

Team: 5th Grade Science - The Wilson School
Team #: 19240
Plant the Moon, Jr., Fall 2024
Elementary Level

QUESTION:

How do different lighting colors affect spinach growth in Martian regolith, Missouri soil, and Charlie's compost?

BACKGROUND:

Spinach

Spinach is good for you and an important crop to grow on Mars. It has a lot of benefits. Spinach is high in nutrients, like vitamins A, C, E, and K, iron, folate, magnesium, and even protein. ([Eating Well](#)) Spinach can help support immune function. It will aid the digestive system and may even have anticancer properties. ([Medical News Today](#))

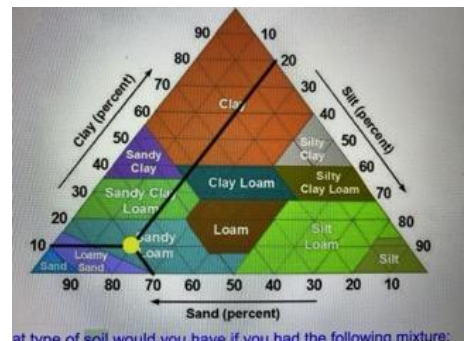
Spinach is very nutritious for anyone to eat, and it is important to have good nutrition for anyone traveling to Mars. The proteins inside spinach can help astronauts get protein on Mars. Spinach can sometimes lower your blood pressure and help your skin become smoother and healthier. ([WebMD](#)) These effects can help astronauts with any problems like getting sick or getting cancer and they can help with stomach aches. This plant is great to grow on Mars!

Spinach grows most quickly in well-drained soil rich in organic matter such as compost or composted manure and with a pH of 6.5 to 7. A pH describes the acidity or alkalinity of your soil or other things. A pH ranges from 0-14, 7 being a neutral factor. ([Bonnie's Plants](#)) We will be trying to keep our pH close to neutral.

Missouri Soil

Missouri soil consists of a combination of sand, silt, and clay particles ([Mefro: Missouri State Soil](#)). Clay soil can hold water and nutrients very well. Clay particles hold onto ammonium and trace elements like potassium, calcium, and magnesium. Fertile soil is a result. Clay can be hard to work with, but breaking it up helps water and airflow in it. Also, adding organic matter, like manure can help it. ([University of Missouri](#))

We took soil from our schoolyard. We made sure we took the soil and not the mulch on top of it. Once we took our sample, we did a mason jar test and discovered our soil is 100% clay. ([Mason Jar Test](#))



Charlie's Compost

We are adding compost to our Missouri soil. This is a soil amendment. A soil amendment is a product that is added to soil to improve it. It is made of organic matter and it helps improve the texture and structure of the soil by adding nutrients, improving drainage or water retention, and adjusting the pH level. ([Ted's Gardens](#))

We selected a compost product from Charlie's Compost. It is made in Kentucky and certified organic. We liked what their website said, "It is concentrated plant fertilizer that will jumpstart the bioactivity and nutrient content of your soil. If you want beautiful, healthy, and vibrant plants or vegetables, this is the product for you!" The website also says it adds nutrients along with microorganisms and matter that are very important for soil health. The ingredients are from chicken manure and are composted cornstalks, composted wheat straw, composted forest products, composted fescue hay, clay, ACS N-converter, ACS Humifier, and ACS Finisher. ([Charlie's Compost](#))

The ratio recommended is 1 part compost to 4 parts soil. To use this, we will be putting 40 g of compost with 120 g of Missouri soil in each pot.

Martian Regolith

Martian regolith is the soil of Mars. It is made up of mineral matter and does not have organic materials like soil does on Earth. This is because organic material is made of biotic factors and since there is no life on Mars, organic material as we know it does not exist. Weathered volcanic rock makes up the mineral matter. It is mostly made of sand but also has some clay and silt particles. It is a reddish color from the iron oxide in it. We have information on the soil of Mars from rovers sent there. However, no regolith from Mars has come to Earth. Therefore, we are using a regolith simulant made by scientists to mimic the soil from Mars. ([The Soil on Mars](#)) ([Martian Soil](#))

For our project, we are going to use 240 grams of Martian regolith, which will be 60% of our soil. We are hoping that the Missouri clay will help balance out the sandy nature of the regolith and that the compost will add the needed nutrients for plants to grow.



Lighting Color Effects on Plants

Plants react differently to different colored lights. Light causes plants to make their own energy (food) called photosynthesis. Studies have shown that green light is the least helpful in growing plants. This is because it is mostly reflected off the green plant. Blue light is helpful in the plant's germination phase. This will help with the plant sprouting and developing roots. It also helps vegetative leaf growth. Violet or purple light has been shown to be good for helping the growth and development of leaves. Red light helps in the blooming and flowering phases. It has a long wavelength that allows it to radiate more energy and heat than other colors.



([Lighting Spectrum for Plant Growth](#)) ([Can Colored Lights Help Plants Grow](#)) ([MDPI](#))

For our project, we will use the following lights: red, blue, purple, and white.

Why Are We Interested in This Topic?

We picked this topic because we think that the lighting might affect the plants in different ways than water and soil alone. We picked red, blue, violet, and white for our light colors. We also think that this topic is interesting because lighting is cool and fun to study. We love this project because we get to help astronauts figure out how to grow plants in space with Martian regolith. We are very excited because we get to use a replica of Martian soil. It helps us learn how to do things in space while staying on Earth. Plus it has been fun to collect soil and mix the compost, soil, and Martian regolith together.

PROJECT HYPOTHESIS:

Based on our research, we think that blue light will produce the most growth since it is the most helpful in germination and helps encourage vegetative leaf growth.

INDEPENDENT VARIABLE:

Our independent variable is what we are changing in this experiment. We are changing the color of the lighting used to grow the plants. Our colors are purple, red, blue, and white. We are testing two pots per color.

DEPENDENT VARIABLES:

The dependent variables are everything we are measuring. Our dependent variables in this experiment are the height the spinach grows, in centimeters, and the number of leaves sprouted on each plant.



CONTROLS:

The controls are what we keep constant. Here is how we will keep things the same:

- Plants are in the same location in the classroom.
- All pots will get a mixture of 40% soil + compost and 60% Martian regolith. Each pot will get 120 g of Missouri soil mixed with 40 g of Charlie's compost and 240 g of Martian regolith.
- The pots are all the same material and size.
- All pots will get one spinach seed from the same package.
- We will water the plants at the same time and from the same water source. We will measure based on the reading from the moisture reader. We will not add water if moisture is at a 7 or higher. If the level is 4-6, we will add 10 mL of water. If the level is 0-3, we will add 20 mL of water.
- All plants are placed in the same type of greenhouse. This will help us keep temperature and humidity levels consistent. A thermometer is placed in each greenhouse to help us monitor temperature.
- We will monitor the pH levels and consistently make adjustments based on the reading.
- Lighting was purchased from the same manufacturer. This is so they will have the same intensity and brightness. We will have the lights on at the same time and for the same length of time - 12 hours on and 12 hours off. We will make sure the angle and height are the same for each plant. The white light serves as our control since most plants get white light that imitates sunlight and allows us to compare colors.
- All plants will grow in the 8 week window given by PTMC.

EXPERIMENTAL DESIGN AND PROCEDURE:

1. Mix 60% Martian regolith (240 g) with 40% soil (40 g compost and 120 g Missouri clay soil).
2. Fill a pot with this mixture (400 g).
3. Repeat 7 more times, so you have 8 pots total.
4. Place 2 pots in each of the 4 greenhouses.
5. Put a grow light in each greenhouse. One will be set to white, one to red, one to blue, and one to violet.
6. Set the timer so the greenhouse will have light for 12 hours daily.
7. Label each plant. White light plants will be labeled as W1 & W2. Red light plants will be labeled as R1 & R2. Blue light plants will be labeled B1 & B2. Violet light plants will be labeled V1 & V2.
8. Plant one spinach seed in each pot 2.5 cm deep.
9. Each day, check the moisture level, pH, temperature, growth, and leaf count.

DATA, RESULTS, & ANALYSIS:

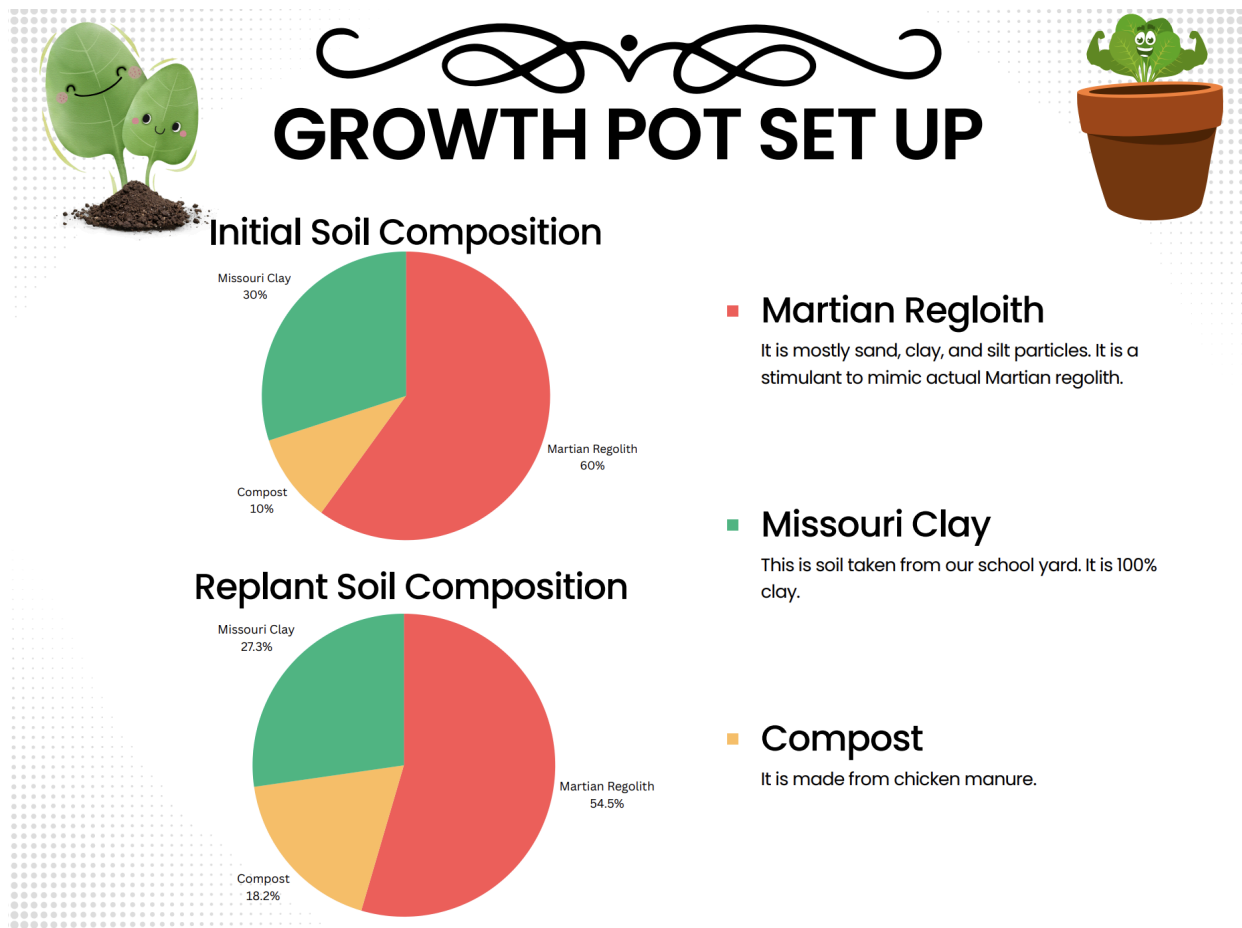
As our plants grew, we collected data on growth, leaf number, moisture level, and pH level. In looking at our data on growth height and leaf count, our hypothesis was inconclusive. There was not enough evidence to support it since the initial spinach crops that we planted all died and we had to replant. The new growth period had different results and we had to stop it at the end of the growth period, so it was hard to tell if the hypothesis was completely right or wrong.

We realized that the most probable cause for our plants suddenly dying was bolting. Bolting is a process in which plants undergo too much stress and fall over and die. All of our plants did this. The stress may be caused by temperature, soil moisture, and too much light. ([Houzz Q & A](#)) This stress on the plants is caused by warm temperatures and spinach plants are happiest in colder climates closer to 4.4 - 21° Celsius. Spinach must have the correct amount of water. Our research told us to make

sure the soil did not get too dry. Additionally, longer daylight can cause bolting. ([The Beginner's Garden](#))

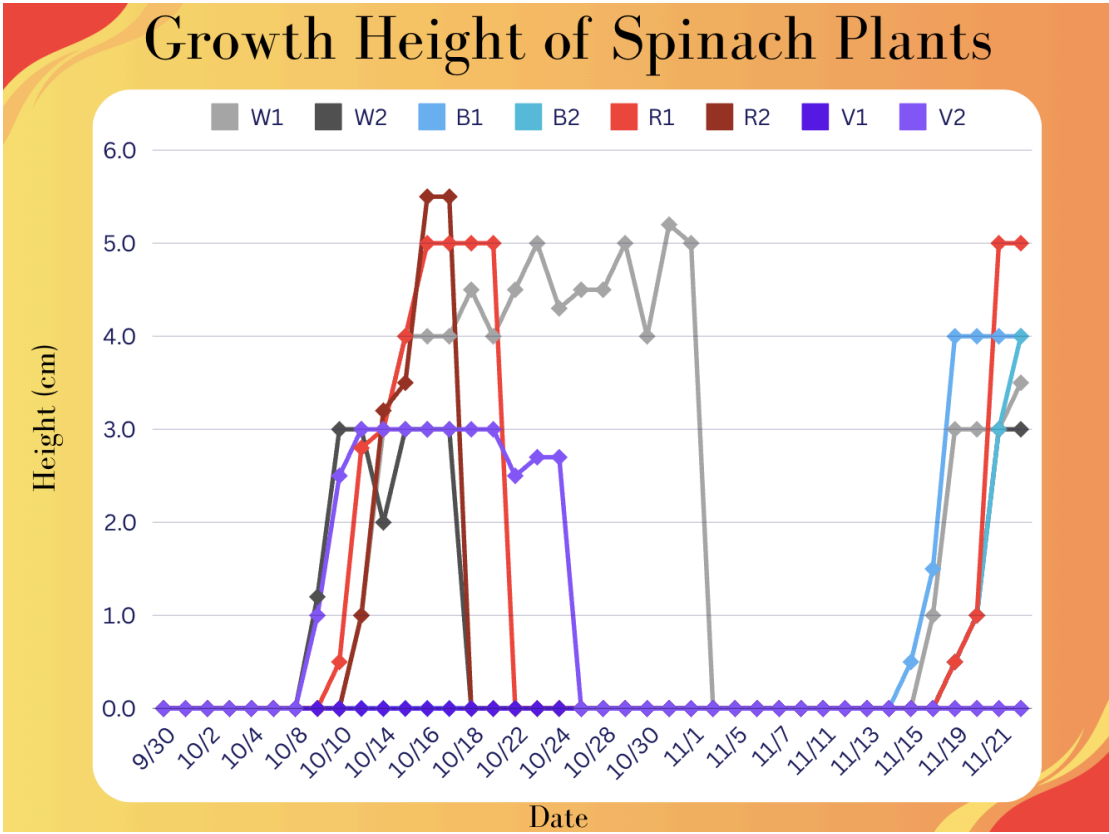
In response to our research on why our plants died, we made the following changes on November 4, the start of our 6th week of the growing season:

- Added 40 g of Charle's compost to our pots. This now makes our pots 240 g regolith, 200 g of compost/soil. Our new per percentages is $220\text{g}/440\text{g} = 45\%$ soil/compost and $240\text{g}/440\text{g} = 55\%$ regolith. We wanted to make sure the plants had enough nutrients.
- Replanted spinach in all the pots, 2.5 cm deep. We kept this the same from the first plant.
- Reset our light to 8 hours on daily instead of 12 hours. This is because we learned that longer daylight can cause bolting.
- We went to what we thought was the coolest place in the school to take temperature readings. It is consistent with our classroom at around 23 degrees C. Unfortunately, we do not think we can cool this down more and hope that the 2 degrees higher from the ideal temperature is not a big problem.
- Will be misting 3 sprays of water in all the pots each school day, regardless of the moisture level. This is because we often noticed the soil looking dry on top even when the moisture reader was telling us that it had enough water. This is also our plan to help cool them.

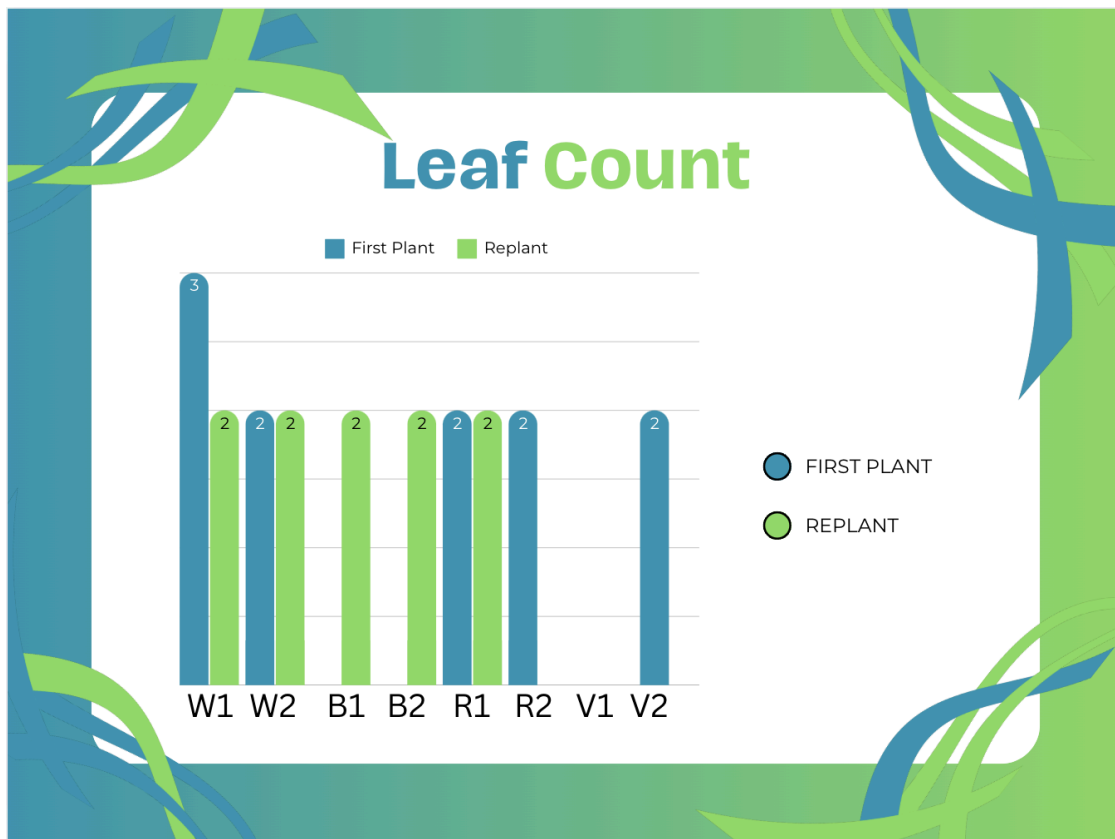


Growth Height & Leaves

Week #	Date	Growth Height (cm)							
		W1	W2	B1	B2	R1	R2	V1	V2
1	9/30	0	0	0	0	0	0	0	0
	10/1	0	0	0	0	0	0	0	0
	10/2	0	0	0	0	0	0	0	0
	10/3	0	0	0	0	0	0	0	0
	10/4	0	0	0	0	0	0	0	0
2	10/7	0	0	0	0	0	0	0	0
	10/8	0	0	0	0	0	0	0	0
	10/9	0	1.2	0	0	0	0	0	1
	10/10	0	3	0	0	0.5	0	0	2.5
	10/11	1	3	0	0	2.8	1	0	3
3	10/14	3	2	0	0	3	3.2	0	3
	10/15	4	3	0	0	4	3.5	0	3
	10/16	4	3	0	0	5	5.5	0	3
	10/17	4	3	0	0	5	5.5	0	3
	10/18	4.5	0	0	0	5	0	0	3
4	10/21	4	0	0	0	5	0	0	3
	10/22	4.5	0	0	0	0	0	0	2.5
	10/23	5	0	0	0	0	0	0	2.7
	10/24	4.3	0	0	0	0	0	0	2.7
	10/25	4.5	0	0	0	0	0	0	0
5	10/28	4.5	0	0	0	0	0	0	0
	10/29	5	0	0	0	0	0	0	0
	10/30	4	0	0	0	0	0	0	0
	10/31	5.2	0	0	0	0	0	0	0
	11/1	5	0	0	0	0	0	0	0
6	11/4	0	0	0	0	0	0	0	0
	11/5	0	0	0	0	0	0	0	0
	11/6	0	0	0	0	0	0	0	0
	11/7	0	0	0	0	0	0	0	0
	11/8	0	0	0	0	0	0	0	0
7	11/11	0	0	0	0	0	0	0	0
	11/12	0	0	0	0	0	0	0	0
	11/13	0	0	0	0	0	0	0	0
	11/14	0	0	0	0	0	0	0	0
	11/15	0	0	0.5	0	0	0	0	0
8	11/18	1	0	1.5	0	0	0	0	0
	11/19	3	0.5	4	0.5	0.5	0	0	0
	11/20	3	1	4	1	1	0	0	0
	11/21	3	3	4	3	5	0	0	0
	11/22	3.5	3	4	4	5	0	0	0

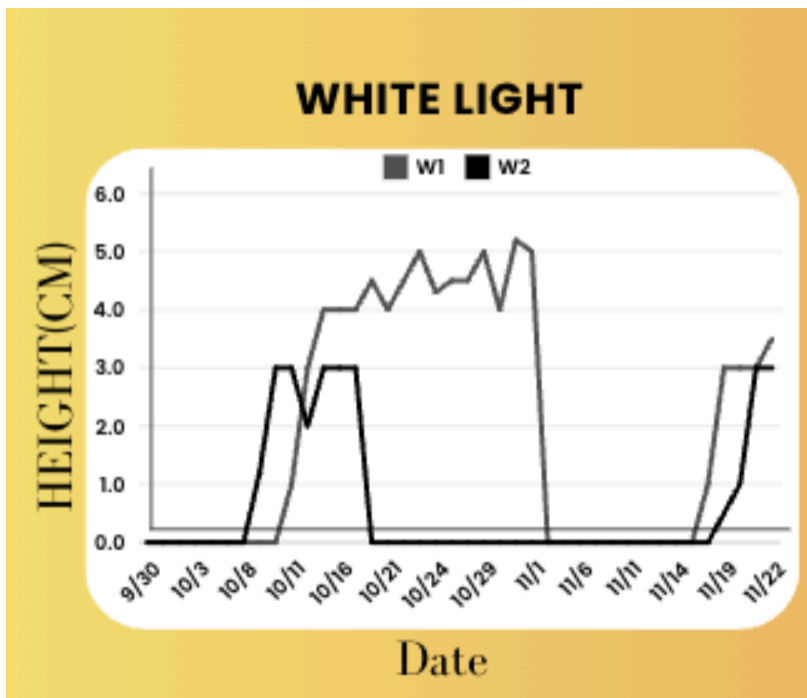


Week #	Date	Leaf Count							
		W1	W2	B1	B2	R1	R2	V1	V2
1	9/30	0	0	0	0	0	0	0	0
	10/1	0	0	0	0	0	0	0	0
	10/2	0	0	0	0	0	0	0	0
	10/3	0	0	0	0	0	0	0	0
	10/4	0	0	0	0	0	0	0	0
2	10/7	0	0	0	0	0	0	0	0
	10/8	0	0	0	0	0	0	0	0
	10/9	0	2	0	0	0	0	0	0
	10/10	0	2	0	0	0	0	0	2
	10/11	2	2	0	0	0	0	0	2
3	10/14	2	2	0	0	2	2	0	2
	10/15	2	2	0	0	2	2	0	2
	10/16	2	2	0	0	2	2	0	2
	10/17	2	2	0	0	2	2	0	2
	10/18	2	2	0	0	2	2	0	2
4	10/21	2	0	0	0	2	2	0	2
	10/22	2	0	0	0	2	2	0	2
	10/23	2	0	0	0	2	2	0	2
	10/24	2	0	0	0	2	2	0	2
	10/25	3	0	0	0	2	2	0	2
5	10/28	3	0	0	0	0	0	0	1
	10/29	3	0	0	0	0	2	0	0
	10/30	3	0	0	0	0	2	0	0
	10/31	3	0	0	0	0	2	0	0
	11/1	3	0	0	0	0	2	0	0
6	11/4	0	0	0	0	0	0	0	0
	11/5	0	0	0	0	0	0	0	0
	11/6	0	0	0	0	0	0	0	0
	11/7	0	0	0	0	0	0	0	0
	11/8	0	0	0	0	0	0	0	0
7	11/11	0	0	0	0	0	0	0	0
	11/12	0	0	0	0	0	0	0	0
	11/13	0	0	0	0	0	0	0	0
	11/14	0	0	0	0	0	0	0	0
	11/15	0	0	0	0	0	0	0	0
8	11/18	2	2	2	0	0	0	0	0
	11/19	2	2	2	2	0	0	0	0
	11/20	2	2	2	2	0	0	0	0
	11/21	2	2	2	2	2	0	0	0
	11/22	2	2	2	2	2	0	0	0



White Light

Pictures on November 22



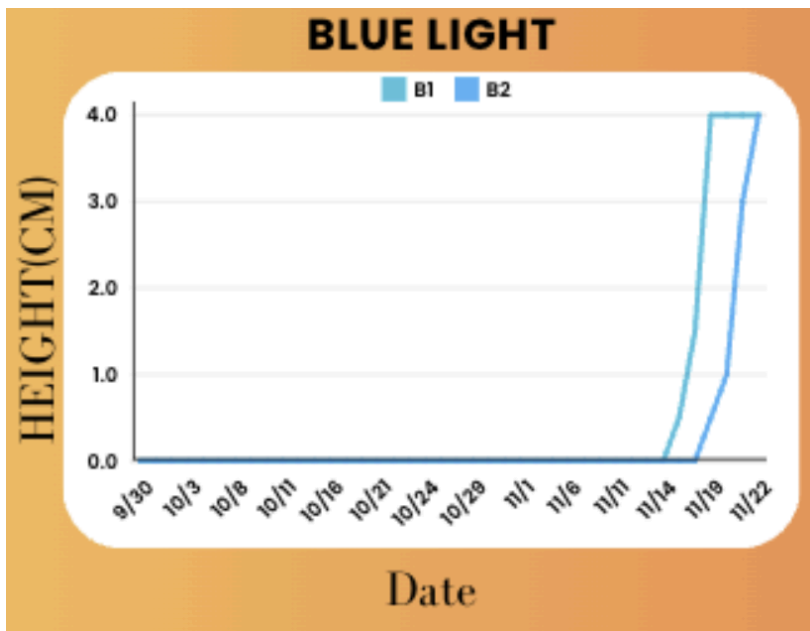
Plant	W1		W2	
	1st Planting Period (9/30-11/4 36 Days)			
Days from Plant to Sprout	11 days		10 days	
Days from Sprout - Full Height	21 days	0-5.2 cm	2 days	0-3 cm
Days of Growing	22 days (died)		9 days (died)	
	2nd Planting Period 11/4 -11/22 19 Days)			
Days from Plant to Sprout	14 days		15 days	
Days from Sprout - Full Height	8 days	0-3.5 cm	3 days	0-3 cm
Days of Growing	5 days + (alive at deadline)		4 days + (alive at deadline)	

Our spinach plants in the white light were our control group. Both plants started to grow successfully but then died. Both also grew in our second planting. W1 sprouted on day 12 and W2 sprouted on day 11. W1 reached a maximum height of 5.2 cm and W2 reached 3 cm. Regarding leaf growth, W1 produced 3 leaves, the most out of any plant. However, W1 in the replant produced 2 leaves and W2 produced 2 leaves both times. In our first plant, W1 was alive for 22 days and W2 had 9 days. 22 days alive was the longest amount of time any of our plants lived. Both were alive at the end of our growing period.

Even though W1 was only the second tallest plant in the experiment, the plants in the white light produced the most consistent growth. We replanted it took longer to sprout. We wished we had more time because we would like to see how much it could have grown.

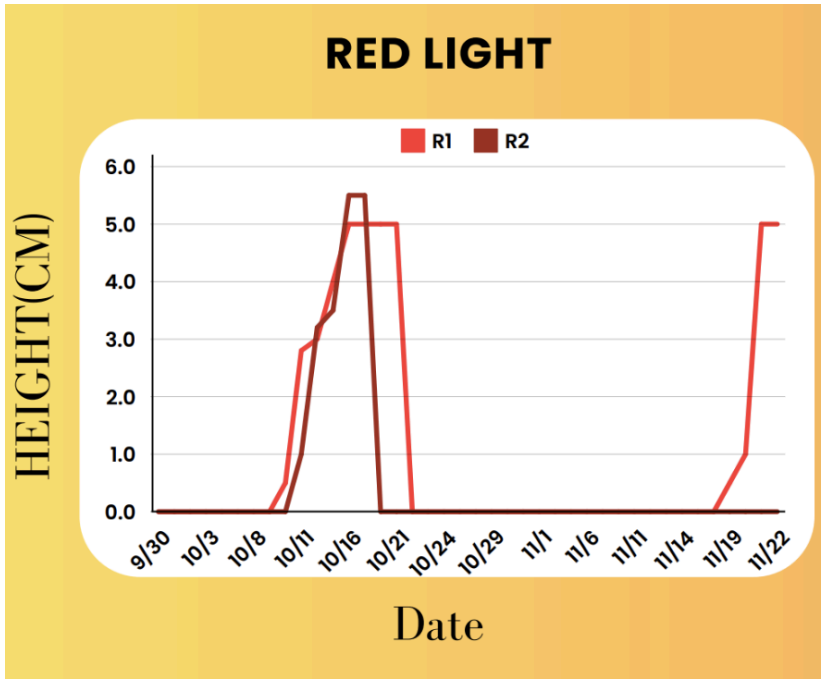
Blue Light

Pictures on November 22

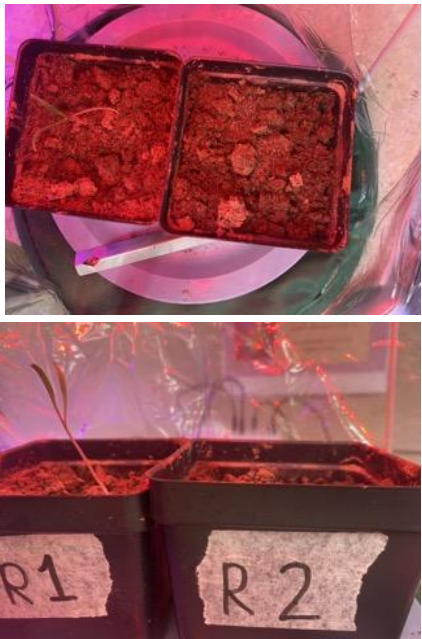


Plant	B1		B2	
	1st Planting Period (9/30-11/4 36 Days)			
Days from Plant to Sprout	No Growth		No Growth	
Days from Sprout - Full Height	No Growth	No Growth	No Growth	No Growth
Days of Growing	No Growth		No Growth	
	2nd Planting Period 11/4 -11/22 19 Days)			
Days from Plant to Sprout	11 days		15 days	
Days from Sprout - Full Height	5 days	0-4 cm	4 days	0-4 cm
Days of Growing	8 days + (alive at deadline)		4 days + (alive at deadline)	

For our first planting, our spinach plants in the blue light did not grow. After we replanted, B1 started to grow on November 15. On November 19, B2 started to grow. They were consistent on growing and both ended on a height of 4 cm on the last day of the growing period. They both had 2 leaves. We believe that the changing of the soil helped them regrow very well. The growth of 4 centimeters in 5 days and 4 days respectively make our hypothesis look like it could be correct. However, with no growth in the first period, we are not sure.



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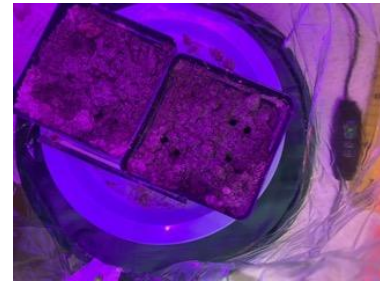
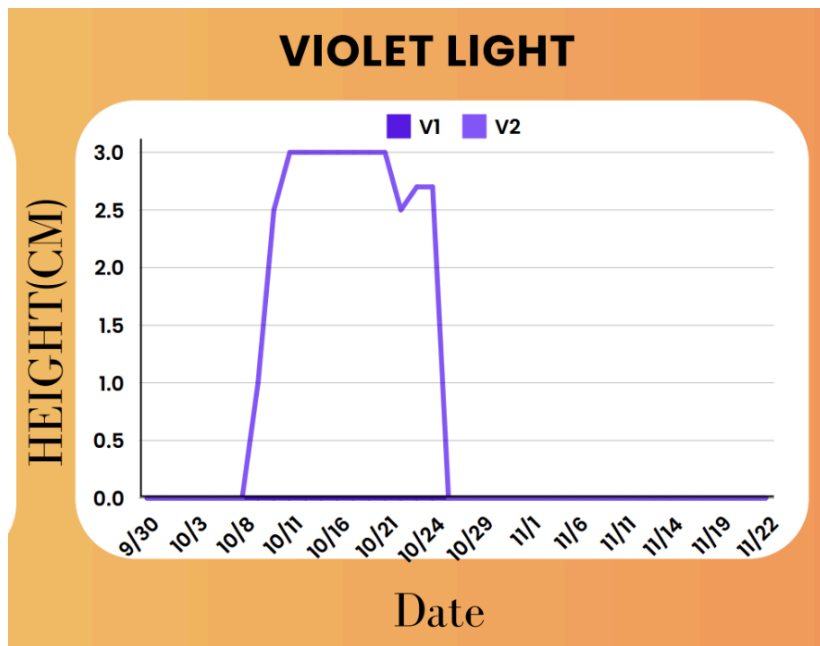
Plant	R1		R2	
	1st Planting Period (9/30-11/4 36 Days)			
Days from Plant to Sprout	10 days		11 days	
Days from Sprout - Full Height	16 Days	0-5 cm	16 days	0-5.5 cm
Days of Growing	12 Days (died)		7 Days (died)	
	2nd Planting Period 11/4 -11/22 19 Days)			
Days from Plant to Sprout	16 days		No Growth	
Days from Sprout - Full Height	3 days	0-5 cm	No Growth	No Growth
Days of Growing	4 days + (alive at deadline)		No Growth	

Our spinach plants in the red light started off strong and then died in our first planting. In our second plant, R1 grew impressively well because it only took 3 days to sprout and when it did, it sprouted just as high (5 cm) as in our first growth period. R2 sprouted on day 12 and died. R2 reached a maximum height of 5.5 cm. R2 was the tallest plant in our study. But, it did not grow in the second growth period. When the plants in the red light grew, they all got 2 leaves.

The red light plants make us wonder why there was good growth in the first planting period and impressive growth in it taking only 3 days to grow from 0-5 cm during the replant, but only for one plant. Our data may indicate that red light is better for the plants than the blue light, but we need more information and time to be sure, especially since R2 never grew.

Violet Light

Pictures on November 22

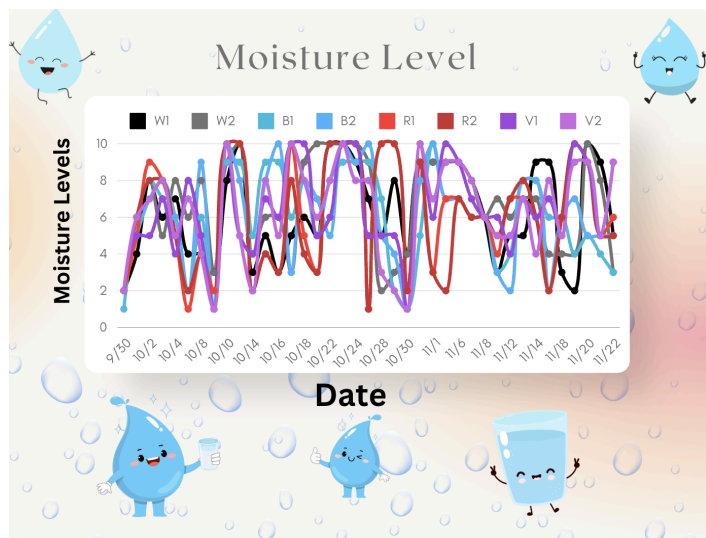
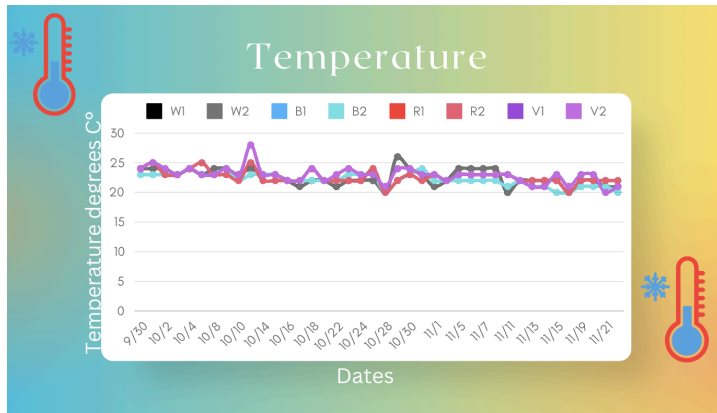


Plant	V1		V2	
	1st Planting Period (9/30-11/4 36 Days)			
Days from Plant to Sprout	No Growth		9 days	
Days from Sprout - Full Height	No Growth	No Growth	11 days	0-3 cm
Days of Growing	No Growth		17 days (died)	
	2nd Planting Period 11/4 -11/22 19 Days)			
Days from Plant to Sprout	No Growth		No Growth	
Days from Sprout - Full Height	No Growth	No Growth	No Growth	No Growth
Days of Growing	No Growth		No Growth	

Our spinach plants in the violet light were the least successful plants. Only V2 grew, and its maximum height was 3 cm. V2 sprouted on day 8 and died on day 20. It only grew for 17 days. After we replanted, V2 did not sprout again. V1 never grew. We do not think violet light is the best light for growing spinach plants.

Moisture, Temperature, and pH level

The temperature of the plants was pretty consistent. But sometimes out of the blue, the temperature would shoot up or shoot down. We noticed that V2 and V1 got up to the highest at 28°C. The lowest the temperature got was with our W2 plant at 20° C. The average temperature was between 22° to 23° C.



We also noticed that the moisture levels varied a lot. The most common level was 6 at the beginning and 10 at the end. We think that the plants sometimes got WAY over-watered at the end. Or that the moisture would sink to the bottom and not drain. And since our measurements were taken with the meter deep in the soil, this would cause the plants to not get enough moisture closer to the top of the soil. So, when we replanted, we added 3 sprays to help keep the topsoil from drying out.

Week #	Date	Temperature (C)							
		W1	W2	B1	B2	R1	R2	V1	V2
1		24	24	23	23	24	24	24	24
	10/1	24	24	23	23	25	25	25	25
	10/2	24	24	23	23	23	23	24	24
	10/3	23	23	23	23	23	23	23	23
	10/4	24	24	24	24	24	24	24	24
2	10/7	23	23	23	23	25	25	23	23
	10/8	24	24	23	23	23	23	23	23
	10/9	24	24	24	24	23	23	24	24
	10/10	23	23	22	22	22	22	23	23
	10/11	24	24	23	23	25	25	28	28
3	10/14	23	23	23	23	22	22	23	23
	10/15	23	23	23	23	22	22	23	23
	10/16	22	22	22	22	22	22	22	22
	10/17	21	21	22	22	22	22	22	22
	10/18	22	22	22	22	24	24	24	24
4	10/21	22	22	22	22	22	22	22	22
	10/22	21	21	22	22	22	22	23	23
	10/23	22	22	23	23	22	22	24	24
	10/24	22	22	23	23	22	22	23	23
	10/25	22	22	23	23	24	24	23	23
5	10/28	20	20	20	20	20	20	21	21
	10/29	26	26	22	22	22	22	24	24
	10/30	24	24	23	23	23	23	24	24
	10/31	23	23	24	24	22	22	23	23
	11/1	21	21	22	22	23	23	23	23
6	11/4	22	22	22	22	22	22	22	22
	11/5	24	24	22	22	23	23	23	23
	11/6	24	24	22	22	23	23	23	23
	11/7	24	24	22	22	23	23	23	23
	11/8	24	24	22	22	23	23	23	23
7	11/11	20	20	21	21	23	23	23	23
	11/12	22	22	22	22	22	22	22	22
	11/13	22	22	21	21	22	22	21	21
	11/14	22	22	21	21	22	22	21	21
	11/15	22	22	20	20	22	22	23	23
8	11/18	20	20	20	20	20	20	21	21
	11/19	22	22	21	21	22	22	23	23
	11/20	22	22	21	21	22	22	23	23

Week #	Date	Moisture Level							
		W1	W2	B1	B2	R1	R2	V1	V2
1	9/30	2	2	1	2	2	2	2	2
	10/1	4	6	6	5	5	6	5	6
	10/2	8	8	8	7	9	8	5	7
	10/3	6	5	7	8	8	8	7	8
	10/4	7	8	6	6	5	5	4	5
2	10/7	4	6	2	2	1	2	8	7
	10/8	4	8	6	9	4	4	5	4
	10/9	3	3	1	1	2	1	1	1
	10/10	8	9	9	10	10	10	10	10
	10/11	10	10	9	8	10	10	5	5
3	10/14	3	4	5	4	2	2	4	2
	10/15	5	6	9	8	4	4	7	8
	10/16	3	6	9	10	3	3	6	5
	10/17	5	3	6	3	10	8	10	10
	10/18	6	9	8	8	5	4	10	8
4	10/21	5	10	5	7	3	3	5	6
	10/22	10	10	8	5	10	10	6	8
	10/23	10	10	9	10	10	10	10	10
	10/24	9	10	9	9	10	10	10	8
	10/25	7	9	9	10	1	1	5	8
5	10/28	5	2	7	5	10	10	5	3
	10/29	8	3	2	4	10	10	5	2
	10/30	4	4	1	1	2	2	1	1
	10/31	9	9	5	8	9	9	10	10
	11/1	9	9	10	10	3	3	6	7
6	11/4	REPLANT DAY: All plants were given 20ML today since we re-mixed the soil and replanted.							
	11/5	9	9	7	7	7	2	10	9
	11/6	9	9	7	7	7	7	9	9
	11/7	8	8	6	6	6	6	7	8
	11/8	6	6	6	6	6	6	6	6
7	11/11	3	7	3	3	4	5	6	5
	11/12	5	6	4	2	7	7	4	5
	11/13	5	7	8	8	7	8	7	7
	11/14	9	7	8	8	6	6	6	4
	11/15	9	4	6	2	2	2	7	8
8	11/18	3	4	6	6	6	6	5	5
	11/19	2	4	4	7	10	10	10	9
	11/20	10	10	5	5	9	9	9	9
	11/21	9	8	4	5	5	5	5	5
	11/22	5	3	3	5	6	5	9	9

Week #	Date	pH Level							
		W1	W2	B1	B2	R1	R2	V1	V2
1	9/30	7	7	7	7	7	7	7	7
	10/1	7	7	7	7	7	7	7	7
	10/2	7	7	7	7	7	7	7	7
	10/3	7	7	7	7	7	7	7	7
	10/4	7	7	7	7	7	7	7	7
2	10/7	7	7	7	7	7	7	7	7
	10/8	7	7	7	7	7	7	7	7
	10/9	7	7	7	7	7	7	7	7
	10/10	7	7	7	7	7	7	7	7
	10/11	7	7	7	7	7	7	7	7
3	10/14	7	7	7	7	7	7	7	7
	10/15	7	7	7	7	7	7	7	7
	10/16	7	7	7	7	7	7	7	7
	10/17	7	7	7	7	7	7	7	7
	10/18	7	7	7	7	7	7	7	7
4	10/21	7	7	7	7	7	7	7	7
	10/22	7	7	7	7	7	7	7	7
	10/23	7	7	7	7	7	7	7	7
	10/24	7	7	7	7	7	7	7	7
	10/25	7	7	7	7	7	7	7	7
5	10/28	7	7	7	7	7	7	7	7
	10/29	7	7	7	7	7	7	7	7
	10/30	7	7	7	7	7	7	7	7
	10/31	7	7	7	7	7	7	7	7
	11/1	7	7	7	7	7	7	7	7
6	11/4	7	7	7	7	7	7	7	7
	11/5	7	7	7	7	7	7	7	7
	11/6	7	7	7	7	7	7	7	7
	11/7	7	7	7	7	7	7	7	7
	11/8	7	7	7	7	7	7	7	7
7	11/11	7	7	7	7	7	7	7	7
	11/12	7	7	7	7	7	7	7	7
	11/13	7	7	7	7	7	7	7	7
	11/14	7	7	7	7	7	7	7	7
	11/15	7	7	7	7	7	7	7	7
8	11/18	7	7	7	7	7	7	7	7
	11/19	7	7	7	7	7	7	7	7
	11/20	7	7	7	7	7	7	7	7
	11/21	7	7	7	7	7	7	7	7
	11/22	7	7	7	7	7	7	7	7

The PH level was all the same the whole time. It stayed at 7. This is good because it means the soil stayed neutral. However, sometimes students would argue if it was 6.5. Our teacher taught us about precision of instruments, so we were told to round to the nearest whole number because our instrument only has whole numbers and not halves.

FUTURE CONSIDERATIONS:

We would like to attempt this experiment again. We found that we were looking successful in our replant and would like to be able to confirm that. We were not able to finish our experiment since we ran out of time in this challenge. We really want to see what would happen if we had more time for our second replant.

Since our replant looked like it produced better results, we will use the same soil composition for the pots as we did in

our second growth period. We will also keep adding sprays of water to the top soil as we water. We will keep 8 hours of lighting instead of 12 hours. And, we will be more consistent in making measurements and observations. We think we can be better at that in the second try because we have more experience.

CONCLUSIONS:

Our hypothesis was that we think that blue light will produce the most growth since it is the most helpful in germination and helps encourage vegetative leaf growth.

Our experiment did not give us the information to confirm or disprove our hypothesis. Our plants died and so we replanted. With a change in the nutrients to the soil, we saw stronger growth but ran out of time. The results we did get in this shortened growing time showed promise to give us results that may be able to support or disprove our hypothesis.

According to our data, blue light showed improvement in the replant. It grew quickly and stayed alive. It reached 4 cm in both plants in 4 and 5 days. In red, we found it also quickly grew to 5 cm in 3 days, but only in one plant. For white, it was consistent. It had the longest time alive and all our plants grew. Violet was the most inconsistent. Only one plant grew out of the 4. It is difficult to say which light is for sure the best for growing spinach on Mars.