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Biology 1 Odd

April 30, 2007

Final Background Report

Viruses, illnesses, diseases - these are words that come to mind when most people think of bacteria. What those people do not know, though, is that not all bacteria are harmful. In fact, most are not, and without bacteria our ecosystem would not function at all.

There are numerous types of bacteria in the soil, and each contributes differently to the nourishment of it. For example, some bacteria decompose dead organic matter which is then recycled into food for plants. Others are responsible for the water movement in the soil. They create substances that bind soil particles together into small aggregates, allowing for water filtration and improving the soils ability to hold water. Bacteria are simple decomposers and consume simple carbon compounds such as root exudates and fresh plant litter. Through this process, bacteria convert the energy in soil organic mater into forms that are useful to organisms living in the soil (Ingham, E. 2007). Many decomposers can also break down pesticides and pollutants in the soil. This is important because it prevents the loss of nutrients like nitrogen in the soil (Ingham, E. 2007). Bacteria help soil stay together by creating slime called polysaccharides. To create polysaccharides bacteria invade the cell walls of plant residue. Next enzymes secret through plant roots and it decomposes organic plant material which create slime. The slime or polysaccharides act as glue and help soil particles stay together (Discovery Education, 2006). It is also valuable to the soil because plant roots can easily grow within the soil; it helps hold water, and polysaccharides help resist erosion. The polysaccharides which pull together and make holes in the soil. Still other bacteria are important in cycling nitrogen which is vital to all life forms on Earth.

Every living thing needs three essential things in order to survive: food, water and oxygen. From birds to human beings, all life depends on these three substances. Plants depend on them as well. They photosynthesize to create food and make oxygen for themselves, but unlike other organisms, plants are not able to get water themselves. They depend on the soil to obtain it. If the soil is compressed, though, by people walking on it too much or buildings and other structures being built on top of it, the plants will no longer receive as much water. Soil compression gets rid of air pockets that are used by water to navigate to the roots of plants, and if the water can no longer navigate to the roots of the plants they die. This causes the bacteria to die as well from a shortage of nutrients that the plants were providing. Also, there becomes little space for oxygen which is important for the bacteria which also results in death of bacteria. Soil compression can eliminate or shorten plant growth which makes it harder for other organisms in the soil such as bacteria to find food and nourish itself (The State of Victoria, 2003).

Soil compression effects how the soil erodes. It enables erosion to erode more quickly. The compressed soil does not allow excess water, such as that from rain, to saturate into the soil because the soil pores are too small. As a consequence, soil erosion is accelerated. Eroded soil particles contain more pollutants and bacteria than other soil particles. These can contaminate living organisms and plants living in the soil. Because when the plants try to get their nutrients from the soil, they absorb the contaminated soil and therefore die. This lets less bacteria live in the soil due to the shortage of plants, because without plants, the bacteria do not have enough nutrients to survive (Bureau of Land & Water Quality, 2005).

When the polysaccharides make holes in the soil, carbon dioxide is exchanged with water and oxygen. The organisms living in the soil can use water and oxygen to survive, but human trafficking can affect this. When plants begin to die due to human trafficking, the holes in the soil begin to decrease. When holes in the soil begin to decrease, the amount of bacteria also decreases. Bacteria decrease because it is not able to use plants as food. When all of this occurs polysaccharides can not be produced.

Every organism is vital to the cycle of life and how the world operates. Plants, animals, and even bacteria contribute an important element, not only to their individual environment but to the world as well. Without existence of bacteria, entire ecosystems will be destroyed because bacteria keep the balance between what is needed and what is not by decomposing and recycling matter. If ecosystems become destroyed, many species will perish and then a repetitive cycle of species becoming extinct will start to evolve. Different organisms depend on other organisms for food. If one becomes extinct then the organism that depends on it will become extinct as well. This is why bacteria are extremely important. Therefore, if humans continue to walk, drive, build or partake in any other form of human trafficking that can be damaging to environments or developing ecosystems; they will destroy it, adding yet another group of evolving organisms to the list of extinct creatures.

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Bacteria are essential in everyday life. They impact erosion, plant life, soil, ecosystems, and numerous other things. Plants help bacteria to thrive, and therefore human trafficking kills both bacteria and plants (Groffman, 2007). We think the places with the most human trafficking have the least bacteria because as people walk on the soil, the plants are killed and due to this, the bacteria are killed. Therefore, we tested three different locations with varying amounts of human trafficking in order to see which has the most bacteria living in it. If the location we chose with the most human trafficking has the least bacteria, our hypothesis is correct that the amount of human trafficking affects the amount of bacteria living in the soil.

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Soil Ecology Problem Lab Report

Problem: Are there more bacteria living in the soil in the secluded area behind the big playground, on the front lawn, or in the soil on the path leading to the lower field?

Hypothesis: There are more bacteria living in the soil in the secluded area behind the big playground.

Independent Variable: The amount of human trafficking that takes place on the soils tested.

Dependant Variable: The amount of bacteria living in the soil.

Negative Control: Soil tested from the secluded area behind the big playground.

List of Controlled Variables:

- How much soil we test
- How deep in the ground we get the soil from
- When we collect the soil (weather conditions)
- Time period in which the soil is collected (all samples around the same time)
- Exact position of where we test the soil (latitude & longitude)
- Condition of soil at the time of testing
- Presence/absence of fertilizer
- Type of plants around soil
- Amount of plants on site
- Amount of sterile water used
- Number of times soil mixture is diluted
- Amount of soil/water mixture used
- How many times culture tube with soil/water mixture is shaken
- How long Petri plates are left to incubate
- Types of nutrient agar
- Size of soil scoop
- How much dilution is put on each plate

Step-by-Step Instructions:

1. Go to first location where soil is being tested and take the longitude and latitude of site (secluded area behind big playground – 39.35705ºN, 76.63615ºW)
2. Mark the site with a flag
3. Get cylinder soil sample 15 cm long and 2 cm wide by hammering the soil core sampler into the soil down to the first marking at 15 cm deep
4. Label plastic storage bag with location, place soil sample in for transportation back to the classroom

5. Repeat steps 1 – 4 once more for each of the two other locations within the same day and time period (front lawn – 39.35800°N, 76.63617°W and path leading to the lower field – 39.35837°N, 76.63692°W)
6. Do serial dilutions at the same time for all of the three bags collected on the same day at the same time.
7. Label 4 culture tubes with location and dilutions (tube one: 10^0, tube two: 10^{-1}, tube three: 10^{-2}, tube four: 10^{-3})
8. Fill 10^0 culture tube with 10 ml of sterile water, and fill each of the other three culture tubes with 9 ml of sterile water
9. Place 1 cc of soil sample (first from the secluded area behind the playground) into the 10^0 culture tube; cap the tube and shake vigorously.
10. Using a serological pipette, remove 1 ml of the soil/water mixture from the 10^0 tube and place into the 10^{-1} culture tube; cap and shake vigorously
11. Using a serological pipette, Remove 1 ml of the soil/water mixture from the 10^{-1} tube and place into the 10^{-2} tube; cap and shake vigorously.
12. Using a serological pipette, Remove 1 ml of the soil/water mixture from the 10^{-2} tube and place into the 10^{-3} tube; cap and shake vigorously.
13. Label each of the *Petrifilm Aerobic Count Plates* with our names, the location (first from the secluded area behind the playground), and the dilution
14. Plate 100 µl samples from the 3rd and 4th tubes (dilutions 10^{-2} & 10^{-3}) onto their own individual *Petrifilm Aerobic Count Plate*™ and allow to incubate at room temperature overnight.
15. Observe number of bacteria colonies on plates from each location and find the plate with least number of bacteria colonies, but more than five, and record dilution value of the plate they are on
16. Use equation to find number of bacteria per cubic cm of soil and record: number of colonies on plate $\cdot 10^2$ = # of bacteria in dilution tube; # of bacteria in dilution tube $\cdot 10^{|\# \text{ of dilutions}|}$ = # of bacteria/cubic cm of soil
17. Repeat steps 9 – 16 for other two samples collected at the same time (front lawn and path leading to lower field)
18. Collect second sets of samples from each of the three locations on the same day and do serial dilutions on each of those samples (steps 7–17)
19. Collect third sets of samples from each of the three locations on the same day and do serial dilutions on each of those samples (steps 7–17)

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Data and Analysis:

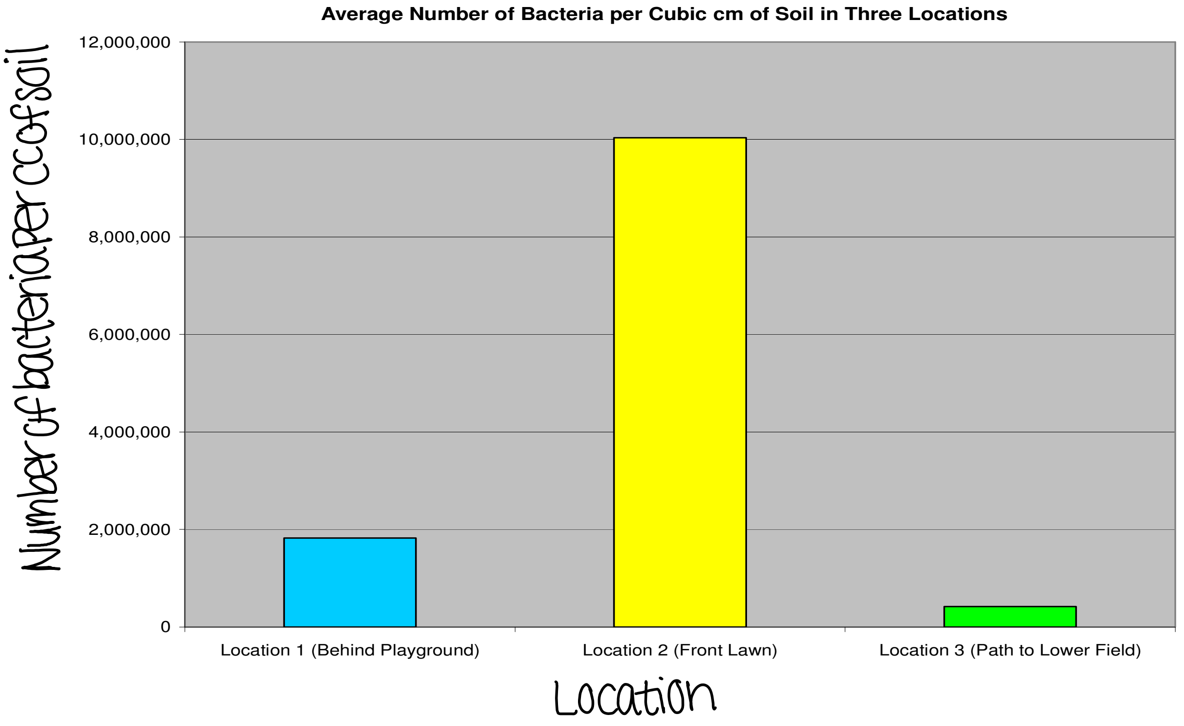
Trial 1 (5/9/07)	# of Bacteria per Cubic cm of Soil
Location 1 (behind playground)	5,300,000
Location 2 (front lawn)	500,000
Location 3 (path to lower field)	710,000

Trial 2 (5/14/07)	# of Bacteria per Cubic cm of Soil
Location 1 (behind playground)	30,000
Location 2 (front lawn)	2,000,000
Location 3 (path to lower field)	290,000

Trial 3 (5/16/07)	# of Bacteria per Cubic cm of Soil
Location 1 (behind playground)	130,000
Location 2 (front lawn)	27,600,000
Location 3 (path to lower field)	260,000

Average	# of Bacteria per Cubic cm of Soil
Location 1 (behind playground)	1,820,000
Location 2 (front lawn)	10,033,333.33
Location 3 (path to lower field)	420,000

Graph:



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Statistical Analysis:

Location 1 (Behind Playground) and Location 2 (Front Lawn)
- P-Value = .45 = 55% Certain

Location 1 (Behind Playground) and Location 3 (Path to Lower Field)
- P-Value = .51 = 49% Certain

Location 2 (Front Lawn) and Location 3 (Path to Lower Field)
- P-Value = .39 = 61% Certain

Conclusion:

Our hypothesis is wrong; the area behind the playground does not have the most bacteria colonies. Instead, we found that the front lawn has the most bacteria colonies. Our data shows us that the area behind the playground has the second most bacteria colonies, and the path leading to the lower field has the least.

Although our hypothesis is wrong, our p-values tell us that we can be 55% certain that the data we found about the playground having less bacteria than the front lawn is correct. We can be 49% certain that the data we found about the playground having more bacteria than the path to the lower field is correct, and lastly, we can be 61% certain that our data showing that the front lawn has more bacteria than the path to the lower field is correct. Since there is a significant difference between trafficking on the front lawn and the path to the lower field and our p-value shows that we can be relatively certain of our data, we should re-do the experiment. In our next trials, we should use those same two locations and an additional location with significantly more trafficking to see if our theory of human trafficking affecting the number of bacteria is valid.

In trial one, the area behind the playground (location 1), has 5,300,000 bacteria colonies. The front lawn, (location 2), has 500,000 bacteria colonies, and the path leading to the lower field, (location 3), has 710,000 bacteria colonies. In trial two, the area behind the playground has the least amount of bacteria colonies; 30,000 bacteria colonies. The front lawn has 2,000,000 bacteria colonies, which is the highest amount of colonies, and again, the path leading to the lower field is in the middle with 290,000 bacteria colonies. In trial three, the front lawn has the highest amount of bacteria colonies; it has 27,600,000 colonies. The path leading to the lower field has the second most colonies (260,000 colonies). The least amount of bacteria colonies are located in the area behind the playground, with 130,000 bacteria colonies.

Overall, the front lawn has the highest amount of bacteria colonies with an average of 10,033,333.33. Second is the area behind the playground with an average of 1,820,000 colonies. The path leading to the lower field has the least amount of bacteria colonies, with an average number of 420,000. We believe that the front lawn has the largest amount of bacteria colonies because it has the most nutrients in the soil and the least amount of human trafficking. The area behind the playground is in the middle because it may have more human trafficking than the front lawn and less nutrients in the soil. The path leading to the lower field has the least amount of bacteria colonies because it has the least amount of nutrients and the most human trafficking.

I HAVE ACTED HONORABLY

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