George Washington Carver – An Original Conservationist: The Importance of Compost (student)

Learn to do common things uncommonly well; we must always keep in mind that anything that helps fill a dinner pail is valuable.

George Washington Carver

One of George Washington Carver's passions was helping impoverished farmers improve their lives by improving their ability to grow crops. Part of this was finding ways to improve soil quality in the least expensive way possible. Many farmers employ artificial fertilizers in order to reintroduce nutrients to the soil. Unfortunately, these fertilizers are often pricey and eat up the farmer's earnings from the previous years which only helps to keep them in poverty. To avoid this George Washington Carver encouraged farmers to create their own compost pile to use to fertilize the soil on their fields.

This experiment will demonstrate the decomposition process and simulate the breakdown of organic matter into compost.

What is Decomposition?

Decomposition is a magical process! It is the result of billions of microorganisms such as bacteria and fungi, as well as some larger decomposers like worms and bugs. These decomposers are often called the "FBI:" fungus, bacteria and invertebrates. The FBI break down organic matter—things that were once alive—into smaller particles called compost.

Compost is the waste product of decomposers and provides necessary nutrients for plants by building up our topsoil and keeping it healthy. It is dark brown like chocolate and smells fresh like the earth after a rain. Compost is a natural fertilizer that is part of nature's recycling process. It is free of synthetic chemicals, which are found in commercial fertilizers and can be harmful to the environment. Decomposition, also called rot, is a critical part of the life cycle. Not only does it provide necessary nutrients for new life to grow, but without decomposition, dead matter would cover the earth!

Why compost?

Composting organic matter has a number of environmental benefits:

- It is a great way to recycle nutrients into your soil-saving you money on fertilizers
- It will reduce evaporation from your soil-saving you water
- It produces minimal amounts of methane (a greenhouse gas), unlike landfilling
- It saves on transporting your waste away from your house to the landfill.

How does compost work?

Compost relies on four main ingredients:

- carbon material (dry leaves, paper and newspaper)
- nitrogen material (grass clippings, food scraps)
- water
- air

Once combined, these ingredients attract bacteria and fungi, which start to feed on the organic matter. As they feed and multiply, they produce heat as a by-product. This heat also helps the decomposition process. Air and oxygen mix through the compost allowing the bacteria and fungi to grow. Moisture also helps these microorganisms survive and multiply.

Lab: Compost in a Bottle

Experiment Aim:
To observe the decomposition process undertaken in a compost bin and monitor the rate of breakdown. Time: 30-minute set up with weekly observations over 3-4 weeks.

What each student will need:
- clear 2ltr plastic bottle with lid
- two cups of fruit and vegetable scraps
- two cups of dried grass clippings/leaves
- two cups of garden soil
- one cup of shredded newspaper
- spray bottle containing water
- one tablespoon of fertilizer (e.g. blood and bone)
- clear tape
- scissors
- permanent marker
- gloves

Method:
1. Cut around the bottle neck to form a flip top lid (large enough to pour the ingredients in).
2. Pour 2-3 cm of soil into the bottom of the bottle.
3. Using the spray bottle, moisten the soil.
4. Add 2-3 cm of fruit and vegetable scraps on top of the soil.
5. Add another 1 cm layer of soil.
6. Using gloves, sprinkle with 1/3 of the fertilizer over the soil.
7. Add a layer of leaves and grass.
8. Cover with another 1 cm layer of soil.
9. Lay moist newspaper over the soil.
10. Repeat steps 4-9.
11. Tape the top of the bottle closed.
12. Mark the top of the compost on the side of the bottle.
13. Place bottles in a sunny spot.
14. Once a week, mark the height of the compost on the bottle and observe the changes in volume and rate of decomposition.

TIP: if the compost gets too moist, take the lid off to dry it out. Alternately, if the compost gets too dry, spray it with a little water.

Analysis

Describe the process of decomposition. Be sure to include a description of what materials seemed to decompose first, second, etc. Compare the end product to how it looked in the beginning.

Research and draw and label a picture of the decomposition cycle.

What happened to the food scraps?

What happened to the paper?

Did the overall volume of the compost increase or decrease over the period of observation?

Did you see any mold or fungi growing in the compost?

Research what should not be put in the compost bin and why. (You need three items)

Lab Extensions – The Importance of Compost (Teacher)

Extension #1

As an added component you can have students include known biodegradable and known non-biodegradable items in the bottle. Students should have items to compare. For example, some Sun Chip bags are noted to be biodegradable (look on the label to find the correct bags). They could be paired with other chip bags that are not biodegradable. Students could also compare paper v. plastic grocery bags; different processed foods (candies, fruits, etc.); cigarette filters v. paper; etc. Have students pick 2 items that are biodegradable and two that are not and follow the instructions for adding them to their compost in a bottle.

To do this add the following instructions:

1. Cut your items so they are about 2 inches square.
2. Tie a piece of string around the items. The string should be about twice as long as the height of your bottle.
3. Use masking tape to label the end of the string with the type of item tied to the other end.
4. Once your bottle is half filled with compost material lay your testing items on top, try to keep them from touching. Stretch the strings so they come out of the top of the bottle and hang down the outside.
5. Continuing adding the composting materials as indicated in the instructions above.
6. Every week open the bottle and gently pull on the strings to remove the items from the bottle. Compare the items. You could also have students take pictures of each item each week so they can look at them over time.
    a. To find the mass **gently** brush off any loose soil from your item. Make sure the scale is at 0
    b. Add the item (with the full length of the string) to the scale. Record the data on Table 1
    c. Before returning the item to the bottle record your observations of the item on Table 2.
7. Using gloves mix up the material in the bottle. Gently push your testing items back into the soil. (Try to keep them from touching).

Data Table 1: Mass

	Mass				Change in mass	% Change
Item	**Start**	**Week 2**	**Week 4**	**Final**	**Starting Mass-Final mass**	**(final mass/starting mass) x 100**

Table 2: Observations

	Observations (look at color, texture, size, other features you think			
Item	**Week 1**	**Week 2**	**Week 3**	**Week 4**

Analysis

1. Describe the changes you saw in your testing items from week 1 to week 4.

2. What do you think caused the changes?

3. Was your expectation correct on which item showed decomposition and which item did not? If one of the items did not decompose do you think that would change if the item was left in the soil for a longer period of time?

4. Research this type of item and see if you can find out how long it would take it to decompose.

Extension #2

Different crops and plants remove different materials from the soil. It is important to reintroduce these nutrients back into the soil in order for the soil to be healthy and maintain healthy crops. Nitrogen and carbon are the two most common nutrients to vary in soil. Additionally, decomposition of matter can affect the temperature of the soil which can affect how the next crop grows on the land. Most farmers have to add fertilizer to a field to improve soil health. Alternatively, composting is a method to reintroduce the nutrients without having to purchase artificial fertilizers which could cause other damage to the soil.

This extension to the soil in a bottle lab will allow you to test the soil for nitrogen content. Additionally, by measuring the temperature of the soil you can show ongoing changes that are occurring. The process of decomposition is exothermic so temperature should change over time. Nitrogen testing kits are available but testing for carbon content requires an advanced scientific lab.

Procedure

Follow instructions provided by your teacher to test for nitrogen content of your starting soil. Follow the primary instructions for building your compost in a bottle.
Each week remove a small portion of the material from your bottle and test for nitrogen content. (Table 1)
Place your thermometer in the soil and record the temperature. (Table 2)
Using gloves mix the material in your bottle. Repeat steps 3-5 each week of your experiment.

Data Table 1: Nitrogen

Nitrogen Content				Total Nitrogen Change	% Change
Start	**Week 2**	**Week 4**	**Final**	**Starting Nitrogen Level-Final Nitrogen Level**	**(Final Nitrogen Level/Starting Nitrogen Level) x 100 Level**

Data Table 2: Temperature

Temperature				Temperature Change
Start	**Week 2**	**Week 4**	**Final**	**Starting temperature-Final temperature**

Analysis

1. What happened to the amount of nitrogen in the bottle over time? Did it change the same amount each week?

2. What happened to the temperature over time? Did it change the same amount each week?

3. What do you think would happen to the amount of nitrogen and the temperature if you allowed the decomposition to continue?

4. What long term effects does decomposition have on a farmer's field?

5. How do you think farmers could improve the health of their soil naturally? What things do you think they could do (outside of adding fertilizers) to help their soil?

6. Can you think of any negative effects of composting?