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

<table>
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<tr>
<th>PLANNING</th>
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<tr>
<td>Curriculum Goal</td>
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<td>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.</td>
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| 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. |
## NYS Standards

New York State Career Development and Occupational Studies (CDOS) Standards  

**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.

## Learning Objectives

### 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.

## Vocabulary

**Academic**  
Sustainability, Recycling, Prototype, Data, Feedback  

**Content**  
Design process, Thumbnail sketch, Scale drawing, Additive manufacturing, Subtractive manufacturing

## Materials and Resources

What is Sustainability? Video (Day 1)  
https://www.youtube.com/watch?v=gTamnIXbgqc  

Learning experiences about recycling (Day 2)
How Plastic Recycling Actually Works
[https://www.youtube.com/watch?v=zO3jFKiqmHo](https://www.youtube.com/watch?v=zO3jFKiqmHo)
What is Sustainability? | Mocomi Kids
[https://www.youtube.com/watch?v=gTamnlXbgqc](https://www.youtube.com/watch?v=gTamnlXbgqc)
Reduce, Reuse, and Recycle Tips for Kids
Plastic Recycling Facts and Figures
Do the Benefits of Recycling Outweigh the Costs?
Why Is Recycling So Important?
[https://www.earthsfriends.com/why-recycling-important/](https://www.earthsfriends.com/why-recycling-important/)
Say No to Mindless Waste…
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

<table>
<thead>
<tr>
<th>INSTRUCTION</th>
<th>What will the teacher do?</th>
<th>What will the students do?</th>
<th>How much time for each activity?</th>
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<tbody>
<tr>
<td>Pre-assessment</td>
<td>Day 1 Have students write their own definition of the words sustainability and recycling.</td>
<td>Day 1 Students write their own definitions.</td>
<td>5min</td>
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<td>Do-now/Hook</td>
<td>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)?</td>
<td>Day 1 (cont.) Students explore the products and answer the questions.</td>
<td>15min</td>
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<td>Procedure for Instruction/ Learning Activities</td>
<td>Day 1 Show students What is Sustainability? Video: <a href="https://www.youtube.com/watch?v=gTamnlXbgqc">https://www.youtube.com/watch?v=gTamnlXbgqc</a></td>
<td>Day 1 Students watch a video and take notes. Students participate in class discussions.</td>
<td>20min</td>
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<td>Day 1</td>
<td>Lead a class discussion about the importance of sustainability and recycling.</td>
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| 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. |
| 40min | |
| Day 2 | Students record design challenges in their Engineering Design Process Design Brief.  
Students record design specifications in their Engineering Design Process Design Brief. |
| 40min | |
| 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. |
<p>| 40min |</p>
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<tr>
<th>Day</th>
<th>Activity</th>
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<td>4</td>
<td>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.</td>
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<td>5</td>
<td>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-golf hole. Encourage students to collect and bring in recycled materials from home. Require students to compile a list of materials they will use.</td>
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<td>6-8</td>
<td>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.</td>
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<tr>
<td>9</td>
<td>Allow students to present their</td>
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<td>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.</td>
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<td>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.</td>
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<td>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.</td>
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<td>Day 9 Students present their prototype and design</td>
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<td><strong>Middle-level CTE</strong>&lt;br&gt;<strong>Learning Experience Template</strong>&lt;br&gt;<strong>March 2019</strong></td>
<td>prototype to golfers from the local Golf Association. Assess students construction and mini-golf hole presentations.</td>
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<td><strong>Differentiation</strong></td>
<td>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.</td>
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<td>Performance Measure</td>
<td>Exemplary</td>
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<td>Allocates Resources to Meet Needs</td>
<td>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).</td>
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<td>Contributes to Well-being of Community</td>
<td>Is a strong advocate for the community and always acts in a manner that benefits the community.</td>
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<td>Demonstrates Understanding of the System and Environment Influencing the Organization</td>
<td>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).</td>
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<td>Sees Consequences of Actions</td>
<td>Consistently considers the implications and consequences of actions.</td>
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