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Biology Honors 2

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Background Information

Nonpoint source pollution is a major cause of water-quality problems. Defined as pollution from an unknown or unfixed source, “nonpoint source pollution occurs when rainfall or snowmelt runs over land or through the ground, picks up pollutants, and deposits them into rivers, lakes, wetlands, and coastal waters or introduces them into groundwater (Nonpoint Source Pollution, 2011).” It can have a major impact on the economy, causing “mass die-offs of fish,” and can “plague the waters surrounding coastal communities.” It can destroy the beauty of land and waters and cause direct harm to humans, as well (Nonpoint Source Pollution, March 25, 2008). For example, three major types of pollutants carried by runoff – pathogens, nutrients, and sediments – can all cause harm to drinking water (Agricultural Engineering, 2011). Bacteria in such runoff are especially dangerous, such as Cholera (Cholera, November 18, 2010), Leptospirosis (Leptospirosis, March 16, 2011), and Typhoid Fever Typhoid (Typhoid Fever, October 5, 2010). Likewise nutrients and sediments from nonpoint source pollution in high concentrations can become an environmental threat. “Nitrogen contamination of drinking water can cause health problems, including ‘blue baby’ syndrome,” and nutrient runoff from agricultural fertilizers, home lawn care, and yard animal waste, along with erosion can cause “algae blooms and aquatic weed growth which can deplete oxygen, increase turbidity, and alter habitat conditions” (Agricultural Engineering, 2011).

Usually factories, construction, and harvesting are the major source of nonpoint source pollution (Nonpoint Source Pollution, 2011). But pesticides and house hold cleaning chemical products can also have an impact on the environment when we use them, and one common form of nonpoint source pollution in daily life is glass cleaner. Windex, a common window cleaner, has been found to be quite harmful to the environment, and it is recommended to avoid Windex runoff into soil, waterways, etc. (Ecolab, 2008). The effect of Windex on the environment vary. It can cause nausea, headache, and vomiting in humans when ingested, its use has even been recommended for killing insects, such as gnats (Braniac, 2003) (Ecolab, 2008). One reason why it does this is because of the high levels of ammonia it contains. Ammonia, an alkaline gas, is very toxic to organisms, and when it mixes with water, it creates ammonium ions that are even more toxic (Environment Agency, 2011). In fact in a study of the Effects of Household Chemicals on Household Plants, 0.5 ml concentration of Windex was added to one group of plants, and 1 ml concentration of Windex was added to another group of plants. The plants with 0.5 ml concentration of Windex were healthier than the plants with 1ml concentration of Windex. The Windex seemed to act as a diluted poison, stunting the growth of the plants, and slowly killing them. The plants with 1 ml. concentration of Windex died faster than those with 0.5 ml. concentration of Windex, and in both experimented situations, the ammonia from the Windex made the soil very dry (Hall, Wood, Kolososki, & Howell, 2003).

However, while Windex can harm plants because of the ammonia in it, there is one organism in the environment that actually uses ammonia; soil bacteria. Ammonium ions can be transformed to nitrate ions in the soil. Nitrate ions are used to help the growth of plants (Ammonia, 2011). In the nitrogen cycle the raw materials to make amino acids and DNA and RNA are recycled. The bacteria are the only organisms that can get the nitrogen out of the air.

They are the original source of the nitrogen being turned into ammonia. Nitrogen and ammonia are used to create the five biological molecules, specifically amino acids, and then DNA and RNA. The pants then take the ammonia and the nitrate to build its amino acids. The animals then take the polymers of the plant apart, and use the monomers to build its own polymers. When the animal dies, decomposers return the ammonium back into the soil, and this whole process starts over (Campbell, Williamson, & Heyden, 2004).

This is significant, because if you harm plants in an ecosystem, you harm the animals in the ecosystem that depend on them. We know that at Roland Park, the windows are washed with “Clear Choice Glass” cleaner; however not all people use this cleaner. We compared the effect of “Clear Choice Glass” with Windex, a more common window cleaner, on the density of bacteria in the soil.

Lab Report

I. Problem: Will “Windex” cleaner (a non-green cleaner) decrease the density of bacteria in the soil more than “Clear Choice Glass” cleaner (a green cleaner)?

II. Hypothesis: Yes, “Windex” cleaner will decrease the density of bacteria more than the “Clear Choice Glass” cleaner will.

III. Procedure:

a. Independent: Type of cleaner applied to the soil

b. Dependent: percent change in the density of bacteria in the soil

c. Negative Control: applying only water to the soil

d. Controlled Variables: brand of each type of cleaner; amount of cleaner added to the soil; amount of water added to the soil; amount of soil taken as a sample; location of soil; temperature of soil; temperature of cleaner; moisture of soil; color of cleaners added, filtered/unfiltered water; temperature of water; when soil sample is collected; where soil sample is collected; temperature of sterilized water, color of 15 ml test tube, temperature of where dilutions take place; degree diluted; which dilutions were plated; type of growth plate; amount of sample put on growth plate; how long samples grew; amount of soil diluted

e. Step-by-step Instructions:

   1. Label nine separate plastic sandwich bags “Trial 1 Sample 1”, “Trial 1 Sample 2”, “Trial 1 Sample 3”, “Trial 2 Sample 1”, “Trial 2 Sample 2”, “Trial 2 Sample 3”, “Trial 3 Sample 1”, “Trial 3 Sample 2”, and “Trial 3 Sample 3” respectively.
   2. Take nine separate samples of soil, each going up to the first line on the soil agar (15.5 cm deep x 2.5 cm wide) from N 39.35712, W

076.63755. (Three of these samples will be used for each trial, but it is necessary to take all samples at the same time, on the same day). Place each separate sample into its correspondingly labeled plastic bag.

3. Measure how many bacteria are in each sample by doing a serial dilution. (Each separate trial can be measured on separate days, but all three samples within a trial must be measured on the same day, at the same time.)
    a. Use a clean, new transfer pipette to add 10 ml of sterile water to a 15 ml culture tube. Label the tube "T1S1 Win1 10^{0}.".
    b. Use the same pipette to add 9 ml of sterile water to a second 15 ml culture tube. Label the tube "T1S1 Win1 10^{-1}."
    c. Use the same pipette to add 9 ml of sterile water to a third 15 ml culture tube. Label the tube "T1S1 Win1 10^{-2}."
    d. Use the same pipette to add 9 ml of sterile water to a fourth 15 ml culture tube. Label the tube "T1S1 Win1 10^{-3}."
    e. Place one cc of soil from the "Trial 1 Sample 1" bag into the "T1S1 Win1 10^{0}"culture tube.
    f. Cap the tube and shake vigorously.
    g. Using a new clean pipette, remove 1 ml of the soil/water mixture from the "10^{0}" tube and place into the "10^{-1}" tube.
    h. Cap and shake vigorously.
    i. Using the same pipette in step h, remove 1 ml of the soil/water mixture from the "10^{-1}" tube and place into the "10^{-2}" tube.

j. Cap and shake vigorously.

k. Using the same pipette in step h, remove 1 ml of the soil/water mixture from the "10^{-2}" tube and place into the "10^{-3}" tube.

l. Cap and shake vigorously.

m. You should now have a total of four culture tubes.

n. Place separate 100 µl samples from the 3rd and 4th tubes (dilutions 10^{-2} & 10^{-3}) onto their own separate, correspondingly labebel 3M Petrifilm TM Aerobic Count Plates containing nutrient agar, (e.g. "T1 S1 10^{-2}" solution on plate labeled "Trial 1 Sample 1

o. Repeat letters a-n, for trial 1, sample 2 and trial 1, sample 3.

p. Allow all samples to grow for 48 hours.

q. Examine the 10^{-3} plate for bacteria colonies (it must have at least 5). If plate 10^{-3} does have at least 5 bacteria colonies, then count the number of colonies on that plate, and ignore the 10^{-2} plate. If the 10^{-3} plate does not have at least 5 bacteria colonies, count number of colonies on the 10^{-2} plate. To make your estimates of the number of bacteria in the original 1 cc soil sample, use the following formula:

Microbes in 1 cc of soil = # Colonies on sheet x 10^2 x 10 |dilution # at which these colonies were found|.

4. Record the number of bacteria for each sample in their respective box in the data table.
5. Repeat step 3 and 4 for trials 2 and 3, changing the labels to match the trial/sample/chemical.
6. Label nine separate petri dishes “T (trial) 1S (sample) 1”, “T1S2”, “T1S3”, “T2S1”, “T2S2”, “T2S3”, “T3S1”, “T3S2”, and “T3S3” respectively. Put the 15.5 cm x 2.5 cm soil sample from bag “T1S1” into petri dish “T1S1”, put the 15.5 cm x 2.5 cm soil sample from bag “T1S2” into petri dish “T1S2”, and so on accordingly, matching up each soil sample with its corresponding petri dish, on the same day at the same time.
7. Complete steps 7, 8, and 9 simultaneously, on the same day, at the same time:
8. Pour 10 ml of sterile water each into petri dishes “T1S1”, “T2S1” and “T3S1”, pouring it all around the dish, not just concentrated in one area.
9. Pour 10 ml of “Windex” cleaner each into petri dishes “T1S2”, “T2S2”, and “T3T2”, pouring it all around the dish, not just concentrated in one area.
10. Pour 10 ml of “Clear Choice Glass” window cleaner each into petri dishes “T1S3”, “T2S3”, and “T3S3”, pouring it all around the dish, not just concentrated in one area.
11. Allow to sit for 24 hours

12. Measure how many bacteria are now in each cup using the instructions in steps 3 and 4, then record numbers in the data table.

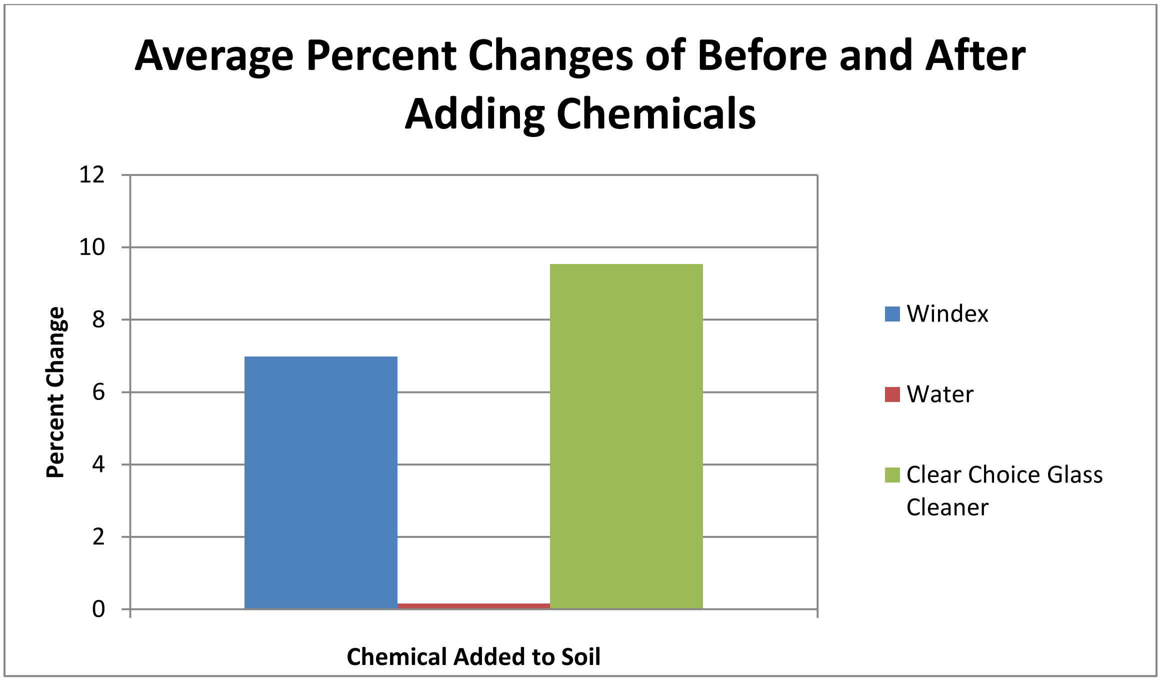
IV. Data and Analysis:

A. Data Table:

Impact of Different Window Cleaners on Soil

	Number of Bacteria in 1 cc of Soil with Windex Cleaner Added			Number of Bacteria in 1 cc of Soil with Water Added			Number of Bacteria in 1 cc of Soil with "Clear Choice Glass" Cleaner Added		
	Before Testing	After Testing	Percent Change	Before Testing	After Testing	Percent Change	Before Testing	After Testing	Percent Change
Trial 1	11220000	112200000	9	41820000	36720000	-0. 1	9180000	28560000	2.1
Trial 2	15300000	127500000	7.3	5100000	12240000	1.4	1020000	17952000	16.6
Trial 3	5100000	28560000	4.6	45900000	8160000	-0. 8	1122000	12240000	9.9
Average	10540000	89420000	7	30940000	19040000	.2	3774000	19584000	9.5

B. Graph:



V. Conclusion:

Based on our research, our hypothesis is incorrect. As the data chart shows, when the bacteria is in the controlled environment, there is very small change in the density of the bacteria, which means that their natural environment was not conducive to them being able to reproduce and grow in numbers, and it was stable. The evidence for that is that the percent change was only 0.2. Had our hypothesis been correct, we should have seen negative percent changes. But, the chart shows that we saw positive percent changes for both the Windex and the Clear Choice Glass Cleaner. The evidence for this is a percent change of 7 for the Windex, and a percent change of 9.5 for the Clear Choice Glass Cleaner. This positive percent change shows that the cleaning products are actually aiding the bacteria to reproduce.

Based on what we learned from our experiment, we do have some evidence that shows that the green cleaner helps the soil more than the Windex does. The evidence for this is that the

Clear Choice Glass Cleaner caused a percent change of 9.5, whereas the Windex only caused a percent change of 7. This information supports the original idea behind our hypothesis, because we have evidence in our background saying that the Windex could potentially harm the bacteria in the soil (Ecolab, 2008). The Windex clearly had some sort of restricting impact, because the bacteria from the soil with the Windex in it did not reproduce as much as the bacteria in the soil with the Clear Choice Glass Cleaner.

Based on our findings and previous evidence (Ecolab, 2008) we would next start researching on why the Windex was more restricting than the green cleaner. We would first find out what the ingredients are in the Windex and the green cleaner. When we find out what the different ingredients are, we would test them separately on the soil and see what their impact is on the density of the bacteria. We would focus on the ammonia in the Windex, because we were puzzled that the ammonia in the Windex had less of an impact on the density of the bacteria. We would see what the specific impact of the ammonia on the bacteria was, and then conduct further research after figuring out how the separate ingredients, especially the ammonia, had on the density of the bacteria in the soil.

Bibliography

Agricultural Engineering. (2011) The Ohio State University: http://ohioline.osu.edu/aex fact/0441.html.

Brainiac. (12 April, 2011) How to Kill Gnats. Demand Media Inc: http://www.ehow.com/how_5383625_kill-gnats.html.

Campbell, N; Williamson, B; Heyden, R. (2004) Biology: Exploring Life. Pearson Prentice Hall.

Cholera. (November 18, 2010). Centers for Disease Control and Prevention: http://www.cdc.gov/cholera/index.html.

Environment Agency. (2011) Ammonia. Environment Agency: http://www.environment agency.gov.uk/business/topics/pollution/5.aspx.

Hall, A; John Wood; Chris Kolososki; Matt Howell. (12 February, 2003) The Effects of Household Chemicals on Household Plants. http://jrscience.wcp.muohio.edu/nsfall99/FinalArticles/TheEffectsofHouseholdChem.html.

Jacob, R; Emily Cordaro. (Fall, 2000) Nitrification. RPI: http://www.rpi.edu/dept/chem eng/Biotech-Environ/Environmental/nitrification.html.

Leptospirosis. (March 16, 2011) Centers for Disease Control and Prevention: http://www.cdc.gov/leptospirosis/.

Nonpoint Source Pollution. (March 25, 2008) NOAA Ocean Service Education: http://oceanservice.noaa.gov/education/kits/pollution/04nonpointsource.html

Nonpoint Source Pollution. (2011) Advameg, Inc.: http://www.pollutionissues.com/Na Ph/Nonpoint-Source-Pollution.html.

Typhoid Fever. (October 5, 2011) Centers for Disease Control and Prevention: http://www.cdc.gov/nczved/divisions/dfbmd/diseases/typhoid_fever/.

Safety Data Sheet: Windex. (9 January, 2008). Ecolab: http://www.advanced appliances.co.nz/products/Ecolab_Products/SDS%20Sheets/Windex%20SDS.pdf.