Decomposition of biodegradable items compared to non-biodegradable items

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Abstract

This experiment aims to observe which biodegradable and non-biodegradable items will decompose over the span of 11 weeks and which factors will influence their rate of decomposition. In this experiment three objects are measured, two pieces of cardboard and one plastic pen. The factors that are observed are their access to sunlight and oxygen which are the same in each container with the testable factor being the amount of water each object receives. The third container which received more water than the other two showed a faster rate of decomposition and proved that water has a significant role in the decomposition process especially when breaking down cardboard.

Introduction

Decomposition is a natural process that breaks down organic material and allows the earth to use it nutrients for new life to be born. Decomposition is important because of its ability to teach us about a wide range of things such as waste management and the use of nutrients in agriculture. In the book *Waste Management and Resource Recycling in the Developing World, 2023* the authors explain that bacteria are mainly responsible for the decomposition of organic waste. They point out the five stages in which bacterial decomposition occurs Hydrolysis/Aerobic Degradation, Fermentation, Acetogenesis, Methanogenesis, and Oxidation (Kumari & Raghubanshi, 2023). This understanding of how decomposition works can help us improve our systems of waste management to make them more efficient and sustainable. Decomposition is also important in understanding agriculture with a large amount of organic waste being created by agricultural processes and understanding how to reuse its nutrients. In the book *Biotechnological Applications of Biomass,* the authors of *Chapter 27 Role of Decomposers in Agricultural Waste Management* explain that there are three types of agricultural waste Livestock manure, Postharvest agricultural waste, and Agro-industrial residue. Livestock manure is waste created by farm animals mainly cattle, pigs, and poultry with about 120 million tons of manure being produced each year by these livestock. Postharvest agricultural waste was defined by the authors as being mainly straw, husks, and the stalks of crops that were left after the harvest. This can be used to feed the livestock with the rest of it being put through different waste decomposers. The other type of agricultural waste the authors mentioned was Agro-industrial residue which is agricultural waste created after processing crops into different bio products (Iqbal, Agrawal, Dubey, & Kumar, 2021). This experiment aimed to observe which materials would be able to undergo biodegradation and which factors would influence their rate of decomposition. The materials which were observed were two pieces of cardboard and one plastic pen with the factors influencing their rate of decomposition being sunlight, oxygen, and water. My hypothesis for this experiment was that if water assists in the decomposition process, then the biodegradable material receiving more water will decompose faster than the one receiving the normal amount because the water will begin to break up the object faster.

Materials

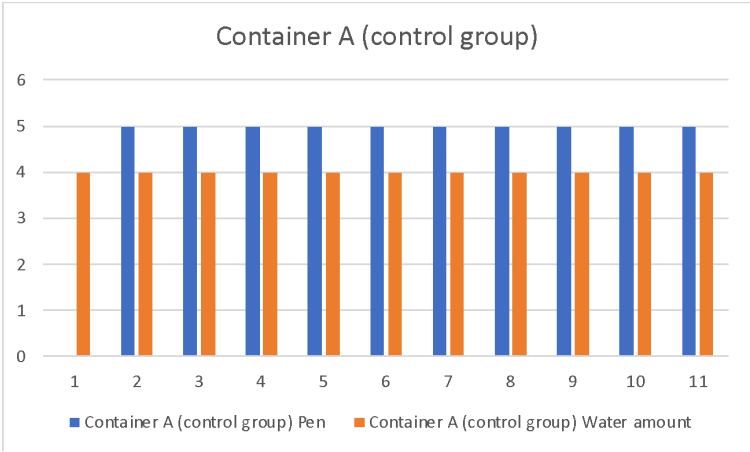
- 3 plastic containers with lid
- 3 cups of outdoor soil
- 1 plastic pen
- 2 3-inch pieces of cardboard
- Spray bottle
- Water 2 oz
- Measuring cup
- Scissors to cut cardboard
- Ruler

Methods

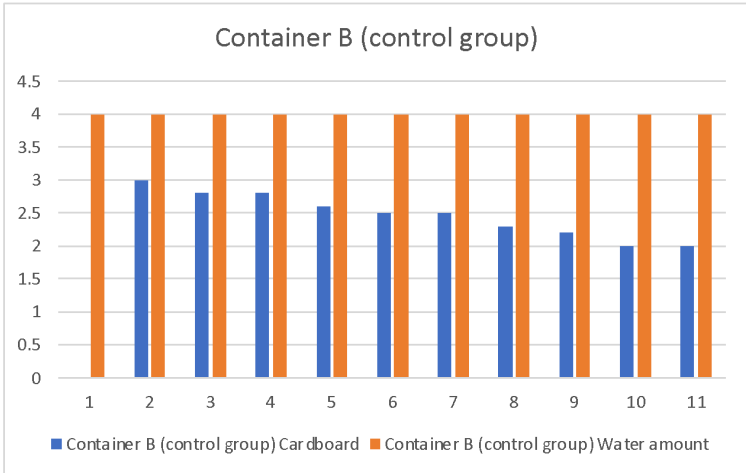
First, I set up my three containers by poking holes in the top of each to allow oxygen to enter. Then I added one cup of soil from my backyard into each container. I then added one plastic pen to the first container, three inches of cardboard into the second container, and another three inches of cardboard into the third container. I then sprayed each container four times with the spray bottle. Lastly, I set each of my containers on a windowsill to insure they all received sunlight. Every week I would open my containers to measure if they had begun to degrade at all and then after making my observations would spray them each with water again. The first container and the second containers were both sprayed four times each week while the third container I sprayed eight times instead. This established containers one and two as my control group since they both received the same amount of water each week, and container three as my experimental group as it received more water than the other two containers. By setting up my containers in this manner it made it easier to observe whether my hypothesis was correct or not.

Results

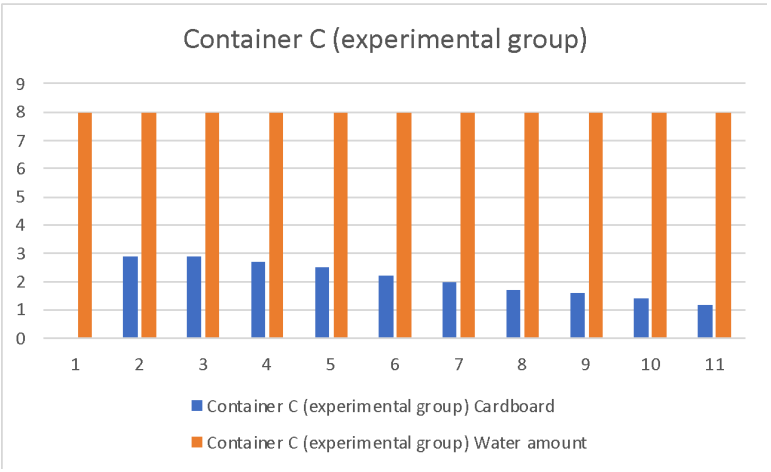
Container A (control group)				
Week	Pen	Water amount	Sunlight	Air
1	5 in	4 sprays	yes	yes
2	5	4 sprays	yes	yes
3	5	4 sprays	yes	yes
4	5	4 sprays	yes	yes
5	5	4 sprays	yes	yes
6	5	4 sprays	yes	yes
7	5	4 sprays	yes	yes
8	5	4 sprays	yes	yes
9	5	4 sprays	yes	yes
10	5	4 sprays	yes	yes
11	5	4 sprays	yes	yes



Container B (control group)				
Week	Cardboard	Water amount	Sunlight	Air
1	3 in	4 sprays	yes	yes
2	3	4 sprays	yes	yes
3	2.8	4 sprays	yes	yes
4	2.8	4 sprays	yes	yes
5	2.6	4 sprays	yes	yes
6	2.5	4 sprays	yes	yes
7	2.5	4 sprays	yes	yes
8	2.3	4 sprays	yes	yes
9	2.2	4 sprays	yes	yes
10	2	4 sprays	yes	yes
11	2	4 sprays	yes	yes



Container C (experimental group)				
Week	Cardboard	Water amount	Sunlight	Air
1	3 in	8 sprays	yes	yes
2	2.9	8 sprays	yes	yes
3	2.9	8 sprays	yes	yes
4	2.7	8 sprays	yes	yes
5	2.5	8 sprays	yes	yes
6	2.2	8 sprays	yes	yes
7	2	8 sprays	yes	yes
8	1.7	8 sprays	yes	yes
9	1.6	8 sprays	yes	yes
10	1.4	8 sprays	yes	yes
11	1.2	8 sprays	yes	yes



After looking through the data I collected over the span of the experiment it was clear to me that water plays a large part in the decomposition process. Comparing my data from container A which received the same amount of water each week compared to container C which received double the amount of water it was apparent that the cardboard in container C degraded much faster. This proved my hypothesis that if water assists in the decomposition process, then the biodegradable material receiving more water will decompose faster than the one receiving the normal amount because the water will begin to break up the object faster. It was also made clear to me that the plastic pen in container B showed no signs of decomposition during the eleven weeks in which I observed it.

Conclusion

After completing this experiment, it was clear to me that there were many factors that influence an object's ability to decompose over a certain period of time. These factors were the material it was composed of, its access to sunlight, its access to oxygen, and the amount of water that it received. The main factor that I was testing in this experiment was the impact of water on the decomposition process with my hypothesis stating that the objects receiving more water would degrade faster. This was proven to be true with the piece of cardboard in container B degrading from 3 inches to 2 inches while the piece of cardboard in container C which received double the amount of water shrinking from 3 inches to 1.2 inches. The data from my containers showed that water had a significant impact when it came to breaking down cardboard but had very little impact when it came to breaking down the pen. In the article *How Long It Takes For 60+ Common Items to Decompose?* the author writes that plastic can take between 20-500 years to decompose based on what it is made of and its exposure to factors such as sunlight. The author goes on to say that cardboard only takes about two to three months to decompose with it decomposing faster if it is shredded or soaked in water (Rinkesh, 2023). With this information as well as the information gathered from this experiment if I was to repeat this experiment in the future, I would pick an object that was more likely to decompose then the pen such as a biodegradable trash bag. I would also add another container and change the variables used and see the difference between objects that did or did not receive sunlight as well as oxygen. In the end, this experiment allowed me to view the process of decomposition firsthand and have a better understanding of what factors can influence an object's ability to decompose over time. This allows me to be more careful when purchasing single use products and searching for biodegradable alternatives instead.

References

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3. Rinkesh. (2023, August 31). How long it takes for 60+ common items to decompose? - Conserve energy future. Retrieved from https://www.conserve-energy-future.com/how-long-does-it-take-to-decompose.php