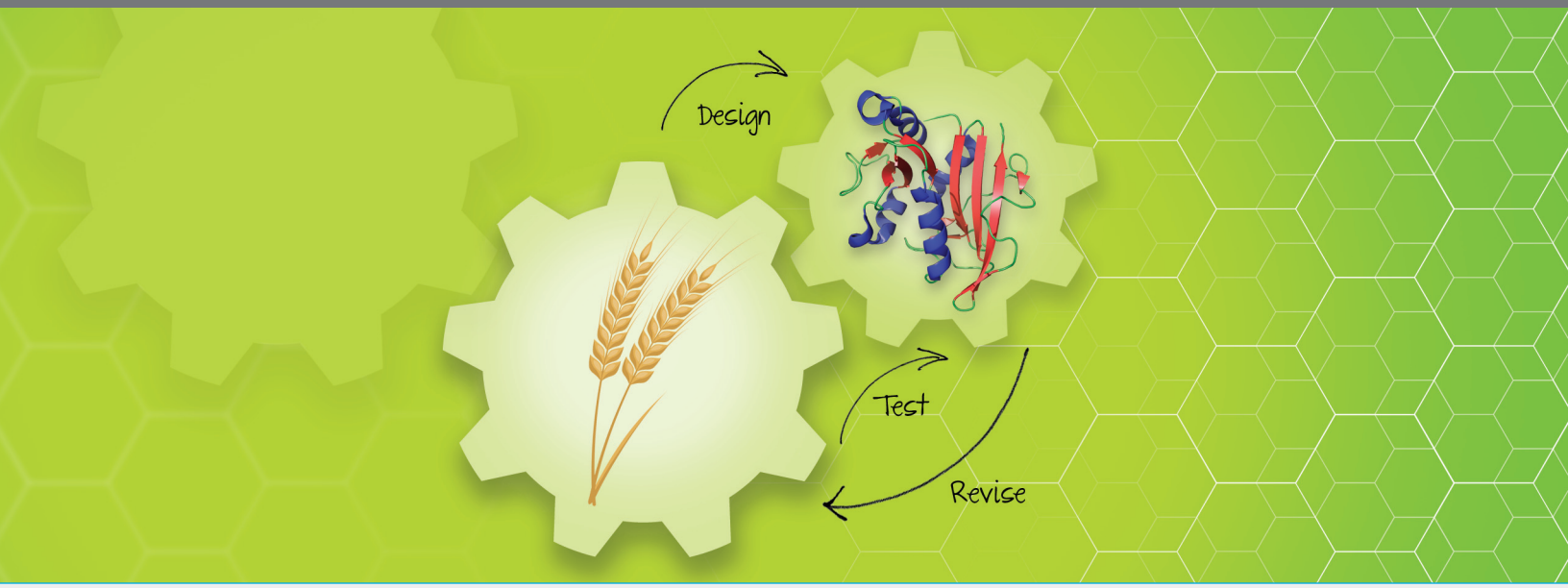
BIO-RAD Explorer



Engineering Solutions for Global Health Kit

Catalog #17005278EDU

Student Guide

BIO-RAD

Activity 1

Understanding Protein-Energy Undernutrition

Defining a problem

1. *Examine the data on global nutrition your teacher provides.*

2. *Record any patterns or anything interesting or puzzling you notice.*

3. *Record any questions you have about the data.*

4. *Discuss and share ideas with your classmates about your observations and questions.*

5. *Individually, record a summary of the problem of protein-energy undernutrition (PEU).*

Activity 2

Investigating Protein Content in Food

First Day: Using scientific data to design an evidence-based solution

1. ***Discuss with your group how Bradford reagent could be used as a tool for investigating elements to include in a treatment plan to address protein undernutrition. Record the ideas from your discussion.***

Second Day: Developing a solution

1. ***Work with your group to brainstorm a list of foods (liquids and solids) you could test with Bradford reagent for possible inclusion in your treatment plan.***

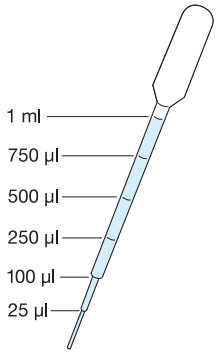
2. ***Discuss and record the top four protein liquids from your list that your group prioritizes for your investigation using Bradford reagent. Explain your reasoning for choosing them.***

Third Day: Conducting the investigation

Student workstation checklist

Material	Quantity
Patient Outcomes (Printed)	1
One set of BSA standards (S1 to S4)	1
One set of sample protein liquids (A to D)	1
Conical Centrifuge Tubes, 15 ml	4
Beaker of distilled water (for dilutions)	1
Beaker of water for rinsing (optional)	1
Beaker of Bradford reagent	1
Plastic pipets	16
Marking pen	1

1. Summarize and calculate (in mg of protein per day) the recommended daily allowance (RDA) requirement your group was given. Note: the RDA of protein for healthy children and adults is a minimum of 0.8 g protein/kg of body weight (or 0.36 g protein/lb).



Prepare the Standards

2. Locate your set of four standards, S1 through S4.

3. Add Bradford reagent to the standards.
- ***a. Label a clean plastic pipet Bradford and use it to add Bradford up to the 5 ml mark on the tube labeled S1.***
- ***b. Cap the tube tightly and invert gently to mix.***
- ***c. Using the same pipet, repeat for tubes S2, S3, and S4.***
- ***d. Incubate the tubes at room temperature for 5 min.***

4. Record the protein concentration of each standard from the label on the tube in the third column of the table below.

5. Observe the color of the liquid samples in the S1–S4 tubes.
- ***a. View the tubes against a white or light background and record your observations about the color of the liquids in the fourth column of the table below.***

Tube	Contents of diluted experimental tube	Protein in original (concentrated) standard (mg/ml)	Observations
S1	100 µl Standard 1 + 5 ml Bradford		
S2	100 µl Standard 2 + 5 ml Bradford		
S3	100 µl Standard 3 + 5 ml Bradford		
S4	100 µl Standard 4 + 5 ml Bradford		

Prepare the Protein Liquids

6. ***If your teacher prepared your set of proteins, locate your set of protein liquids, A, B, C, and D and skip steps 7, 8, and 9.***

7. ***Label four tubes, A, B, C, and D.***

8. ***Use a clean plastic pipet to transfer 100 µl of protein liquid A into tube A.***
   Note: ***Be sure to keep pressure on the pipet bulb after you draw up the liquid to prevent liquid from being drawn into the pipet shaft or bulb. Rinse the pipet at least two times using the distilled water beaker labeled Rinse. To do this, gently squeeze the bulb then place the pipet in the beaker of distilled water, release the bulb to draw water up into the pipet, and squeeze the bulb to expel the water.***

9. ***Using the same pipet and rinsing each time, repeat step 8 for tubes B, C, and D.***

10. ***Use a clean plastic pipet to add 5 ml of distilled water into tube A. Cap the tube tightly and invert gently to mix.***

11. ***Using the same pipet and rinsing each time, repeat for sample B, C, and D.***

12. ***Label four new tubes, A 1:50, B 1:50, C 1:50, and D 1:50.***

13. ***Use a clean plastic pipet to add 100 µl from tube A to tube A 1:50.***

14. ***Using the same pipet and rinsing at least two times using the beaker labeled Rinse, repeat step 13 for samples B 1:50, C 1:50, and D 1:50.***

15. ***Add Bradford to the protein liquids in tubes A 1:50, B 1:50, C 1:50, and D 1:50.***
    a. ***Reuse the Bradford pipet from step 3 to add Bradford up to the 5 ml mark on the tube labeled A 1:50.***
    b. ***Cap the tube tightly and invert gently to mix.***
    c. ***Use the same Bradford pipet and repeat for tubes B 1:50, C 1:50, and D 1:50.***

16. ***Incubate tubes at room temperature for 5 minutes.***

17. Visually compare each of your protein liquids to the four standards against a white or light background.

a. In the third column of the table, record your observations of the color of each protein liquid and the standard that matches it most closely.

b. In the fourth column, record the estimated protein in each diluted protein liquid from the label of the standard with the closest color match.

c. In the fifth column, record the estimated protein in the original undiluted protein liquid by taking the concentration of the 1:50 diluted protein liquid from column four and multiplying by 50.

Tube	Contents	Color and closest standard match	Estimated protein in 1:50 diluted protein liquid (mg/ml)	Estimated protein in original undiluted protein liquid (mg/ml)
A 1:50				
B 1:50				
C 1:50				
D 1:50				

It is important to record what you actually do in an investigation even when you are following a written procedure. That way you can take note of anything you do differently from your original plan. Record your steps in the left-hand column of the table below as you conduct your investigation. Record any observations you make in the right-hand column.

Steps	Observations and data collection

Activity 3

Designing a Treatment Proposal for Protein-Energy Undernutrition

First Day: Designing and testing an initial treatment proposal

1. ***Develop an initial treatment proposal. Include the following:***
   a. ***Description of RDA requirement card and calculations***
   b. ***Type of protein liquid recommended and volume required to meet the RDA***
   c. ***Any information learned from researching PEU that you think is important to include such as, in which part of the world do the people live, and what social, environmental, and economic factors are at play?***

Initial Treatment Proposal

2. ***In the first row of the Initial Proposal Validation chart on page 11, write a brief description of your assigned RDA requirement and your calculation.***

3. ***Consider the constraint your teacher gives you.***
   a. ***In the second row (Constraint 1) of the Initial Proposal Validation chart, write a brief description of the constraint in the second column.***
   b. ***Record whether the constraint is a product or user constraint in the third column.***
   c. ***Discuss the constraint with your group and revise your initial treatment proposal accordingly. If you cannot meet the constraint, explain your reasoning in your initial proposal, and note how close you can get to meeting the constraint.***

4. ***For validation of your RDA requirement and constraint:***
   a. ***Record the results from validation for the RDA requirement by circling or marking the value your teacher gives you on your Initial Proposal Validation chart.***
   b. ***Record the results from validation for the constraint you were given by circling or marking the value your teacher gives you on your validation chart.***

5. ***For the outcomes of your RDA requirement:***
   a. ***Identify the RDA requirement in the left column of the Patient Outcomes chart. Match the value you were given from the initial proposal validation in 4a to a "dire," "mediocre," or "good" outcome in the right column.***
   b. ***Record the outcome in the last column on the Initial Proposal Validation chart.***
      i. ***Was the outcome positive?***
      ii. ***How could you revise or add to your initial treatment proposal?***

6. ***For the outcomes of your constraint: repeat step 5 for the outcomes of the constraint you were given.***
   ***Note:** A single set of outcomes might match up with more than one constraint.*

Second Day: Revising and finalizing an initial treatment proposal

7. ***If your teacher instructs you, repeat Step 3 and 6 for an additional constraint.***
   ***Note:** If you are not given an additional constraint, leave any unused constraint rows blank.*

8. ***If your teacher instructs you, repeat step 7.***

Criteria	Description	Product or User	Value = 1	Value = 2	Value = 3	Outcome
RDA requirement			Incorrect calculation of RDA, and incorrect calculation of protein concentration of protein liquid, and inaccurate/ inappropriate selection of protein liquid	Either incorrect calculation of RDA OR incorrect calculation of protein concentration of protein liquid OR inaccurate/ inappropriate selection of protein liquid	Correct calculation of RDA, and correct calculation of protein concentration of protein liquid, and accurate/appropriate selection of protein liquid	
Constraint 1			Constraint was not successfully applied	Constraint was only partially applied	Constraint was successfully applied	
Constraint 2			Constraint was not successfully applied	Constraint was only partially applied	Constraint was successfully applied	
Constraint 3			Constraint was not successfully applied	Constraint was successfully applied	Constraint was successfully applied	

9. ***Follow your teacher's instructions to construct an evidence-based argument for your final treatment proposal for PEU. Include the following in your proposal:***
   - ***A claim that summarizes what treatment you propose and a summary of the RDA requirement and constraint(s). Include the volume of treatment recommended and any other important details***
   - ***Evidence that supports your claim, including the evidence from your investigation with Bradford and the outcomes of your prototype testing***
   - ***Any other relevant social, economic, or environmental information/evidence related to PEU (packaging, cost, etc.)***
   - ***Reasoning for how strong the evidence is in supporting your claim***
   - ***A reasonable counterargument to your argument***

Scientific Argument

Initial Treatment Proposal

Claim

Evidence

The evidence that supports this claim is…

Reasoning

The strength of the evidence to support this claim is _____ (low/medium/high) because…

Counterclaim

Others might argue…

Post-Investigation Questions

1. ***Why do you think athletes may require a higher recommended daily allowance of protein than people with an average activity level?***

2. ***The recommended daily allowance (RDA) of protein for healthy children and adults is a minimum of 0.8 g protein/kg of body weight or 0.36 g protein/lb of body weight. Athletes require approximately 1.2 -2.0 g protein/kg of body weight. Calculate the RDA of protein (in mg of protein) needed per day for:***

   a. ***Yourself***

   b. ***Healthy 2-year-old child who weighs 27 pounds (12 kg)***

   c. ***Healthy adult who weighs 180 pounds (82 kg)***

   d. ***Athlete who weighs 110 pounds (50 kg)***

3. ***The treatment proposal you designed addresses the symptoms of undernutrition, but not the factors that lead to undernutrition. Review the data about global nutrition from Activity 1. What actions would you recommend an organization such as WHO or UNICEF take to address the factors that cause world hunger?***

4. ***There are many connections between nutrition and the 17 global Sustainable Development Goals. Choose at least one of the Sustainable Development Goals and explain how you think nutrition is linked to the goal(s) you chose.***

5. ***Explain what food deserts are and where they are found. If instructed, do some research.***

6. ***Why would policy experts on climate change be interested in learning about global nutrition?***

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