Middle-level CTE Learning Experience Title: Marble Mini-Golf Design Challenge Educator: Matthew Lugo, Somers School District Length of Lesson: 10 days (40 minute periods) Grade Level: 7	CTE Area: Technology and Engineering Education CTE Theme: Sustainability CTE Content: The Designed World Date Created: September 9, 2019

PLANNING	
Curriculum Goal	Students develop a product for production that can be produced from recycled or sustainable materials. Students develop working drawings, a production plan, materials lists, and a list of required tools. The class forms a production line based on the production plan, focusing on how production waste can be reduced or eliminated. Students plan the lifecycle of the new product through manufacture, sale, use, and disposal. Consider products such as bird feeders, plant starting containers, puzzles, home aides, or organizational products.
Essential Question(s)	What knowledge and skills are necessary to evaluate the long-term effects of personal practices on the environment and to demonstrate an introductory understanding of how to use and conserve resources to meet human needs while minimizing harm to the environment? What do students need to understand how the designed world supports the development of systems and products by humans?
National Standards	Common Career Technical Core Standards www.careertech.org/career-ready-practices Career Ready Practices 1. Act as a responsible and contributing citizen and employee 2. Apply appropriate and academic and technical skills 5. Consider environmental, social, and economic impacts of decisions 6. Demonstrate creativity and innovation 8. Utilize critical thinking to make sense of problems and persevere in solving them 9. Model integrity, ethical leadership, and effective management 11. Use technology to enhance productivity 12. Work productively in teams while using cultural global competence International Technology and Engineering Education Association Standards for Technological Literacy www.iteea.org/39197.aspx The Designed World 16. Students will develop an understanding of and be able to select and use energy and power technologies. 19. Students will develop an understanding of and be able to select and use manufacturing technologies. 20. Students will develop an understanding of and be able to select and use construction technologies.

<table>
<tr><td>NYS Standards</td><td colspan="2">New York State Career Development and Occupational Studies (CDOS) Standards
http://www.p12.nysed.gov/cte/
Standard 1: Career Development
Students will be knowledgeable about the world of work, explore career options, and relate personal skills, aptitudes, and abilities to future career decisions.
Standard 2: Integrated Learning
Students will demonstrate how academic knowledge and skills are applied in the workplace and other settings.
Standard 3a: Universal Foundation Skills
Students will demonstrate mastery of the foundation skills and competencies essential for success in the workplace.</td></tr>
<tr><td>Learning Objectives</td><td colspan="2">Sustainability
1. Resources
Students will
a) Define "sustainability" as it applies to resource use.
b) Explain how sustainability can be a factor in decision making.
c) Define and give an example of renewable and non-renewable resources.
d) Explain factors to consider when evaluating the environmental implications of decisions.
e) Investigate practices that promote stewardship of environmental resources.
f) Research the personal, environmental, and financial costs and benefits of sustainability-conscious decisions to individuals, families, schools, workplaces, and communities.
g) Practice making decisions that show consideration for sustainability of resources in a variety of classroom applications.

Manufacturing Technologies
Students will
a) Describe or demonstrate how manufacturing processes convert natural or raw materials into products
b) Demonstrate manufacturing processes to design products, gather resources, use tools to separate, form or combine materials for a finished product.
c) Classify manufactured goods as either durable or non-durable.
d) Demonstrate manufacturing processes for product design, development, production.</td></tr>
<tr><td>Vocabulary</td><td>Academic
Sustainability, Recycling, Prototype, Data, Feedback</td><td>Content
Design process, Thumbnail sketch, Scale drawing, Additive manufacturing, Subtractive manufacturing</td></tr>
<tr><td>Materials and Resources</td><td colspan="2">What is Sustainability? Video (Day 1)
https://www.youtube.com/watch?v=gTamnlXbgqc
Learning experiences about recycling (Day 2)</td></tr>
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	How Plastic Recycling Actually Works https://www.youtube.com/watch?v=zO3jFKiqmHo What is Sustainability? | Mocomi Kids https://www.youtube.com/watch?v=gTamnlXbgqc Reduce, Reuse, and Recycle Tips for Kids https://www.reusethisbag.com/articles/reduce-reuse-and-recycle-tips-for-kids/ Plastic Recycling Facts and Figures https://www.thebalancesmb.com/plastic-recycling-facts-and-figures-2877886 Do the Benefits of Recycling Outweigh the Costs? https://www.thoughtco.com/benefits-of-recycling-outweigh-the-costs-1204141 Why Is Recycling So Important? https://www.earthsfriends.com/why-recycling-important/ Say No to Mindless Waste… http://www.theworldcounts.com/stories/Recycle-Facts-for-Kids Materials and Tools (Day 6 - 8) Scroll saw, drill, hand miter saw. 3D printer, CNC router, laser cutter, Cardboard, Fabric (for turf), Marbles, Plastic bottles, Plastic containers, Paper towel tubes, Glue, Tape		
INSTRUCTION	What will the teacher do?	What will the students do?	How much time for each activity?
Pre-assessment	Day 1 Have students write their own definition of the words sustainability and recycling.	Day 1 Students write their own definitions.	5min
Do-now/Hook	Day 1 (cont.) Give students recyclable products to examine (ex: plastic bottles, plastic containers, paper products, aluminum cans). Have students answer the following questions: What was this product used for? How could this product be reused (be creative)?	Day 1 (cont.) Students explore the products and answer the questions.	15min
Procedure for Instruction/ Learning Activities	Day 1 Show students What is Sustainability? Video: https://www.youtube.com/watch?v=gTamnlXbgqc	Day 1 Students watch a video and take notes. Students participate in class discussions.	20min

	Lead a class discussion about the importance of sustainability and recycling. Day 2 Explain to students that they have been hired as engineers by the Professional Golf Association to design and build a prototype of a mini-golf hole made from recyclable materials that will be built in the local community. Identify the design specifications: Be made using recycled materials, Have a base perimeter of 34" or less, Have borders surrounding the perimeter of the hole, Have at least one 3D printed part, Have a start and finish sign, Have a creative theme, Be safe for people to use. Provide guidance on recycled materials, showing different examples and learning experiences Day 3 Model effective internet research methods for students. Guide students to conduct research about existing mini-golf holes using the internet and generate a list of ideas for mini-golf holes. Guide students to research more information about recycling specifically in their community. Allow time for students to share some of their favorite findings.	Day 2 Students record design challenges in their Engineering Design Process Design Brief. Students record design specifications in their Engineering Design Process Design Brief. Day 3 Students conduct research of existing mini-golf holes using the internet. Students create a list of their favorite ideas, Students analyze the positive and negative attributes of these ideas, Students share their research findings with their classmates.	40min 40min

	Day 4 Explain to students that they are expected to brainstorm multiple ideas for what their mini-golf hole can look like. Encourage creative brainstorming. Model effective thumbnail sketching and labeling for students.	Day 4 Students create at least eight labeled sketches of possible mini-golf designs based on their research: Students share their designs with their classmates to gather feedback, Students choose one of their designs to build, Students present proof based on their research and peer feedback on why their choice is the best choice to move forward creating, Students may also choose to optimize their choice before presenting their proof.	40min
	Day 5 Model and show how to create an effective full scale product drawing of their mini-golf hole. Explain the logical construction plans in the drawing. Explain options of materials students can use for mini-gold hole. Encourage students to collect and bring in recycled materials from home to use. Require students to compile a list of materials they will use.	Day 5 Students create a full scale drawing of their prototype: This drawing contains a logical construction plan, this drawing will contain a material list. Students bring in recycled materials from home.	40min
	Day 6 - 8 Explain and demonstrate tool and machine safety. Emphasize class safety and wearing safety glasses at all time. Explain how to use tools that you want students to be using. Explain and demonstrate different mini-golf hole prototype construction methods for working with reused recyclable materials.	Day 6 - 8 Students create their prototype using appropriate tools, machines, and materials. Students will record the steps they take in the building of their prototype, Students will take time to reflect on their progress in order to make timely adjustments to their design. Students test their prototype with marbles.	40min x 3 days
	Day 9 Allow students to present their	Day 9 Students present their prototype and design	40min

	prototype to golfers from the local Golf Association. Assess students construction and mini-golf hole presentations. Day 10 (Closure) Teacher leads students in the evaluation of their projects based on design criteria (ex: function, form, sustainability) and record possible improvements they could make to innovate their design in the future. Teacher leads a class discussion where students explain their vision for how the creation of their hole will impact the community.	experience to the PGA and local community. Students participate in a class Mini-Golf Tournament, Students provide feedback to their classmates about possible product improvements. Day 10 Students evaluate their project based on design criteria (ex: function, form, sustainability) and record possible improvements they could make to innovate their design in the future. Students explain their vision for how the creation of their hole will impact the community.	40min 25min 15min
Differentiation	Students will be grouped by their abilities and interests. Teacher will provide scaffolded support where needed. Students who have physical disabilities will be accommodated for. Students who are meeting all of the expectations will be challenged to go above and beyond.		
Closure	Students evaluate their project based on design criteria (ex: function, form, sustainability) and record possible improvements they could make to innovate their design in the future. Students will explain their vision for how the creation of their hole will impact the community.		
ASSESSMENT			
College, Career, and Life Readiness Skills	See below Based on Middle-level Life/Career Rubrics available at https://nyctecenter.org/middle-level-life-career-rubric-database/rubrics		

Performance Measure	Exemplary	Proficient	Developing	Beginning
Allocates Resources to Meet Needs	Consistently plans in advance how much stock can and should be used to complete a project promptly (e.g., portioning meals, making a budget, having correct quantity and type of materials onsite).	Correctly figures how much stock can and should be used to complete a project promptly (e.g., portioning meals, making a budget, having correct quantity and type of materials onsite).	Often guesses how much stock should be used to complete a project (e.g., portioning meals, making a budget, having correct quantity and type of materials onsite).	Does not understand how much stock can and should be used to complete a project (e.g., portioning meals, making a budget, having correct quantity and type of materials onsite).
Contributes to Well-being of Community	Is a strong advocate for the community and always acts in a manner that benefits the community.	Understands the responsibility of the individual to the community and acts in a manner that benefits the community.	Usually considers the well-being of the community even if occasionally acts in self-interest.	Favors self-interest over the well-being of the community.
Demonstrates Understanding of the System and Environment Influencing the Organization	Consistently acknowledges the economic, political, and social relationships that impact multiple levels of an organization and uses this knowledge in interactions within the group (e.g., local, national, international).	Acknowledges the economic, political, and social relationships that impact multiple levels of an organization (e.g., local, national, international).	Acknowledges some social relationships that impact multiple levels of an organization.	Does not acknowledge social relationships that impact multiple levels of an organization.
Sees Consequences of Actions	Consistently considers the implications and consequences of actions.	Considers the implications and consequences of actions.	Occasionally acts in ways that fail to anticipate consequences.	Acts impulsively and fails to consider consequences of actions.