**Mars Farm**

**Lesson Eleven & Twelve: Construction of 3D Model**

**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 requires the children to turn their 2D plans into 3D models (if teachers wish) while adjusting a scale.

**Learning Objectives:**

1. Students will learn how to translate a 2D scale model into a physical 3D model.
2. Students will collaborate with group members to achieve a shared objective and realize their plan from previous lessons

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

MS-ETS1-4 Engineering Design

Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

CCSS Math Content 6. RPA 1: Understand ratio concepts and use ratio reasoning to solve problems.

CCSS.Math. Content 7. GA.1 Solve problems involving scale drawings of figures.

**Teacher Notes:**

In this lesson, students will gather materials that they will use to build their 3D model using their scaled 2D model and project notes to estimate quantities from data. The materials are provided by the instructor in a central location and students are tasked with collecting what they need based on plans they have made up to this point. Suggested materials are provided below but individual teachers have room for creativity in materials they use to provide for this activity.

**Materials**

* Problem statement (copied and glued/taped into notebooks)

**Note:** Teachers may choose to use a traditional notebook or an electronic system such as Google Drive.

* 2D Scaled model from previous lesson
* Lab/Project specific notebook and writing utensil (1 per person)
* Food data excel spreadsheet
* Equipment for 3D model construction
  + Computer/ipad
  + Plastic trays (bakery) -- see photograph below
  + Post-it note grid paper
  + Construction paper
  + Styrofoam
  + Grid paper
  + Clay



**Lesson Preparation**

* Gather all necessary construction materials as outlined in the list above
* Prepare a mock-up Mars farm for demonstration for the students and to ensure that the materials selected are appropriate and pliable

**Time Required**: 60 minutes. Additional class times will likely be necessary, for further work time. (In our initial run through of this unit, one class completed their 3-D models in 2 class periods, and one class worked through 4 class periods.)

**Procedure[[1]](#footnote-0):**

Lesson Components:

* Teacher leads discussion on how to think about translating a 2D model to 3D emphasizing ratios and using the garden plan made in previous lessons. (Depending on the group, teacher may decide to model the transfer of information.)
* Teacher gives instructions on material availability and gives each group an opportunity to collect materials from a central location. Students may also bring additional supplies from home if desired. Students are encouraged to be creative when thinking about possible supplies.
* Students should be reminded of the previously established constraints for the model.
* Additional review of nutritional needs (carbs, protein, fats) and the approximate number of calories required per day, may be required.

Allow students time to explore with their 2D plan and material in front of them how to translate the model into 3D. Teacher circulates among the groups actively monitoring progress and scaffolding knowledge for those groups that may need additional help.

* Allow students to move around the classroom and share ideas across group but keep them focused on-task.
* Emphasize iteration from the 2D to 3D and making modifications as necessary.
* Remind students to document any changes to their model in their notebooks in preparation for the final presentation.

**Assessment:**

* Each student lists challenges associated with creating a 3D model in their notebooks
* Make a list of what needs to be finished in order to complete the model

**Accommodations:**

* Teacher will be monitoring progress and intervening where necessary accommodations need to be made
* Classrooms have microphones for hearing impaired.

1. The sub-sections of the procedure section (e.g., Understand the Problem, Explore the Problem) are from the Illinois Math and Science Academy’s PBL Teaching and Learning Template, however, the descriptions were developed by WABS and do not necessarily represent the views of IMSA. [↑](#footnote-ref-0)