

# The Effect of Household Items on Soil pH

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## Abstract

We hoped to discover how certain household items change soil pH. In doing this experiment, we aimed to give a better understanding of pH to people like gardeners and gardeners. We hypothesized that the addition of eggshells and baking soda would increase soil pH, while epsom salts and pine needles would decrease it. In our experiment, we put five cups filled with the same amount of soil but different additives onto a windowsill. We watered each cup until the end of the week, when we measured the final soil pH and compared it to the constant pH to see how each additive affected the soil pH. We found that while the pine needles and eggshells did not affect the pH, epsom salts decreased the pH, and the baking soda increased the pH, which is what we hypothesized. Through our data, our hypothesis was supported, and our research backed what our experiment found.

## Research Question

### Asking Questions

- Gardeners and groundskeepers should have an understanding of soil pH and how to manipulate it effectively, proposing the question:

How can soil pH be manipulated using household substances?

## Introduction

### Content Knowledge

- Soil is a combination of minerals and organic materials used to mediate plant growth.
- Soil pH value is measured by the concentration of  $H^+$  and  $OH^-$  ions present in a substance.
- Soil pH affects nutrient solubility, which directly impacts their availability to plants.
- Soil pH can also affect the activity of beneficial microorganisms, which when slowed can lead to nutrient deficiencies in the soil and hinder/alter plant growth.

### To Lower pH

- To lower the pH of the soil, elemental sulfur, and aluminum sulfate are commonly used by homeowners.
- Materials such as pine needles and peat moss can be utilized in small areas and can slowly reduce the pH, although this method is not as effective.

### To Raise pH

- Other household items, such as baking soda and wood ashes, can be used to increase soil pH, however, they do not have long-term effects.
- Limestone is often used to raise soil's pH in larger quantities, on acres of land to effect large crop growth.

## Research Methods

### Planning Investigations

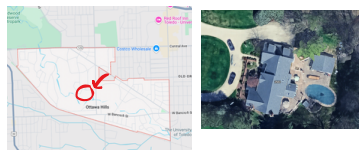
#### Setting up the Experiment

Our study site was a home in Ottawa Hills, Toledo, Ohio (see map). Soil was collected on a cold day outside the home, but testing occurred when the soil was room temperature. The experiment was set up inside after soil collection.

To find the pH of the soil, we used GLOBE's soil pH protocol (see further details below)

To set up our experiment we measured 20 grams of room temperature soil into five different cups, using a scale set to grams. 7.5 mL of each additive were crushed and measured before being stirred with 7.5 mL of water. Each additive was combined (by stirring) with their respectively labeled soil, and monitored for ten days, adding 14 mL of water every day.

Data collection took place 10 days and 3 hours following the experiment set up. Each soil sample was tested using a pH strip twice, and an average was calculated to find the new pH of the soil. This collection also occurred indoors, in the same environment it was set up.



### Carrying Out Investigations

#### Conducting Experiment

The GLOBE soil pH protocol was used to find the soil pH. This protocol includes: taking soil and adding equal amounts water as there is soil. In our experiment, this meant 20 mL. Stir the soil and water together for 30 seconds, then wait 3 minutes. Repeat this cycle for 5 rounds, then let the soil rest for 5 minutes before taking a pH strip and dipping it in the liquid that separates above the solid soil. Record result. The sampling occurred inside the home where the experiment was set up, under the same conditions.

2 pH strips were used to test each soil, and the average value of the two strips is represented by a single pH value. This allowed for one accurate data point per soil type.

When collecting, one team member took charge in stirring and the other ensured accurate timing. The pH was only tested on one occasion, as testing the pH requires using the whole soil sample to ensure accuracy.

### GLOBE Badges

Be a Data Scientist

The report includes in-depth analysis of students' own data as well as other data sources. Students discuss limitations of these data, make inferences about past, present, or future events, or use data to answer questions or solve problems in the represented system. Consider data from other schools or data available from other databases.

## Results

### Analyzing Data

How can soil pH be changed using household substances?

#### Results:

**CONSTANT** - The pH of the constant was a 6.2 value.

**EPSOM SALTS** - The pH decreased, dropping to 5.8 from the constant 6.2.

**PINE NEEDLES** - No change in pH, remained at 6.2 value.

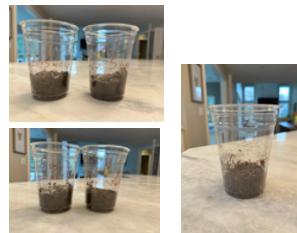
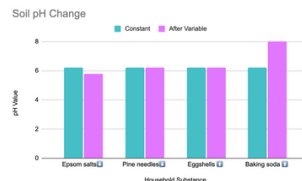
**EGGSHELLS** - No change in pH, remained at 6.2 value.

**BAKING SODA** - Increased by 1.8 pH value, from 6.2 to 8.0.

To get these values, 2 pH strips about 3-4 cm in length were used per soil sample to test the pH, and the two collected values were added and then divided by 2, calculating the average.

This data shows that overall, very little change occurred over such a short amount of time, but what did take place was supported by research. The epsom salts, as hypothesized, caused the soil pH to decrease, and the baking soda, also as hypothesized, caused the soil pH to increase.

Figure #1



## Experiment Photos

## Discussion

Our hypothesis was mainly supported, with a few expected errors that can be explained. We believe the lack of change exemplified in adding pine needles and eggshells is because both substances are natural and come directly from a plant or animal process. This means that its qualities are less potent, and therefore, either needed more time to show a significant pH change, or there wasn't enough of it to cause a change. For example, while eggshells contain sulfur, which is the main substance we predicted would change the pH, less than 10% of the material contains such sulfur (Eggshells and their valuable minerals. 2021, March 16). Another possible explanation for the lack of change could be in part due to the granularity of the substance. Therefore if the pine needles and eggshells had been more finely ground, they would have been better taken in by the soil and caused a greater effect on the pH, as "the smaller the shells are, the faster they decompose and develop their effect." (Eggshells and their valuable minerals. 2021, March 16). In future experimentation, it would be important to ensure that every substance is equally ground, which could be done by blending and sifting each substance.

This kind of experimentation is essential for farmers to find the most efficient and cost-effective way to maintain the pH of their land. As described, soil pH is integral in how its inhabiting plants survive and grow to their full potential. The data also shows that baking soda makes the most drastic change over a short period, which can be essential to know in times of desperate need of a quick fix. Student research such as this is important because it informs us of the value and meaning of our environment and the impact we have on it, and more importantly, the impact it has on us.

## Conclusions

Through experimentation, the question of how the pH of soil can be changed using household substances is answered. Our hypothesis stated that if baking soda or eggshells are added to soil, then the pH will increase; however, if Epsom salts or pine needles are added to the soil, then the pH will decrease. It was found that baking soda increased the pH, pine needles and eggshells caused no change, and epsom salts caused the pH to decrease.

Research and published data shows similar effects, although much of the previous testing uses more agricultural agricultural substances. The lower concentration and application of our testing likely contributed to the smaller pH change, however, the data collected can be clearly backed by our research.

To expand on this research, different substances should be tested to gauge effect on soil pH, and if possible, done on large land areas to provide data more applicable to real-world users. This experiment could be improved using distilled water and collecting pH at more stages of experimentation.

## Bibliography

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