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Water Issues

After visiting the settlements and exploring the problems facing the residents we felt that one of the major issues that needed to be addressed were water problems. Many of the residents use water that contains a lot of bacteria, have problems with their wells, and just do not understand the importance of using clean water. Thus we developed a few methods to address some of the problems that face the people in the settlements.

The group working on the water issues focused on four main projects. These included:
1. **Water testing** using the low cost water kit, which uses membrane filtration to determine the level of contamination of the water
2. **SODIS**, solar disinfection of water using soda bottles or plastic bags and the sun
3. **Well cover**, an easily constructed cover to protect the well from outside contaminants and to prevent children from falling in
4. **Slow sand water filter**, an inexpensive filter designed with materials accessible to the settlement residents

Here are images of each of the projects worked on by the team.

Figure 1: Foundation Bradesco Students Performing Water Testing

Figure 2: Bottles and Bags of water on roof for Solar Disinfection

Figure 3: Installing and Testing the Well Cover

Figure 4: Slow Sand Filter

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Water Testing

Objective:
The water testing was used to determine the condition of the water quality in the settlement and determine where the largest amounts of bacteria exist. From this data we would be able to develop useful technologies that could be used to educate and fix the problems facing the residents. The testing could then be used again the measure the effectiveness of the technologies implemented.

Data:
Two main tests were performed during this session. For the first four samples of water were taken from various sources at one of the settlements. They were collected from the well, sink, water storage container and the water filter container. Membrane filtration tests were performed to determine the extent of contamination. From the results we found the three of the four sources contained e-coli bacteria and all four contained some amount of other coloforms. The most contaminated source was the sink, followed by the well, then the storage container, and with the least contaminated being the filter. The filter also did not have any e-coli bacteria.

The second test that was performed was to see how the solar disinfection process would work in the region. Water was collected from the river and placed in bottles and bags. From there the samples were placed on the roof in the sunlight and samples were collected after 2, 4 and 8 hours. Tests were run on these samples to see how many bacteria remained after a specific amount of time in the sunlight. The results can be seen in the section on solar water disinfection.

Resources:
The materials that are needed to perform these tests are all part of the inexpensive membrane water testing kit developed by Amy Smith. The kit consists of a baby bottle, baby bottle drop-ins, a metal washer, rubber washer, metal mesh, filter paper, tubing and a syringe.

Obstacles and Problems:
One of the main obstacles is in the future maintenance of the testing. There is some concern that some of the materials provided in the kit will be difficult to obtain in the region; mainly the bottle drop-ins and the m-coli blue bacteria food.

Another concern is that the students will be unsure of how to implement a solution for each specific problem that they uncover with the testing.

Sustainability:
Overall the goal is for the students to know how to perform the water testing so that they can continue to analyze the conditions in the settlement throughout the year and use the results to determine which technology will be most useful to fix the problem. The students plan to continue the testing as well as do tests in the future on technologies that were developed during this session. One example of that is that they plan on testing the water in the well for which the well cover was developed in 6 months to see if it is effective. The main need for sustaining the water testing program is making sure that the

school has the necessary materials to perform the tests. The students are fully educated in how to perform the tests and analyze the results.

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SODIS: Solar Water Disinfection

Objective:
The objective of this project is to provide the residents of the settlements with an inexpensive and effective means of disinfecting their water. The process works very easily and all that is needed is a clear plastic soda bottle or plastic bag and the sun. These materials are both readably available in the settlements. By placing the water in the container and then on the roof in the sunlight the UV-A rays and heat then penetrate the plastic and kill the bacteria in the water. This provides water that is much safer to drink then if it were to be directly taken from the contaminated source.

Data:
A study was done to determine how effective this process would be in the settlements. Samples of water were taken and placed in plastic bottles and bags. The samples were left on the roof in the sunlight. Tests were performed on the samples after 2, 4 and 8 hours to see how many bacteria were in the water before and after the solar disinfection. This allowed us to determine the amount of time that the bottles and bags needed to be left in the light for effective disinfection. The results can be seen in the attached chart. We were also going to take data after 24 hours, but unfortunately some children took the bottles off of the roof and poured out the water so we lost that data.

Resources:
The only materials that are needed to continue this technology are the plastic bottles and bags which were very abundant in all of the settlements. Also, the students at the Bradesco Foundation are going to develop a means for educating the residents of the settlements of its importance.

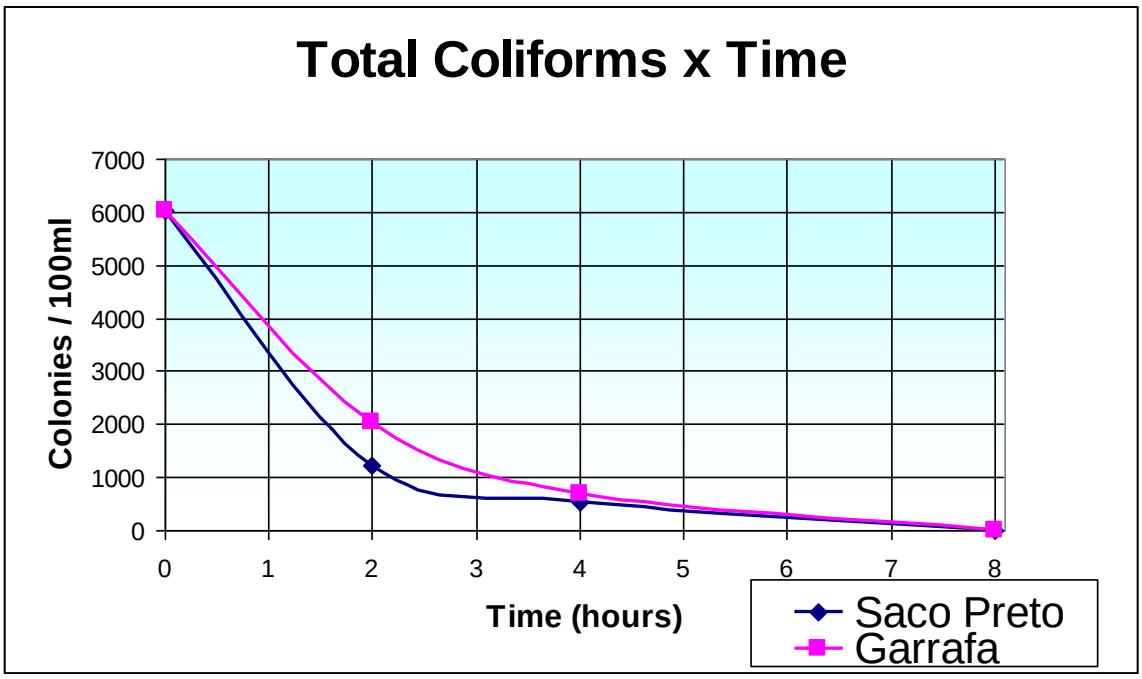
Obstacles and Problems:
One problem with this process is that it is only effective in killing bacteria and not in changing the color of the water or removing other chemicals that may have contaminated it. However, it is very effective in killing the bacteria which is a large cause of illness in the settlements.

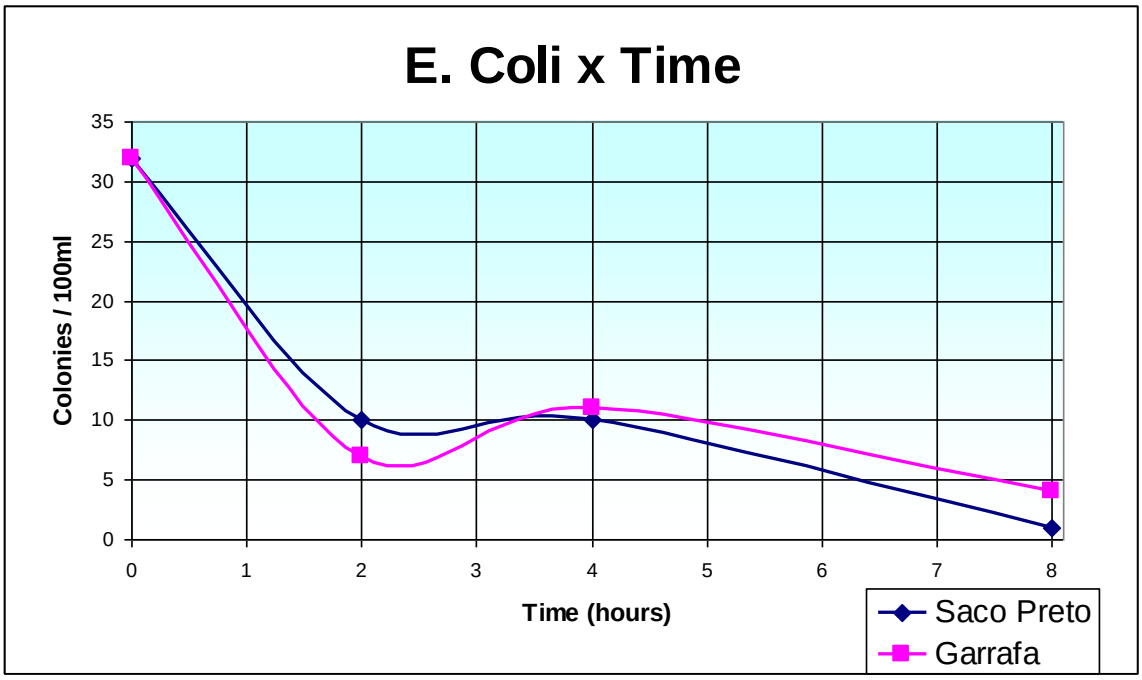
Another problem that occurred is that with some of the plastic bags that were developed by MIT students, when they were placed on the roof the easily slid off, and when then hit the ground they would burst and all of the water was lost. Also, they are less sturdy then the bottles and sometimes develop leaks.

A problem with the bottles is that since the plastic is thicker then that of the bags it takes a little longer for full disinfection to occur. Also, since the cap of the bottle is not transparent disinfection does not occur there and any bacteria that may be trapped there will not be killed. When pouring water out of the bottle it will pass over the area where bacteria can be trapped and re-infect the water.

The only draw back with this process is that it takes time, but if educated the residents will understand its importance. Since plastic bottles are abundant the can disinfect many at one time and then have them available while the next batch is being disinfected.

Sustainability:
The students at the Bradesco Foundation are going to develop an effective way to educate the community about the usefulness of solar disinfection. Because of the water tests done at the school they know the correct amount of time that the bottles and bags need to be left out in the sun for effective disinfection. This project can be easily sustained because it only requires resources that are readably available and thus it's very inexpensive.





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Well Cover

Objective

The objective of this project was to provide the residents of the settlements with an easy way to protect their drinking water and themselves. The residents often didn't understand the importance of protecting their well. Thus we developed a well cover made from materials readably available to the residents which could be easily constructed.

Data

While visiting the settlements it was realized that many of the wells were kept uncovered. This is dangerous for many reasons. First children can fall into the well and drown. Second foreign matter such as small animals can fall in and die and contaminate the water source.

Resources

The well cover was designed with wood, and screws. A saw and tape measure are also needed. The students developed a hand out and presentation to show the community members how to take the necessary measurements and construct the well cover.

Obstacles and Problems

One obstacle is that the community doesn't understand the importance of protecting their well. Thus, they will need to be educated before they would accept a new technology. Second the cover can't be overbearing because then they won't want to use it if it creates more of an inconvenience. It is necessary to make sure the well is still easily accessible. Also cost and access to materials wasn't fully explored.

Sustainability

The students developed a presentation and brochure and planned on talking with the community about the project. It is important that they continue talks with the house where the project was implemented so they know the necessary concerns before they bring it to the rest of the community. They also plan on doing water testing on the well to see how the water quality improves with the new cover.

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Slow Sand Filter

Objective
To provide the community with a low cost, effective means for disinfecting their water from bacterial contamination.

Data
The technology was presented by Daniel, a USP student in civil engineering. It used two plastic containers that were connected with a piece of pvc pipe and surrounded by sand. With the help of gravity the water is forced through the sand and gradually filtered. The technology is known to work in the civil engineering. With the materials that we used we weren't sure of the full functionality and we ran out of time for testing, but the students were going to keep refilling the filter and then test the water to see if the filter was functional.

Resources
The materials necessary for the project is two plastic containers, a small piece of pvc pipe, epoxy, and sand. It would also be important to find them readably available in the area.

Obstacles and Problems
Since there wasn't time to test the filter it is necessary to make sure that it works before it could be presented to the community. Also, the filter only works for certain pollutants and not all. Thus, the community would need to be educated on that as well.

Sustainability
This is a project that could be revisited next year to see if any progress was made and what the results are of the testing.