**Could Mark Watney have actually grown plants on the small amount of water provided?**

Background: Water application in *The Martian.*

250 liters in Habitat + 600 liters “manufactured” = 850 liters

Soil volume = 126 m2 x 0.1 m deep = 12.6 m3 = 12600 L

Volume Ratio = 850 /12600 = 0.067

*Educational Opportunities*

A. Learn about assembling an experiment and maintaining a record of observations.

B. Become familiar with the metric system for measuring weight

C. Learn about the essential need for water in growing plants

*Materials and Experimental Environment*

* While potato can be used in this exercise, we used sweet corn to allow use of 1-L containers.
* Soil: Either collected soil (sandy loam) or obtain potting soil
* One-liter plastic soda bottles, with tops removed giving about 25-cm depth
* Saucers (e.g. aluminum pie plates) on which to place containers to catch drained water
* Volumetric cylinder to measure water volume.
* Balance to weigh pots with capacity up to ~2 kg.
* Sunny location to place pots

*Procedures* (The material in the box below can be put on the blackboard for students to copy into her/his notebook.)

1. Each laboratory group (2-4 students) prepare a container for each of the various watering treatments

a. One liter soda bottles need to be cleaned and carefully cut to allow soil depth of about 25 cm. These containers may need to be precut so that children do not have to use "sharps".

b. Poke small holes (~ 3-5 mm diameter), maybe using pointed scissors, in bottom of containers to allow drainage

2. Provide students with oven-dried soil. Oven drying will remove water from the soil.

3. Fill each container with soil to a depth of 20 cm. The soil should be gently packed in the container.

4. Sow three seeds in each pot to a depth of about 3 cm.

5. Add water to each container for prescribed treatments. The treatments will depend somewhat on the soil weight added in the pots. In our case, the soil weight was about 700 g and the water to be added on the first day was approximately 2%, 4%, and 12% of this weight. That is,

a. *The Martian* addition: 0.02 x 700 = 14 mL

b. Dry soil addition: 0.04 x 700 = 28 mL

c. Wet soil addition: 0.12 x 700 = 94 mL

(For simplicity, we gave the treatments to the students as 15, 30, 90 milliliters.)

6. After the water is added, each container is to be weighed to obtain initial weight for each treatment.

7. Place on drainage saucers in sunny location. (Actually, there should be no drainage. If drainage occurs from “wet soil”, then it is necessary to decrease amount of water added.)

8. Once emerged, students will record observations on plants every 7 to 10 days. On these days, containers should be re-weighed. From the weight data, the amount of water loss is calculated and the students add this amount of water to the pot to match each of the original treatment weights.

9. The exercise can be ended after about 4 weeks.

OBJECTIVE: Test growth of potatoes when given different amounts of water

PROCEDURES:

1. Fill containers with dry soil to 20 cm with gently packed soil.

2. Sow three seeds at 3 cm depth.

3. Add water to each pot according to the treatment (e.g. 15, 30, 90 milliliters)

4. Weigh and record containers to obtain initial weight

6. Every to 10 days record observations on plant heights, leaf length and color, and roots.

7. Also, on each of these days weigh and record container weight.

8. Calculate amount of water lost and add water to pot to return each container to initial weight.

*Results* (To be recorded in notebook similar to the tables given below.)

The key results from this exercise will be the length of the shoots on each day. The tables below can be used to guide data recording by students. In addition, we have learned that some students like to add drawings and/or narratives about the plants. These notes should also be encouraged as part of the notebook.

A graph can be plotted for each of the depth treatments of shoot length vs. dates. The slope of this graph could give insight about the influence of soil depth on growth.

**15 milliliters Water Added**

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| --- | --- | --- | --- | --- |
| **DATE** | **Weight** | **Water**  **Added** | **Shoot**  **Length** | **Shoot & Root Observations** |
| Initial |  | 15 | 0 | 0 |
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**30 milliliters Water Added**

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| --- | --- | --- | --- | --- |
| **DATE** | **Weight** | **Water**  **Added** | **Shoot #1**  **Length** | **Shoot & Root Observations** |
| Initial |  | 30 | 0 | 0 |
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**90 milliliters Water Added**

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| --- | --- | --- | --- | --- |
| **DATE** | **Weight** | **Water**  **Added** | **Shoot #1**  **Length** | **Shoot & Root Observations** |
| Initial |  | 90 | 0 | 0 |
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