December 2, 2024

Today I started developing my leading question and research questions revolving around the ideas of comparing natural and artificial cleaners. Ex. Windex, dish soap, febreeze, cleaner, etc vs homemade concoctions of vinegar, lemons, fruits, etc. I also created documents for research, citations and this logbook.

December 20, 2024 - Jan 15, 2025

I mainly worked on completing all my research questions and started to think about the materials I would need to complete my experiment. I also decided the 3 categories of cleaners I would be doing are disinfectant, all purpose spray and shiner/buffer. I decided that it would be more appropriate to do homemade v.s. store bought cleaners instead of artificial and natural because some of the ingredients in the homemade cleaners were not natural.

January 21, 2025

I made the petri dishes I planned on using the following week to test my cleaner. I also signed up on the CYSF platform and filled out some of the basic project info and research.

January 28, 2025

I completed the write up for my petri dishes as well as planned my first round of experiments. I also gathered the materials I would need to make a homemade incubator to grow my petri dishes in.

February 2, 2025

I made the homemade incubator and began to test and see how well it could maintain a temperature warm enough to grow my bacteria.

February 5, 2025

I did a lot of things on this day because I was sick, so I focused on writing out the procedures I intend to follow as well as finding the cleaning products I will test my homemade recipes against.

February 7, 2025

I came up with my hypothesis and my variables for my disinfectant spray experiment. I also remade my petri dishes because I noticed that some of them had developed a film on the surface or had a few small chunks in them. I think this could possibly have been agar agar powder so when I remade them I was careful to boil the agar medium for a little longer.

February 7, 2025 - Later in the day

When I was examining the petri dishes in the fridge I noticed similar small chunks in the medium. I think they are not the agar but actually the beef bouillon I used to make broth. I boiled it for 5 minutes so I am confused why they are still not working correctly. However since I think this should not have a large impact on my results I am going to go ahead and use them because I plan to do testing this weekend and I can’t remake them again. I am going to take before photos of the dishes and hope that the bacteria grows most on the actual surface of the dish.

February 8, 2025

I made the cleaner I plan to use for the disinfectant experiment as well as purchased the cleaning product I plan to test it against.

February 9, 2025

Over the weekend I was thinking about the petri dishes and I decided I would try one more time to get them right before I start experimenting. I got some advice from a friend who used agar agar powder before and she recommended stirring the powder in cold water first before boiling to help it dissolve better. I also thought it might be of some benefit to strain the beef broth in hopes that it may help remove some of the particulate matter. So I remade my petri dishes.

February 10, 2025

I used the remade petri dishes which were much clearer when I used the strategy of filtering the broth with a coffee filter and stirring the agar agar powder in cold water before use. I started my first round of testing of my disinfectant cleaners and tested our bathroom counter and the window ledge in my parents bedroom. I chose the ledge because our cats frequently climb up there and a layer of grease and hair accumulates.

Observations:

* All the cleaners seem to work equally well, all the surfaces appeared to be visible clean after using the cleaners
* The method had the strongest scent of the store bought cleaners, the clorox barley smelt like anything
* The homemade cleaner smelled quite strongly of vinegar which I found to be a bit of an unpleasant smell
* I didn’t need to apply extreme elbow grease for any of the cleaners, just rubbing firmly with a paper towel got the job done

February 13, 2025

I worked on organizing my research as well as finishing editing my experiment procedure. My petri dishes have also been incubationing for 3 days so later tonight I plan on counting the microbial colonies that have formed.

February 13, 2025 - Later in the day

I counted all the microbial colonies visible on the petri dishes and took many photographs of the dishes. I also transferred all of my data onto google sheets so it would be easier to make graphs with the data later.

Observations of the petri dishes:

* On only one off the petri dishes I noticed that the pattern the microbial colonies grew in followed the exact direction I swabbed in
* I noticed two main different types of bacteria, one was larger and oval shapes and the others were just small white dots
* They had a very strange and unpleasant smell that I would sort of describe as mold but in a lighter way
* The petri dishes became a little bit more yellowed

Microbial Colony Data:

| Location | Control | Natural store | Store | Homemade |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
| Bathroom | 11/304 | 16/60 | 22/272 | 29/52 |
|  |  |  |  |  |
| Window | 30/46 | 19/43 | 32/64 | 11/108 |

February 17, 2025

I made the petri dishes I would need for the experiment the next day as well as started to plan more in depth my experiments for the shinner and all purpose spray

February 18, 2025

I started my 2nd round of the disinfectant experiment which was my coffee table and our kitchen countertop. I took photos and added onto my observations.

February 21, 2025

I examined my petri dishes, counted the bacterial colonies and recorded them on my spreadsheet. I also photographed my petri dishes. I continued to work planning my remaining experiments which include the shinner and the all purpose spray.

Microbial colony count:

| Location | Control | Natural store | Store | Homemade |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
| Kitchen Counter | 1/78 | 4/16 | 4/16 | 8/15 |
|  |  |  |  |  |
| Down stairs table | 2/38 | 4/16 | 3/13 | 4/12 |

February 25, 2025

I made the petri dishes I would need for my final disinfectant experiment and worked on perfecting and uploading much of my research and variables to the CYSF site.

February 26, 2025

I started the last disinfectant experiment and followed my usual procedure of photographing the surfaces before and after.

March 1, 2025

I recorded the last batch of data from my disinfectant experiment and logged all data to my google sheet. I also started to graph all the data from the disinfectant experiment.

Microbial colony counts:

| Location | Control | Natural store | Store | Homemade |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
| Hand railing | 17/62 | 3/37 | 5/23 | 7/31 |
|  |  |  |  |  |

March 3, 2025

I continued to work on all aspects of my project and worked on polishing my plans for my final two experiments.

March 6, 2025

I made the homemade eggshell powder I would be using for my shiner experiments and then I finished my costs analysis.

March 7, 2025

I did the experiment for my shiner, recorded the results, graphed and analyzed them and worked on the portion of my conclusion. I then started to plan out the organization of my trifold.

Shiner observations:

* I accidentally touched the bar keepers powder during the experiment and it made my skin a little red and felt very chemically opposed to the eggshells which I could just touch
* The bar keepers friend once exposed to water formed a kind of paste, while the eggshells stayed more powdery
* The bar keepers friend overall did a much better job on the rust and dirt then the eggshell powder did
* The eggshell powder however did a better job the the very heavy burn build up one of the pots
* Overall I was a little disappointed by both cleaners, they did remove lots of grime but there was still a lot of grime and rust left on the pots afterwards

Shiner Results:

Pot 1: Homemade

Pot 2: Store bought

Pot 3: Store bought

Pot 4:Store bought

Pot 5: Homemade

Pot 6: Store bought

| Pot Number | Homemade (score of 10) | Store bought (score of 10) |
| --- | --- | --- |
| 1 | 5 | 7 |
| 2 | 2 | 1 |
| 3 | 6 | 8 |
| 4 | 2 | 5 |
| 5 | 10 | 10 |
| 6 | 4 | 6 |
| Average: | 4.83 | 6.16 |

March 9, 2025

Today was a big grind day for me. I did my final experiment - all purpose spray, and logged all the data for it. I finished formatting and adding my hypothesis and variables to the CYSF platform. I also wrote my acknowledgement.

March 10, 2025

I finished all aspects of my project and uploaded it to CYSF.

March 11, 2025

I completed the trifold and the scripts.

Original Research:

**Main question: Are homemade or store bought cleaners better in terms of cost, effectiveness, and environmental impact?**

Research questions:

How are cleaners produced?

Here are the steps that most factory produced cleaners are made by.

1. To make any cleaning products the first step is to select the ingredients based on the purpose of the cleaner. Most common cleaning products contain ingredients such as surfactants, solvents, acids and bases, disinfectants, fragrances, preservatives, thickeners or stabilizers and colours.
2. To make a good cleaner the second step is to create the formula. The most important factors involved in making a formula is to make sure all the chemicals are balanced so the formula is safe for use, effective and stable.
3. The third step is the mixing of all the ingredients. The ingredients are mixed in large industrial tanks where the temperature, pressure and mixing time are strictly controlled to ensure the best final product.
4. The fourth step is the process to make a cleaner is quality control, the cleaners are tested to ensure they are effective, they are labeled correctly based on the toxicity, that they are stable and don’t separate or mold over time and the pH levels are compatible with the target surfaces.
5. The final step is to package the cleaning product and ensure they are labeled with the correct safety warnings depending on the chemicals they contain. After this the products can be shipped out to stores where they are available for the public to purchase.

What is the purpose of the ingredients in store bought cleaners?

Table A: Common store bought cleaner ingredients

| **Ingredients:** | **Purpose:** |
| --- | --- |
| Surfactants | Surfactants help remove grease and grime by breaking the surface tension between water and oils |
| Solvents | Dissolve grease and grime |
| Acids and Bases | Adjust the pH to insure for the most effective cleaning on the designed surface |
| Disinfectants | Kill germs, bacteria, fungi, viruses - which is very important in many cleaning products |
| Preservatives | Prevent microbial growth in the product |
| Thickeners/Stabilizers | Help maintain the consistency of the cleaning products and evenly distribute the chemicals |
| Colours/Fragrances | Make the product more aesthetically pleasing and nice to use |

What is the difference between homemade and store bought cleaners?

One of the main differences between homemade and store bought cleaners is the chemicals and ingredients that they contain. Store bought cleaners often contain synthetic ingredients and chemicals such as surfactants, preservatives, VOCs, and stabilizers. On the other hand homemade cleaners are usually made of simple and natural ingredients like vinegar, baking soda, lemon juice, and essential oils. One of the many benefits of this is that the ingredients in homemade cleaners are much less likely to irritate the skin or lungs while some of the chemicals in store bought cleaners can cause respiratory issues or skin irritation and rashes.

Another one of the main differences between homemade and store bought cleaners is the cost. Most homemade cleaners can be made with ingredients you are likely to already have at home. Store bought cleaners you have to buy a very large array of different ones to be able to clean all the different types of surfaces. This is because the chemicals in store bought cleaners are harsher which means that on delicate surfaces like marble or granite countertops require specialized chemicals to clean which means that you have to buy more products. Homemade cleaners on the other hand aren't as harsh so they won't damage delicate surfaces.

The third main difference between store bought and homemade cleaners is the effectiveness of the products. Because store bought cleaners are formulated for specific tasks they can be more effective, the only problem is that sometimes store bought cleaners can contain unnecessary chemicals which are not really needed and can quite often harm the environment. Homemade cleaners are effective for general cleaning but can sometimes not be as strong on extreme grease and grime.

The last main difference between store bought and homemade cleaners is the environmental impacts which I researched in detail later. This also connects to safety because store bought cleaners can be hazardous if mishandled or mixed with other chemicals improperly or disposed of incorrectly. In general homemade cleaners are safer because the ingredients in them are less toxic.

What is the environmental impact of cleaners?

**Water:**

A study conducted by the United States Geological Survey in 2002 found detergent traces in 69% of streams and 66% of streams containing disinfectants across the USA. These statistics just started to show how much cleaners make it into our water.

When a combination of VOC (volatile organic compounds) are introduced into the waterways many large bodies of water can become contaminated with these chemicals. This can often be connected to the fact that the water treatment plants that filter the waste water coming out of cities are unable to remove VOCs such as phosphates. These phosphates can be found in some of the most common cleaning products like laundry and dish washers detergents. This then causes the process of eutrophication. Eutrophication is when a large amount of algae grows because of surplus nutrients in water. This then depletes the amount of oxygen in the water which can kill aquatic life. Surplus amounts of algae in the water also can block sunlight from entering the water which means that underwater aquatic plants are unable to do photosynthesis which means that they are deprived of essential nutrients. Over time this can do significant damage to aquatic ecosystems. VOCs

Common chemicals we use in our cleaners today are responsible for hurting the environment and aquatic life. We often use bleach surfactants and ammonia in our cleaners and all of these ingredients can have very negative impacts on the environment. Bleach and ammonia are both chemicals that remove dirt and grime from surfaces, but the chemical in them once put in the environment kills many fish and contaminates water. Drinking it in your water can pose a threat to your health.

**Air:**

Many cleaning products we use today contain VOCs. One of the main issues with VOCs is that once they are in the air they can have a significant impact on climate change. Another big problem with these chemicals is that they can have very negative impacts on human health. Breathing in these chemicals for too long can hurt your lungs and cause extreme nausea. Even one of the most common air fresheners on the market - Febreze, is found to contain propellants and solvents, like ethanol.

**Earth:**

Besides the impacts that these chemicals have on the soil, water and ecosystems of earth, the packaging that these products come in can also be just as harmful. Most cleaning products are packaged in plastic bottles, and the majority of these are incorrectly disposed of. This means that many of them end up in the environment or in the ocean. Since most of the plastic the products are packaged in is not biodegradable this plastic starts to slowly break down into microplastics.

**Disposal**

Most traditional cleaning products that we use today end up in our water. The most common ways cleaners are disposed of is washing them down a sink or flushing them down a toilet. Even chemicals that are disposed of in a trash can often end up in the environment. These chemicals often end up in local waterways where they start to damage the environment and pollute the water. Unfortunately most of our water filtration plants can not completely remove all toxins in the water and this means that many of them still end up in the environment.

What are recipes to make homemade cleaners?

Homemade disinfectant:

* Water
* White vinegar
* Rubbing alcohol
* Lemon juice

Homemade shiner:

* Baking soda
* Eggshell powder

Simple all purpose cleaner

* White vinegar
* Distilled water
* Essential oils

What do those ingredients do?

Vinegar is one of the main ingredients in most of my recipes and can remove bacteria from surfaces. Vinegar is also effective against most average dirt and grime, one of its best qualities being that instead of just smearing grime around it actually dissolves it making it much easier to remove. Another disinfecting ingredient that is in my disinfectant recipe is rubbing alcohol. Rubbing alcohol is proven to be a powerful germicide that can kill a variety of germs, bacteria, viruses and fungi. Depending on the concentration of the rubbing alcohol, it can kill between 60 and 90 percent of all germs. One of the main ingredients in your standard hand sanitizer is isaprobly alcohol which is very similar to rubbing alcohol. This helps prove that rubbing alcohol is a good disinfectant for standard everyday disinfectant purposes.

Some of the other materials in my recipes are essential oils and lemon juice. Lemon not only makes the surfaces it cleans smell good but can also be used to remove soap scum and if used correctly can remove rust on some pots and pans. It can also have some effect on bacteria and remove mold and mildew. In terms of essential oils citrus oils can have some effect on grease and grime but mostly adding them just makes the cleaner smell better. One of the ingredients I am using in my homemade shiner is baking soda. While baking soda does not have any antibacterial properties it is very effective against grease and grime.

What will allow me to see bacteria and measure their quantity?

Petri dishes are small see-through dish-like containers that allow you to grow bacteria. In order to use a petri dish you need to create an agar medium that will allow the bacteria to grow. To make these agar plates you need to combine agar powder, water and some kind of nutrients like sugar or yeast and then simmer in a pot on the stove until all the agar is dissolved. After that you can wrap them in foil or cling wrap and store them in the fridge until you are ready to use them. To use petri dishes use a sterilized q-tip to swab the surface and then move in a zig-zag pattern over the dish. After seal the plate and then place it in a dark space about 37 degrees celsius. After that it should only take 24 to 72 hours for bacteria to start to grow. Later you can remove them from the spot and place them under light and count the number of bacterial colonies. For my project this will help me see how effective the disinfectant spray was at removing the bacteria.