

Final PTMC

The effects of purple light on plants in regular soil and moon soil simulant

Team Incrementums

7th & 8th Grade

St. John's Catholic School

Brunswick Maine

Team Members:

Hypothesis Team: Luke A. Audrey L. Joseph S. Chloe C. Parker G.

Background Info Team : Allie L. Ellie H. Nate S. Aria G. Agnes E.

Procedure Team: Jesse D. Leo C. Gwen S. Patrick B. Cole W. Mary Kathleen S.

Material Team : Bella I. Isabelle M. Madigan W. Tiara S. Zoe B.

Problem or Question

a) What does purple light do for plant growth in Moon regolith vs Earth soil?

Background

Purple light is highly beneficial for plant growth during the vegetative stage, as it promotes the production of leaves and stems, which are crucial for flowering and fruiting. Purple light, particularly when it leans toward the red spectrum, is ideal for germinating seeds as it provides the necessary energy for chlorophyll production, a key element in photosynthesis. This targeted spectrum ensures plants receive exactly what they need to grow efficiently without expending energy on excess or wasted light ("How the Lighting Color Spectrum Affects Plant Growth," 2024).

In the context of an experimental setup, we plan to sow seeds $\frac{1}{4}$ -inch deep and space them about 1 inch apart in rows that are 10 inches apart. To ensure optimal hydration, the seeds will receive 5 milliliters of water daily on school days, totaling approximately 24.6 milliliters weekly. The arugula plants will be exposed to more than 6 hours of direct sunlight per day, which aligns with their requirements for optimal growth ("How to Plant, Grow, and Harvest Organic Arugula in a Raised Bed").

Additionally, purple light parallels the Moon's reflective properties. While the Moon does not emit its own light, "moonlight" is sunlight reflected off its surface, with half the Moon always in sunlight at any given time (Lunar Rocks, 2003). The lunar highlands, which are located above the dark maria basins, experience extreme temperature variations, ranging from approximately 390 K to 104 K, depending on the location and time of lunar day (Lunar Rocks, 2003).

Hypothesis

If purple light is compared to natural light, then there will be more leaves, it will flower faster, and overall it will grow better because it is documented that blue light helps chlorophyll production, increases plant quality, maximizes growth, and quickly helps with germination.

Blue light regulates stomata of plants and makes plants shorter, smaller, and thicker, and with greener leaves. Plants grown under red light are usually tall with thin leaves and lengthy height. Red light increases plant biomass and also creates faster flowering times. Therefore, a combination of blue light and red light, in the form of purple light will help the growth of the plant overall. Purple light should in theory cancel out the negative effects of both the blue light and the red light alone. For example, a less desirable trait of plants grown under blue light is that it makes plants in general shorter and thicker. This trait should be canceled out by the red light's common trait of being

taller and lengthy. We will test if the combined traits of red and blue light will help the plants grow successfully in such harsh conditions as lunar soil, microgravity, and quick changes in temperature, which are similar conditions that would be found on the moon.

Variables

- b) Independent variable? Color of Light: purple
- c) Dependent Variables ideas? Plant height and leaf color
- d) Control? Natural Light, earth soil, arugula (Roquette, heirloom non gmo seeds) in all 4 set-ups

Materials Needed:

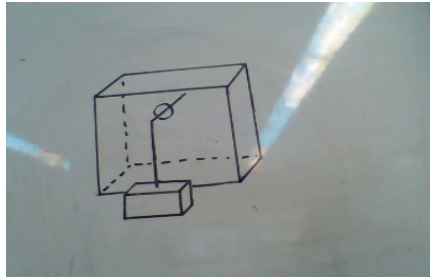
- Black planter (provided in box sent by nasa)
- Clear top (part of mini greenhouse kit)
- Green bottom (other part of mini greenhouse kit)
- Arugula seeds
- 5 ml tap water a day
- Water tube with lip
- Ruler
- Purple light, 20 led, auto on & off with 12hr timer, 9 dimmable lights
- Sunlight
- 2 and ½ cup moon regolith
- 2 and ½ cup earth soil
- 4 white name tags
- Cardboard box Box; dimensions W: 43.18 cm, L50.8 cm H:33.02 cm
- oDuct tape
- Electrical tape
- Scissors
- Pencil
- Marker
- highlighter
- gloves
- aprons
- N95 masks
- paper

Procedure

1. Gather Materials

2. Apply lab safety
 - a) lab goggles
 - b) disposable gloves
 - c) lab coat
 - d) hair tied up
3. Set up
 - a) assemble ($50.8\text{cm} \times 43.18\text{cm} \times 33.02\text{cm}$) grow light containment box
 - b) assemble ($15\text{cm} \times 11\text{cm} \times 11\text{cm}$) grow light stand
 - c) assemble purple grow light
 - d) fill 2 black planters (volume 343 cubic centimeters) with 311.15 cubic centimeters of lunar highlands regolith
 - e) fill 2 black planters (volume 343 cubic centimeters) up to 5 cm mark
 - f) place black planters in mini greenhouses
 - g) fit purple grow light into grow light containment box

Ex.:



- h) turn on grow light
- i) place 1 lunar highlands regolith greenhouse and 1 earth soil greenhouse in grow light containment box
- j) place 1 lunar highlands regolith greenhouse and 1 earth soil greenhouse in windowsill
- k) have 4 people do the following: plant 4 arugula seeds 0.635 cm deep and 2.54 cm apart in each greenhouse, close greenhouse lids.
- l) water each respective mini greenhouse with 5 ml of tap water each day
- m) record data in data table

Regolith type

For the plant the moon challenge, the 7/8 class chose moon regolith, in place of martian regolith. The reason for using moon regolith is because astronauts are going to survey the moon before the planet Mars. Another intention for using moon regolith was that our school was given a grant toward supplying the Lunar Regolith kits for this experiment. In conclusion, we are grateful for the opportunity to work with moon regolith.

Mission Patch



Data Tables

Earth Natural Light

	<i>Mon. Height</i>	<i>Mon. Buds</i>	<i>Fri. Height</i>	<i>Fri. Buds</i>	
<i>Total Height</i>					
Week 1	X	X	3/10 cm	0	+3/10 cm
Week 2	X	X	X	X	X
Week 3	X*	X*	X	X	X
Week 4	1 1/10 cm	0	No Measure	No Measure	+1 1/10 cm
Week 5	2 ½ cm	0	2 ½ cm	0	+2/10 cm
Week 6	3 1/10 cm	0	4 cm	0	+9/10 cm
Week 7	4 cm*	0*	4 ½ cm	0	+ ½ cm
Week 8	5 cm	0	6 cm	0	+ 1 cm

*Long Weekend. Data Recorded on Tuesday

0 = there are no buds

X = there is no evident plant

No Measure = we forgot to measure

Moon Natural Light

	<i>Mon. Height</i>	<i>Mon. Buds</i>	<i>Fri. Height</i>	<i>Fri. Buds</i>	
<i>Total Height</i>					
Week 1	X	X	1/10 cm	0	+1/10 cm
Week 2	2/10 cm	0	4/10 cm	0	+2/10 cm
Week 3	1/10 cm*	0*	X	X	-1/10 cm
Week 4	7/10 cm	0	No Measure	No Measure	+1/10 cm
Week 5	2 ½ cm	0	2 1/2 cm	0	+ 0 cm
Week 6	2 cm	0	1 ½ cm	0	- ½ cm
Week 7	1 ½ cm*	0*	2 cm	0	+ ½ cm
Week 8	2 ½ cm	0	2 cm	0	- ½ cm

*Long Weekend. Data Recorded on Tuesday

0 = there are no buds

X = there is no evident plant

No Measure = we forgot to measure

Moon Purple Light

	<i>Mon. Height</i>	<i>Mon. Buds</i>	<i>Fri. Height</i>	<i>Fri. Buds</i>	
<i>Total Height</i>					
Week 1	X	X	9/10 cm	0	+ 9/10 cm
Week 2	2 1/2 cm	0	2 7/10 cm	0	+2/10 cm
Week 3	2 1/2 cm*	0*	3cm	0	+1/2 cm
Week 4	3/10 cm	0	No measure	No measure	+3/10 cm
Week 5	X	X	X	X	X
Week 6	2cm	0	1 cm	0	-1cm
Week 7	5cm*	0*	½ cm	0	-4 ½ cm
Week 8	X	X	X	X	X

* Long Weekend. Data Recorded on Tuesday

0 = there are no buds

X = there is no evident plant

No Measure = we forgot to measure

Earth Purple Light

	<i>Mon. Height</i>	<i>Mon. Buds</i>	<i>Fri. Height</i>	<i>Fri. Buds</i>	
	<i>Total Height</i>				
Week 1	X	X	8/10 cm	0	+8/10 cm
Week 2	1 3/10 cm	0	9/10cm	0	- 4/10cm
Week 3	1 cm*	0*	X	X	-1/10 cm
Week 4	X	X	No measure	No measure	X
Week 5	X	0	X	0	X
Week 6	3 cm	0	4 ½ cm	0	+1 ½ cm
Week 7	2 cm*	0*	5 cm	0	+3 cm
Week 8	4 9/10 cm	0	3 ½ cm	0	-14/10 cm

* Long Weekend Data Recorded on Tuesday

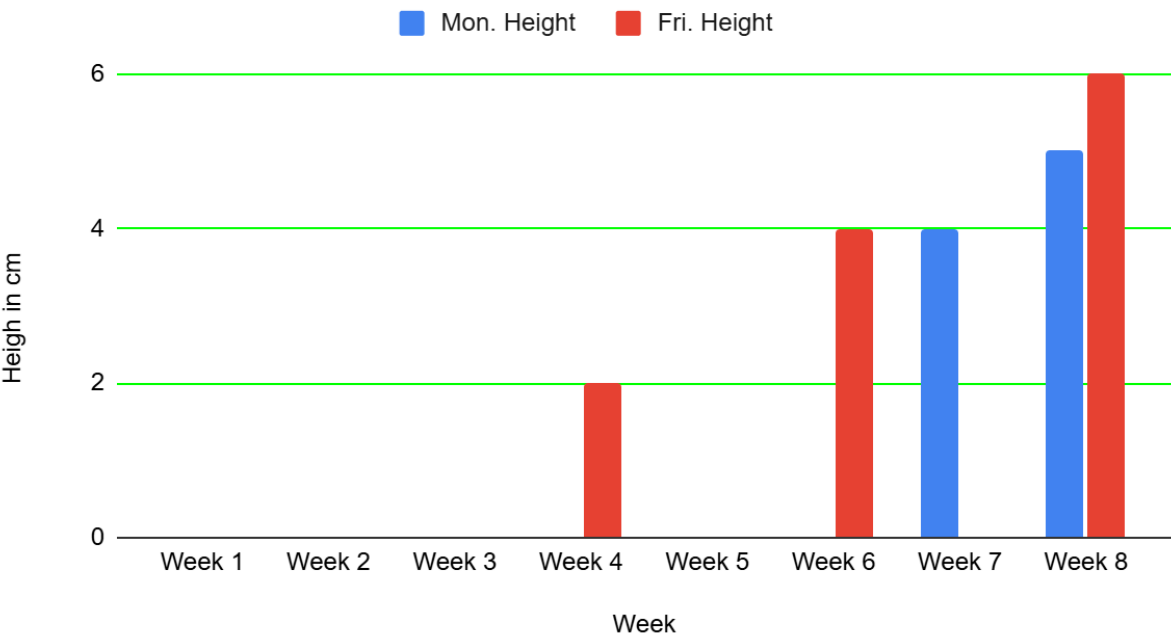
0 = there are no buds

X = there is no evident plant

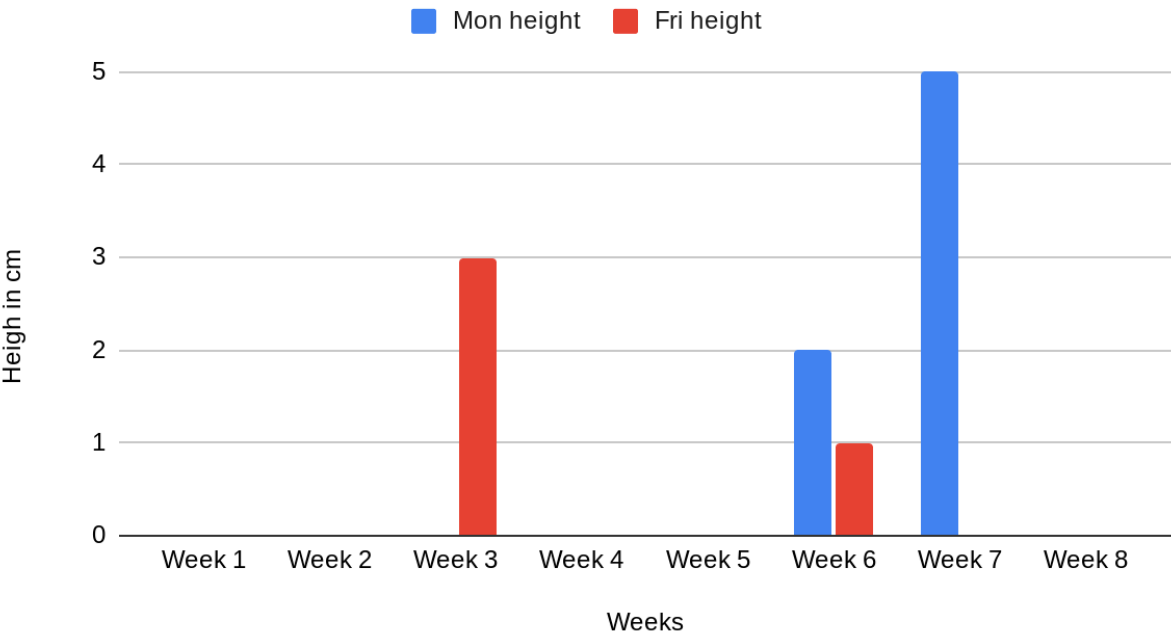
No Measure = we forgot to measure

Analysis/Graphs

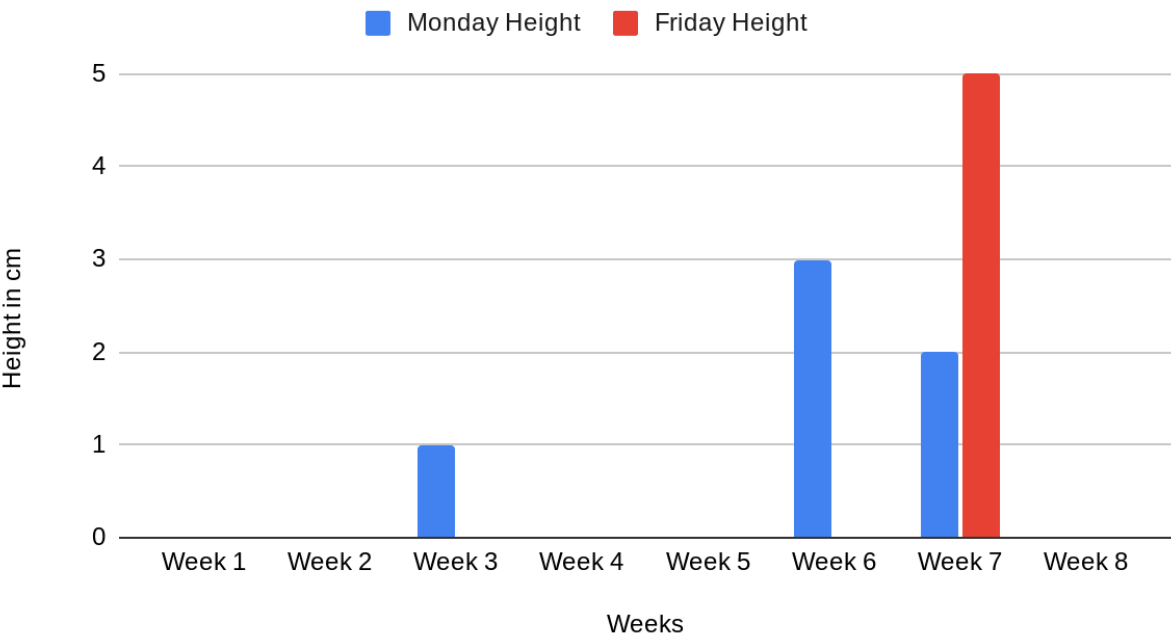
Moon Natural Light



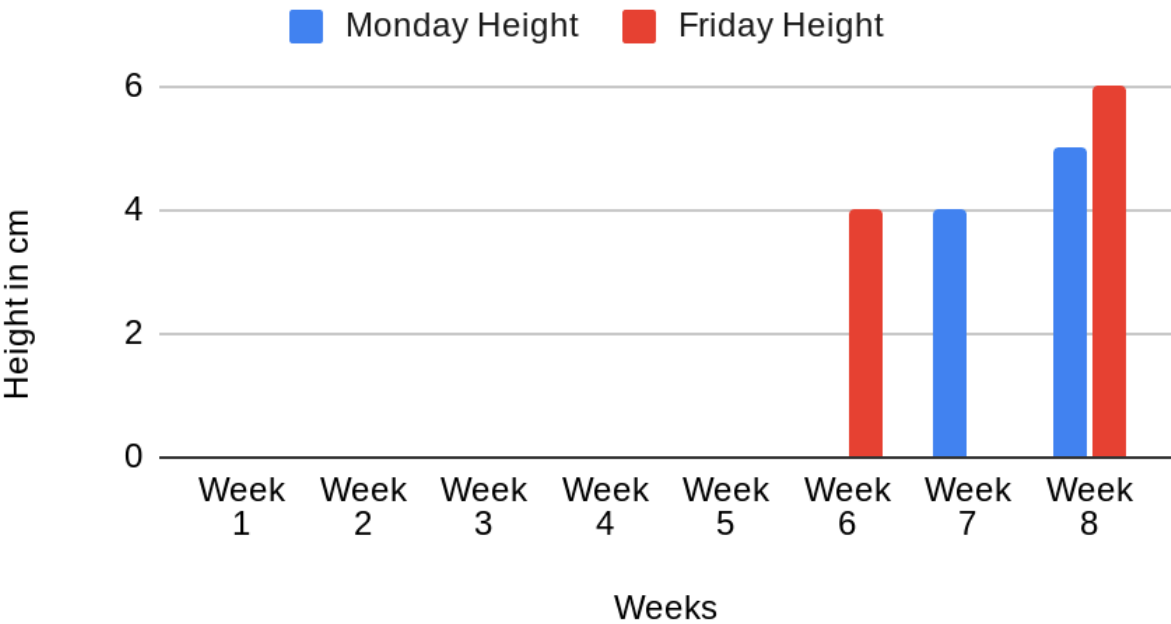
Moon Purple Light



Earth Purple Light



Earth Natural Light



Conclusion

During our eight weeks in the PTMC, we faced a lot of challenges that helped us learn how to adapt and solve problems. One big challenge was figuring out how much water the plants needed to grow best. At first, we gave them 5 milliliters of water, but when they didn't grow much, we changed it to 20 milliliters, and they started growing better.

Our original hypothesis was that plants would grow better under purple light than natural light. But the data in our chart rejects the hypothesis statement—plants under natural light grew a lot better! This taught us how important it is to stay flexible and think critically when things don't go as planned in experiments.

Looking back, we saw ways to improve. For example, if we had started with more water right away, the plants might have grown even better.

We also started asking new questions, like how astronauts can provide natural light for plants in space, where sunlight doesn't work the same way. Maybe advanced lighting or reflective materials could help. It's exciting to think about how science can solve these problems.

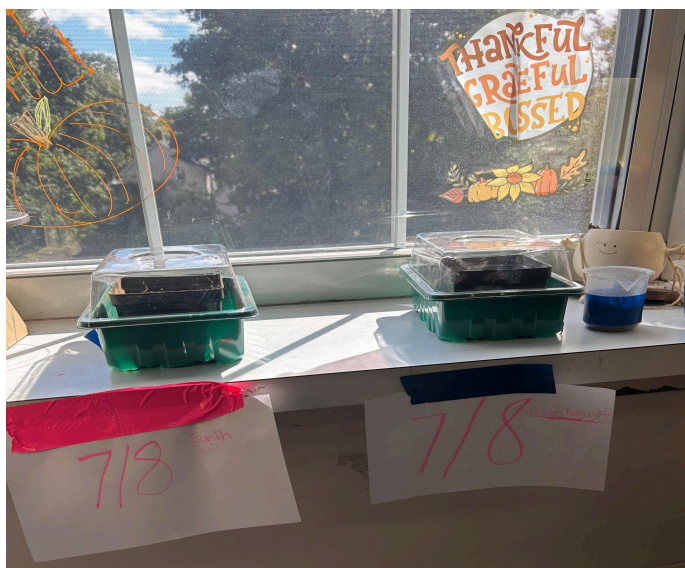
The PTMC didn't just teach us the steps of the scientific method; it made us curious about space and agriculture. It showed us how experiments can connect to real-world problems, and it inspired us to think about how we can be part of solving them.

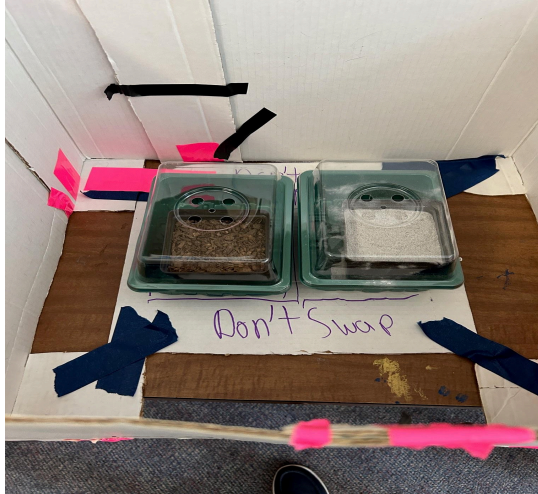
Team picture





Experiment photos





Box for Purple Light experiment both moon regolith simulant and earth soil.

Control Natural Light



Lunar Regolith Natural light

Earth Soil Purple Light





Earth Soil Arugula Purple Light



Moon Regolith natural light

Earth Natural Light



Works Cited

Albee, Arden L. "Lunar Rocks." *Encyclopedia of Physical Science and Technology*, 2003, pp. 825–837, <https://doi.org/10.1016/b0-12-227410-5/00390-2>. Accessed 26 Sept. 2024.

"How to Plant, Grow, and Harvest Organic Arugula in a Raised Bed." *Gardenary*, www.gardenary.com/blog/how-to-plant-grow-and-harvest-organic-arugula-in-a-raised-bed. Accessed 26, Sept. 2024.

Your Webster Design. "How the Lighting Color Spectrum Affects Plant Growth." *SpecGrade Grow*, 4 Apr. 2024, www.specgradeled.com/grow/news/how-the-lighting-color-spectrum-affects-plant-growth/. Accessed 26 Sep. 2024.