The Trouble With Alien Plants

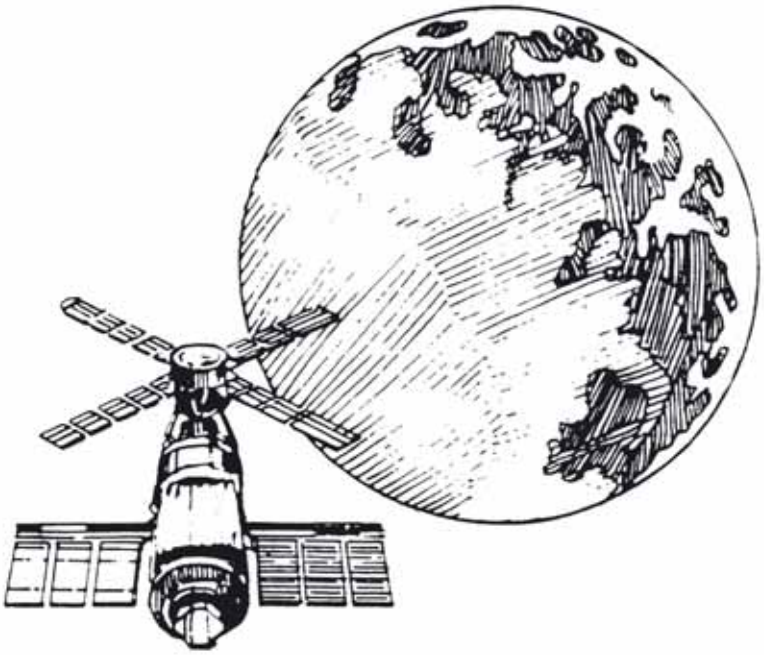
Activity Provided for 1990-1991 Engineers Week
by
National Talent Network (NTN) of EMC,
Junior Engineering Technical Society (JETS), and
Challenger Center for Space Science Education

Note to engineers: Three options for suggested use of this lesson during your Engineers Week visit are:

1. **Pre-visit Construction**
   This option allows you to focus on critiquing students' completed solutions during your visit. It requires set up with the teacher at least two weeks in advance of your visit.

2. **On-site Construction**
   This option allows you to monitor students' construction efforts during your visit. It requires set-up with the teacher a few days in advance of your visit.

3. **On-site Discussion**
   This option provides you with a focused discussion with students. It does not require a set-up in advance of your visit.



DISCOVER "E"
Engineering Our Environment

Introduction

For centuries, people have dreamed of traveling to other planets, even other galaxies. Not until the past 20 years has this dream become real, with people landing for the first time on the moon. Among NASA's current plans is an orbiter to circle Mars.

In our mind's eye, we can envision some years down the line a human colony on Mars. Like any other new venture, of course, with opportunities come problems.

Let us review one of these situations now, in which we are the colonists. Among the units in our domed Mars colony is a greenhouse, which serves two purposes: (1) the green plants produce oxygen for humans to breathe and (2) various necessary fresh produce items are grown for the colonists' diet. However, more dead plant material is being accumulated than can be disposed of. This situation is not only unsightly, but takes up valuable space and is potentially toxic. As colonists dependent on a limited and fragile environment, we must solve the problem now.

Problem

Students will design and produce a solution which will convert the dead plant materials into a useful product which:

1. is safe to use,
2. is user friendly,
3. is safe to the environment, both inside the Martian colony and outside, and;
4. does not involve composting or burning the dead plant materials

Developmental Steps

The following items help students focus on variables affecting the design of their solution.

1. Review the "Mars Facts in Brief", to give you a picture of the environment in which your colony and its greenhouse exist.
2. Review the basic living requirements which are addressed in extreme environments on Earth, for example, an Antarctic or a desert encampment or a Biosphere, such as the planned Biosphere II in Tucson, Arizona. How are these living requirements met? What consideration is given to the fragile environments mentioned above by those encamping in them?
3. Brainstorm ways in which excess dead plant materials are used here on Earth, besides composting. Notice how these uses are different from those for the original live plants.
4. Research what is planned or projected for life in a space colony. What must it include? What could it include? What needs will the colonists have and how will they spend their work and leisure time?

(Desert Equipment)

5. Brainstorm uses for the dead plant materials on your Martian colony.

6. Brainstorm possible devices for applying your best use from #5 above.

7. Evaluate your methods against the four criteria listed in the Problem section.

8. Design your method as a physical solution and construct a working model from the materials provided.

Mars Facts in Brief

1. Atmosphere - 95.32% carbon dioxide (CO_2) clouds and prevailing westerly winds are present.

2. Water - present as water vapor and ice; .03% of the atmosphere is water vapor in summer, mostly in the northern latitude: converts to polar ice caps and ground frost in winter, both more extensive in northern latitude.

3. Temperature - can vary by 90°F daily. Extremes: -225°F to +80°F.

4. Surface - rocks, soil of undetermined composition.

5. Solar day length - 24h 39m 35.28s

6. Solar year - 686.9794 solar days

Suggested Activity Sequences

1. Pre-visit Construction

Before your visit

a. Provide the teacher with a copy of the problem, suggest construction materials:

- tape
- rubber bands
- cardboard boxes
- garbage bags
- foil wrap
- string
- scissors
- stapler
- newspapers or Xerox paper

b. Arrange for each student team to present their solution to you during the first half of your visit. (3-4 minutes per presentation).

c. Ask that students be informed of the three evaluation criteria for their solution, each expressed as a 1-10 rank.

i. scientific accuracy
ii. engineering feasibility
iii. creativity

d. Agree to the timeline for your visit.

On the day of your visit

e. View the student presentations and informally evaluate them on the above criteria.

f. Debrief: discuss your rankings and how you arrived at them; how the sequence students followed is also followed in the engineering profession; and how your own engineering discipline might approach this problem.

2. On-site Construction

Before your visit

a. Provide the teacher with a copy of the problem and ask that Development Steps 1-5 be completed with students in advance of your visit.

b. Arrange with the teacher what materials you will supply and what are already available in the classroom. (Refer to list of materials in 1a.)

c. Remind students that today's purpose is to analyze the ideas behind their project. Their physical creation, which due to limited time must be a rough construction, is meant to serve as a motivational prop to focus their discussion.

On the day of your visit

d. Set up teams of 3-5 students.

e. Provide 15 minutes to brainstorm Development Steps 6 and 7.

f. Provide 15 minutes for teams to construct their solutions, reminding them of the three evaluation criteria in 1c.

g. In the final 15 minutes, debrief as in 1f.

3. On-site Discussion

On the day of your visit

a. Introduce students to the problem and work through Development Steps 1-7 with them. (15 minutes)

b. Have students brainstorm physical solutions and critique them as a group using the three evaluation criteria listed in 1 c.

c. Discuss how your own engineering discipline would approach the problem.

"The Trouble With Alien Plants" is a joint contribution of:

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