The Effect of the pH Level In Water on the Speed of Plant Germination

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Research Question

If I change the water pH level how does it affect how long the seed takes to germinate?

I will investigate if adding different amounts of baking soda to raise the pH level will affect how long it takes for a plant to germinate.

Measuring pH in level in water measures how much acid is inside the water. pH level is from zero to fourteen. The best pH level in water is between 6.5 to 8.5. Testing the pH level in water is important because if the pH level is either too high or too low then the organisms inside of the water can/will die. Another reason why testing the pH level is important is because it can tell you the solubility as well as the toxicity of the water chemicals.

Germination Process

The germination process occurs in all seeds. Germination is when the pea first starts to grow and you see a curvy stem starting to form out of the pea. The steps of the germination process are:

1.) The water fills the seed
2.) The plant starts to grow because the water activates enzymes inside the plant
3.) The seed starts to grow roots to access water underground
4.) The seed starts to grow these shoots that grow up towards the sun
5.) And finally the seeds shoots start to grow leaves and begin the photomorphogenesis process

Hypothesis

- If I change the water pH level how does it affect how long the seed takes to germinate?

- I will investigate if adding different amounts of baking soda to raise the pH level will affect how long it takes for a plant to germinate.

Variables

I. **Independent Variable:**

Different measurements of baking soda I add to the water.

II. **Dependent variable:**

How fast each plant germinated. (I will visit the plant twice a day and record when the plant germinates.)

III. **Outline how sufficient, relevant data will be collected:**

I will add different measurements of baking soda into water and see which one will germinate the pea plants the fastest. Because I will be using pH sticks to see the pH level it will be clear what the pH level is after the substances. I will also be recording the plant growth to see which plant germinates faster.

Controlled Variables

Controlled variables	*Why it needs to be controlled*	*How to control the variable*
The plant (type, where it is, planted at the same time…)	*This could affect the outcome and this could be another independent variable.*	*Gather the same plants, plant at the same time…*
The set up	*Other variables can affect the result of the experiment*	*Same set up for each trial and experiments*
Time the substance is in the water	*This could affect the outcome or the experiment*	*Time how long the substance is inside of the water*
Substance (Temperature, exposure, age, contact with spaces…)	*These could all affect the substance effectiveness throughout the experiment*	*Keep all of them in the same environment.*
Where the water is from	*Different water and different substance would be two independent variables*	*Use the same water for every experiment and trial.*
Water temperature	*All of the water has to be the same temperature because it can ruin the outcome*	*Make sure each water is relatively the same temperature*
pH level before added substance	*This could affect the outcome*	*Measure the pH level before the experiment*

Measuring Data

- I predict that if I add different amounts of baking soda inside water, then the plant with the least amount of baking soda will germinate the fastest. This is because the least amount of baking soda will be most like water, which is the nutrient every plant needs. My prediction is testable because the materials needed are easy to supply and they are all at school and my dependent variable is easy to measure.

Materials

Equipment	*Used in method*
9 pH sticks	*To measure the pH level before and after experiment*
3 Towels	*For germination process*
Baking Soda	*One of the substances added to the water*
Water	*To add the substance in*
2 Beaker	*To measure water and substances*
1 Recording device	*To know exactly when each plant germinates*
1 Data table (Paper)	*To record my findings as well as observations*
1 Computer (Digital)	*To record my findings as well as observations*
1 Table	*The surface that I am going to test on*
1 Timer	*To record how long the pH stick is inside the water and baking soda*
4 Ziplock bags	*To put the seeds inside of*

Procedures

1. *Gather all materials from materials list*
2. *Record water pH level in data table (Have the pH stick in water for 10 seconds) (FIll 80 ml of water)*
3. *Wait for 40 seconds*
4. *Record pH level in data table*
5. *Fill 140 ml beaker with water and add 1/2 tablespoon of baking soda (Beaker A)*
6. *Mix in a circular motion for 40 seconds*
7. *Set aside*
8. *Fill 140 ml beaker with water and add 1 tablespoon of baking soda (Beaker B)*
9. *Mix fin a circular motion or 40 seconds*

Procedures

10. *Set aside*
11. *Fill 140 ml beaker with water and add 5 tablespoons of baking soda (Beaker C)*
12. *Mix in a circular motion for 40 seconds*
13. *Set aside*
14. *Fill 140 ml beaker with water and add 10 tablespoons of baking soda (Beaker D)*
15. *Mix in a circular motion for 40 seconds*
16. *Set aside*
17. *Fill 140 ml beaker with 140 ml of water (Beaker D)*
18. *Set aside*

Procedures

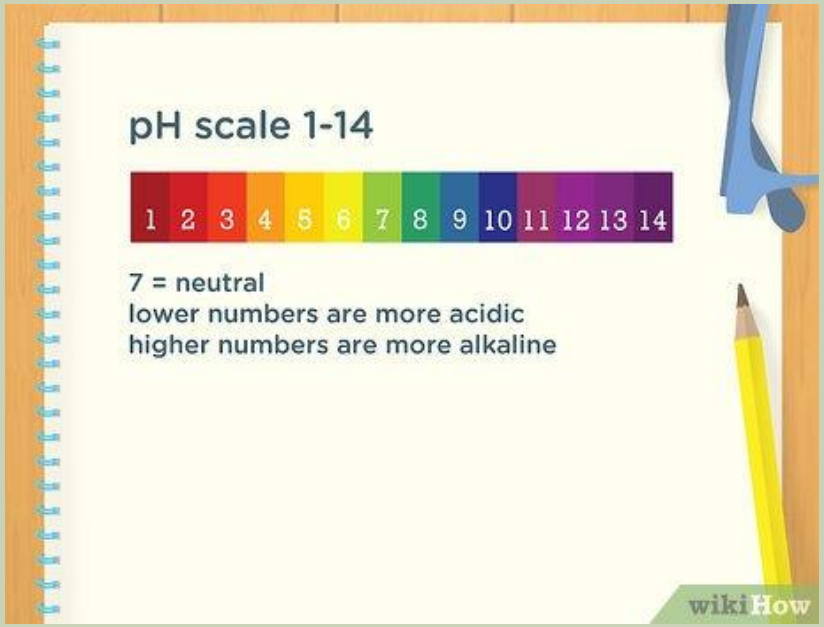
19. *Put a different pH stick inside beaker A for 10 seconds*
20. *Set aside*
21. *Record pH level in data table*
22. *Put a different pH stick inside beaker B for 10 seconds*
23. *Set aside*
24. *Record pH level in data table*
25. *Put a different pH stick inside beaker C for 10 seconds*
26. *Set aside*
27. *Record pH level in data table*
28. *Put a pH stick inside beaker D for 10 seconds*
29. *Set aside*
30. *Record pH level in data table*

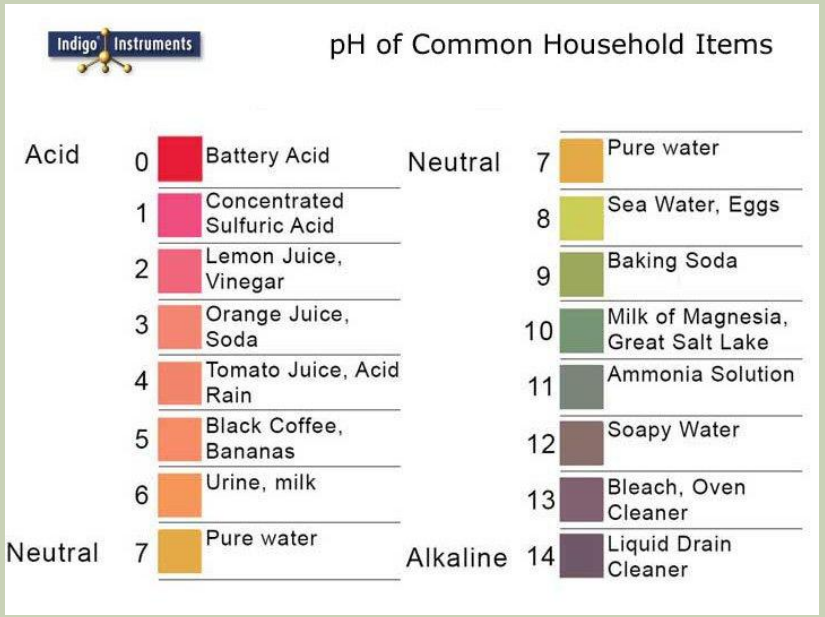
Procedures

31. *Fold Bounty paper towel four times and drop in beaker A*
32. *Take Bounty paper towel out of water and unfold*
33. *Place ten seeds on paper towel One inch apart **All on One half of paper towel***
34. *Fold paper towel over pea seeds into three folds*
35. *Repeat steps 29-32 with beaker B*
36. *Repeat steps 29-32 with beaker C*
37. *Repeat steps 29-32 with beaker D*
38. *Observe plants twice a day*
39. *Record all observations on data tables.*

How Do You Read a pH Stick?

First, you dip the pH stick inside the liquid for about 10 seconds. The stick will change color. Why does the stick change color? Because the strip makes contact with acidic or alkaline inside the substance. The strip will change more red if the liquid is more acidic and if the liquid is not as acidic it will change into a bluish color.

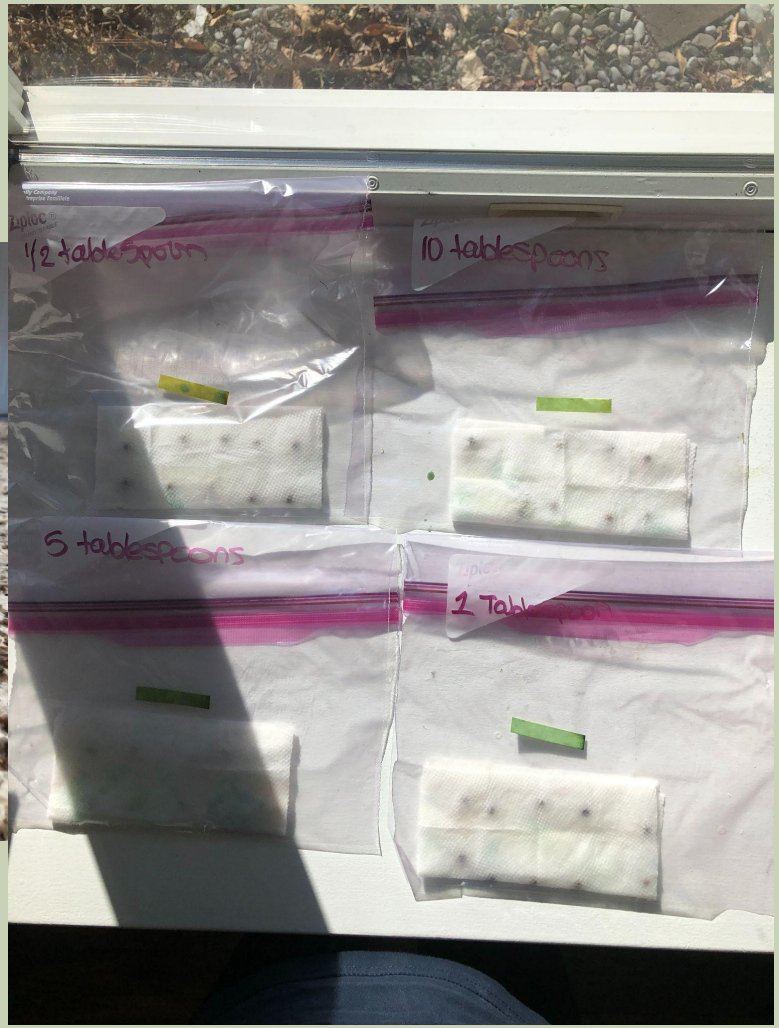




Set up

pH stick container

pH stick container



Pea plant set up

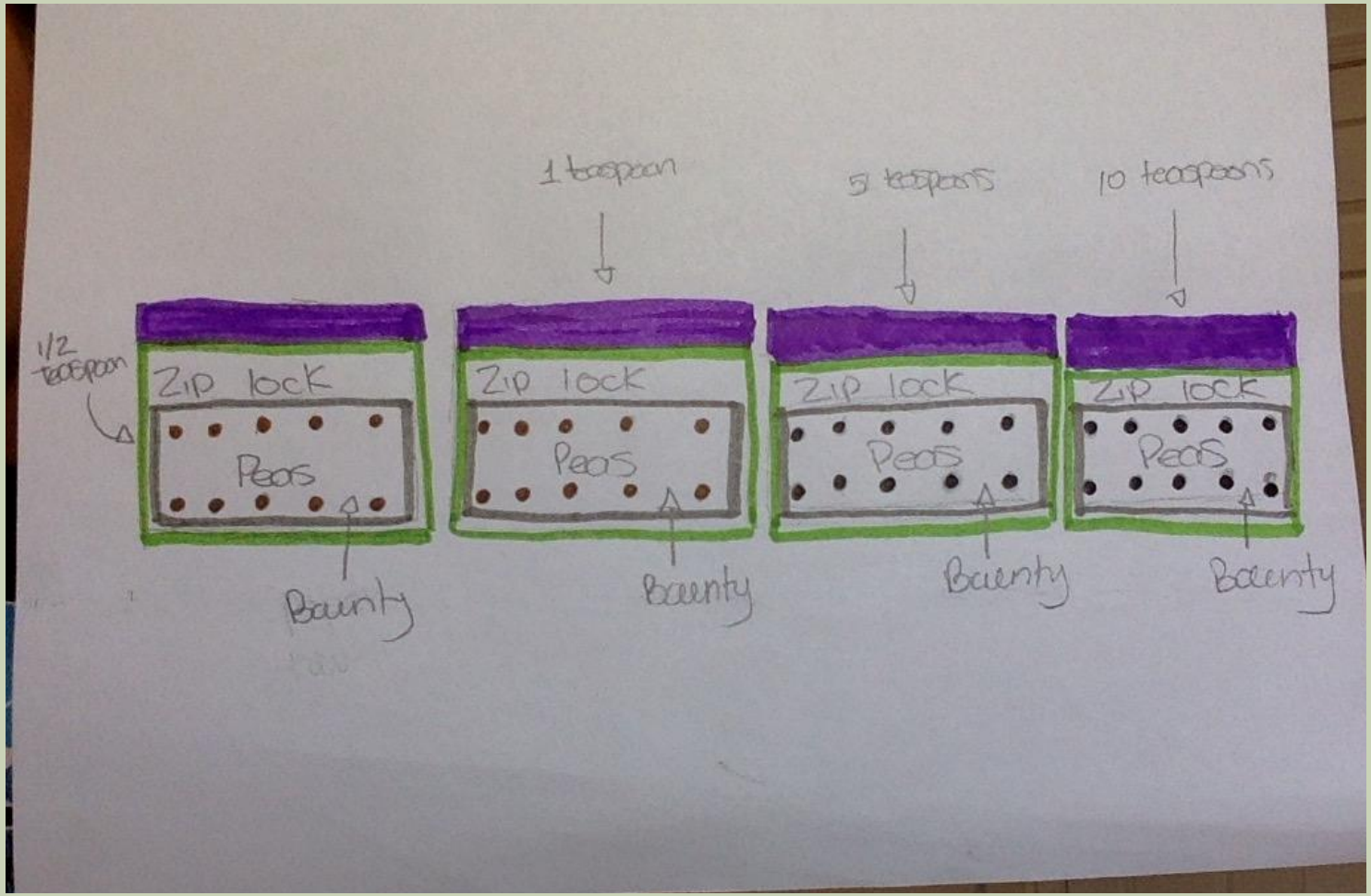
½ tablespoons of baking soda

10 tablespoons of baking soda

5 tablespoons of baking soda

1 tablespoon of baking soda

Labeled Diagram

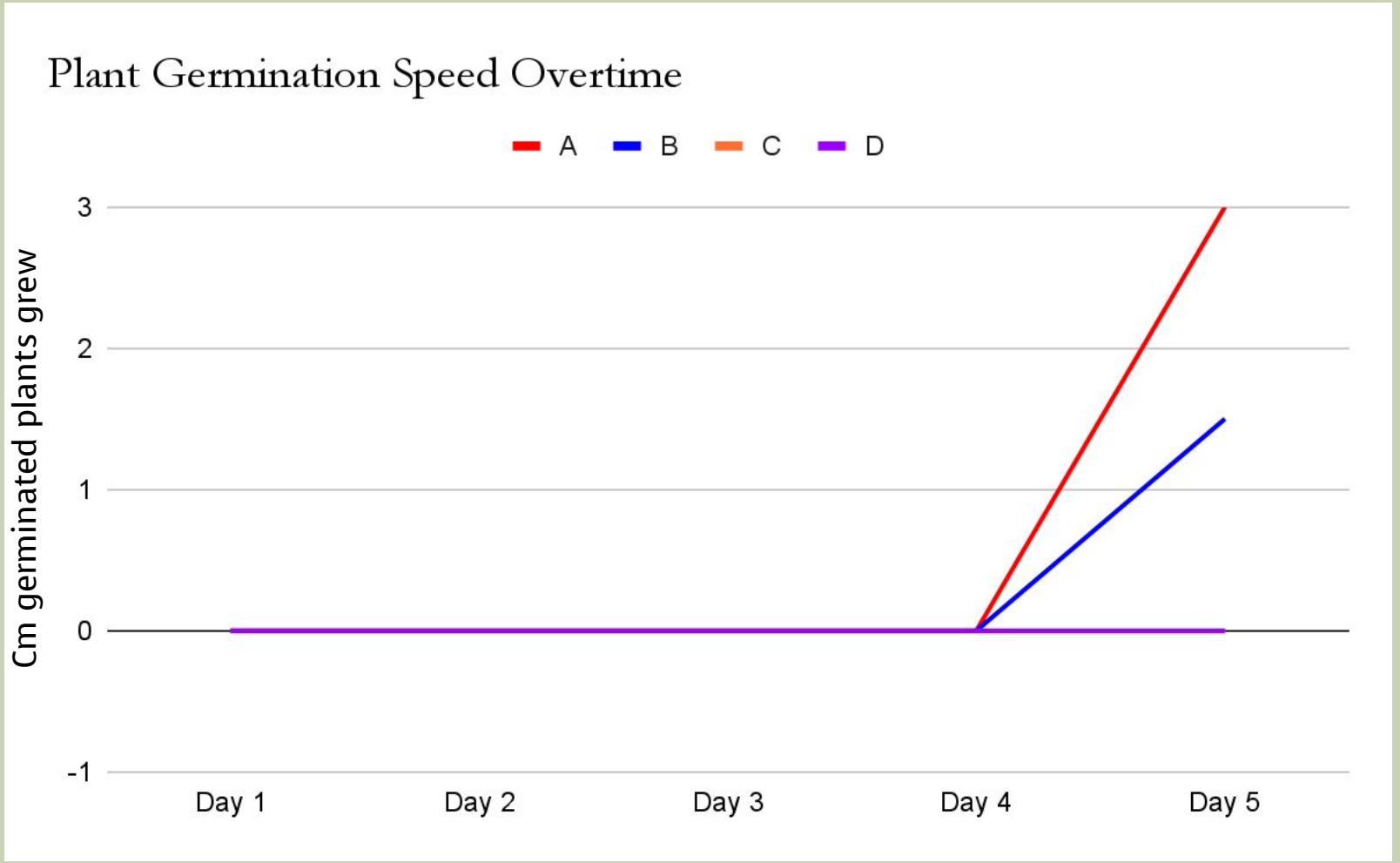


Data

	pH Level before Baking soda	pH Level After baking soda	Plant Growth Day 1	Plant growth Day 2	Plant growth Day 3
Beaker A	X	~9.0	n/a	n/a	n/a
Beaker B	X	~8.0	n/a	n/a	n/a
Beaker C	X	~7.5	n/a	n/a	n/a
Beaker D	~7.0	~7.0	n/a	n/a	n/a

	Plant Growth Day 4	Plant Growth Day 5
Beaker A	 Really light brown	Germination!
Beaker B	 Lighter brown	Germination!
Beaker C	n/a	n/a
Beaker D	 Dark brown	n/a

Graph



A = ½ tablespoon of baking soda

B = 1 tablespoon of baking soda

C = 5 tablespoons of baking soda

D = 10 tablespoons of baking soda

Analysis

- My data suggests that the peas that were in the paper towel with ½ a tablespoon of baking soda germinated the fastest. My data supports my hypothesis because the fastest germinating pea plant was the one with least amount of baking soda. My data shows that increasing the pH level in water does not help the germination process speed up. Beaker B germinated three hours after Beaker A. Beaker C and Beaker D still have not germinated after two weeks. This may be because too much baking soda includes sodium which can be toxic to plants. The reason why some plants germinated was because (as stated before) they had little baking soda.

Summary

- My data shows that Beaker A germinated the fastest because it only had ½ teaspoons of baking soda. My data suggests that Beaker A germinated the fastest, and then Beaker B, followed by Beaker C and then D. This may be because peas are supposed to be germinated with water and Beaker A and B had minimal amounts of baking soda. I conclude that this experiment helped me prove my hypothesis and problem. This is because I found out that Beaker A germinated the fastest out of the other three beakers. This is what I hypothesized about what would happen.

Work Cited

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Thank you for your time!