Township of Ocean Schools

Assistant Superintendent
Office of Teaching and Learning

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

Curriculum Development Timeline

School: Township of Ocean Intermediate School

Course: Design and Modeling, Grade 6

Department: Applied Technology

Board Approval	Supervisor	Notes
August 2019	Patrick O'Neill	Name Change/Revisions

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Pacing Guide	
Week	Marking Period 1
1	Introduction to Design Process Thinking-PLTW
2	Introduction to Design Process Thinking-PLTW
3	Introduction to Design Process Thinking-PLTW
4	Introduction to Design Process Thinking-PLTW
5	Introduction to Design Process Thinking-PLTW
6	Introduction to Design Process Thinking-PLTW
7	Introduction to Design Process Thinking-PLTW
8	Introduction to Robotics
9	Introduction to Robotics
10	Introduction to Robotics
Week	Marking Period 2
11	Introduction to Robotics
12	Introduction to Robotics
13	Introduction to Robotics
14	STEAM project (team or independent) on a self-selected topic related to the essential question
15	STEAM project (team or independent) on a self-selected topic related to the essential question
16	STEAM project (team or independent) on a self-selected topic related to the essential question
17	STEAM project (team or independent) on a self-selected topic related to the

	essential question
18	STEAM project (team or independent) on a self-selected topic related to the essential question
19	STEAM project (team or independent) on a self-selected topic related to the essential question
20	STEAM project (team or independent) on a self-selected topic related to the essential question

Core Instructional & Supplemental Materials including various levels of Texts
PLTW.org student login PLTW consumable supplies Endeavor STEM careers module login on everfi.com Class set of headsets LEGO EV3 kits Makey Makey kits Laptop cart with LEGO EV3 Mindstorms, LEGO WeDo, and SketchUp Pro 2017 software Class set of mice Merge Cubes 3D printers Snap Circuit kits 9V batteries, hobby motors, wires, wire cutter/strippers STEM supplies: hot glue guns, glue sticks, cardboard, utility knives, cutting mats, safety goggles, wooden dowels, hand saws, screwdrivers, power drills, screws, clamps, wood glue, plastic cups, pipe cleaners, paper plates, scissors, glue, masking tape, shoeboxes, construction paper, popsicle sticks Graham crackers box and crackers, icing, candies

Time Frame	**7 Weeks**
Topic	
Introduction to Design Process Thinking-PLTW	
Essential Questions	

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How is a design process used to effectively develop a design solution that solves a problem or addresses a design opportunity?

What role do team norms play in making a collaborative team more successful?

Why is accurate measurement, precise dimensioning, and thorough documentation necessary for both mechanical dissection and creative problem solving?

Why is it important for an engineer to be aware of the criteria and constraints when designing a product?

Enduring Understandings

Collaboration and communication are important for a multi-disciplinary team.

Sketches are used to document and communicate design ideas with accuracy.

Accurate measurement, precise dimensioning, and thorough documentation is necessary for both mechanical dissection and creative problem solving.

The design process is used to effectively develop a design solution that solves a problem or addresses a design opportunity.

An engineer must be aware of the criteria and constraints when designing a project.

Alignment to Standards

8.2.8.A.1 - Research a product that was designed for a specific demand and identify how the product has changed to meet new demands (i.e. telephone for communication - smart phone for mobility needs). (Foot and Ankle Orthosis)
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.A.5 - Describe how resources such as material, energy, information, time, tools, people, and capital contribute to a technological product or system.
8.2.8.B.2 - Identify the desired and undesired consequences from the use of a product or system.
8.2.8.B.4 - Research examples of how humans can devise technologies to reduce the negative consequences of other technologies and present your findings.
8.2.8.B.5 - Identify new technologies resulting from the demands, values, and interests of individuals, businesses, industries and societies.
8.2.8.B.7 - Analyze the historical impact of waste and demonstrate how a product is upcycled, reused or remanufactured into a new product.

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Learning Activities & Key Concepts and Skills

- Foot and Ankle Orthosis: Describe and/or analyze moments within a problem-solving process where persistence, iteration, and the positive role of failure played an important role in gaining understanding about a problem or unexpected observation.
- Puzzle Project: Collaborate and communicate effectively for specific purposes and settings on a diverse and multi-disciplinary team.
- Puzzle Project: Document a process according to professional standards.
- STEM Careers module on everfi.com: Describe the role, connections between disciplines, and impact of engineering, biomedical science, and computer science on society.
- Puzzle Project: Measure and present values appropriate to standards of accuracy and precision.
- Foot and Ankle Orthosis: Analyze and describe design functionality by observation of an artifact.

Assessments

Formative:
- Class and group discussions while working on projects
- Student self-reflection/journaling during the design process
- Peer feedback (P-Q-P) while working on projects

Summative:
- Criteria on each project Design Brief met
- Independent and group project rubrics

Benchmark:
- Pre-assessment performance based vs final project
- Pre-assessment vs summative content information test

Alternative:
- Self-reflection
- Contest entries
- Peer review

Career Education

CRP1. Act as a responsible and contributing citizen and employee. (establishing Team Norms)
CRP2. Apply appropriate academic and technical skills. (Puzzle Project)
CRP4. Communicate clearly and effectively and with reason. (all projects)
CRP5. Consider the environmental, social and economic impacts of decisions. (Foot and

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Ankle Orthosis)
CRP6. Demonstrate creativity and innovation. (all projects)
CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. (all projects)
CRP10. Plan education and career paths aligned to personal goals. (STEM careers on everfi.com)
CRP11. Use technology to enhance productivity. (Google Classroom, Screencastify)
CRP12. Work productively in teams while using cultural global competence.(all projects)

21st Century Skills

9.1.8.A.5 - Relate how the demand for certain skills determines an individual's earning power.
9.1.8.E.4 - Prioritize personal wants and needs when making purchases.

Interdisciplinary Connections

RST.6-8.3 Students will follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks during the foot and ankle orthosis.
RST.6-8.9. Students will compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic during the foot and ankle orthosis.
NJSLSA.W6. Students will use technology, including the Internet, to produce and publish writing and to interact and collaborate with others during the STEM career module.
NJSLSA.W7. Students will conduct short as well as more sustained research projects, utilizing and inquiry-because research process, based on focused questions, demonstrating an understanding of the subject under investigation through the unit in certain projects.
WHST.6-8.7. Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration with the PLTW projects.

Technology Integration

8.1 Educational Technology- All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaboratively and to create and communicate knowledge.

- See Alignment to Standards Section Above.
- Students will use internet based game sites such as Quizizz, Kahoot and Quizlet live to reflect on their learning progress.
- Students will use PLTW.org to further investigate lesson concepts and demonstrate

understanding of standards.

- Additional resources and extension activities will be posted on Google Classroom in order to encourage students to reflect on their learning and expand on their knowledge.

Time Frame	**6 weeks**

Topic
Introduction to Robotics

Essential Questions
How does electricity power things like computers, lights and robots? Can I build a robot to do things that I can control? How can students make one of their ideas using the LEGO® set, and can use other materials if needed to build their ideas, encourage them to break problems down into smaller parts? Do we have to come up with the whole solution from the start? Why do we use an iterative process to solve problems? Why do we use models to help our thinking become visible?

Enduring Understandings
Problem solving involves a community of learners, not an individual working alone. Productive talk is instrumental in a group's growth of ideas. Solving problems is a messy endeavor and takes multiple revisions. Modeling is a key part of making sense of your solution and can be used in the presentation of your ideas.

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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.

Students will consider problems analytically and use data to inform decisions through real and approachable educational robotics system of the EV3.

Robotic technologies are a part of our modern industrial society and future careers will rely on understanding how to use them.

Alignment to Standards

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.A.3 - Investigate a malfunction in any part of a system and identify its impacts.
8.2.8.B.1 - Evaluate the history and impact of sustainability on the development of a designed product or system over time and present results to peers.

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

Learning Activities & Key Concepts and Skills

#1 Programming is Precise:
If you want a robot to do something, you need to communicate that idea with mathematical and logical precision, or it won't quite be what you intended.
#2 Sensors, Programs and Actions:
Data from sensors gives a robot information about its environment. A program uses that data to make decisions, and the robot acts on those decisions. Data underlies the core of the entire process.

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#3 Make Sense of Systems:
To understand the way something works, construct a mental "model" of it in your head that captures the important features and rules of the system. This helps you make sense of it, and also give you a tool to "play out" similar or new scenarios in your head to predict what would happen.
#4 Break Down Problems and Build Up Solutions:
To solve a difficult problem, try breaking it down into smaller problems. Then, solve the smaller problems, building up towards a solution to the big problem.
#5 Computational Thinking Applies Everywhere
These skills-- mathematical and logical clarity, using data, systems thinking with mental models, and problem-solving --are not just for robotics. They are the key to solving many problems in the world.

Assessments

Formative:
- Self-quizzes embedded in the EV3 tutorials
- Note-taking of key ideas about software/hardware usage

Summative:
- Student Worksheet for each open-ended, themed challenge scenario is helpful for basic documentation of the activity. Students can also refer to it when presenting their work in front of the class or as a portfolio for performance evaluations or for student self-evaluation.
- Robot to complete the Obstacle Orchard Challenge or the Line Tracking Challenge

Benchmark:
- Pre-assessment performance based vs final project
- Pre-assessment vs summative content information test

Alternative:
- Group share/debriefing of progress so far in the challenge at the end of each class

Career Education

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.
CRP11. Use technology to enhance productivity.

21st Century Skills

9.1.8.A.5 - Relate how the demand for certain skills determines an individual's earning power.
9.1.8.E.4 - Prioritize personal wants and needs when making purchases.

Interdisciplinary Connections

NGSS
MS-ETS1-2: Students will evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of a problem during the Make Sense of systems lesson.
ELA:
RST.6-8.9. Students will compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text in theSensors, Programs and Actions lesson.
Math:
7.EE.3: Students will 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 with the programming or the robot.

Technology Integration

8.1 Educational Technology- All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaboratively and to create and communicate knowledge.

- See Alignment to Standards Section Above.
- Students will use internet based game sites such as Quizizz, Kahoot and Quizlet live to reflect on their learning progress.
- Students will use PLTW.org to further investigate lesson concepts and demonstrate understanding of standards.
- Additional resources and extension activities will be posted on Google Classroom in order to encourage students to reflect on their learning and expand on their knowledge.

Time Frame	**7 weeks**

Topic

STEAM project (team or independent) on a self-selected topic related to the essential question

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Essential Questions
What problem would you wish had a solution? How can we use technology to engineer solutions to environmental problems/challenges?
Enduring Understandings
Renewable resources are more sustainable way to produce energy. Due to nonpoint source pollution, ocean animals are impacted by plastic pollution. World population is estimated to rise to 9 billion people by 2050 and food and clean water supplies are limited. Growing a school garden could help us become more sustainable.
Alignment to Standards
Technology: 8.2.8.A.1 - Research a product that was designed for a specific demand and identify how the product has changed to meet new demands (i.e. telephone for communication - smart phone for mobility needs). 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.A.5 - Describe how resources such as material, energy, information, time, tools, people, and capital contribute to a technological product or system. 8.2.8.B.2 - Identify the desired and undesired consequences from the use of a product or system. Science: MS-ESS3A.1: Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. MS-ESS3C.1: Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. MS-ESS3C.2: Typically as human populations and per capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.
Learning Activities & Key Concepts and Skills

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Students will identify problems in our environment and brainstorm their causes. Based on one cause, students will research and design a model/way to address this issue. They will share their thoughts with other people to then evaluate and optimize a design. Once they have a solution, they will present their solutions through a presentation.

Design Process
Building and testing models
Evaluating and optimizing a design
Presenting solutions

Problem Solving
- Use a structured problem solving process to help address new problems
- View challenges as solvable problems
- Break down larger problems into smaller components

Persistence
- Expect and value mistakes as a natural and productive part of problem solving
- Continue working towards solutions in spite of setbacks
- Iterate and continue to improve partial solutions

Creativity
- Incorporate personal interests and ideas into activities and projects
- Experiment with new ideas and consider multiple possible approaches
- Extend or build upon the ideas and projects of others

Collaboration
- Work with others to develop solutions that incorporate all contributors
- Mediate disagreements and help teammates agree on a common solution
- Actively contribute to the success of group projects

Communication
- Structure work so that it can be easily understood by others
- Consider the perspective and background of your audience when presenting your work
- Provide and accept constructive feedback in order to improve your work

Assessments

Formative:
- Daily calendar with listed goals checked off/moved to the next day
- Summary notes in group folder of the documented design process

Summative:
- Group commercials with their STEAM Tank pitch recorded at Ocean View Studios shared during group presentations where they share the steps they engaged in the design process

Benchmark:
- Entry to the STEAM Tank competition

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Alternative:

- Group share without entry to the competition

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.
CRP5. Consider the environmental, social and economic impacts of decisions.
CRP6. Demonstrate creativity and innovation.
CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
CRP11. Use technology to enhance productivity.
CRP12. Work productively in teams while using cultural global competence.

21st Century Skills

9.1.8.A.5 - Relate how the demand for certain skills determines an individual's earning power.
9.1.8.E.4 - Prioritize personal wants and needs when making purchases.

Interdisciplinary Connections

ELA:
RST.6-8.1. -Students will cite specific textual evidence to support analysis of science and technical texts when presenting.
RST.6-8.3 -Students follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks during building and testing models.
RST.6-8.9. Students will compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic during the redesign process.
NJSLSA.W6. Students will use technology, including the Internet, to produce and publish writing and to interact and collaborate with others when submitting solutions idea for STEAM Tank contest.
WHST.6-8.7. Students will conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration during the STEAM Tank competition.

Technology Integration

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- See Alignment to Standards Section Above.
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- Additional resources and extension activities will be posted on Google Classroom in order to encourage students to reflect on their learning and expand on their knowledge.

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

ELL:

- Use visual aids
- Provide peer support
- Use of Google Translate
- Guided notes and/or scaffold outline for written assignments

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
- 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
- Leveled texts according to ability

Common Misconceptions

Engineers only build bridges.
Kids can design solutions to small and large problems.
Proper use of a ruler on graph paper and isometric paper to represent 3D objects
How to make a scale drawing
How to properly use utility knives and hot glue guns
How we can use software to make 3D objects using a 3D printer

In order for electricity to flow and provide power to things, there needs to be a closed circuit.
Programming is too challenging for middle school students.
Robotics cannot help solve many problems.
Communication is key in solving problems.
When solving a problem, you may have to go back to the first step and identify the problem.

As engineers, each group built a prototype of a new invention or innovation. That is all engineers need to worry about.
There is only one way to solve a problem.
Asking others for feedback through testing (and then analyzing data) is an important piece in making improvements/revisions to your prototype.
As an entrepreneur, you need to not only how and why your product is fantastic; you also need to be able to persuade and explain why people need your product.

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Teamwork is easy.
Meeting deadlines may involve extra time invested in the project, besides our class time.

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