September 10, 2024 - Umaima
Today we had our very first Science fair meeting. Dr. Garcia introduced us to the idea, and today we made a rough timeline and have started surfing through projects.

Timeline:
October - November: Choose a topic
November: Ethics + Background Research
December: Finish Background Research, write variables, write hypothesis
January - February: Complete Experiment
February: Write Conclusion
March: Finish analysis and observations. Make tri fold and finish presentation
March 11: School science fair

October 5, 2024 - Umaima
Today I went over to Kylah's house. We again just looked through some projects. Below I started brainstorming and added any projects that sounded interesting:

- Eyewitness Testimony
- Vertical planting
- Teenage pregnancy
- Study of human crime and why they do it
- Effects of non-ionizing radiation on plant growth

October 7, 2024 - Umaima
Kylah and I decided to the effects of non-ionizing radiation on plant growth. That idea was partially due to Ms. Schmidt's help. She shared with us a article about NASA's new plans of colonizing Mars and we saw an issue with this, and this was plants. From there we got the idea to study the effects of radiation on plant growth. Kylah offered to grow the plants.

October 19, 2024 - Kylah
We haven't worked on science fair for a couple of weeks. Umaima came over today and we wrote our ethics. We were wondering what type of radiation we should use. It was slightly confusing, we were first planning on using a microwave however we thought it might be more effective with a strong UV light. I began finding some resources online and just citing them into a Google doc. Umaima started writing the variables:

Manipulated: The manipulated variable is the amount of time the plants are radiated. (Once a day, once a week, once every other day, and never)

Responding: The responding variable is the growth of the plants, measured from the roots up to the top of the leafs. (Ruler, cm)

Controlled: The controlled variables are the amount of sunlight the plants receive, the amount water the plants received, the type of soil.

November 18, 2024 - Kylah
Yesterday evening our Ethics was approved which is awesome, Umaima and I are beginning to surf the internet looking for some sites and books about our project. We will begin our background research soon.

November 21, 2024 - Umaima
I looked through some sites and I cited them ahead of time. Below are my citations and the sites that I found.

1). Cherlinka, V. (2025, February 28). *Stages Of Plant Growth And Their Role In Agriculture*. EOS Data Analytics. https://eos.com/blog/stages-of-plant-growth/

2). Lifecycle of a Plant. (n.d.). Dr. Zigs. https://drzigs.com/pages/lifecycle-of-a-plant?srsltid=AfmBOor8rHDokUWy7ODw-yGKPIJwImDvmVfR-g9ZH02SjmRoxiYCrG6e

3). Sadeghianfar, P., Nazari, M., & Backes, G. (2019, February 24). *Exposure to Ultraviolet (UV-C) Radiation Increases Germination Rate of Maize (Zea maize L.) and Sugar Beet (Beta vulgaris) Seeds*. National Library of Medicine. https://pmc.ncbi.nlm.nih.gov/articles/PMC6409551/#:~:text=UV-C%20rad

4). Stamnes, K. (2003). *ULTRAVIOLET RADIATION*. Science Direct. https://www.sciencedirect.com/science/article/abs/pii/B0122270908004449

5). Types and sources of radiation. (2024, March 12). Canadian Nuclear Safety Commission. https://www.cnsc-ccsn.gc.ca/eng/resources/radiation/types-and-sources-of-radiation/#non-ionizing-radiation\

6). *Understanding Radiation*. (2020, August 12). Canadian Nuclear Safety Commission.https://www.cnsc-ccsn.gc.ca/eng/resources/fact-sheets/understanding-radiation/

December 2, 2024 - Kylah
I began looking through the websites that Umaima said would be useful. I essentially just wrote questions and answers. Umaima said that we should write it in an essay format but I included the question/answers below.

What is UV Radiation?

UV radiation, also known as Ultra violet radiation, is a type of non-ionizing radiation. This means, contrary to ionizing radiation, it does not have the power to remove electrons. The most common form of this type of radiation is from the sun; however, in this experiment we will be using a plant UV light.

UV light vs natural light:

While natural light may travel in an almost straight line, the UV light will travel in waves the size of molecules. In addition to the former, the UV light will also carry more energy due to the tighter waves.

What is seed germination?

Seed germination is the transformation of a seed into a seedling. The basic necessities of a plant, like light, water, and oxygen, are crucial for this process. In this experiment we will be swapping natural light for UV light and observing the changes in growth and overall well-being of our chosen plant: radishes.

Radish growth:

The average radish is harvested at the early age of 4 weeks, and grows to about a diameter of 2.5cm. It must be exposed to constant moist conditions, and in cool weather conditions. Radishes must also be exposed to light for at least 6 hours a day.

December 5, 2024 - Umaima
We are still working on the background research. I wrote it on a separate google doc. It is not nearly close to done however with Midterm season coming up, we won't have much time to work on our research. I will try to finish this before Winter Vacation.

January 20, 2025 - Umaima
I am almost done writing the background research portion of our project, I will hopefully finish it before February. We plan on starting our project experiment in February. We are running a bit behind our initial schedule plan.

January 28, 2025 - Umaima
I finally finished the final draft of background research. Kylah proof read it and I included it below. I think I will create various tabs for all of our research.

Plants typically undergo a series of stages before reaching their full growth. It begins with seed germination. Seed germination is the process of a seed maturing into a seedling. If placed in the correct settings (with an appropriate amount of water and UV light), the embryo cells begin to enlarge. The seed coating then breaks and slowly roots begin to grow.

From there, leaves begin to shoot up from the maturing plant and it can now feed through a process of photosynthesis (the gaining of food for plants through sunlight). Once leaves are grown, the plant begins flowering, the process by which plants grow flowers. In some cases it can continue and plants begin to grow fruit (ex. an apple tree). At this stage they are fully grown plants. From there, the plants begin seed dispersal. This is the process by which plants grow more plants essentially.

There are two main types of radiation that we can find on Earth, ionizing and non-ionizing radiation. Non-ionizing radiation is often thought of with a positive, non-harmful connotation. This type of radiation does not carry enough energy to ionize atoms or molecules. All of us are exposed to non-ionizing radiation on a daily basis such as microwaves. Ionizing radiation is a type of radiation with enough energy they can alter the electron and proton balance in an atom. This creates ions, hence the name ionizing radiation.

Ultraviolet radiation, commonly referred to as UV light, is a form of non-ionizing radiation essential for all life on our planet. Typically on Earth, UV light is found from the Sun. UV light can supply essential vitamins and growth in plants.

Ultraviolet radiation has a positive effect on seed germination. A study by Pouria Sadeghianfar, Meisam Nazari, and Gunter Backes showed positive results when plant seeds were exposed to high levels of UV light (8 hours and 12 hours), the plants had the most positive amount of seed germination.

January 30, 2025 - Both
Now that we finished the background research, we developed our hypothesis. Based on the research we completed we hypothesized that:

If the plants are exposed to radiation once a week then they will grow to be the longest plant, followed by never, every other day, and every day. This is because too much non-ionizing radiation can be harmful to plant growth, however radiation in little chunks (ie. one a week) can have a beneficial impact on the growth of plants.
We will insert this into the CYSF platform later.

January 30, 2025 - Umaima
Today after our hypothesis, I worked on the methodology part of our experiment. We wrote it before the growing period so we know the procedure.
I included the materials and steps below. We might have to make some slight edits if we change the procedure during the or before the growing period.
Materials needed:

- 4 pots
- Plant lights
- Radish seeds (in this experiment we used 32 seeds)
- Water

Firstly, separate the radish seeds into groups of eight. Plant the groups of eight into each of the four pots. Grow the plants using the same amount of water and place them where they may receive the same amount of sunlight. Radiate each plant using the plant light for the corresponding time (once a day, once every other day, once a week.) Leave one of the plants as a control and never radiate that with the plant light.

February 1, 2025 - Kylah
Today I began the growing period for the radishes. We are growing them for thirty days so, I will finish the growing period on March 2, 2025. I bought these two lamps from Amazon, one them was a plant light, to replace sunlight so that we can have an even amount of sunlight for the plants and the second light was a strong UV light to act as our extra source of non-ionizing radiation. I essentially placed the seeds in soil today and I radiated the plant that was meant to be radiated every day. I made sure to label the pots because I would most likely forget.

February 1, 2025 - Umaima
I inserted the background research, variables, and hypothesis that we wrote into the CYSF platform. We still have quite a bit of work left and we can't really finish it before the plants are finished growing. I really hope we will have enough time.

February 2, 2025 - Kylah
So far there is no visible growth, this is expected of course because they have only been planted for a day. I radiated two plants today, the plants radiated once a day and the plants radiated once every other day.

February 3, 2025 - Kylah
There is so far no growth. Today I radiated the plants that are radiated every single day.

February 4, 2025 - Kylah
There is still no visible growth. Today I radiated two plants. One radiated every day and the other radiated every other day.

February 5, 2025 - Kylah
Today was different growth wise. There is a little bit of growth in the plants that are our control and a little bit the plants radiated once a week. However they haven't been exposed to any radiation at all.

February 6, 2025 - Kylah
Today I didn’t notice any major changes in the growth of the plants. I radiated the plants that were radiated every day and once every other day.

February 7, 2025 - Kylah
Today I saw the plants radiated once every other day had started sprouting. I radiated the plants radiated every day and once a week. I’ve been radiating them for 30 minutes at a time.
February 8, 2025 - Kylah
Today I radiated the plants every day and every other day. I’ve been seeing some good growth over the past few days with all the plants except for the plants being radiated every day.

February 9, 2025 - Kylah
Today I radiated the plants every day. Finally, I saw just a tiny increase in the leaf of the plants radiated every day. Only one of the plants however have actually started growing a leaf.

February 10, 2025 - Kylah
Today I radiated the plants every day and every other day. Not any significant changes from the last few entries.

February 11, 2025 - Kylah
Today I radiated the plants every day. I wonder if the actual radishes have started growing. I planted eight seeds into each pot, so I am a bit concerned about the spacing in between the actual radishes.

February 12, 2025 - Kylah

Today I radiated the plants every day and every other day. All the plants except for the plants being radiated every day have some really good growth and I can see multiple plants actually growing leafs. However, the plants radiated every day only has one and its quite small currently.

February 13, 2025 - Kylah
Today I radiated the plants every day. There is still no significant growth that I can see.

February 14, 2025 - Kylah
Today I radiated the plants every day, every other day, and once a week. I had to hold the plant light up for an hour and a half to radiate all three of them.

February 15, 2025 - Kylah
Today I radiated the plants every day. It is halfway through the growth period. We still have about 15 days until the plants can be unrooted.

February 16, 2025 - Kylah
Today I radiated two plants, the ones to be radiated every day and the ones radiated once a week. The plants that are our control and the ones that are radiated once a week are flourishing. Even the plants being radiated once every other day are well. However the plants being radiated every day are almost dead. They aren't doing so well.

February 17, 2025 - Kylah
Today was another day of radiating the plants. Today, I only radiated the plants that were radiated every day.

February 17, 2025 - Umaima
The growth period is almost done. Today I worked one setting up the table with our variables all good to go. Below I included just the empty table with none of the values written in yet.
Once the growth period is done, after recording the raw data, Kylah will insert the values into this graph

Amount radiated	Once a day	Once a week	Once every other day	Never
Amount of growth (cm)				

February 19, 2025 - Kylah
Today I radiated the plants every day and once every other day. We are almost done with the growth period and are heading into the final stretch. So far there is substantial differences

between the growths of the various plants. The plants being radiated once a week appear to be the largest and from what I counted, 6 out of the eight seeds have begun to sprout leafs.

February 20, 2025 - Kylah
Today I radiated the plants every day. I've been using this UV light and it can't stay up on its own, so I have to hold it up. It's not the most convenient as sometimes I have to hold it up for an hour and a half.

February 21, 2025 - Kylah
Today I radiated three of the plants, the ones being radiated every day, every other day, and once a week. They are all doing so well!

February 22, 2025 - Kylah
Today I radiated the plants for every day. They still only have one little seed growing. Its very sad amount, the other ones still have not sprouted.

February 23, 2025 - Kylah
Today I radiated the plants every day and every other day.

February 24, 2025 - Kylah
Today I radiated the plants every day. THERE IS STILL NOT MUCH GROWTH! I don't think the other seeds will sprout and I think this plant will be our worst in growth rate.
February 25, 2025 - Kylah
Today I radiated the plants every day and every other day. There is such a huge difference in growth for all the plants.

February 26, 2025 - Kylah
Today I radiated the plants every day.

February 27, 2025 - Kylah
Today I radiated the plants every day and every other day.

February 28, 2025 - Kylah
Today I radiated the plants every day and once a week. There is only 2 days left of the growing period! I made some edits to the procedure, and rather than the paragraph I separated it into step by step instructions.

March 1, 2025 - Kylah

Today was the second last day of radiating plants. I radiated the plants every day and every other day. There is still no growth in the plants radiated every day. I don't think they will be growing much aside from the growth that has already happened.

March 2, 2025 - Kylah
Today was the very last day of the growing period. I radiated only one plant today (every day) and tomorrow I will unroot and measure the plants. I've been making sure to give them the same amount of water every day and I put them underneath a plant light for 9 hours a day each.

March 3, 2025 - Kylah
Today after school, I unrooted the plants. The radishes did not grow! It was just the leaf and the root. After a little bit of research I realized that the radishes were way too close to each other. I don't think this substantially impacted our results aside from the fact we don't get fresh radishes but it was a minor mistake on my part. I wrote the measurements below. I measured the radishes from the roots to the tips of the leafs. Since there was no radish bulbs it was pretty easy.

Once a week:
Plant #1: 14 cm
Plant #2: ~8.3cm
Plant #3: ~14.2 cm
Plant #4: ~11.6cm
Plant #5: ~ 15.1cm
Plant #6; ~10 cm

Average (mean)

$$\frac{14+8.3+14.2+11.6+15.1+10}{6} = 12.2 \text{ cm}$$

Once a day:
Plant #1: 9.4cm
Average: 9.4cm

Once every other day:
Plant #1: 10cm
Plant #2: 9cm
Plant #3: 9cm
Plant #4: 6.1cm
Plant #5: 8.4cm

Average (mean)

$$\frac{10+9+9+6.1+8.4}{5} = 8.5$$

Never:
Plant #1: 10cm
Plant #2: 9.5cm
Plant #3: 11.5cm
Plant #4: 9cm
Plant #5: 10.1cm

Average (mean)

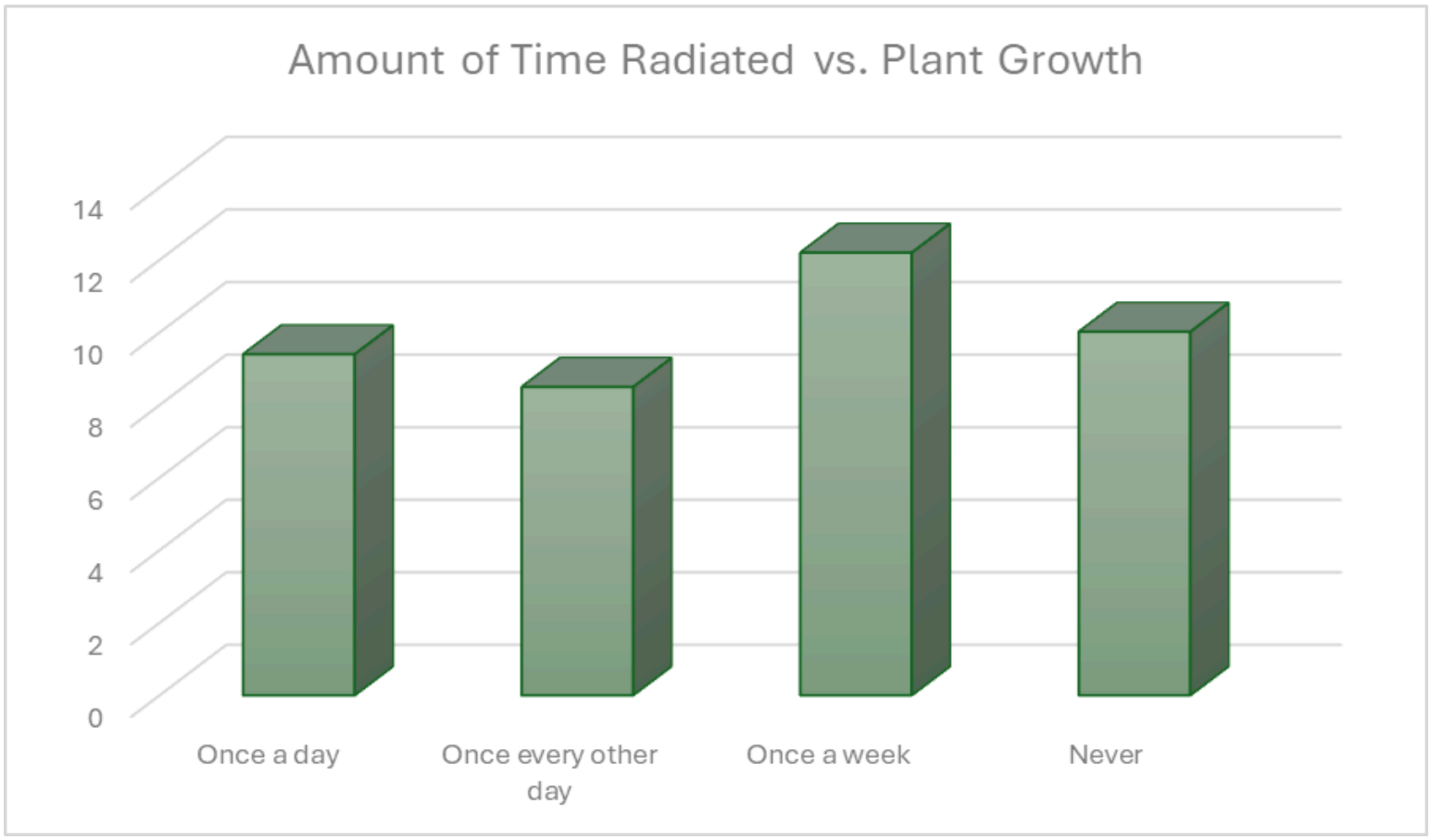
$$\frac{10+9.5+11.5+9+10.1}{5} = 10.02$$

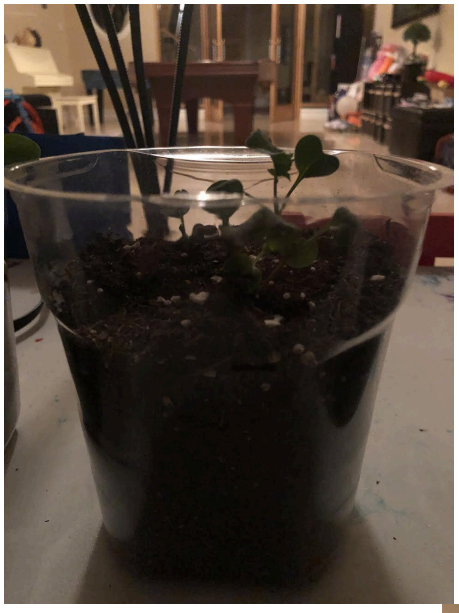
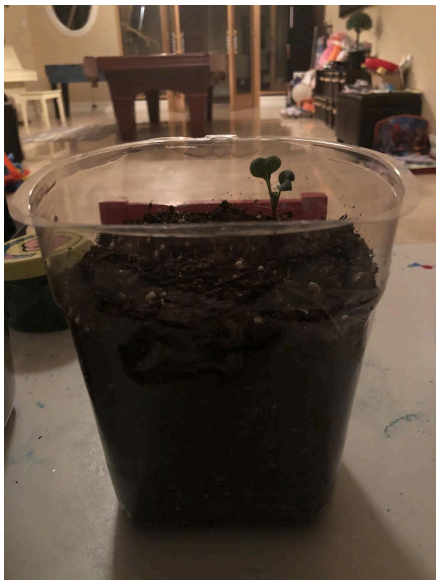
March 4, 2025 - Umaima
Today Kylah sent me all the results via text message. Today I just inserted them into the table which is below. I essentially began inserting the data into Google Sheets to make graphs. I have not figured out how yet however. So, I just left it for now and decided to continue tomorrow.

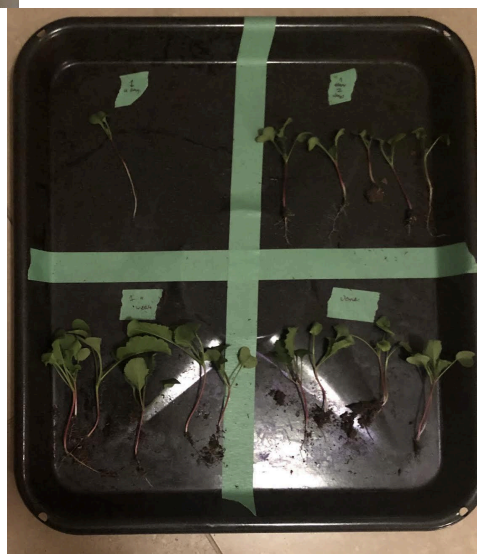
Effects of Non-Ionizing Radiation on Plant Growth

Amount of time radiated	Once a day	Once every other day	Once a week	Never
Average growth of plants (cm)	9.4	8.5	12.2	10.02

March 5, 2025 - Umaima
The school science fair is in a week! We still have quite a bit left to do and simply not enough time to do it. I tried figuring out the Sheets program and I did! Below I inserted the graph I made. I also asked Kylah to send me some pictures of the plants at the end of the growing period which I think I will include here too. It will give it some nice visual representation on the Trifold. Tomorrow I will go pick up the trifold.


Amount of Time Radiated vs. Plant Growth
14
12
10
8
6
4
2
0
Once a day
Once every other day
Once a week
Never



March 6, 2025 - Umaima
So I finished the graphs yesterday and I began working on the conclusion. Its not complete yet, however it is quite close to. I picked up the trifold from Dr. Garcia, and Kylah is coming over on March 8 to work on it.

March 7, 2025 - Kylah
Today I went to Micheals to buy some supplies for our trifold. I bought the borders, lettering, and some background paper.

March 7, 2025 - Umaima

Today I finished writing the conclusion and the abstract. The abstract is essentially a preview with all your data but super condensed. I also completed all the citations we need. I also finished the sources of error and our acknowledgements. Below I included our conclusion and abstract as well as our completed citation.

Conclusion:

In this experiment we tested the effects of non-ionizing radiation (in the form of a plant light) on radish seeds.

Our scientific question was how non-ionizing radiation affects radish plant growth. Based on our research, we hypothesised that the seeds radiated once a week will grow to be the tallest (cm, ruler), followed by 1 every two days, never, and finally 1 every day. Our hypothesis was proven correct

The radish seeds that were radiated once a week ended up having the best results, with a). the longest root to stem length and b). the most amount of plants grown from the pot. Once a day ended up with only one of the eight plants growing averaging to the worst results. Plants radiated once every other day ended up with an average growth of 8.5 cm and our control plants "never" ended up growing 10.02 cm. In conclusion, the plants which were radiated on a weekly basis ended up with the most growth.

Abstract:

The purpose of this investigation is to determine, from the growing samples of radish seeds, the amount of non-ionizing radiation needed to grow the largest plant. There were three samples used, one radiated every day, one every other day, one once a week, and one never. In each sample pot were eight radish seeds growing. We hypothesized the plants exposed to radiation once a week would grow to be the largest plant. We ended up growing radish plants and used a plant light as a form of non-ionizing radiation. After a month of growing the plants and consistent radiation, the plants once a week had flourished and grown to be an average of 12.2 cm. Six out of the eight plants had grown. This project has contributed to the agricultural side of society. By growing and measuring the amount of radiation needed to produce the largest plant, this can impact the way agriculture is shaped. Non-ionizing radiation can be beneficial to plants and can actually help them grow larger.

Sources of error:

The experiment was well executed, however it had a few flaws. There was time for one trial only, in the future, we would do a few more trials (ex. 3-4 trials), this would give us mor accurate results. During the plant growth process, the stems had grown but the radishes themselves did not. This may have been due to too many radishes seeds planted in the same pot. In the future, we would plant each radish seed to have their own pot to grow.

March 8, 2025 - Umaima
Before Kylah came, I prepared all the papers for printing, I essentially just took all the data that I've been writing here in the logbook (under the various tabs) and made the sizing bigger. I also made subheadings (Ex. abstract, background research). I printed them out and now I am just waiting for Kylah so we can get started.

March 8, 2025 - Both
We took the big sizes of the information and cut them out. We pasted them to some background papers and we put down the titles as well. We haven't glued anything to the trifold yet.

March 9, 2025 - Both
Today we placed down a border on our trifold and glued everything down. It looks pretty good! We began writing our presentation script, which we included here.

March 10, 2025 - Umaima
Tomorrow is the school science fair. I wrote flashcards for our presentation. It took a very long time…however I think we will do very well.

March 11, 2025 - Both
Today was the school science fair, we got some very helpful feedback which was really good. So if we make it to the next round we will know some things to improve. We will know how we did on Wednesday, so tomorrow!

March 12, 2025 - Both
We got our results back. We ended up achieving silver and we got in the top 15 students to go the Calgary Youth Science Fair! We still have to work on our CYSF platform and just insert everything in.

March 15, 2025 - Umaima
Today I just took everything we had in our logbook and I put it in the CYSF platform. The platform is due in five days and Kylah and I still have to film our presentation.

March 19, 2025 - Both
Today we filmed our presentation and it went well!

Objective/Scientific Question:

The objective of this experiment is to measure and analyze the growth of radish plants based on the amount of non-ionizing radiation the plant is exposed to.

How does non-ionizing radiation affect the growth of radish plants?

Background Research:

Plants typically undergo a series of stages before reaching their full growth. It begins with seed germination. Seed germination is the process of a seed maturing into a seedling. If placed in the correct settings (with an appropriate amount of water and UV light), the embryo cells begin to enlarge. The seed coating then breaks and slowly roots begin to grow.

From there, leaves begin to shoot up from the maturing plant and it can now feed through a process of photosynthesis (the gaining of food for plants through sunlight). Once leaves are grown, the plant begins flowering, the process by which plants grow flowers. In some cases it can continue and plants begin to grow fruit (ex. an apple tree). At this stage they are fully grown plants. From there, the plants begin seed dispersal. This is the process by which plants grow more plants essentially.

There are two main types of radiation that we can find on Earth, ionizing and non-ionizing radiation. Non-ionizing radiation is often thought of with a positive, non-harmful connotation. This type of radiation does not carry enough energy to ionize atoms or molecules. All of us are exposed to non-ionizing radiation on a daily basis such as microwaves. Ionizing radiation is a type of radiation with enough energy they can alter the electron and proton balance in an atom. This creates ions, hence the name ionizing radiation.

Ultraviolet radiation, commonly referred to as UV light, is a form of non-ionizing radiation essential for all life on our planet. Typically on Earth, UV light is found from the Sun. UV light can supply essential vitamins and growth in plants.

Ultraviolet radiation has a positive effect on seed germination. A study by Pouria Sadeghianfar, Meisam Nazari, and Gunter Backes showed positive results when plant seeds were exposed to high levels of UV light (8 hours and 12 hours), the plants had the most positive amount of seed germination.

Hypothesis:

If the plants are exposed to radiation once a week then they will grow to be the longest plant, followed by never, every other day, and every day. This is because too much non-ionizing radiation can be harmful to plant growth, however radiation in little chunks (ie. one a week) can have a beneficial impact on the growth of plants.

Variables:

Manipulated: The manipulated variable is the amount of time the plants are exposed to UV radiation through a plant light (once every other day, once every day, once a week, never)

Responding: The responding variable is the amount of growth measured after a month of experimentation. (Ruler, cm)

Controlled: The controlled variables are the amount of regular sunlight the plants are exposed to, the amount of water given to the plants, the amount of time the plants are exposed to (30 minutes). One of the plants being grown will receive no radiation as our control plant.

Method/Procedure:

Materials needed:

- 4 pots

- Plant seeds (in this experiment radishes) - Used 32 seeds for this project

- Water

- Form of non-ionizing radiation (here used a strong UV lamp)

- Water

Step 1). Firstly separate the seeds into groups of eight.

Step 2). Plant the groups of eight into four pots.

Step 3). Begin growing the plants. Water with the same amount of water and place them in an area where they can receive the same amount of sunlight.

Step 4). Radiate each plant with the UV lamp (one plant once a day, one plant group once every other day, one plant group once a week, and one as control, never radiated)

Step 5). Unroot the plant at the end of the growing period (30 days)

Step 6). Measure the plants (in cm) from the roots to the top of the leafs

Results

Effects of Non-Ionizing Radiation on Plant Growth

Amount of time radiated	Once a day	Once every other day	Once a day	Never
Average growth of plants (cm)	9.4	8.5	12.2	10.02

Individual plant growth:

Once a day: 9.4 cm

(1/8 seeds had germinated)

Once every other day growth: 10cm**,** 9cm, 9cm, 6.1cm, 8.4cm

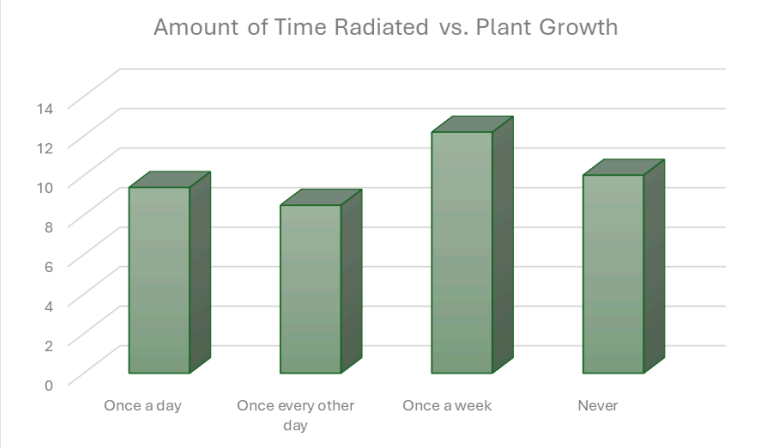
(5/8 seeds had germinated)

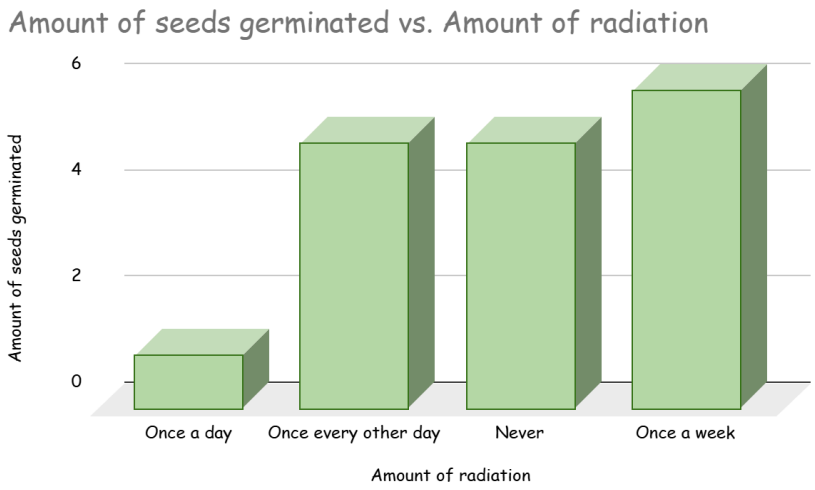
Once every week growth: 14cm, 8.3cm, 14.2cm, 11.6cm, 15.1cm, 10cm

(6/8 seeds had germinated)

Control Plant growth: 10cm, 9.5cm. 11.5cm**.** 9cm, 10.1cm

(5/8 seeds had germinated)




Amount of seeds germinated vs. Amount of radiation
Amount of seeds germinated
6
4
2
0
Once a day
Once every other day
Never
Once a week
Amount of radiation

Conclusion:

In this experiment we tested the effects of non-ionizing radiation (in the form of a plant light) on radish seeds.

Our scientific question was how non-ionizing radiation affects radish plant growth. Based on our research, we hypothesised that the seeds radiated once a week will grow to be the tallest (cm, ruler), followed by 1 every two days, never, and finally 1 every day. Our hypothesis was proven correct

The radish seeds that were radiated once a week ended up having the best results, with a). the longest root to stem length and b). the most amount of plants grown from the pot. Once a day ended up with only one of the eight plants growing averaging to the worst results. Plants radiated once every other day ended up with an average growth of 8.5 cm and our control plants “never” ended up growing 10.02 cm. In conclusion, the plants which were radiated on a weekly basis ended up with the most growth.

Sources of Error and Applications

The experiment was well executed, however it had a few flaws. There was time for one trial only. If we could re-do this a second time, we would do a few more trials (ex. 3-4 trials), this would give us more accurate results. During the plant growth process, the stems had grown but the radishes themselves did not. This may have been due to too many radishes seeds planted in the same pot. In the future, we would plant each radish seed to have their own pot to grow.

Works Cited

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