Product Design – A Candy Bar

Oakmont High School – International Baccalaureate Design Technology

Project description – Students will use the "Produce Design Model" to develop a delicious candy bar. Students will be given the design specifications for the candy bar, which will be used as criteria to evaluate the finished product.

Project Goal - to engage each student in all aspects of the product design cycle. Additionally, students will become more aware of career opportunities associated with each aspect of a products design, manufacturing, quality control, testing, marketing and distribution.

Academic Core Skills:

- Reading a metric scale
- Reading and following written and vocal directions
- Calculating volume and associated costs

Objectives/Competency:

California CTE Model Curriculum Standards 2013

Standards for Career Ready Practice

4. Apply technology to enhance productivity.
10. Demonstrate creativity and innovation.

Engineering and Architecture sector standard

6.0 Health and Safety
6.1 Locate, and adhere to, Material Safety Data Sheet (MSDS) instructions.
10.0 Technical Knowledge and Skills
10.3 Construct projects and products specific to the Engineering and Architecture sector requirements and expectations.

Engineering and Architecture Career Pathway Standards

Engineering Technology Pathway

B6.0 Employ the design process to solve analysis and design problems.
B6.1 Understand the steps in the design process.
B6.6 Construct a prototype from plans and test it.
B9.0 Understand the fundamentals of systems and market influences on products as they are developed and released to production.
B9.1 Understand the process of product development.
B10.0 Design and construct a culminating project effectively using engineering technology.
B10.1 Use methods and techniques for employing all engineering technology equipment appropriately.
B10.2 Apply conventional engineering technology processes and procedures accurately, appropriately, and safely.
B10.3 Apply the concepts of engineering technology to the tools, equipment, projects, and procedures of the Engineering Technology Pathway.

Engineering Design Pathway

B2.0 Demonstrate the sketching process used in concept development.

B2.1 Understand the process of producing proportional two- and three-dimensional sketches and designs.
B2.2 Apply sketching techniques to a variety of architectural and engineering models.
B2.3 Present conceptual ideas, analysis, and design concepts using freehand graphic communication techniques.
C2.0 Understand the effective use of engineering design equipment.
C2.1 Employ engineering design equipment using the appropriate methods and techniques.
C2.2 Apply conventional engineering design equipment procedures accurately, appropriately, and safely.
C2.3 Apply the concepts of engineering design to the tools, equipment, projects, and procedures of the Engineering Design Pathway.
C3.0 Understand the sketching process used in concept development.
C3.2 Produce proportional two- and three-dimensional sketches and designs.
C3.3 Present conceptual ideas, analysis, and design concepts using freehand, graphic, communication techniques.
C4.0 Understand measurement systems as they apply to engineering design.
C4.2 Understand the degree of accuracy necessary for engineering design.

Tools & Equipment needed:

- 3D modeling software (Solidworks)
- 3D printer (Dimension) or model making (prototyping) capacity
- Vacuum forming machine
- Shear – to cut HDPE
- Graphic software for making the label (Microsoft Word)
- Hot glue gun or spray adhesive for wrappers
- Stove top – camp stove

Materials needed:

- 30 mil HPDE (high density polyethylene)– TAP Plastic
- 2 part Silicone – Smooth Sil 940
- Chocolate – Wilton Melting Chocolate
- Thin aluminum foil – Michael's Craft Store
- Contact cement or rubber cement – Michael's Craft Store, Home Improvement Store

Student Skills Prerequisites: none. Would be nice if student had used 3D modeling software before but not required.

Procedure:

1. Present the idea of a "Product Design Cycle"
2. Introduce the candy bar as the "product"
3. Have the students sketch up 3 - 4 candy bar shapes.
4. Introduce the candy bar specifications:
    a. Rectangular shape – 3.5 cm x 6 cm maximum size
    b. Circular – 6 cm dia.
    c. Maximum thickness – 9 mm (which included any raised letters or objects)
    d. Letters or objects – maximum height/depth 2 mm
    e. Fillets and rounds minimum Radius of1 mm
    f. Draft angle - 5 degrees

g. There have been experiments with a variety of shapes and sizes. The listed specifications work well for the consumables in this project.

5. Students with the instructor's guidance select one of the sketched candy bar designs to develop into a finished product.
6. Student re-sketches the agreed upon design and includes the necessary draft angles, fillets and rounds.
7. Student draws the candy bar with 3D modeling software.
8. If using a 3D printer (Dimension or Z-Corp) save the 3D model as a .STL file.
9. Load the .STL file into the 3D printer queue and produce the prototype.
10. Provide students with information on "Food Safe" materials and proper sanitation. Also, the MSDSdata sheet for HDPE
11. Vacuum Forming: If producing the candy bar mold with a Vacuum Forming machine; place the finished candy bar prototype on the vacuum former table. Heat the 30 mil HDPE material so it is pliable. Raise the vacuum former table into the pliable plastic, turn on the vacuum. Watch for undesirable webbing at the corners and internal cavities of the part. Also, be cautious of wall thickness of the HDPE on deep drawn parts.
10. Casting: if creating a casting mold for the candy bar: prepare a containment box for the 'Food Safe' silicone to be poured into. Manufacturer suggests a minimum of ½ inch around the part in all directions. Secure the part to the base of the containment device. Consider using hot glue, pressing the part into the hot glue and trimming the excess glue from around the part. The silicone will seep under the part, necessitating trimming after the silicone mold has cured. Follow the manufacturer mixing, pouring and cure time instructions. Suggest using a small stiff brush (stearate brush) to apply mixed silicone around the prototype to minimize trapped air bubbles.
11. After the molding process, carefully remove the prototype from the mold (HPDE or silicone).
12. Follow the manufacturer's direction to cleanse and/or cure the mold after it has cooled or hardened. Through cleaning with dish soap and warm water for the HDPE. Several hours in a heated oven (medium range) for the Silicone.
13. Prepare to melt and pour the chocolate into the molds. Sanitation and cleanliness need to be stressed. If available, follow the chocolate manufacturer's directions for heating the chocolate. We use a double boiler. Experiment with adding nuts and other appropriate ingredients.
14. Pour the desired amount of melted chocolate into the mold cavity.
15. While the chocolate is still molten, lightly bang the mold against a hard surface (desk, countertop) until the trapped bubbles stop surfacing.
16. Let the chocolate cool before removing the candy bars from the mold.
17. Wrap the candy bar in the thin aluminum foil.
18. Have the students design a wrapper for the candy bar. We used Microsoft word. See attached template used.
19. Produce the wrapper with adhering tabs, and then cut the wrapper to the finished size.
20. Apply glue to the tabs, and then glue the wrapper in place.
21. Evaluate the finished project against the produce specifications. Please send all rejects to the Product Consumption Lab at Oakmont High School.
22. We conducted a cost analysis of the finished candy bar. We assigned a cost value to the volume of chocolate used per bar, calculated the cost of the casting mold, the prototype and packaging. We found the cost to produce a single candy bar and the cost to produce a thousand candy bars. Whoa!!

Sources of supplies:

- **Vacuum Forming Machine - Delvies Plastics Inc.** *133 West Haven Ave Salt Lake City, UT 84115 (800) 533-5843 Fax (801) 467-1540*
- **HDPE - TAP Plastics** *4538 Auburn Blvd. Sacramento, CA 95841 916.481.7584 Fax: 916.481.3036*
- **Solidworks software, training and support - Paton Group -** *7470 N Figueroa St, 103, Eagle Rock, CA 90041 800.826.0570 fax 323.258.8945*
- **Silicone - Smooth-On Inc. -** *2000 Saint John Street, Easton, Pennsylvania 18042 (800) 762-0744*
- **3D Dimension printer - Paton Group -** *7470 N Figueroa St, 103, Eagle Rock, CA 90041 800.826.0570 fax 323.258.8945*

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