LESSON GUIDE

Golf Putter

Level	Advanced
Academic Connections	Engineering, Design Thinking, Presentation and Communication, Prototyping, Design for Manufacturability, Hands-On Learning
Core Concepts	Engineering Design, Engineering Analysis, Design, Design Optimization, Print Optimization, Assembly, Computer Aided Design (CAD)
Duration	8-12 weeks

In this lesson, students will design a golf putter that adheres to U.S. Golf Association (USGA) specifications. They will explore moment of inertia (MOI) and how it affects a putter's action when striking the ball. They will use the swing weight scale and the putter's length to determine the approximate head weights needed for the design. The design will need a solution to meet varying head weight requirements. The final result should be a full size playable design which meets USGA specifications and will be tested in a putt-off competition by students, staff, and faculty. For this project we will be using the 3D printer to model the final putter head and create an appearance model to present to the customer. We will also be using the 3D printed model as our pattern for casting. Students will work in teams of two.

LEARNING OBJECTIVES

By the end of this workshop, the student will be able to:

- Design a putter to USGA specifications.
- Apply market research and design thinking to understand the MOI and how it influences putter design.
- Prepare detailed drawings for part production.
- Communicate design intent and design improvement over existing putters.
- Participate in a putt-off competition with students, staff, and faculty.

Side note: a fundraiser event can be planned as well.

ESSENTIAL QUESTIONS

Use these questions to guide students understanding:

- How did MOI influence your design?
- What happens if the moment is too high? What would cause this?
- Why is market research important?
- Why are detailed design drawings necessary for manufacturing?

ASSIGNMENTS

Lecture: Moment of Inertia and how it applies / functions

Homework: Initial design research of putters, golf industry and market information, examples of putter designs, USGA rules and standards

Class work and homework: Design critique of original sketches and ideas, ideation thumbnails, orthographic views, shaded 2 point perspectives

Lab: SolidWorks model and prints, 3D models from printer

Class/Lab: Presentation and putt-off

For information about moment of inertia and how it relates to club-head playability, see the website of Ralph Maltby, one of the world's premier golf equipment experts.

http://www.ralphmaltby.com/

MILESTONE DEADLINES

Initial Research, Design Critique, Sketches – TBD

Initial Model – Next day, or next class session

SolidWorks Model and Prints – 2 weeks later

Final Presentation/Putt-Off – TBD (depending on foundry availability)

ASSESSMENT

NAME: _____

	VALUE	SCORE	CRITERION
Initial Research Presentation	15		Moment of Inertia, golf industry and market information, examples of putters USGA rules and standards
Design critique of original sketches and ideas	25		4 Ideation thumbnails 1 orthographic view (shaded) 1 two point perspective (shaded)
SolidWorks model and prints	25		Thoughtful design Production quality prints Casting and Machined Drawings Assembly Drawing
Final Presentation and Putt Off	25		Good rationale of design and how it works 3D model of putter design Golf Hole Constructed with care
Professionalism	10		Handed in on due date Followed Directions Worked Well with Group
Score	100		

GROUP MEMBER PERFORMANCE:

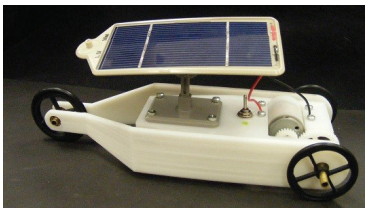
NAME:	RATING: (1=POOR.....5=EXCELLENT)	COMMENTS:
_____	1 2 3 4 5	_____
_____	1 2 3 4 5	_____

GOLF PUTTER

SUGGESTED NEXT LESSONS

SOLAR CAR

Design, 3D print and assemble a working solar car. When developing the design consider aerodynamics, rolling resistance, torque, the gear ratio, bearings and the wheel base.



WEIGHT SUPPORT CHALLENGE

In this challenge, the goal will be to build a structure that can support a weight that is suspended above a surface.

ROCKET

Covers all topics necessary to pass the Certified SolidWorks Associate (CSWA) exam while designing and 3D printing a rocket. Although the SolidWorks rubric is discussed here and the course is designed to prepare students for the CSWA exam, the lesson can accommodate a range of 3D CAD packages.

To access additional 3D Learning Content and resources visit:

http://www.stratasys.com/3DLC

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