

**Project Report, Life Science, Junior Division
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Hand Me the Soap!

Background, Purpose, and Hypothesis

Hand washing has long been considered one of the primary ways to prevent the spread of disease. In the 19th century, up to twenty-five percent of women who had their babies delivered in hospitals died of “childbed fever” (puerperal sepsis). After it was made mandatory for nurses and doctors in the maternity wards to wash their hands with soap and water, the mortality rate dropped significantly. Hand washing in public places such as libraries, public sport facilities, and schools is possibly one of the best ways to prevent the spread of infections caused by organisms such as Norwalk virus, *E. coli*, influenza and many others that affect the digestive and respiratory systems. Recently, Severe Acute Respiratory Syndrome (SARS) has been a hot topic in the headlines, and many people are worried about becoming affected by the virus. After doing some investigation, I learned that hand washing is one of the best ways to prevent contracting the virus.

When someone gets sick, they go to a hospital to receive the proper medical treatments in order to become well again. But what if you went to the hospital to get better, and ended up contracting a more harmful virus or disease than you had in the first place? This happens to about 5% (about two million) of people worldwide admitted to hospitals. These diseases and infections cost an estimated 5 billion dollars to treat, and cause 20,000 deaths each year worldwide. Hand washing is the number one way to prevent these infection and deaths. Nurses, doctors, and other healthcare workers know the importance of hand washing, but still do it less often than they know they should.

At my school last year, each student missed an average of 10.7 days. At least some of this time was probably due to illness that might have been prevented by proper hand washing.

I was interested in seeing how well hand washing reduces organisms that cause illness. Although viruses cause many of these infections, I used bacteria as markers to study the effect of hand washing, because it was beyond my resources to work with viruses.

For my Science Fair project, I tested the effectiveness of two soaps: one used in schools of the Upper Grand District School Board, and one made for use in hospitals. **My first hypothesis was that washing hands reduces hand bacterial counts. My second hypothesis was that the soap used in hospitals would be more effective in reducing hand bacterial counts.**

Procedure

At 11:30 AM, on the first day of my experiment, eleven students were asked to press the upper palm of the hand that they write with onto a blood agar plate. The students were then asked to wash their hands using a hospital soap (Huntington *Bacti-Stat*TM), washing for one minute with one squirt of soap from the dispenser. After one minute of washing, the students rinsed their hands until all suds were washed away. The students then dried their hands with fresh paper towels from a dispenser. The eleven students then pressed the upper palm of the hand they write with into a second blood agar plate. During the whole process, students did not touch faucets or other facilities. Both the pre-hand washing and post-hand washing plates for all of the students were then incubated for twenty-four hours at 37° C.

One week later, the same procedure from day one was followed, this time using the soap used in schools (*Coraline*TM by Wood Wyant Inc.). Once again, both pre- and post-hand washing plates for all students were incubated for twenty-four hours at 37° C.

After the incubation of the agar plates, a bacterial count was obtained by counting individual bacterial colonies. I received some help from a medical statistician in analyzing my data. Results were reported as mean \pm standard deviation and range. A T-test was used to test for statistical significance ($p = \leq .05$). A power curve was used to estimate how many students would be needed to enlarge the data when statistical significance was not present.

Gram stains of some of the more interesting looking colonies were made to get a better idea of the types of bacteria present. A swab was taken from each of four different looking colonies and smeared in water on a slide. The slide was then fixed using a flame. A few drops of primary crystal violet stain were added to the slide. Thirty seconds later, a few drops of a mordant stabilised iodine stain were added. After thirty seconds, the slide was rinsed with a decolouriser (alcohol), and a few drops of safranin counterstain were added. After ten seconds, the slide was rinsed and dried. The slides were viewed using an oil immersion lens (1000 x magnification). By viewing the slides, it could be determined whether the bacteria were Gram positive or Gram negative, and the shape of the bacteria (cocci or bacilli) could also be described.

By looking at Gram stains and the shape, size, and other appearance of the bacteria, we can start to guess what the bacteria might be; however, it was beyond my resource ability to properly identify the bacteria.

Results/Observations and Conclusions

I was able to confirm my first hypothesis: on average, washing hands with either type of soap reduced bacterial counts ($p = 0.048$). Contrary to my second hypothesis, on average, the school soap appeared to reduce the bacterial colony count more effectively than the soap used in hospitals, but the results were not statistically significant ($p = .52$). School soap reduced bacterial colony counts by 60.4 %, while hospital soap reduced bacterial counts by only 30 %. I found that I would need 150 students to check for statistical significance.

Interestingly, in some cases, counts went up after washing. There are many possible reasons for why this happened: there could have been bacteria present in the soaps, and I would like to have cultured the two soaps to see if this was true. Also, there could have been bacteria present on the paper towels. Another possibility is that after the students washed their hands, the pores in their skin may have opened up, and the bacteria normally present in the skin may have worked their way up to the surface of the hand.

In conclusion, hospitals might consider using a different type of soap than *Bacti-Stat*TM (the brand I used in this experiment). Schools should probably not change the brand of soap they use. I was surprised when I discovered that my study showed the soap used in schools was more effective, as I expected the brand of soap used in a hospital to be more effective. I would like to expand on my project with more students washing their hands, in order to confirm my results.

It might be a good idea to try to encourage proper hand washing procedure. After reading a previously performed experiment on female college students, I learned this information: 63% washed hands after using the bathroom, 38% used soap, 32% used soap and washed for 5 seconds or more, and only 2% used soap and washed their hands for 10 seconds or more. Fewer students left without washing hands when somebody else was present (9%) than when they were alone (45%).

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