Smoothie Design Challenge

Design, test, and improve a food option for lactose intolerance

HAP.13.8 "Enrichment: Use an engineering design process to develop effective treatments for gastrointestinal diseases (e.g., methods to regulate stomach acids or soothe ulcers, treat food intolerance, and dietary requirements/modifications).*"

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the team's problem and three design constraints, circle its first prototype, and number the test and revision steps to trace how the design improves.

A Smoothie That Works

1. When the cafeteria adds a yogurt smoothie, Maya wants to drink one but develops cramps after foods with lactose, a sugar in dairy products. Her clinician has identified lactose intolerance: her small intestine makes too little lactase, the enzyme that breaks down lactose. This is not a milk allergy, which involves the immune system and needs different precautions. A student design team frames its problem: offer a smoothie Maya can drink without discomfort. The solution must also provide calcium, fit the cafeteria's budget, and taste good enough that students will choose it.

2. The team compares two ideas: use lactose-free dairy milk instead of yogurt in the recipe, or provide lactase tablets alongside the original smoothie. Lactose-free milk has already had its lactose broken down and generally retains dairy milk's calcium; a tablet must be taken as directed and may not work equally well for everyone. The team chooses lactose-free milk for its first prototype because it does not depend on students remembering a tablet. They keep the fruit and portion size the same, check the milk label for calcium, and calculate the cost per serving before offering any samples.

3. With consent, six students who report lactose intolerance try the prototype during a school week. The team asks about stomach discomfort afterward and whether each student would choose the smoothie again; it never asks anyone to drink something that makes them sick. Five students report no discomfort, but only three would choose it again because it tastes too sweet. The team decides to reduce the added sweetener without changing the milk, then repeat the same questions with another sample. A useful treatment design meets safety and nutrition needs as well as symptom and preference goals; one promising result is not proof of a cure.

2 ANSWER WITH EVIDENCE

Use the passage

1. Why does changing the dairy ingredient address the cause of Maya's cramps more directly than changing the fruit?

2. What practical concern led the team to prototype lactose-free milk instead of lactase tablets?

3. What two checks did the team plan to make before offering samples, and which design constraints do those checks address?

4. Based on the trial, what should the team change and what should it keep for its next sample? Use one result to support each choice.

3 YOUR TURN

Your own words

A student gets heartburn after a large, late cafeteria lunch, and a clinician has ruled out urgent problems. Design one cafeteria change to test for two weeks; state a nutrition constraint, a safe way to measure whether the change helps, and what you would do if it does not.

ANSWER KEY

Smoothie Design Challenge

PART 1 · READ AND MARK

Underline the team's problem and three design constraints, circle its first prototype, and number the test and revision steps to trace how the design improves. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Why does changing the dairy ingredient address the cause of Maya's cramps more directly than changing the fruit?	**Maya makes too little lactase to break down lactose in dairy products. Lactose-free milk has had its lactose broken down; changing the fruit would not address that cause.**
2	What practical concern led the team to prototype lactose-free milk instead of lactase tablets?	**Students would have to remember to take a tablet as directed, and it might not work equally well for everyone. The lactose-free milk option does not depend on remembering a tablet.**
3	What two checks did the team plan to make before offering samples, and which design constraints do those checks address?	**They checked the milk label for calcium to address nutrition and calculated cost per serving to address the cafeteria's budget.**
4	Based on the trial, what should the team change and what should it keep for its next sample? Use one result to support each choice.	**Reduce the added sweetener because only three of six students would choose the smoothie again and said it was too sweet. Keep the lactose-free milk because five of six reported no discomfort.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Offer a smaller lunch with an afternoon snack instead of one large meal. Keep the total food and protein about the same so the student still gets enough nutrition. With the student's consent, record the number of heartburn episodes after lunch each school day for two weeks and compare it with the previous two weeks. If episodes do not decrease, ask a clinician about other options rather than cutting more food.

Accept other safe, feasible lunch changes if the response includes a nutrition constraint, a measurable outcome, and a reasonable revision or referral. Students should not claim that one trial proves a cure.