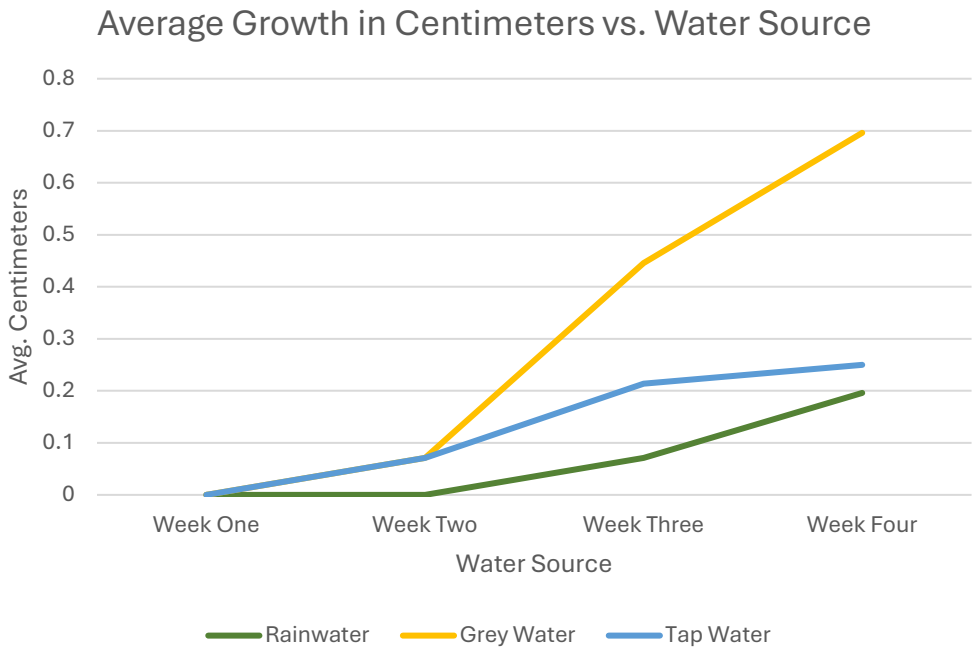
The effects of precipitation, potable water, and greywater on *petunia nana compacta*

Research Question

How does potable tap water, grey water, and rainwater affect the growth of petunia seeds?

How do the results of sustainably – sourced water compare with the control group, tap water?



Procedures

1. Four pots of petunia nana compacta for three different water sources
2. Seven seeds of petunia nana compacta per pot
3. Every two days, pots were watered with 100 ml of their assigned water source
4. Growth measured in centimeters and leaves counted every week
5. Data was recorded in a lab notebook and formatted into excel to produce the graphs

Conclusions

The greywater, which was collected with a basin from the washing machine, was the best water source. The average growth among the greywater group was 0.696cm with a total growth of 19.5cm. Rainwater was the least productive water source with only an average of 0.196cm and 5.5cm total growth. This proved the initial hypothesis incorrect.

Petunias (*petunia nana compacta*) are a garden flower that spouts colorful blooms. They tend to germinate and sprout after 2 weeks. (7) They are common and well known, frequently found in gardens and used as décor, making them an optimal plant to observe.

Photo by Jonathan Buckley , Bloomsbury Publishing *Petunia x hybrida F1 Tidal Wave Purple (Tidal Wave Series)*

Reusing water can also reduce the financial strain of water bills significantly.(6) It strengthens national and global water economy but also derives benefits for local communities and homes, especially in low-income areas. (3)

Background Information

- 3% of the globes water supply is fresh water, and only about 0.5% of that is readily available for human consumption. (9)
- Water can be recycled from dirty sources like sinks and laundry machines and used again in irrigation. (8)
- Similarly, rainwater can be collected to be used in dry seasons and replace the strain on tap water. (5) Different methods for harvesting rain and runoff can maximize the amount of water collected. (4)
- The additional properties in these two sources, such as minerals or bacteria(1) can also enhance the growth quality and quantity of certain garden plants.

What makes water sustainability and reuse important?

Water is a vital resource for life and earth, specifically the growing of plants. However, water has become scarce in many areas around the globe, and reservoirs drained. Everyday applications dry up what was previously plentiful.

Image by Pixabay

However, inventive new ways have been developed to use and reuse water to reduce the depletion of natural supplies. Understanding and utilizing these techniques commercially can make an even larger change for the environment and long-lasting benefit for future generations. (2)

Research Questions

How do sustainable sources of water affect the growth of petunias?

How do the results of sustainable sources compare with basic tap water?

Hypothesis

Rainwater samples of *petunia nana compacta* will have the most sprouts, the greatest average vertical growth, and most leaves across all the three test groups.

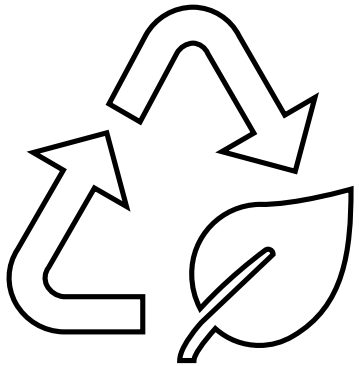
Null Hypothesis: The source of water will have no effect or observable change across groups on the vertical growth or number of sprouts of petunia.

Predictions

The overall growth across the experimental groups will be greater than that of the control group's growth.

Rainwater results and grey water results will be similar compared to that of the tap water sample plants.

Results will appear after 1 to 2 weeks before visibly sprouting due to the common germination period of *petunia nana compacta*.



Materials List

- 28 petunia seeds per water source to test for potential confounding variables
- 12 pots, four allocated to a testing group each to test for potential confounding variables
- 1500 ml greywater
- 1500 ml tap water
- 1500 ml rainwater
- “Miracle Grow” soil that filled the pots for petunia seeds
- Measuring cups to portion water for the plants ensuring they receive equal treatment
- Ruler to measure plant growth in centimeters
- Excel for analysis of data across multiple weeks

Photograph of *Seed Packet*. 28, Jan. 2025. Authors personal collection

Photograph *Beginning Set Up*. 5, Jan. 2025. Authors personal collection.

Procedure

1. Rainwater was collected in a large bucket during a rainstorm (Dec. 24, 2025) .

2. Grey water was collected and stored in a tub using the water drainage system.

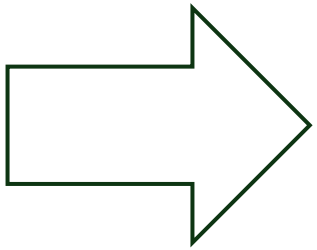
3. 12 individual 500 ml pots were filled with soil. In each pot 7 *petunia nana compacta* seeds were placed and buried in soil.

4. 4 pots were placed in each test group and watered with their corresponding water source.

5. The entirety of the test samples/pots were placed in a tray next to a window to receive equal sunlight.

6. Every 2 days each pot was watered equally with approximately 100 ml of water for the duration of the study

7.The growth in centimeters was measured and number of leaves counted every week and recorded.

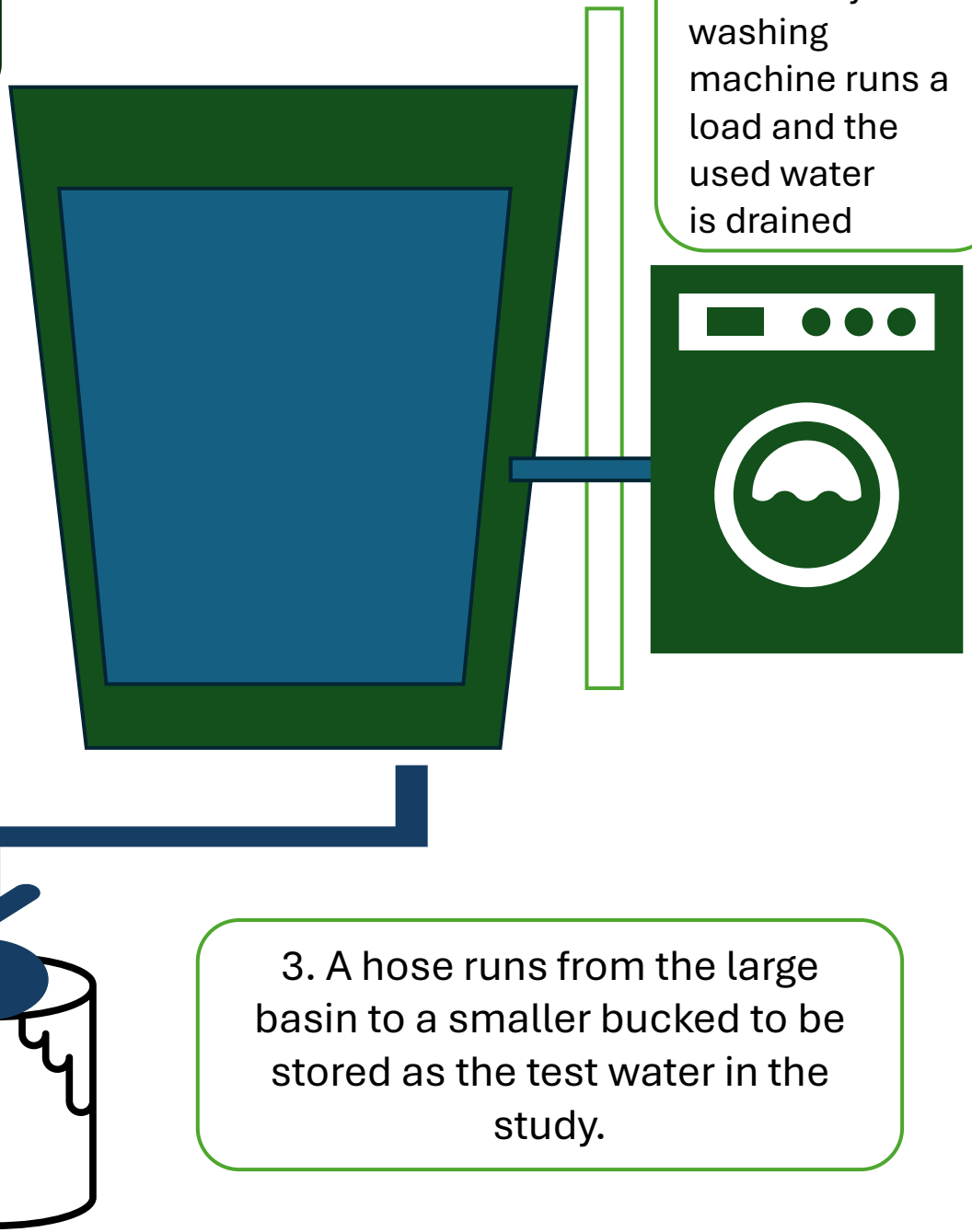


CDC recommended safety handwashing procedure was followed after any interactions with soil.

Grey water collection process

1. Laundry washing machine runs a load and the used water is drained

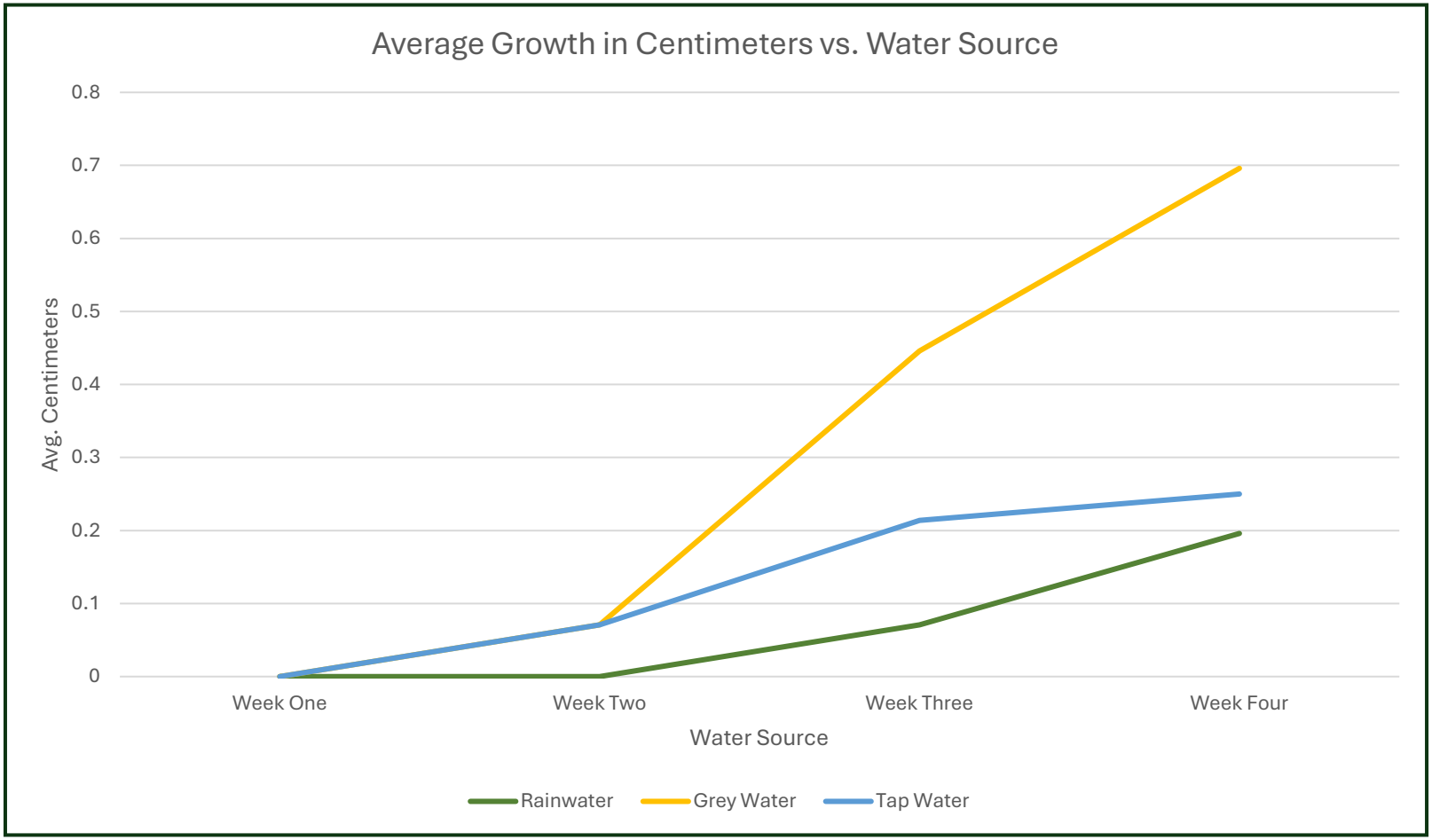
2. After being drained from the laundry machine through a tube, it is gathered and stored in a large basin.



3. A hose runs from the large basin to a smaller bucked to be stored as the test water in the study.

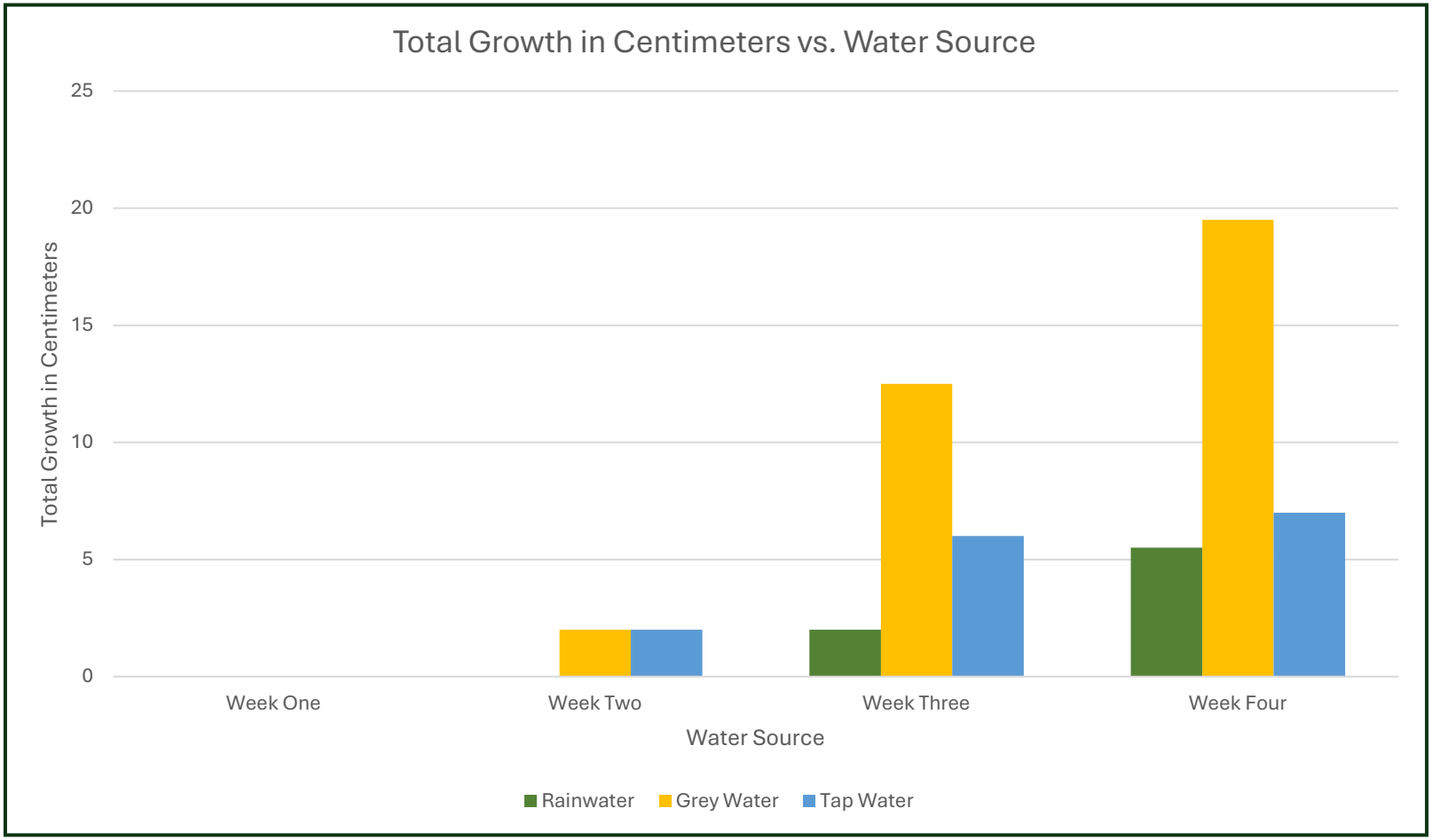
NOTE: No water was collected from sources that may have harmful bacteria or organic compounds.

Results



Greywater samples have the greatest average growth between twenty-eight seeds, in centimeters. At the conclusion of the study, greywater had an average growth of 0.696cm. The control group – tap water – has a lower average of growth by week four with an average of 0.250 cm. Rainwater sprouts had an overall lower average height of 0.196 cm and had less seedlings. Each group increased in average over time.

Results



The total growth for Grey Water (19.5cm) is significantly better than rainwater and tap water at weeks three and four. Tap water and grey water preformed the same at weeks one and two at 2cm. Rainwater preformed significantly less than both greywater and tap water during all weeks suggesting it is the least productive water source of the three.

Results

Number of Sprouts and Number of Leaves per Water Source

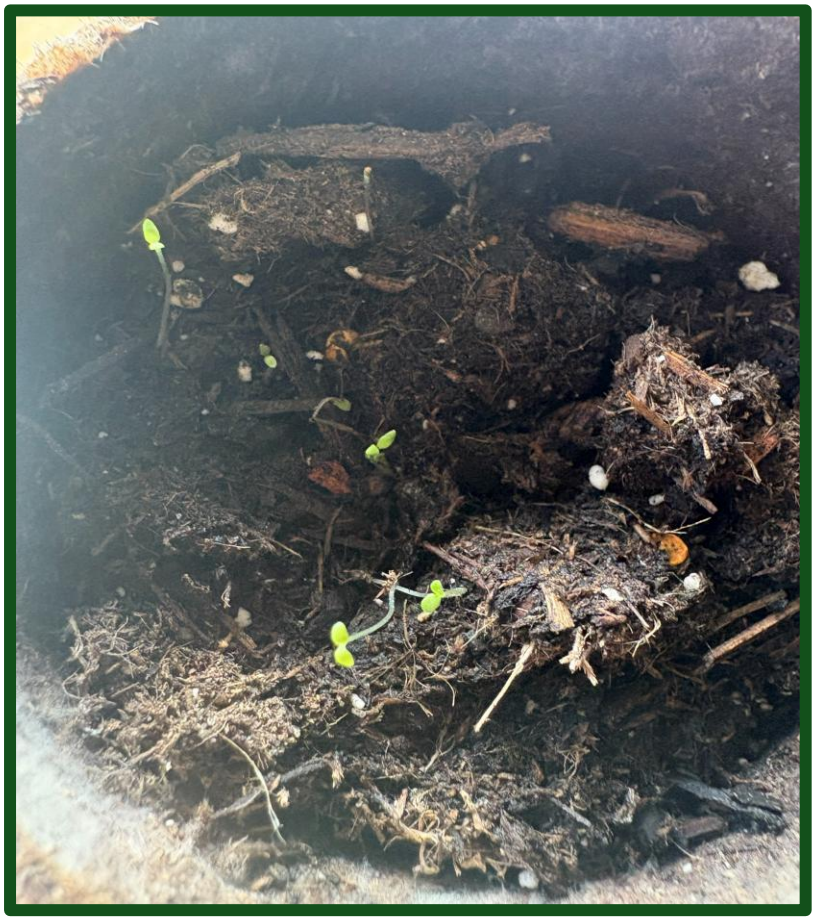
	Week 1 Sprouts	Week 1 leaves	Week 2 Sprouts	Week 2 leaves	Week 3 Sprouts	Week 3 leaves	Week 4 Sprouts	Week 4 leaves
Rain	0	0	0	0	1	2	3	6
Grey	0	0	3	5	6	12	8	14
Tap	0	0	2	3	3	4	3	4

The data displayed on the table indicates that grey water had not only greater average vertical height, but also higher germination percentages compared to the other sources.

The greywater and tap water sprouts took two weeks to germinate whereas rainwater took three weeks. By week three the greywater had both doubled the tap water in sprouts and leaves. The low activity of the rainwater implies that stored rainwater is the least productive water source to use for irrigation.

Photos

Grey water growth pot #2 – containing 7 out of the 8 grey water tested plants
At end of study



Photograph of *Greywater 1*. 30 Jan 2026. Authors personal collection

Rainwater growth pot #1 – containing 2 out of the three sprouts at end of study.

Photograph of *Rainwater 1*. 30 Jan 2026. Authors personal collection

Conclusion

Claims

- The greywater was the best water source. It provided the fastest germination and greatest average growth out of the three tested water sources. Rainwater indicated the slowest and least average growth over the test groups.
- These results negated the hypotheses, which stated that rainwater would have the greatest overall growth. In addition, the rainwater and tap water plants were the most similar, which negated the prediction that grey water and rainwater would share the most similar results.

Evidence

- Grey water and tap water yielded germinated sprouts after 2 weeks of the study and increased over time. Rainwater test groups only sprouted after 3 weeks of the testing period.
- Grey water had an average of 0.696 cm's after the duration of the study and had 8 total sprouts and 16 leaves. Tap water had an average of 0.250 cm's with three sprouts and 6 leaves. Rainwater had and average of 0.196 cm's, three total sprouts and 5 total leaves.

Reasoning

- The study sought to measure the overall growth in vertical centimeters and number of leaves. Grey water can be deemed the best water source based on this criteria, since its number of leaves and average vertical growth were both the greatest.

Explanation and Application

Scientific Explanation

- Minerals and bacteria may have been in grey water that benefited the seeds and the sprouts of petunia.
- The pH of the rainwater may have not fallen in the range of optimal growth of petunias, causing lower average growth and preventing germination. Similarly, tap water may have been too hard or contain small amounts of chemicals damaging to seeds.

Application

- The real-world impact of this project is to encourage people to use more reusable water sources to grow plants. In the conclusion of this experiment, we have determined that greywater is better to use for the growth and germination of petunia seeds. Rather than abuse potable water reserves, this research can promote different irrigation methods that prove to be more sustainable.
- Data like this reduces stigma and increases awareness that uncovers curiosity to both investigate our world's resources and further research water sources and their benefits.

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Error Analysis

Possible Improvements

Extending the trial periods for a longer amount of time would allow for the petunia to reach full bloom and show any more inherent differences between the test groups.

Carrying out water quality tests – such as pH - in conjunction with the plant tests would give a more complete understanding of the water sources themselves.

Future Studies

Creating a study that compared the results of petunias to that of other common garden flowers, herbs and vegetable plant growth would provide generalizable results in addition to this study.

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