SMCOE Green Career Awareness Program

Product Innovation and Design Module

Module	Product Innovation and Design
Designed by	SMCOE and The Biomimicry Institute

Overview

Unit Storyline

This module is designed to pique students' interest in careers within the CA industry sector "Manufacturing and Product Design", and encourage them to enroll in the high school CTE Pathway called "Product Innovation and Design". During this instructional unit, students will explore innovative products that are either sustainable or support the circular economy. In addition, students will learn how to use Tinkercad, a free, online design tool, and how to utilize Design Thinking and the principles of biomimicry to design a new product that is environmentally sustainable.

Over the course of this module, students will focus and reflect on the UN Sustainable Development Goal #12 (Responsible Production and Consumption), with the hope that students will implement sustainable and socially-responsible practices at home, school, and as future members of the workforce. By learning about biomimicry, students will learn how to look toward nature for inspiration and ideas that will help them design a product that is more efficient, sustainable, and has proven its success as a result of the evolutionary process.

Essential Question	Enduring Understanding
How can we use nature to inspire students to design more innovative and environmentally-sustainable products?	By learning about the principles of biomimicry, students will be able to design products that are more efficient, innovative and environmentally sustainable.

Design Challenge

Apply biomimicry in addressing an issue related to climate change. Communicate your idea by making your model using Tinkercad, clay, or recycled materials.

Equipment, Instructional Resources, and Materials

incrEDIBLE Spoons (one per student)
Sugru (one per student)
Device (laptop or iPad)
www.tinkercad.com
See materials list (PI&D tab):
https://docs.google.com/spreadsheets/d/1CPAWWXoA_7QAuexJFlc2GN3bk7GM5WvrAAcNjKNrTWw/edit?usp=sharing

The Learning Sequence

Phase One: Fundamentals
Access Prior Knowledge and Build a Shared Foundation For Learning

Guiding Question:

Lesson #	The Learning Goal (Purpose, Outcome)	Teaching Strategy	The Learning Experience (description of activities and resources)
1	To learn the principles of product innovation and design by exploring products that are environmentally sustainable or support the circular economy.	Hands-on learning, Engineering	Students receive and observe an incrEDIBLE spoon, a product that exemplifies environmental sustainability, and Sugru, a product that supports the circular economy, to learn about innovation, design, and the values of the companies that manufacture them.

2	To learn about the tools and features of Tinkercad by modeling a ship.	Hands-on learning, Engineering, Making	Students learn how to use Tinkercad by repeating the procedural steps used to design a ship. This lesson is self-guided, as students will watch an instructional video and complete the tasks at their own pace.
3	To further explore using Tinkercad by modeling a household object.	Hands-on learning, Engineering, Making	Students continue to explore the features and tools of Tinkercad, and apply their knowledge to design either a pencil, wrench, or phone cradle.
4	To understand the principles of biomimicry, and how they could be used to innovate and design new products.	Hands-on learning, Engineering, Making	Students are introduced to the innovative practice of biomimicry. It is important that students understand that biomimicry is a practice where deep observation of nature provides inspiration for learning how nature designs. The goal is to have students begin to shift their lens from nature as an obstacle to designing solutions to nature as an elegant designer of all things, with 3.8 billion years of success. Biomimicry offers a sustainable way to design for our world.
5	To further explore Tinkercad by modeling an organism, while focusing on those features that confer evolutionary benefits.	Hands-on learning, Engineering, Making	Students explore the structures of a grasshopper, especially those features that help it survive. Students apply their Tinkercad knowledge and skills to model the design of a grasshopper, and their knowledge of biomimicry to ideate products based on the grasshopper's features.

Phase Two: Problem Cycle

Each Problem Cycle follows a general pattern: context, problem identification, and problem exploration

Problem: How can we use nature to inspire us to innovate and design products that are more environmentally sustainable and/or support the circular economy?

Lesson #	The Learning Goal (Purpose, Outcome)	Teaching Strategy	The Learning Experience (Detail Activity)
6	Introduction to empathy Interviews	Design thinking; Systems thinking	During this lesson students are introduced to a practice in design thinking and product innovation. It is important that students understand that design is a result of human needs

			and wants.
7	Using nature as a design partner	Design thinking; systems thinking	During this lesson, students will understand that design in the process of iterating on technologies. Students will identify some biological strategies and examples from nature that inspire design ideas.
8	Researching nature to identify inspirational organisms	Student-Directed research; Environmental justice	During this lesson, students will identify some biological strategies that organisms have and decide on a design champion to learn from as they create an object, system or process in response to a challenge.
9 and 10	The Design Challenge: Identifying and researching a problem	Solutionary Design Challenge	During this lesson, students will review the module, learn about the design challenge, research and define the problem, and begin to devise possible solutions.

Phase Three: Solution Identification and Implementation

Find Leverage Points, Plan Solutions, Anticipate Unintended Consequences, Implement Action and Advocacy

Guiding question:

Lesson #	The Learning Goal (Purpose, Outcome)	Teaching Strategy	The Learning Experience (Detail Activity)
11 - 13	Students work on challenge in Tinkercad and slide deck presentation	Modeling; High-performing teams	Students create (1) a model of their solution using Tinkercad, and (2) a presentation that summarizes the identified problem and the solution that uses biomimicry as a design strategy.
14	Presentations	Peer feedback	Student groups share their presentation with two other groups using a sharing protocol.

Phase Four: Reflection

Evaluate Impact, Reflect on Enduring Understanding, Celebrate Personal Growth

Guiding questions:

Lesson #	The Learning Goal (Purpose, Outcome)	Teaching Strategy	The Learning Experience (Detail Activity)
15	Reflections on Process	Environmental justice	