Ocean Blues

By Erin Jeon

Purpose

Many people who are residents or visitors of California plan events and vacations near or on the shore. But what people might not realize is how dirty and unsafe some beaches can be. I noticed that many popular beaches are in bigger cities where runoff empties out. If I found out which beaches in what types of areas were cleaner, I would be able to make rough generalizations that could help people who don't live near the tested beaches to plan a safe event and/or vacation. The government or city officials could also use this information to help improve the environment, since the sewage runoff could be majorly impacting bacteria levels in the water.

Question

My question was: how does the location of the beach affect its levels of E. coli? The goal was to find which of three beach environments yielded the most and least amounts of bacteria.

Manipulative Variable: beach location
Responding Variable: E. coli levels

Hypothesis

To predict which beaches would have the highest and lowest scores, I looked at the garbage, sewage, and any water runoff near the beaches. Santa Monica Beach is right next to Santa Monica Pier. The Pier's attractions, along with the runoff, generate lots of trash and sewage, which could affect the bacteria levels on the beach. Laguna Beach has an outdoor mall right next to it, which means lots of people and trash. The mall's location next to the beach, would again affect the amount of bacteria. Although, Laguna did not have lots of runoff like Santa Monica. Crystal Cove wasn't near big malls or attractions that could draw lots of people toward the area. The smaller amount of people meant less litter and a smaller amount of bacteria in the water. I thought Crystal Cove Beach would have the least amount of E. coli and Santa Monica would have the most.

Research and Background Info

Every day, the people who regulate beaches test the beach waters for bacteria levels. One of the most common reasons beaches are closed is because of high levels of Escherichia Coli (E. coli), a type of bacteria that comes from animal feces. Not all E. coli is bad; in fact, most E. coli are beneficial. Bad E. coli are very rare, but they can be fatal. There is no way to specifically pick out the bad E. coli, but a larger amount of E. coli overall suggests that there is a larger amount of dangerous E. coli. E. coli is more common in areas that have warm, moist sand, sewage, waste water runoff, and trash, so cleaner beaches will tend to be safer. Beach E. coli can get into people when they swallow ocean water or come in contact with animal feces. The beaches I chose for this project were Crystal Cove Beach, Santa Monica Beach, and Laguna Beach. I chose these beaches because I have been to all of them before, and each beach's population and trash and animal exposure varied. I wanted to see how and to what extent these factors affected the E. coli levels in the water.

Abstract

As a resident of Southern California, I have often gone to the beach for the weekends or for vacations. I wanted to see how a beach's location affected its bacteria levels. I predicted that the beaches with the more visitors would have the highest bacteria levels.The experiment I conducted tested three beaches for their E. coli levels, a bacteria that contaminates the water and can become fatal. I tested Crystal Cove Beach, Laguna Beach, and Santa Monica Beach because the number of attractions and visitors varied at each beach. I thought Crystal Cove Beach would be the cleanest because it was the most inactive and most secluded beach, which indicated that there should be less bacteria there. I thought Santa Monica Beach would have the most E. coli because it was in an urban area with a sewage runoff emptying out nearby, and the sewage stimulates E. coli growth. After testing, I determined that Crystal Cove Beach had the least amount of E. coli with an average of slightly less than one(0.9833) Most Probable Number (MPN) of E. coli and Laguna Beach had a fairly low score of 2.33 MPN/100mL. Santa Monica had an average of over 100 MPN/100mL. The positive correlation between beach activity and development and E. coli content supported my hypothesis that a runoff and more highly populated beaches have higher levels of E. coli growth and can be dangerous.

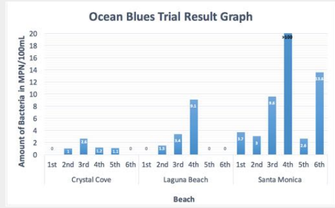
Materials

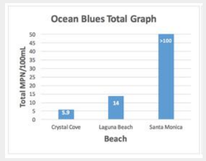
- 1 Thermometer
- 1 Pipette pump
- 1 pipette per test
- 100mL of distilled water per test
- 10mL of ocean water per test
- 1 water collection bottle per test
- 1 testing bottle per test
- 1 Beaker
- 1 E. coli growth medium per test
- 1 compartment bag per test
- 3 chlorine tablets per test
- 1 scoring table

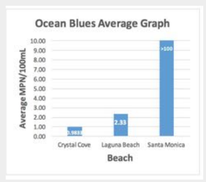
Procedure

1. Use a thermometer to check the weather and the water temperature at the beach.
2. Take one of the water collecting bottles and submerge it in ocean water without touching the inside of the bottle or cap.
3. Take the bottle out of the water so that the bottle is filled nearly to the top with ocean water. This should be at least 10 mL.
4. Have the bottle sit for 7 hours in a cooler.
5. Before testing, wipe the workspace/table with disinfectant and make sure to wear gloves.
6. Take a pipette and use it to take 10mL of ocean water out of the collection water and into a beaker.
7. Use a new pipette to put 100 mL of distilled water into the same beaker.
8. Stir all the water in the beaker for 30 seconds.
9. Use a pipette to take out 10mL of water from the beaker.
10. Pour all the beaker water into a test bottle.
11. Put the E. coli growth medium into the bottle without touching it and wait 15 minutes, shaking periodically.

Data







Results

My data supported my hypothesis. Crystal Cove's average MP/100mL was 1.966. Laguna Beach had an average of 2.33MPN/100mL while Santa Monica's average was greater than 100 MPN/100mL. Santa Monica did not have a definite answer because in Trial 4, all the compartments in the Compartment Bag Test changed color. According to the kit instructions, if all the compartments changed color, the MPN/100mL was greater than 100. I did not know the exact measurement, but I knew that the score was over 100 MPN/100mL. These results made sense because at Santa Monica, the water looked murky and there was trash, which stimulates bacteria growth, everywhere. Crystal Cove and Laguna Beach had fairly low levels of E. coli and were most likely safe. Santa Monica's scores were high and meant the water was unsafe. If the >100 MPN/100mL was not counted in Santa Monica's score, the average would've been 6.5 MPN/100mL which is still relatively high compared to the other two beaches: nearly three times the score of Laguna Beach.

Conclusion

The goal of this experiment was to find out how the location of the beach affected its bacteria levels. In the end, I achieved this goal. Through research, I found that warm weather, moist sand, trash, and sewage can stimulate bacteria growth. My results supported my hypothesis. Crystal Cove had the smallest amount of E. coli while Santa Monica had the most. These results make sense since Crystal Cove didn't have many visitors and wasn't near any large attractions. Santa Monica, on the other hand, attracted many people and was by the busy Santa Monica Pier along with lots of runoff. Laguna Beach had a relatively low score despite the amount of people that visited the beach and the mall right by it. Ultimately, Laguna Beach did not have much runoff while Santa Monica did, which shows that runoff can make a big difference in bacteria levels.

Future Research

For future research, I would like to test on a wider variety of beaches. This way, I could get more accurate information on the characteristics of safe beaches. I would also want to see the difference in bacteria levels between water from bays and free flowing water. This project can go in many different directions and those are just two ways in which I want to take it.

This board was compiled by Shiyuan Guo