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 **ED532: Space Orientation for Educators**

“A blind study on the investigation of the effects of space on the germination rate of tomato seeds”- A Lesson Plan

**Overview**

This is an 8th grade lab investigation used in my Life Science class to re-introduce and implement the scientific method, metric measurements and the collecting and organizing of data. Students do this by studying the germination rates of two sets of tomato seeds that were exposed to space conditions to ultimately decide if these seeds will grow and be able to support human life in space. Tomato seeds are used because they are easy to work with, are healthy, and can provide clean water when it evaporates from the stomata underneath the leaves. Why space? Space is one of the last frontiers of exploration. Mars is a planet that most closely resembles earth and is currently being explored to see if it could sustain life.

 This lesson action plan is inspired by the *Tomatosphere* webpage and was developed and supported by [Let's Talk Science](http://www.letstalkscience.ca/%22%20%5Ct%20%22_blank), the [Canadian Space Agency](http://www.asc-csa.gc.ca/eng/default.asp%22%20%5Co%20%22Canadian%20Space%20Agency%20website%22%20%5Ct%20%22_blank), [HeinzSeed](http://www.heinzseed.com/%22%20%5Co%20%22HeinzSeed%20website%22%20%5Ct%20%22_blank), [Stokes Seeds](http://www.stokeseeds.com/home.aspx%22%20%5Co%20%22Stokes%20Seeds%20website%22%20%5Ct%20%22_blank), [the University of Guelph](http://www.uoguelph.ca/%22%20%5Co%20%22University%20of%20Guelph%20website%22%20%5Ct%20%22_blank), and [First the Seed Foundation](http://www.firsttheseedfoundation.org/%22%20%5Co%20%22First%20the%20Seed%20Foundation%20website%22%20%5Ct%20%22_blank). The lab protocol presented in this plan is my modification of what is outlined on the website.

**Purpose**

The purpose of this lab is to introduce my students to three major concepts in the Life Science curriculum: Plant growth, where students will be able to care for and monitor the germination of seeds. Metric measurements, where students will be able to use the correct tools and units to accurately measure the height of plant growth. Scientific Inquiry, where students will use the scientific method to create, and test a hypothesis; gather, organize and interpret their data in order to come to a logical conclusion on which seeds were the control and which seeds were the experimental before submitting their results online to *Tomatosphere.*

**Goals/Objectives**

Students will be able to:

* Plant tomato seeds
* Understand seed germination and photosynthesis
* Generate and test a hypothesis
* Monitor germination rates
* Measure the heights of plants using metric tools and units
* Organize, collect, record and analyze data
* Follow safe lab protocols
* Accept/reject original hypotheses using data to explain
* Understand the differences between variable and control
* Work as a team in a positive, productive manner

**Next Generation Science Standard**

MS-LS1-5 Construct a scientific explanation based on evidence for how

 environmental and genetic factors influence the growth of organisms.

**Common Core State Standards Connections**

CCSS.ELA-Literacy.W.8.1 Write arguments to support claims with clear reasons and

 relevant evidence.

CCSS.ELA-Literacy.W.8.2f Provide a concluding statement or section that follows

 from and supports the information or explanation presented.

CCSS.ELA-Literacy.W.2.7 Participate in shared and writing projects (e.g., read a

 number of books on a single topic to produce a report; record scientific

 observations).

CCSS.ELA-Literacy.W.8.2e Use precise language and domain-specific vocabulary to

 Inform about or explain the topic.

**Standards for Math practice**

MP.2 Reason abstractly and quantitatively

MP.4 Model with mathematics

MP.5 Use appropriate tools strategically

**Assessments**

Formative: Walking around and listening to what students are saying

 Answering questions students may have

 Ticket out the door

 KAHOOT:

https://play.kahoot.it/#/k/c468a905-8c26-4401-a183-a33fc5a8d54d

Summative: The formal lab report

 Quizzes/exams

**Engagement:** I will open with [**https://www.youtube.com/watch?v=Osi\_SIGH0V0**](https://www.youtube.com/watch?v=Osi_SIGH0V0)and have a class discussion

**Exploration:** Students actually conducting the lab

**Explanation**: Students compare and contrast data and engage in class discussion

**Elaboration:** Reviewing of websites/class discussion

**Evaluation:** Conclusion of team experiments

Name Date

Tomatosphere lab

**Overview**

Man has explored almost every frontier for food, medicine and a place to live. Some of those frontiers include the rainforests, oceans, the Artic and space. Some ideas that must be considered are: how similar is the environment to that of Earth?

Can we grow plants for food there? Is there access to any water?

In this lab, you will participate in a “blind study” where neither you nor your teacher know which sample is the experimental or the control. Your goal is to gather data on germination and growth rate of two sets of tomato seeds. Then, based on your data, you will make a conclusion as to which set of seeds you think is the control and which set you think is the experimental.

**Title:** Tomatosphere

**Purpose:** What are the effects of exposing tomato seeds to a space environment on

 germination and growth?

**Materials:**

Tomato seed packets supplied from Tomatosphere

8 x 50 count seedling trays

400 Jiffy-peat pellets

Water

Graduated cylinder

Metric ruler

Stirring rod

Graph paper with chart designs (2)

Green house

Promethean Board and Chrome books

**Procedure**:

 1. Label your tray with the number and letter of your seed packet.

 2. Place 1 peat pellet in every space of each seedling tray.

 3. Fill each section containing a peat pellet with warm tap water until each peat pellet fully expands.

 4. Pour off any excess water.

 5. Using the stirring rod, gently poke a 25mm indentation into each pellet.

 6. Very **carefully** open your packets of seeds and place **ONE** seed into each indentation.

 7. Gently, cover each seed with peat using your fingers.

 8. Place all seedling trays in the greenhouse on the counter in front of the window.

 9. Monitor for germination daily. Place the date of each seed’s germination on

 chart #1 in the appropriate space.

 10. Once each seed has germinated, measure the height in mm over a 5 day

 period.

 11. Record your height measurements in chart #2 in the appropriate space.

 12. Record any unusual characteristics you may notice as well.

 13. Water each peat pellet 5 ml every other day.

 14. Once all team data is collected, usually within a two week period, one

 member from each team will record the # of seeds that germinated and

 the # of seeds that did not germinate in the class data chart on the

 Promethean board.

 15. A class discussion will ensue on any growth anomalies teams may have

 noticed. A designated class recorder will keep track of this data and

 record it on the Promethean board.

 16. As a class, data will be sent to the Tomatosphere web site where we will

 then learn which packet of seeds was the control and which was the

 experimental. We will then compare this information with our hypotheses

 and have a final class discussion.

 17. Do a “ticket out the door” and turn it in to Mrs. Erikson before leaving.

**Data:**

1**.** Your **team data** are the filled-in charts on pages 3 and 4 of this lab.

 2. Include sketches with labels of your experimental set-up in team data.

**Analysis:**

1. Fill in the following information. Who was the
2. Seed planter \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Germination data collector \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Height data collector \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Experimental Set up sketcher \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. On a separate piece of paper, **each team member** must answer the

 following questions in complete sentences:

1. Define the following terms:
2. Hypothesis
3. Independent Variable
4. Dependent Variable
5. Control
6. Constant
7. Conclusion
8. What was the independent variable in this experiment? How do you know?
9. What was the control in this experiment? How do you know?
10. What was the dependent variable in this experiment? How do you know?
11. List at least 3 constants that were used in this experiment.
12. Was your hypothesis correct? Use your data to explain why or why not.
13. After learning which packet was the control and which was the experimental, are you surprised? Explain why or why not in 2-3 sentences using your data to support your reasoning
14. Who is Scott Kelly? (use tomatosphere.org as a resource)
15. Why study tomato seeds?
16. What is the International Space Station and why is it important?
17. Log onto <http://inhabitat.com/four-plants-grown-in-mars-like-soil-are-officially-declared-edible/> describe current research on growing food on Mars.
18. Based upon your review of the two websites AND the data gathered from this lab, explain why you think growing food on Mars is possible or impossible.
19. Explain how you used mathematics in this experiment.
20. Explain how you used ELA in this experiment.
21. If you could change anything in this experiment, what would it be and why?

**TEAM \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Data Chart #1: Germination rates Tray \_\_\_\_\_\_, seed packet labeled \_\_\_\_\_\_\_.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |

**TEAM\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Data chart #2: Height measurements, mm for 7 days**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **1**DDDDDDD | **2**DDDDDDD | **3**DDDDDDD | **4**DDDDDDD | **5**DDDDDDD | **6**DDDDDDD | **7**DDDDDDD | **8**DDDDDDD | **9**DDDDDDD | **10**DDDDDDD |
| **11**DDDDDDD | **12**DDDDDDD | **13**DDDDDDD | **14**DDDDDDD | **15**DDDDDDD | **16**DDDDDDD | **17**DDDDDDD | **18** DDDDDDD | **19**DDDDDDD | **20**DDDDDDD |
| **21**DDDDDDD | **22**DDDDDDD | **23**DDDDDDD | **24**DDDDDDD | **25**DDDDDDD | **26**DDDDDDD | **27**DDDDDDD | **28**DDDDDDD | **29**DDDDDDD | **30**DDDDDDD |
| **31**DDDDDDD | **32**DDDDDDD | **33**DDDDDDD | **34**DDDDDDD | **35**DDDDDDD | **36**DDDDDDD | **37**DDDDDDD | **38**DDDDDDD | **39**DDDDDDD | **40**DDDDDDD |
| **41**DDDDDDD | **42**DDDDDDD | **43**DDDDDDD | **44**DDDDDDD | **45**DDDDDDD | **46**DDDDDDD | **47**DDDDDDD | **48**DDDDDDD | **49**DDDDDDD | **50**DDDDDDD |

 **TICKET OUT THE DOOR QUESTION**

**Your friend told you that scientists have already grown vegetables in space- in Mars atmosphere. Do you think they are telling the truth, why or why not? Base your answer on what you learned while performing this lab and viewing the videos in class. Include two facts, one aha moment and a question you still have.**

**Fact #1**

**Fact #2**

**Aha moment**

**Question**