

Algaculture and Biofuel Design Challenge

Objectives:

Students will understand how to use the Engineering Design Process to create a solution to a contemporary problem involving algaculture.

Description:

Easy-to-access fossil fuel reserves are becoming more and more scarce, and although new extraction technologies are being developed to access large, but harder-to-reach reserves, these technologies are expensive and time consuming. Further compounding the problem, geopolitical tensions and conflict in oil-rich regions threatens the supply of imported crude oil, which has caused fuel prices to increase. This has caused transportation prices for food and other goods to increase as well, impacting virtually all sectors of the economy. Several companies and research organizations have formed to fill the market need for cheap, sustainably derived fuels, including solutions such as biodiesel. Current research has suggested that algae can be used to produce the lipid compounds necessary to make biodiesel, but until now there has been a lack of financial incentive to pursue these technologies to production. However, as fossil fuel prices increase, the financial incentive for biofuel production will also increase.

Your Role:

You are a biological engineer, and you have been hired by a small company specializing in biofuel research and production. Your team has been hired to develop a growing environment for lipid-producing microalgae.

Your Solution:

You will work with a team of 2-3 other students to develop a solution meeting the following design criteria and constraints:

1. Be self-contained (water and nutrients may be added)
2. Fit within a 36"x24"x12" space
3. Be constructed entirely from recycled, repurposed, and/or sustainably produced materials
4. Cost \$10 or less
5. Successfully produce at least 1 gram of uncontaminated algae (dry) in a 2 week period, starting from a 1 mL sample culture.

Design Process

You will also be required to document the design process you follow by keeping a design notebook. The design notebook will include a log of your daily activities, any pertinent drawings and diagrams, written explanations of all activities, drawings/diagrams, etc. It is expected that your design notebook will be a high-quality work that is legible and organized.

For more detailed information on assignment criteria and standards, see the attached rubrics.

Design Challenge Rubric

	Meets Standard 3 points	Partially Meets Standard 2 points	Does Not Meet Standard 1 point	No Attempt 0 points	Student Self-Evaluation	Instructor Evaluation
Self-Contained	System requires no outside inputs except to replenish water and/or nutrients	System requires one outside input other than water and nutrients	System requires multiple outside inputs	System inputs must be constantly managed		
Space requirements	System fits within all three required dimensions	System exceeds dimensions in one direction by less than 2 inches	System exceeds dimensions in two directions by less than 2 inches	System exceeds all dimensions, or exceeds any dimension by more than 2 inches		
Materials	Constructed entirely of recycled or sustainably produced materials	Constructed of at least 75% recycled or sustainably produced materials	Constructed of less than 75% recycled or sustainably produced materials	Not constructed of recycled or sustainably produced materials		
Cost	Under \$10	Under \$11	Under \$12	More than \$12 (materials exceeding \$12 will not be purchased)		
Production	Produces at least 1 gram of dry algae	Produces at least .5g of dry algae	Produces less than .5g dry algae	No measurable quantity of algae is produced		
				Total:	/15	/15

Design Notebook Rubric

	Meets Standard 3 points	Partially Meets Standard 2 points	Does Not Meet Standard 1 point	No Attempt 0 points	Student Self-Evaluation	Instructor Evaluation
Daily Log	Notebook includes a daily log of all activities, with date	Missing 1 day	Missing more than 1 day	No daily log		
Drawings and Diagrams	Notebook includes detailed drawings and diagrams showing design progression	Notebook includes some drawings showing progression of design but are not detailed	Notebook includes few drawings and does not show progression of the design	No drawings or diagrams included		
Written Detail	Written material is detailed and shows the progression of thought	Written material is present, but lacking in some important details or missing links	Written materials are missing significant chunks, and lack detail	No written material is included		
Quality	Notebook is legible and organized throughout	Notebook is mostly legible and organized	Significant portions are not legible or disorganized	Most of the notebook is illegible and lacks any organization		
				Total:	/15	/15