**Mars Farm**

**Lesson 5:** Explore constraints and criteria

**Problem Statement:** Students must work together in teams to create a design a growing environment on Mars that will sustain three researchers for three years. This lesson launches the research process required in this unit as students become experts on one or more potential food crops.

**Learning Objectives:**

Explore constraints and criteria with independent research of what it takes to build a crop. Students will become “experts on one crop”.

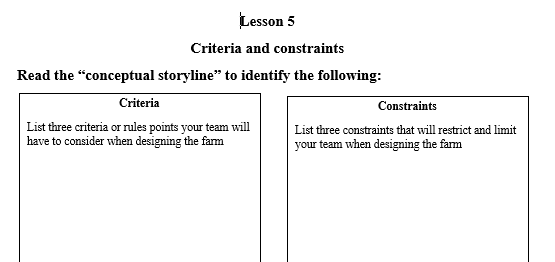
**Lesson Standards (NGSS, CCSS, CTE):**

MS-ETS1-2 Engineering Design

Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

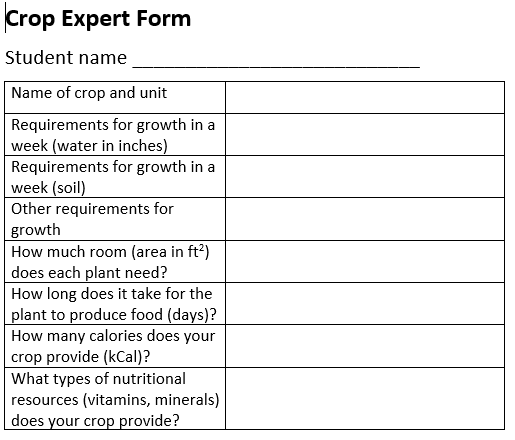
**Materials**

* “Criteria and constraints form”



**Note:** Teachers may choose to use a traditional notebook, printed form or an electronic form. Form can be found in “Student Sheets”.

* “Crop Expert Form”



**Note:** A teacher’s guide and an example of how to fill out the form can be found in “Students Sheets” folder.Teachers may choose to use a traditional notebook, printed form or an electronic form. Consider using Google drive (see example in “Students Sheets” folder) where all students can input their answers and their answers can be easily shared with the rest of the class.

**Lesson Preparation**

* Understand the importance of identifying criteria and constraints when solving a problem
* Students will practice pulling information from a text to identify specific requirements such as criteria and constraints in this case, that will be utilized to solve a problem
* Encourage students to understand the importance of doing research and utilizing resources such as books, internet, etc.
* Understand how to fill out the Crop Expert Form. See “Crop Expert Form\_Teacher guide” and “Crop Expert Form\_Example” in “Student Sheet” folder. Additional examples included in Crop Expert Form Google drive
* If classroom is not a 1:1 ratio of students to technology, teacher must locate enough devices able to access internet for a 1:1 ratio OR pair children.

**Time Required**: 45 – 60 minutes

**Lesson Components:**

* Brainstorm a list of fruits and vegetables children might consider eating on Mars or serve as their favorite fruits and vegetables. Write on board or chart paper.
* Ensure students know the difference between criteria and constraints. Have them give examples from real life it time allows.
* Let students know the importance of research. Emphasize how researchers and engineers try to find a solution to a problem.
* Remind children of our nutritional needs (carbs, protein, fats) and the approximate number of calories required per day.
* Ask children to choose one or two fruits or vegetables they are curious about. Show Google Form (student worksheet folder) and ask children to at least locate the basic information on the form and include any additional information they feel would be important to know if one is growing a crop. By using Google Doc, teacher can collect the information quickly in a spreadsheet format and share with class if desired.

**Assessment:**

Each student will fill out an “Expert on a crop form” and share with the class

**Accommodations:**

If Google Drive is used, ensure there is internet connection, teacher should have a Google account, and a projector and a screen will be needed to share all students’ results with the class.

**Extensions:**

If time allows and/or students are interested introduce and practice “companion planting”. Ask students to do some research about ‘companion planting” where they will find out what crops do well together and what crops should not be planted together.

**References/Resources:** See “Students Sheets”.