H2GROW

student guide

Purple Plow
Uncovering STEM Solutions

H2GROW Challenge

Identify a Problem

According to the USDA "food insecurity" is defined as a household's consistent access to adequate food being limited by a lack of money and other resources at times during the year. Often, we think of this as being a problem affecting only third world countries. However, Feeding America shares that 42.2 million Americans live in food insecure households, including 32.8 million adults and 13.1 million children. Often, we think of individuals that are living with food insecurity to be homeless or easy to identify, but they could be your neighbor or even a classmate. What can we do to help solve this problem? The best way to start solving this problem of food insecurity is to create sustainable local food systems.

Response to Problem

With the challenge of feeding 9 billion people by 2050, your team has been selected to design a prototype and construct a life-size model of a system that will integrate the use of waste from an aquatic animal growth system as a beneficial nutrient for a plant growth system.

This system must address the following needs:

- Produce a plant-based food source
- Produce an aquatic animal-based food source
- Hold, at maximum, 20 gallons of water
- Produce weekly documentation of water quality by pH

Success will be determined by:

- Harvest an edible food product within 90 days or show progress of plant and animal growth within the timeframe allotted for your specific situation
- Create, construct, and maintain an environment that is suitable for aquatic animal life within 90 days
- Produce a presentation and post to social media

1. Identify

PURPOSE OF STEP

Define the problem and how it is affecting life globally, nationally, and locally. Research and consider how others have approached solving the program. Describe why this problem needs a solution. Determine constraints (e.g., time, space, resources, etc.).

STUDENT PROMPTS AND GUIDING QUESTIONS

- Why do people go hungry?
- What are different ways to grow or raise food?
- What is needed to grow food?
- What kinds of foods grow in the local community?
- What are solutions to the problem of world hunger?
- What is food insecurity?
- What is the level of food insecurity in the United States?
- What are some ways Americans help fight food insecurity?
- What resources are available locally to help with food insecurity issues?

SIGNS OF STEP COMPLETION

Present a description of the problem to the facilitator. Be sure to include how this problem affects communities globally, nationally, and locally. The description should also include ways in which others have addressed finding a solution and constraints to be considered (e.g., time, space, resources, etc.).

1. Identify reflection

Important discoveries during this step:

Impacts to the global, national, and local community:

Plans for the next step (e.g., knowledge to gain, questions to answer, preparations to make, etc.):

2: Imagine

PURPOSE OF STEP

Brainstorm solutions to the problem. List all of your ideas – don't hold back! Discuss and select the best possible solution.

STUDENT PROMPTS AND GUIDING QUESTIONS

- How do inputs of photosynthesis affect plant growth?
- What nutrients does a plant need to grow?
- How do nutrients affect plant growth?
- How do the outputs of plant photosynthesis affect animal growth in aquatic systems?
- How do nutrients affect animal growth in aquatic systems?
- How do water quality factors affect animal growth in aquatic systems?
- What is the benefit of water flow in an aquatic system?
- How does the movement of water affect nutrients?
- What are the components of an integrated aquatic and plant growing system?

SIGNS OF STEP COMPLETION

Present a list of possible solutions to your identified problem to the facilitator.

2: Imagine Reflection

Important discoveries during this step:

Impacts to the global, national, and local community:

Plans for the next step (e.g., knowledge to gain, questions to answer, preparations to make, etc.):

3: Design

PURPOSE OF STEP

Diagram the prototype. Identify the materials needed to build the prototype. Write out the steps to take. Describe the expected outcomes.

STUDENT PROMPTS AND GUIDING QUESTIONS

- Design a structure that meets the demands set forth in the challenge.
- Determine what specific materials would be used in the construction.
- Justify why particular design choices have been made.
- Justify why particular materials have been chosen.
- What plants and animals will successfully grow in the structure?
- Create a supply list and budget.
  - What specific materials will be used to build the growing structure?
  - How will materials be obtained?
  - What is the cost of these materials?
- In what ways will the production of the growing structure be measured?
  - What will need to be observed (qualitative data)?
  - What information can be put into a chart of graph (quantitative data)?

SIGNS OF STEP COMPLETION

Present a detailed diagram of the prototype as well as a written plan of how it will be built. Be sure to include a materials list with budget, detailed directions, and expected outcomes.

3: Design Reflection

Important discoveries during this step:

Impacts to the global, national, and local community:

Plans for the next step (e.g., knowledge to gain, questions to answer, preparations to make, etc.):

4: Create

PURPOSE OF STEP

Follow the design plan and build the prototype.

STUDENT PROMPTS AND GUIDING QUESTIONS

- Use all research, knowledge gained, and the design plan to create the growing structure.
- Repeat any of the previous steps should issues arise during the building process.
- Consider the parameters of the challenge and what needs to be accomplished for a successful challenge.

SIGNS OF STEP COMPLETION

Build the prototype and share with the facilitator.

4: Create Reflection

Important discoveries during this step:

Impacts to the global, national, and local community:

Plans for the next step (e.g., knowledge to gain, questions to answer, preparations to make, etc.):

5: Test + Improve

PURPOSE OF STEP

Test the design and collect quantitative and qualitative data. Discuss results and compare with the expected outcomes. Seek areas of improvement and make changes where needed.

STUDENT PROMPTS AND GUIDING QUESTIONS

- Analyze the production of the structure created.
- Create data tables, graphs, photographs showcasing production, etc.
- How does pH affect aquatic animal and plant growth?
- Test the pH of the system regularly.
- Calculate growth efficiency.
- Based on the data, what predictions can be made about the sustainability of the growing structure?
- What other factors are affecting the systems and what observations can be collected?

SIGNS OF STEP COMPLETION

Keep record of all test trials and share data with the facilitator. Entries should include both qualitative and quantitative data. Record any improvements made to your design prototype and the effect they had on outcomes.

5: Test & Improve Reflection

Important discoveries during this step:

Impacts to the global, national, and local community:

Plans for the next step (e.g., knowledge to gain, questions to answer, preparations to make, etc.):

6: Share

PURPOSE OF STEP

Communicate what was learned. Share the design, data, and conclusions. Present results.

STUDENT PROMPTS AND GUIDING QUESTIONS

- Develop a presentation including knowledge gained, design plans, materials used to create the structure, testing completed during challenge, and data analysis.

SIGNS OF STEP COMPLETION

Present what was learned through the design process. Share how the prototype addresses the problem, key aspects of design, data from test trials, and end results.

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