Title: Soil Column Lab

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Purpose

What are the key factors in decomposition? If two identical ecosystems were exposed to radically different lighting environments, which would decompose faster? What is the rate of decomposer? How does this relate to the earths ecosystems?

Hypothesis

I hypothesize that the ecosystem exposed to sunlight will decompose at a rate 50% faster than the ecosystem in complete darkness. I hypothesize the key factors in decomposition are temperature, microorganisms, composition & availability of oxygen. I hypothesize that after three weeks both ecosystems compostable material will have decomposed entirely.

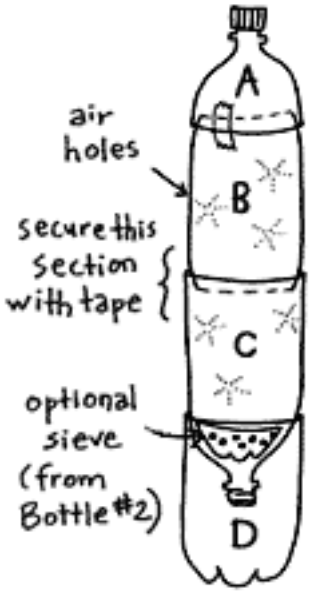
Materials

- 2 columns (each made from 3 2L bottles)
- 2 loafs of bread
- Rocks
- 6 cups of sand
- Soil
- Water
- 1 Ruler
- Data tables

Procedure

1. Create 2 columns (instructions on next page)

Step 1 – Cut the top off bottle #1 about an inch or so below the shoulder so that the cylinder has straight sides. Label the top portion with a small "A" using your sharpie, and the bottom portion with a small "D".



Bottle 1

Step 2 – Cut the top off of Bottle #2 about an inch above the shoulder. Cut the bottom off about an inch below the hip. The resulting cylinder should have two tapered ends. Label the cylinder with a small "B".

Bottle 2

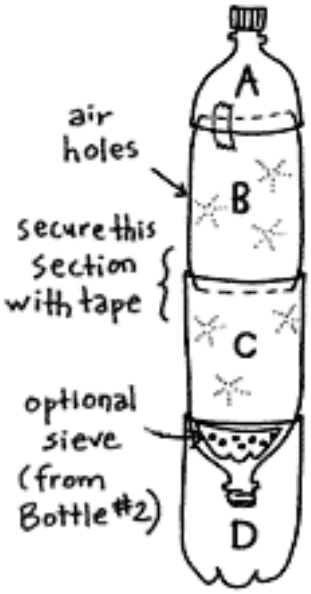
Step 3 – Cut the bottom off of Bottle #3 just above the hip, so the cylinder has a straight end. *Leave the cap on the top of this bottle*. Label the upper portion with a small "C".

Step 4 – Using a heated dissecting probe, poke a row of drainage holes around the neck of bottle 3. Wiggle the wire to make the holes somewhat bigger than the wire itself. (**Remember to wear safety glasses when using the hot dissecting probe**)

Bottle 3

Step 5 – Invert "C" and stack into base "D." Stack "B" and tape middle seam securely. Add top "A" with a piece of tape for a hinge to the bottle column. If you prefer, you can use one of the leftover bottom portions for the very top.

Step 6 – Poke a few small air holes in the column. (**Remember to wear safety glasses when using the hot dissecting probe**)



2. Put a handful of perlite into the bottom of both of your columns where you poked the drainage holes. Make sure you have put in enough to cover the drainage holes. This will allow water to drain out of the bottom without letting soil down to clog the drain holes.

3. Put enough sand in both of your columns to reach the seam where the two bottles B and C meet.

4. Add a mixture of dried leaves, chopped lettuce, in each of the columns and compress the mixture equally in both bottles.

5. Label your column with a piece of labeling tape, indicating your group members' names

6. Mark 60 centimeters on 2 strips of tape (2 feet long) and place them on an easily visible side of each column.

7. Record the height (in centimeters) of each ecosystem component (soil, drained water, compostable material).

8. Record any notable qualitative data in the incipient stages of the experiment.

9. Place column B in a concealed cabinet undisturbed by light, and place column A and an area near a window in plain view of the sun.

10. Record the height of each ecosystem component every three days for 3 weeks. As well as any observations such as condensation, aberrant smells, etc.

Data Tables & Observations:

Ecosystem Comp.	Original	Day 2	Day 3
Compostable Material A	7.5	7.25	7
Compostable Material B	7.5	7.25	7.25
Soil A	2	2.25	2.5
Soil B	2	2.15	2.25

Ecosystem Comp.	Original	Day 2	Day 3
Observations	The heights are not equal		Notable active organisms clenching to the plastic of Column B

Ecosystem Comp.	Day 4	Day 5	Day 6
Compostable Material A	6.8	6.5	6.25
Compostable Material B	7.15	7	6.9
Soil A	2.65	3	3.25
Soil B	2.45	2.55	2.65
Observations		The bread has almost entirely become white	Organisms clinging on the outside of the container of the sunlight exposed bottle, not visible in unexposed bottle

Ecosystem Comp.	Day 7	Day 8	Day 9
Compostable Material A	6	5.25	4.25
Compostable Material B	6.85	6.55	6.25
Soil A	4	4.75	5.25
Soil B	2.75	2.85	3

Ecosystem Comp.	Day 7	Day 8	Day 9
Observations	Condensation has accumulated on the exposed bottle, while there is none on the unexposed bottle		It seems as though the moisture from the organic material has been extracted and filtered down

Ecosystem Comp.	Day 10	Day 11	Day 12
Compostable Material A	4.15	4	3.55
Compostable Material B	6.15	6	5.75
Soil A	5.5	5.75	5.95
Soil B	3.15	3.15	3.15
Observations		There are no longer visible organisms on the inside of the exposed bottle	

Ecosystem Comp.	Day 13	Day 14	Day 15
Compostable Material A	3.55	3.55	3.55
Compostable Material B	5.75	5.75	5.75
Soil A	5.95	5.95	5.95
Soil B	3.15	3.15	3.15

Ecosystem Comp.	Day 13	Day 14	Day 15
Observations	The soil still contains whole pieces of compostable material	It appears as though the material has completely decomposed given the lack of heigh change	On the last day the compostable material is entirely discolored and the soil seems quite rich

Data Analysis & Results:

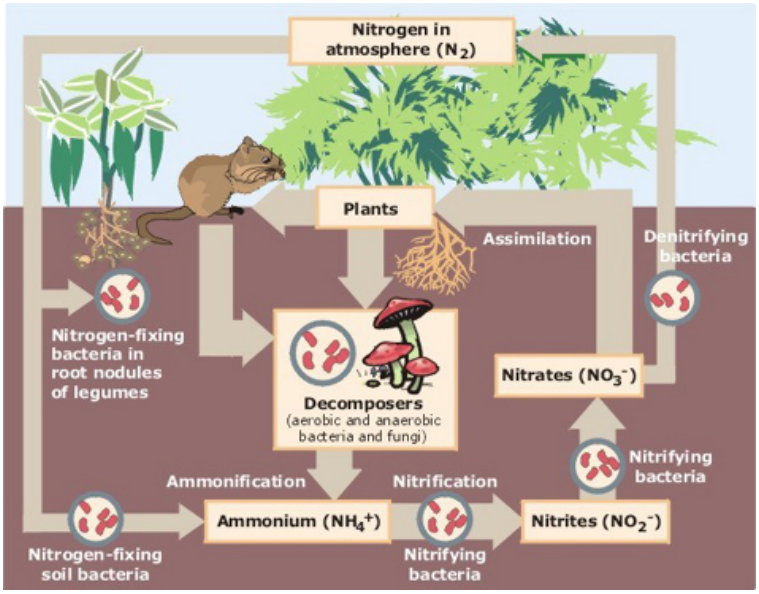
The purpose of this lab was to identify the specific factors that have an effect on decomposition rates. In our lab we created two identical environment with only one varying factor, light. By creating identical ecosystems exposed to all the same conditions except for one, we can layover the data and identify the importance (or lack of importance) of sunlight to the process of decomposition in an ecosystem. Our columns were built to represent a cross-section of an everyday environment, containing elements found in (but not exclusive to) North Carolina. We introduced our controlled environment to a very little amount of soil, however we intentionally added living organisms such as worms to assist in the decomposition.

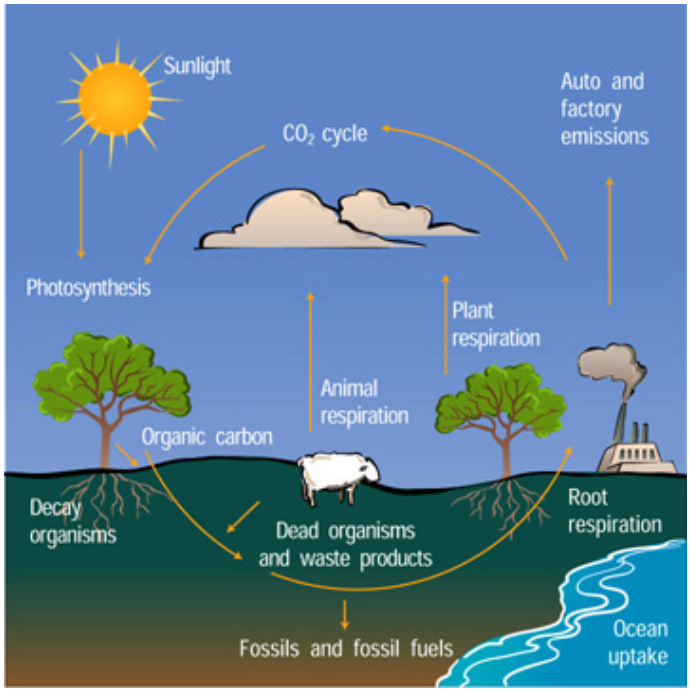
When our experiment started there were worms, flies and many other organisms already living in the compostable material (although they did not reveal themselves until very later in the experiment). I expected at the incipient stages of this lab that an enormous amount of carbon dioxide would accumulate over the course of our trials. I also expected that much of the compostable material would simplify into the elements that created it, such as carbon and a combination of other elements in the form of soil. My predictions were for the most part true, the aberrant smells originating from the experiment were carbon dioxide and as illustrated in our data there was an increase of soil around equal to the decrease of organic material and can thus be inferred due to the conservation of mass that this increase was due to the decomposition of the compostable material.

Most of the carbon from the soil column was actually the material we introduced at beginning of the experiment. This carbon was in the form of the organic compounds from autotrophs (the fruit, bread, all compostable material). All the previously listed materials are products of autotrophs such as trees or plants (Citation 1). Another form of carbon that was present in our column when the experiment began was carbon dioxide (a certain percentage of the gasses in our column was carbon dioxide). The importance of identifying carbon as having an intricate role in this experiment is identifying the cycle that the carbon underwent under the course of our trials.

Surmising that our experiment appropriately represented the natural cycles of our environment, we can state with confidence that under the course of our experiment the living organisms in our columns were fragmenting the elements of our material and emitting them as CO2. Given we did not have a full cycle (there were living organisms undergoing photosynthesis) we can speculate that the CO2 was residing in the experiment. (Citation 2). If our experiment had actually contained an organism capable of performing photosynthesis, we would have had a full cycle transpiring in our columns. The organic material would decompose, resulting in an increase of atmospheric Carbon or CO2, this CO2 would then be used for photosynthesis (a process plants use to produce food) along with water and sunlight with the byproduct of oxygen. When this plants die they contribute the to compostable material which would also act as growing ground for more plants (Citation 3).

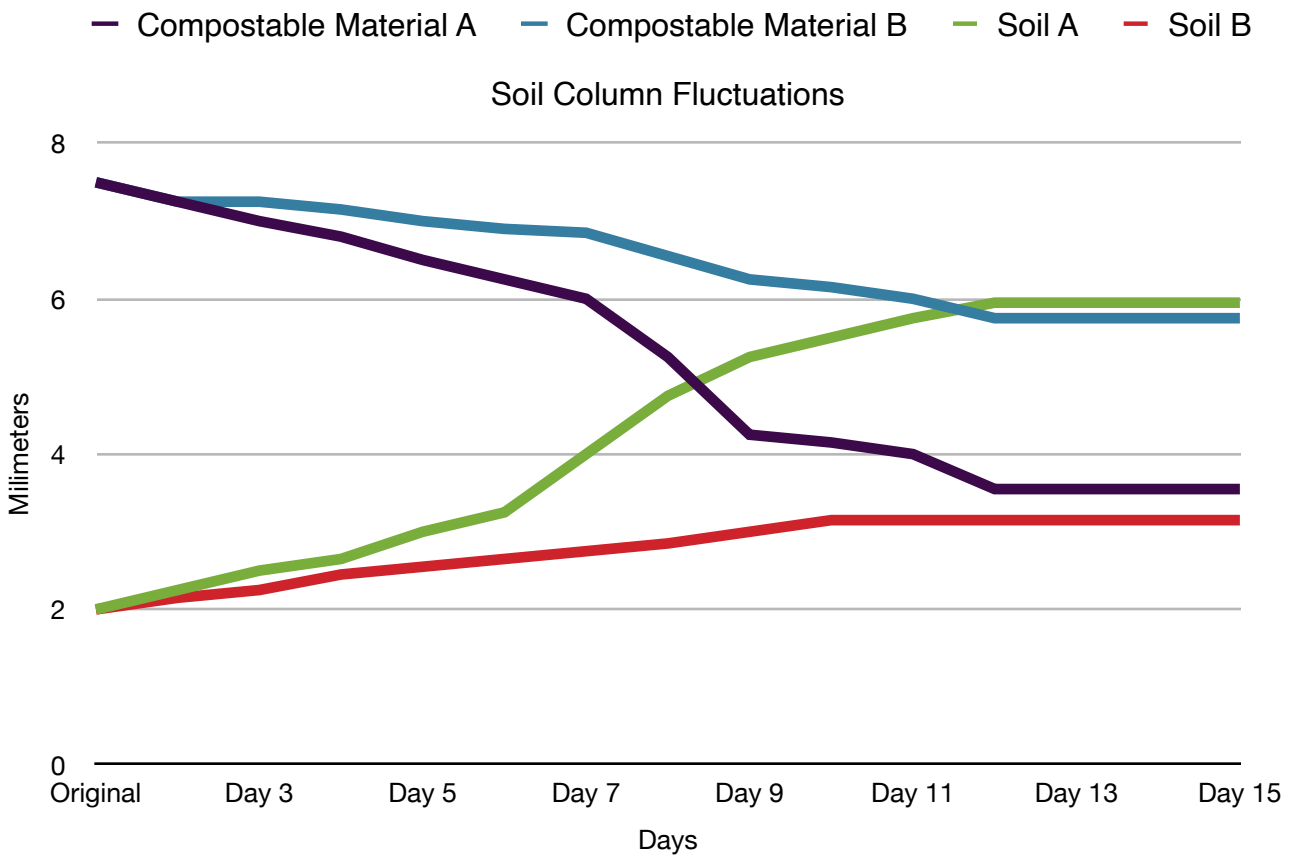
Nitrogen is another intricate element in this process, in this situation (as well as most other natural situations) nitrogen acts a fertilizer for the plants and more directly assister in the decomposition of organic material. The nitrogen in our columns undergo nitrogen fixation by bacteria, this process allows the previously inert form of nitrogen (N2) far more usable. Once the nitrogen is "fixed" it can be used by both plants and animals to grow.





Our column did contain primary producers but only in the form of compostable material. We did not observe any primary producers performing photosynthesis however it is important to note that all the necessary elements required for such a process to occur were present. For instance Ammonia (byproduct of nitrogen fixation), carbon dioxide, and sunlight (referring to bottle A) were all available in quantities capable of supporting photosynthetic life.

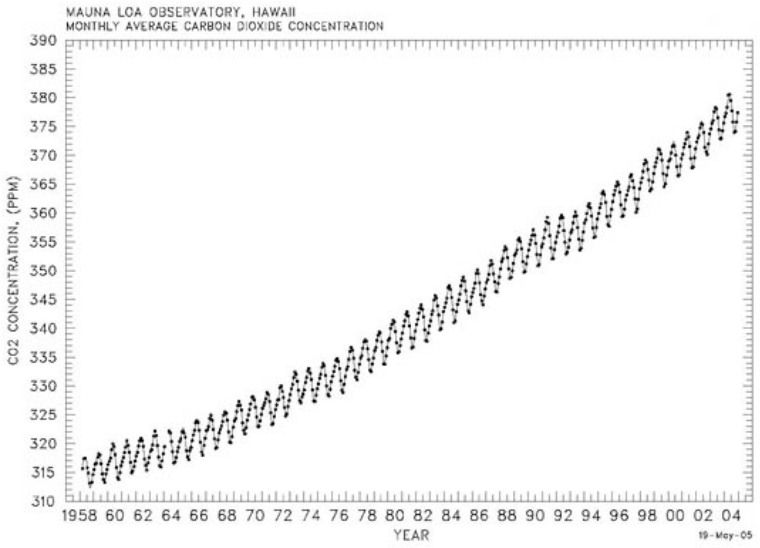
Our columns contained both flies and worms which can be considered first level consumers because they were consuming living and nonliving autotrophs. It should also be noted that worms would be more appropriately defined as decomposers. The detritivores present were a wide variety of bacteria, fungi and protists. It should be noted that not all organisms capable of categorization were recorded.



There is a quite overt difference between each set of data. Most interestingly the difference between the increase of Soil A and Soil B is equal to the difference between the decrease of Compostable Material A and Compostable Material B. More simply, the

decrease of compostable material A was far greater than that of compostable material B. It would be appropriate to state that this difference is due to the one variable in the two experiments, the availability of sunlight.

The increase of soil A was also larger than that of soil B, although this is consequential of the compostable material difference, it is important to note. Another observation of the data is that it plateaued near the end of the trials which indicate a limit to the amount of decomposition given the conditions. All of these changes are due to the decomposition of the compostable material by the various detritivores. The knowledge that each of the processes that take place in our ecosystem is a cycle we can deduce that if our columns were to have contained photosynthetic life a graph of any given element (specifically not broadly, for instance C02 not just carbon) any graph would look much like an annual atmospheric carbon graph shown below (Citation 4):



The graph above is what any cycle would look like when observing a single component of that cycle.

Note to Ms. Tate: So far I've been following the structure of my previous lab report format and for the sake of consistency I've put the last two questions of "Part Four: Analysis" in the conclusion given the nature of the questions.

Conclusion:

My hypothesis was mostly correct, I hypothesized that the bottle exposed to the light would decompose at a rate faster than the one that was not exposed. However my hypothesis was partly incorrect for I stated that the material would decompose entirely which it did not. If I were to changed the design of our column in any way I would have

ensured it was an entirely closed system and prohibited any tampering that may cause aberrant data.

Bibliography:

Citation 1 & 2

Brown, Wm. C. "Carbon Cycle." *An Online Biology Book*. 1994. Unknown, Web. 20 Sep 2009. <http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/C/CarbonCycle.html>

Citation 3

Gardiner, Lisa. "The Carbon Cycle." *Cycle Tour*. 08/12/2008. UCAR, Web. 20 Sep 2009. <http://www.windows.ucar.edu/tour/link=/earth/Water/co2_cycle.html>.

Citation 4 (image)

www.anenglishmanscastle.com/ archives/2007_04.html