



Metabolism Engineering Internship:

Health Bars for Disaster Relief

Copymaster Compilation



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Table of Contents

Day 2 Researching Ingredients Family After-Hours Experience: Exploring Metabolism

Day 4

Ingredients Analysis Project Summary

Day 5 RecipeTest Data RecipeTest Design

Day 6 Design Feedback Summary Trade-offs Reflection

Day 7

Proposal Rubric Proposal Outline

Day 8 Final Proposal Outlines to Paragraphs

Day 10 The Solutions Sequence

Researching Ingredients

Name: _____ Date: _____

- 1. Choose a food from the Ingredients Table in Dossier Chapter 3. Each member of your design team should choose a different ingredient.
- 2. Use the information in Chapters 2 and 3 in the Dossier and the diagram below to gather information about your ingredient.
- 3. Complete questions in Part 1.
- 4. Share information about your ingredient with the other members of your group.
- Discuss and complete the questions in Part 2 with your group members. 5.

Part 1

Record the following information about your ingredient:

- Carbohydrate content: _____ •
- Protein content: _____
- Glycemic index: _____



Researching Ingredients (continued)

Name: _____ Date: _____

What happens in your body after you eat the ingredient you investigated?

What important molecules does your ingredient provide to your cells? Why do your cells need those molecules?

Part 2

Choose an ingredient that one of your group members researched. What happens in your body after you eat that ingredient? How is it similar to or different than the ingredient you researched?

Look back at the Ingredients Table in the Dossier. If you could only eat one food on the ingredient list all day for one week, which one would you choose and why?

Family After-Hours Experience: Exploring Metabolism

Name: Date:

Work with a member of your household to find examples of foods in your home that meet differing metabolic needs of your family, like growth and repair and short-term and long-term energy needs.

- You may work with more than one member of your household.
- You might need to explain a little about metabolism in order for the member of your household to be able to work with you.
- Let them know that you have been investigating how different ingredients help people meet different metabolic needs. Share why is it important to consider an ingredient's protein and carbohydrate content and glycemic index when thinking about metabolic needs.

Describe one food you found that would be good for growth and repair, one for short-term energy, and one for long-term energy needs.



Ingredients Analysis

Name	Date
	Dute.

- 1. In your group, decide which four ingredients each pair of students will test. Circle each ingredient that you and your partner are responsible for investigating.
- 2. In your pair, decide which partner will test for Rescue Workers and which partner will test for Patients.
- 3. Test 1 ingredient at a time by selecting 100 grams of the same ingredient and click SEND TO LAB.
- 4. Compare the results with your partner to see how the target populations are similar or different.
- 5. In the table below, record notes on the results for each criterion for both target populations.
- 6. Share your findings with your group members, and answer the questions that follow.

Туре	Metabolic Needs Patients	Metabolic Needs Rescue Workers	Taste Score	Cost per Bar
Raisins	Notes on Growth & Repair and Energy needs:	Notes on Growth & Repair and Energy needs:		
	Notes on Patients vs. Rescue Workers:			
Pumpkin Seeds	Notes on Growth & Repair and Energy needs:	Notes on Growth & Repair and Energy needs:		
	Notes on Patients vs. Rescue Workers:	I		
Nonfat Milk Powder	Notes on Growth & Repair and Energy needs:	Notes on Growth & Repair and Energy needs:		
	Notes on Patients vs. Rescue Workers:			
Puffed Wheat	Notes on Growth & Repair and Energy needs:	Notes on Growth & Repair and Energy needs:		
	Notes on Patients vs. Rescue Workers:	1		

Туре	Metabolic Needs Patients	Metabolic Needs Rescue Workers	Taste Score	Cost per Bar
Puffed Rice	Notes on Growth & Repair and Energy needs:	Notes on Growth & Repair and Energy needs:		
	Notes on Patients vs. Rescue Workers:			
Soy Beans	Notes on Growth & Repair and Energy needs:	Notes on Growth & Repair and Energy needs:		
	Notes on Patients vs. Rescue Workers:			
Nutritional Yeast	Notes on Growth & Repair and Energy needs:	Notes on Growth & Repair and Energy needs:		
	Notes on Patients vs. Rescue Workers:			
Chocolate Chips	Notes on Growth & Repair and Energy needs:	Notes on Growth & Repair and Energy needs:		
	Notes on Patients vs. Rescue Workers:			

Туре	Metabolic Needs Patients	Metabolic Needs Rescue Workers	Taste Score	Cost per Bar
Prunes	Notes on Growth & Repair and Energy needs:	Notes on Growth & Repair and Energy needs:		
	Notes on Patients vs. Rescue Workers:			

Ingredients Analysis (continued)

Name: _____ Date: _____

Based on your research:

1. Which ingredients do you think will make the best tasting bar? Why?

2. Which ingredients do you think would produce the best bar for meeting growth and repair needs? Why?

3. Which ingredients do you think would produce the best bar for getting an immediate burst of energy? Why?

4. Which ingredients do you think would produce the best bar for storing energy to use later?

5. Which ingredients do you think will be best for keeping the cost of the bar low?

Project Summary

Name: Date:

Defining the Problem: Summarize your understanding of the project by answering the following questions. You may wish to review the Dossier to help you respond to the questions.

1. What is the engineering problem you are trying to solve?

2. Describe the first criterion: meet the metabolic needs of the target population. Why is it important?

3. Describe the second criterion: have a high taste score. Why is it important?

4. Describe the third criterion: keep costs low. Why is it important?

5. Based on your research so far, which criterion do you think is most important for a successful health bar design? Why?

RecipeTest Data	Design Team	Date	_ FUTURA
-	Target Population Patients	Rescue Workers	Ţ.
VERSION PLAN		VERSION PLAN	
BUILD Design Details		BUILD Design Details	
Raisins (g)	PumpkinNonfat MilkSeeds (g)Powder (g)	Raisins (g) Pump Seeds	kin Nonfat Milk (g) Powder (g)
Puffed Wheat (g)	Puffed Rice (g) Soybeans (g)	Puffed Wheat (g)	Rice (g) Soybeans (g)
Nutritional Yeast (g)	Dark Chocolate Chips (g)	Nutritional Dark (Yeast (g) Chips	Chocolate [g]
% Protein	% Carbohydrates Glycemic Index	% Protein % Car	bohydrates Glycemic Index
TEST Test Results	Test User 2 Test User 3 Test User 4	TEST Test Results	Jser 2 Test User 3 Test User 4
% of Growth and Repair Needs Met		% of Growth and Repair Needs Met	
% of Energy Needs Met After 15 Minutes		% of Energy Needs Met After 15 Minutes	
% of Energy Needs Met After 60 Minutes		% of Energy Needs Met After 60 Minutes	
TasteCost perScoreBar (\$)	People Served	TasteCost perScoreBar (\$)	People Served
ANALYZE		ANALYZE	

RecipeTest Design

Name: _____

Date:

Target Population: Patients / Rescue Workers (circle one)

Record your strongest recipe and testing data here. Then you will submit your strongest recipe in the RecipeTest Design form in Futura Workspace in order to receive feedback from the project director. **Note:** Only one partner needs to submit a form for feedback.

Version: _____



Design Feedback Summary

Name			Date		
Submitted Version	Protein Content (Criterion: Meet metabolic needs)	Carbohydrate Content (Criterion: Meet metabolic needs)	Glycemic Index (Criterion: Meet metabolic needs)	Criterion: Taste Score	Criterion: Cost per Bar
Design details					
Feedback from proj- ect direc- tor					
Goal for meeting criterion					
Redesign strategy					



Trade-offs Reflection

Name: _____ Date: _____

A trade-off happens in a situation where a design has good results for one criterion but not for another. Look at the results for your optimal FuturaBar design. Describe some of the trade-offs you noticed while designing your FuturaBar.

- 1. Which criterion did you prioritize?
 - metabolic needs of target populations met
 - ☐ high taste score
 - 🗌 keep cost low per bar
- 2. Why did you prioritize this criterion?

3. When you prioritized this criterion, what were some of the trade-offs? Describe what happened to the results of the other two criteria.

Proposal Rubric

	Needs Improvement	Developing	Proficient	Excels
Introduction	Introduction is incomplete; missing one or more criteria and no mention of the proposed design	Lists the criteria of the project but does not describe them; mentions the proposed design by listing the results or details but not both	Summarizes the design request and describes most criteria; describes the proposed design by listing the results or details but not both	Thoroughly summarizes the design request and describes the proposed design by listing the variables or details and the final results
Design Decisions (same for each criterion)	No evidence is provided to support the design decision; explanation is inadequate or missing	Uses minimal evidence to support the design decision and does not explain why the specific feature was selected over other options and/or how that feature of the design relates to the criterion	Uses some evidence to support design decision, mostly explaining why the specific feature was selected over other options and how that feature of the design relates to the criterion	Uses multiple pieces of strong evidence to support design decision, thoroughly explaining why the specific feature was selected over other options and how that feature of the design relates to the criterion
Conclusion: Considering Trade-offs	Two or more of the following need attention: design priorities, summary of trade- offs in the optimal design, or a closing statement	One of the following needs attention: design priorities, summary of trade-offs in the optimal design, or a closing statement	Includes all of the following, but may lack detail: design priorities, summary of trade- offs in the optimal design, and a closing statement	Description of design priorities is clear; summary of trade-offs in the optimal design is detailed and thorough; includes a strong closing statement
Scientific Communication	Lacks topic-specific vocabulary; uses informal style or language	Attempts to use topic-specific vocabulary and formal writing style, but needs improvement	Uses some topic-specific vocabulary; uses formal writing style somewhat successfully	Uses topic-specific vocabulary clearly and appropriately; uses formal writing style successfully

Proposal Outline



Name

Date ____

Glycemic Index

INSTRUCTIONS

For this outline, list the pieces of evidence from your iterative testing, Ingredients Analysis, Design Feedback Summary, and Dossier research that support your optimal design.

OPTIMAL DESIGN

% Carbohydrates

DESIGN DECISIONS

% Protein

For each criterion, list the pieces of evidence from your data analysis and background research that support your optimal design.

Metabolic Needs

Nutrient Details:

DATA ANALYSIS	
Nutrient Details: Protein Content(%)	Design goal:
Nutrient Details: Carbohydrate Content(%)	Design goal:
Nutrient Details: Glycemic Index	Design goal:
Comparison to another design:	
BACKGROUND RESEARCH	
Think about how your design choices affected metabolic ne carbohydrates and proteins in your recipe affect the result about these nutrients applies specifically to the metabolic specific ingredients to meet specific metabolic needs?	eeds. How did the glycemic index and the amount of s for growth and repair and energy needs? What information needs of your target population? Why did you choose

DATA ANALYSIS

Final result:

Design goal:

Comparison to another design:

BACKGROUND RESEARCH

Think about how your design choices affected taste. What information about the ingredients is related to the taste score?

Cost

DATA ANALYSIS

Final result (\$):

Design goal (\$):

Comparison to another design:

BACKGROUND RESEARCH

Think about how your design choices affected the cost of the FuturaBar. What information about the ingredients is related to the cost?

Final Proposal

Name: Date:

When writing your Final Proposal, remember to write in a clear and professional manner. Refer to these resources:

- Proposal Rubric and Sample Proposal
- RecipeTest Data
- Background research and notes
- Food Engineer's Dossier
- Proposal Outline feedback letter

Introduction

Use your responses from the Project Summary to describe the project goal and criteria. Add one to two sentences to describe your optimal design.

Design Decisions

Use your Proposal Outline and feedback from your project director to explain how your design addresses each criterion.

Metabolic Needs

Final Proposal (continued)

Taste

Cost Per Bar
Conclusion, Considering Trade-offs
Use your responses from the Trade-offs Reflection to describe your design priorities and the resulting
ose your responses nom the made ons reflection to describe your design phonties and the resulting
trade-offs. Add your closing statement.

Outlines to Paragraphs

Criterion 2: Keeping mouths clean

Data Analysis			
Final result (%): <mark>84%</mark>	Design goal (%): 80%		
Comparison to another design: · cheaper design using nylon bristles (\$1.20 per toothbrush), but the clean-mouth rating was 53%			
Backgroun	d Research		
How did the design choices/features you selected affect the clean-mouth rating? What information about bristles and handles is related to cleaning mouths, such as how much plaque is removed or handle strength?			
· more removed plaque means less toot	· more removed plaque means less tooth decay, so people are now healthier		
· bamboo handles are better for the environment			
the strength of the handle affects how much plaque			
is removed			
• plastic handles are stronger			

not important for this criterion

Keeping mouths clean: Our design has a clean-mouth rating of 84% which is better than our goal of 80%. We found that plastic bristles and natural-fiber bristles both removed at least 80% of plague and since more removed plaque means less tooth decay, people are now healthier. Therefore, we selected the natural fiber bristles for our design. Our cheaper design used nylon bristles (\$1.20 per toothbrush), but the clean-mouth rating for that toothbrush was only 53%. The plant-based plastic handle also affected the clean-mouth rating because the strength of the handle affects how much plague is removed. Plastics are stiffer and help people remove more plaque while brushing compared to more flexible handles, made from all-plant material.

:semeN meeT

Srainstorm project ideas:

Guiding Question: What solutions can you design to address problems related to tood shortage,

food packaging, or meeting the metabolic needs of a new target population?

Circle the idea (above) that is most interesting to you.

Define your engineering problem:

criteria ideas as you can on one piece of statement. blank paper. Place your paper back inside the 9. Share. envelope. Metabolism Engineering Internship—Day 10 © 2019 The Regents of the University of California fold

3. Choose and circle one idea that is most interesting to your group. Pass your envelope to another group.

the new envelope you receive. Write as many

4. Brainstorm criteria for the idea circled on

- them on the outside of your envelope.
- might be some repeated ideas! 7. Choose three criteria your group feels are the most important to consider for possible

design solutions.

Step 4 for any new envelopes you receive. 6. When you get your envelope back, read all the criteria your peers brainstormed. There

8. Define your engineering problem. Write your

idea and the criteria you select in a project

5. Pass the envelope to another group. Repeat

food packaging, or meeting the metabolic needs of a new target population?

The Solutions Sequence

1. Choose a focal issue (food shortage, food

2. Brainstorm 10–20 project ideas and record

a new target population).

packaging, or meeting the metabolic needs of

Guiding Question: What solutions can you design to address problems related to food shortage.

Design Question: Which criteria would make that solution the strongest?