same thing. All Boolean blocks in VEXcode are hexagonal shaped. Therefore, the optical sensing blocks are all hexagonally shaped because they are Boolean blocks.

SWBAT understand the following concepts (Activity 2.2):

- Use conditional statements with the optical sensor receiving inputs and sending them to the brain. The focus of this activity is on programming without a mechanical build.
- Use a forever loop to continuously check a conditional statement.

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SWBAT understand the following concepts (Activity 2.3):

- Build a cam and follower that is driven by a motor. They will use what they learned in the previous activities to automate the system to move when the optical sensor senses that an object is detected.
- Review the Client Summary with students to make sure they understand the requirements.

SWBAT understand the following concepts (Activity 2.4):

- Build a new mechanism—a chain drive.
- Review the client summary with students to make sure they understand the design requirements.

SWBAT understand the following concepts (Activity 2.5):

- Use the chart provided to guide students about which Client Summary to choose for this project. The design requirements provide the basics—from that foundation, any of the projects can be made as challenging as desired.
- Complete the Decision Matrix to make a final design plan.
- Use a project grading rubric to self-check their work before final project submission.

Assessments

Formative:

- At the end of each activity/build, each student will use their group build, discuss the answers to the check-out reflection questions and then individually write the answers on paper or on a google doc.
- Students will also keep an interactive notebook to take notes and keep drawings of their ideas as they develop over time. This is also a space to document the steps of the design process and will be a resource to reference throughout the course.

Summative:

- At the end of the unit, groups will use the design process to create a prototype of a solution to help someone in need. This prototype will utilize the brain, sensors, motors and switches along with the created and debugged code to have their robot perform one or multiple helpful tasks.

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Benchmark:

- At the beginning and end of the course, each student will take the pre and post test.

Alternative:

- As students work through learning how to build mechanical devices as well as code, there will be group and individual quizzes to check for understanding.

Interdisciplinary Connections

RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. Students use an instruction manual for assembly, and guided tutorials within coding software.

RST.9-10.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics. Students learn to use the Mindstorm programming software and become familiar with the purpose of different coding blocks and robotic sensors.

RST.9-10.5. Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). Students design robots to maximize pushing force and friction needed to accomplish

Career Readiness, Life Literacies, and Key Skills

- **9.2.12.CAP.6:** Identify transferable skills in career choices and design alternative career plans based on those skills.
- **9.4.12.CI.1:** Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
- **9.4.12.CI.2:** Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
- **9.4.12.CI.3:** Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
- **9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
- **9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
- **9.4.12.TL.1:** Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specific task (e.g., W.11-12.6.)**.**

- **9.4.12.TL.3:** Analyze the effectiveness of the process and quality of collaborative environments.
- **9.4.12.TL.4:** Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).

Technology Integration

● Students will use VEX Robotics Programming Software to collaborate and work towards solving authentic problems.

- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas

● Students will use Google Classroom to collaborate, work towards solving authentic problems, or participate in an online classroom discussion.

- 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem

Career Education

- **CRP1.** Act as a responsible and contributing citizen and employee.
- **CRP2**. Apply appropriate academic and technical skills
- **CRP4.** Communicate clearly and effectively and with reason
- **CRP6.** Demonstrate creativity and innovation
- **CRP8.** Utilize critical thinking to make sense of problems and persevere in solving them
- **CRP10.** Plan education and career paths aligned to personal goals
- **CRP11.** Use technology to enhance productivity
- **CRP12.** Work productively in teams while using cultural global competence

Modifications (ELL, Special Education, At-Risk Students, Gifted & Talented, & 504 Plans)

ELL:

- Work toward longer passages as skills in English increase
- Use visuals
- Introduce key vocabulary before lesson
- Teacher models reading aloud daily
- Provide peer tutoring

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- Use of Bilingual Dictionary
- Guided notes and/or scaffold outline for written assignments
- Provide students with English Learner leveled readers.

Supports for Students With IEPs:
- Allow extra time to complete assignments or tests
- Guided notes and/or scaffold outline for written assignments
- Work in a small group
- Allow answers to be given orally or dictated
- Use large print books, Braille, or books on CD (digital text)
- Follow all IEP modifications

At-Risk Students:
- Guided notes and/or scaffold outline for written assignments
- Introduce key vocabulary before lesson
- Work in a small group
- Lesson taught again using a differentiated approach
- Allow answers to be given orally or dictated
- Use visuals / Anchor Charts
- Leveled texts according to ability

Gifted and Talented:
- Create an enhanced set of introductory activities (e.g. advance organizers, concept maps, concept puzzles)
- Provide options, alternatives and choices to differentiate and broaden the curriculum
- Organize and offer flexible small group learning activities
- Provide whole group enrichment explorations
- Teach cognitive and methodological skills
- Use center, stations, or contracts
- Organize integrated problem-solving simulations
- Propose interest-based extension activities
- Expose students to beyond level texts.

Supports for Students With 504 Plans:
- Follow all the 504 plan modifications
- Text to speech/audio recorded selections
- Amplification system as needed

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- Leveled texts according to ability
- Fine motor skill stations embedded in rotation as needed
- Modified or constrained spelling word lists
- Provide anchor charts with high frequency words and phonemic patterns