

Name \_\_\_\_\_ Period \_\_\_\_ Date \_\_\_\_\_

## MISSION TO MARS – Growing plants on mars

### 1. Task Context

View clip from *Mission to Mars*: (Suggested Start: 1:30; Suggested End: 8:00)  
And clip from the Martian

### 2. Task Explanation

You have just seen a scene from the movie, *Mission to Mars*, in which scientists on the rescue mission find their buddy, Luke, living successfully in a greenhouse on Mars. Imagine that you are one of those scientists, but when you arrive, you find the plants dying and Luke is having a difficult time breathing. You have 26 hours to figure out what is going wrong before the plants, Luke AND all of you die. The key is the plants...your task is to figure out why the plants are dying. Then design and construct a greenhouse model that will enable the plants to live

### 3. Hypothesize

**Hypothesis:** What could cause the plants to die that also makes it difficult for Luke to breathe.  
**The answer can include anything, but the explanation must make sense.**

### 4. Data Review

While you have been hypothesizing about what could go wrong, your colleague has been doing research and has found the environmental data that Luke has been collecting over the past two weeks. Examine the data provided. Then follow the directions to complete your task and save the plants and your lives!

**Table: Week 52 and 53 in Mars Greenhouse**

#### Environmental data

Day	Temp (°C)	Light (nm)	CO <sub>2</sub> (%of air)	O <sub>2</sub> (% of air)	water intake by plant	Stomatal opening	Photosynthesis rate
Week 52							
1	25	1500	0.03%	21%	1.0	1.0	100
2	25	1500	0.03%	21.0%	1.0	1.0	100
3	25	1500	0.03%	21 %	1.0	1.0	90
4	25	1500	0.03%	20.5%	0.9	1.0	100
5	25	1500	0.04%	21%	0.9	0.9	90
6	25	1500	0.06%	21%	0.8	0.9	90
7	25	1500	0.08%	20.5%	0.8	0.8	80
Week 53							
8	25	1500	0.1%	20.5%	0.8	0.9	70
9	25	1500	0.36%	20.5%	0.6	0.8	50
10	25	1500	0.68%	20%	0.5	0.6	30
11	25	1500	1.1%	19%	0.5	0.4	20
12	25	1500	1.8%	17%	0.4	0.2	10
13	25	1500	2.1%	15%	0.3	0.1	0
14	25	1500	2.9%	13%	0.1	0.1	0

For each of the columns in data table, write a sentence which describes the trend of the data.

**Temperature** – *“The temperature in the greenhouse remained constant at 25°C during week 52 and week 53*

**Light** –

**CO<sub>2</sub>** –

**O<sub>2</sub>** –

**Water** –

**Stomata** –

**Photosynthesis rate** –

## **5. Explanation of the Problem Google Doc**

Having examined the data, reassess your hypothesis and determine whether or not it was accurate or if it should be revised. Make a statement of your inferences as to what is killing the plants. Fully describe the factor(s), primary and secondary, causing the plant death and Luke’s breathing problem. Be sure to support this with data; reference the data tables provided and the graphs you created. Write a detailed explanation of how the factor(s) affects the photosynthetic rate. Include as much detail as you can on the process of photosynthesis.

## **6. Proposed Solution to the Problem – Google Doc**

In detail, recommend how to fix the problem in the greenhouse, explain why you came to those conclusions and develop a model of your solution.

## **7. Greenhouse 3D Model**

Using easily available materials, your team is going to construct a model of a greenhouse to grow plants on mars that will enable the plants to live

Parameters:

Model must be 3D

Model can be made by using available materials in class

Materials may be brought from home

If any materials are purchased by group members, the TOTAL expense, must be no more than \$10

Paper and cardboard may be used, indicating where glass is etc.

## **8. Presentation – You will present your project to class**

Describe your solution to the problem

Explain how your model solves the problem

## Notes and facts

- Mars is about 1.5 times further than the earth from the sun
- Temperature is -87 to -2 degrees Celsius
- Diameter is about  $\frac{1}{2}$  earth diameter
- Mars has no liquid water but does have frozen water
- Mars has very thin atmosphere
- Mars is tilted like earth and therefore has seasons
- The land mass surface of earth is the same as earth's dry land mass
- Mars gravity is 40% of earth's
- 1 orbit (1 year) of Mars is 687 days
- Mars rotates once in 24 hours and 37 mins (1 day)
- the usual concentration of oxygen in earth's atmosphere is 21%
- The usual concentration of CO<sub>2</sub> in outdoor air is .05%
- At 1% concentration of carbon dioxide CO<sub>2</sub> (10,000 parts per million or ppm) and under continuous exposure at that level, such as in an auditorium filled with occupants and poor fresh air ventilation, some occupants are likely to feel drowsy.
- The concentration of carbon dioxide must be over about 2% (20,000 ppm) before most people are aware of its presence unless the odor of an associated material (auto exhaust or fermenting yeast, for instance) is present at lower concentrations.
- Above 2%, carbon dioxide may cause a feeling of heaviness in the chest and/or more frequent and deeper respirations.
- If exposure continues at that level for several hours, minimal "acidosis" (an acid condition of the blood) may occur but more frequently is absent.
- Breathing rate doubles at 3% CO<sub>2</sub> and is four times the normal rate at 5% CO<sub>2</sub>.
- Toxic levels of carbon dioxide: at levels above 5%, concentration CO<sub>2</sub> is directly toxic. [At lower levels we may be seeing effects of a reduction in the relative amount of oxygen rather than direct toxicity of CO<sub>2</sub>.]