F.A.R.M. Collaboration Activity - S.T.E.A.M. Assignment Challenge

How are we going to feed 9 billion people in the coming decades? With population growth expected to peak between 9 & 11 billion people, the agriculture sector is due for a New Green Revolution. This New Green Revolution needs to ensure conventional agriculture continues to innovate and improve farm efficiency. The technological advances we have seen developed in the 21st century combined with smaller scale, local methods of growing food will ensure food security and food sovereignty.

What follows is a plan to make our schools and the students within them the innovators of future food. Students and staff advisors from schools across districts, provinces and potentially the planet will collectively share their experiences with other schools and through Taking It Global Education platform collaborate on a variety of future projects and research best practices.

Using the R & DIY method schools will share in a collaborative in-class / online experience that engages students in The F.A.R.M. - The Future Agriculture Research Module. It is an attempt to share future indoor farming ideas. Students will be responsible for designing and building a prototype of an indoor micro-farm while strategically sharing their progress virtually. After the build phase students are going to be responsible for designing an experiment with the help of their teacher and conducting research on using this prototype to grow food in an indoor, controlled environment.

Using a STEM framework developed by NASA, (see below) participants will work collaboratively within their class and remotely with other participating classes to design, build a prototype and test an indoor food growing method. The idea is based on the fact that schools offer an untapped potential of future innovators, our students, in addition to an indoor environment they can learn and perfect methods of growing food. The school environment offers the perfect indoor grow space where the ideas generated can then be scaled up to meet the demands for more local, fresh food.

Inspire, Collaborate, Innovate - The F.A.R.M. (The Future Agriculture Research Module)
**Project Vision**

The F.A.R.M. - The Future Agriculture Research Module

This is an attempt to share future indoor farming ideas. Students will be responsible for designing and building a prototype of an indoor micro-farm. After the build phase students are going to be responsible for designing an experiment with the help of their teacher and conducting research on using this prototype to grow food in an indoor, controlled environment.

The following are 3 potential areas that can be explored and used as a method to grow food indoors.

Aquaponics Technology

Hydroponics Technology

Green Wall Technology

Using the following link, explore the concept of Farming for the Future. In it they show how schools and industry can work collaboratively towards designing and troubleshooting technology driven food systems in what is called open source technology. I am more interested in the sharing of ideas, and what worked or did not work while completing this project.

https://www.redhat.com/en/open-source-stories/farming-for-the-future?sc_cid=7013a00002D3cpAAC&fbclid=IwAR1chQL1cET7MpLrfDU5y1GrfAZ2N3wyV3fJtwgXdzgLPBAbZHBbNA_Y
Problem #1 - Fresh produce is something the system has stacked up against us. The rising price of fresh produce is only going to continue to pose challenges for feeding people a more healthy balanced diet. Task #1 - we are going to create a typical grocery list of fresh produce and we want you to tell us what it is going to cost to feed your family this fresh, wholesome food.
Problem #2 - This, along with a growing population which is expected to reach 9.8 billion by 2050, will result in a 49% increase in the demand for food. Food insecurity is going to be a reality for a majority of the world’s population unless we can find some solutions. Future communities will need to have some form of food sovereignty and we need to reduce our dependence on commercial food operations.

**Step 2 - NASA OPSPARC DESIGN PROCESS**
Using the NASA OPSPARC framework, (found in Appendix A, see below) I want you to complete the Design Process Steps

- **Identify Criteria and Constraints**
Your group task is to design and build an indoor micro-farm unit to grow some fresh produce in your classroom.

**Criteria:**
- A minimum of 50% of your project should be made using recycled materials ie. pop bottles, cardboard, plastic totes.
- Budget - This is a difficult challenge as part of this collaborative action research initiative we are hoping that host schools can find budget in the amount of $300, no more, to help with the cost of additional supplies and technology.
- Projects must be completed by **DATE TO BE DETERMINED**.

**NEXT STEP**

**Step 3 - Brainstorm Possible Solutions**
Given that this is a design project you are going to follow a process to make sure that you meet the design criteria and established benchmarks. It is recommended that time is given to classes to brainstorm possible ideas. It is recommended that once ideas are generated they are shared in the class and that we move on to Step 4.

**SECOND CONTACT**

**Step 4 - Select a design**
On this date we will have a share session of the best 2 or 3 ideas that were generated at each school and allow for questions and feedback.
NEXT STEP
Step 5 - Create

A - Plan and Build a Prototype
You are expected to select at least one of the designs presented to the group. You must then create a plan, make a list of materials, begin gathering materials and build the prototype. Keep detailed notes throughout this process in addition to document the entire build as you are going to be expected to share eventually a “How to...” presentation of your design and build.

B - Test and Evaluate the Prototype
Test the prototype to see if it is functional and while doing so create a list of the strengths and weaknesses of the design.

C - Refine the Design
Upon completion of initial testing of the prototype and identification of the strengths and weaknesses, your group is expected to make improvements to the design.

THIRD CONTACT
Step 6 - Share
At this point we will have a show and tell of our prototypes to other schools, discuss some of the problems your team encountered during the process. A shared folder will be created to share your “How to...” presentation with the other schools which they can view on their own time.

NEXT STEP
Step 7 - Experimentation
As a class you will design an experiment using your prototype to see if you can successfully grow fresh food indoors. Use the following as an example: Seeds were started on the exact day and time using two different grow methods. Method 1 is a hydroponic unit and method 2 is a soil based planter. Grow conditions in the form of light and temperature were identical. Over the course of the next few weeks, document the growth rates and share your results with the other schools by completing the following experimental design questions.
A. Hypothesis:
B. Materials
C. Procedure / Experiment (what are you going to do?):
D. What is the control group?
E. What is the experimental group?
F. The independent variable:
G. The dependent variable:
H. Observations:
I. Conclusion:
Mission 3
Be the spark to a new NASA Spinoff!

https://opsparc.gsfc.nasa.gov/
Design Process Steps

1. IDENTIFY THE PROBLEM
   - State the problem clearly.

2. IDENTIFY CRITERIA AND CONSTRAINTS
   - Identify the conditions that must be met to solve the problem.
   - Identify anything that might limit a solution, such as cost, availability of materials, safety.

3. BRAINSTORM POSSIBLE SOLUTIONS
   - Consider what others have done to solve this problem and include prior research.
   - Generate new ideas for solutions.

4. SELECT A DESIGN
   - Choose two or three of the best ideas from the brainstormed list.
   - Make a sketch of each design.
   - Select one design to construct.
   - Justify your choice by listing reasons for selecting the design.

5. CREATE
   - Create a plan to build the model or prototype.
   - List materials needed to construct the model.
   - Build the model.

6. SHARE
   - Explain your ideas to others.

7. TEST AND EVALUATE THE MODEL
   - Test the model to see if it works.
   - List the strengths of the design.
   - List the weaknesses of the design.
BRAINSTORM POSSIBLE SOLUTIONS

What have others done to solve the problem?

Generate new ideas for solutions.

Sketch ideas.

SELECT A DESIGN

Choose one design to construct. Justify the selection of the chosen design.
PLAN AND BUILD A MODEL OR PROTOTYPE

Develop a plan for building a prototype.

TEST AND EVALUATE THE MODEL

Test the prototype. Describe the strengths and weaknesses of the model.

REFINE THE DESIGN

Make improvements to the design. Justify the changes.

SHARE THE DESIGN

Describe what you have learned throughout this process.
Engineers share their ideas with others through Design Reviews. Organize your work so that you could share your ideas with other engineers and Subject Matter Experts (SME).

Create a Design Review Video (<3 minutes) that answers these questions:

- What is the problem being solved by the newly created Spinoff technology?

- How did the original technology work and how have you adapted or modified this technology?

- How did you build and test your model?

- How does the science, math, and engineering support this work?
• What makes this Spinoff technically feasible?

• What have you learned through the engineering design process?

• If you were able to talk with Subject Matter Experts (SME) or engineers, what would you ask them to help you improve your Spinoff design?

You may use Adobe Spark Video to create the video. Once completed, be sure to post the video in your Adobe Spark Page. Beside your video, also post:

• The problem statement and video.
• A brief introduction to the video, in text.
## OPSPARC Mission 2 Final Product

<table>
<thead>
<tr>
<th>Task A: Mission Patch (8 pts)</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Image of an original mission patch.</td>
<td>(__/4)</td>
</tr>
<tr>
<td>• Introduction of each team member and description explaining the mission patch.</td>
<td>(__/4)</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Spinoff Scavenger Hunt (8 pts)</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Collage includes 8-10 spinoffs.</td>
<td>(__/4)</td>
</tr>
<tr>
<td>• The images are real (not from the Internet).</td>
<td>(__/4)</td>
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</table>

<table>
<thead>
<tr>
<th>Design Review (28 pts)</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>A video (&lt;3 minutes) includes these components:</td>
<td></td>
</tr>
<tr>
<td>• Problem statement addresses a real-world problem.</td>
<td>(__/4)</td>
</tr>
<tr>
<td>• Description of how the original technology is adapted to create the Spinoff.</td>
<td>(__/4)</td>
</tr>
<tr>
<td>• The process of building and testing the model.</td>
<td>(__/4)</td>
</tr>
<tr>
<td>• A justification of how science, math, engineering support the design.</td>
<td>(__/4)</td>
</tr>
<tr>
<td>• A justification that the Spinoff is technically feasible.</td>
<td>(__/4)</td>
</tr>
<tr>
<td>• Explanation about what has been learned through the engineering design process.</td>
<td>(__/4)</td>
</tr>
<tr>
<td>• Questions the team would ask a Subject Matter Expert (SME) or engineer to improve the Spinoff design.</td>
<td>(__/4)</td>
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**Total: **\( \_/44 \)

***Note: Judges may award up to 8 additional points for unique and exceptional work. (__/8)***

**Total: **\( \_/52 \)

### Assessment

4 (Excellent) = All criteria (procedures, steps, and details) are met or followed.  
3 (Good) = Most criteria are met with only a few errors.  
2 (Fair) = Many criteria are met, but work has significant errors.  
1 (Poor) = Most criteria are not met.  
0 (No effort) = No effort to meet criteria.