Inquiry Project on

WATER QUALITY

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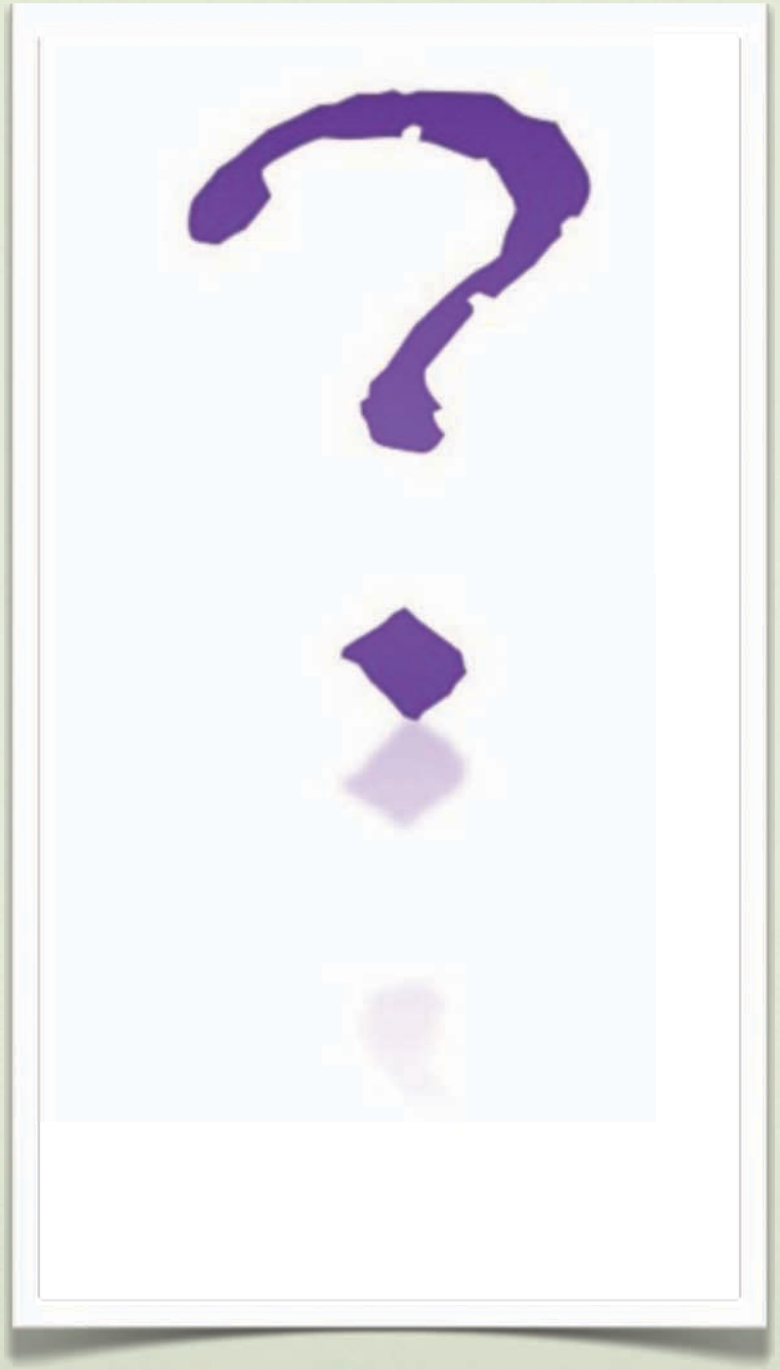
INITIAL QUESTIONS

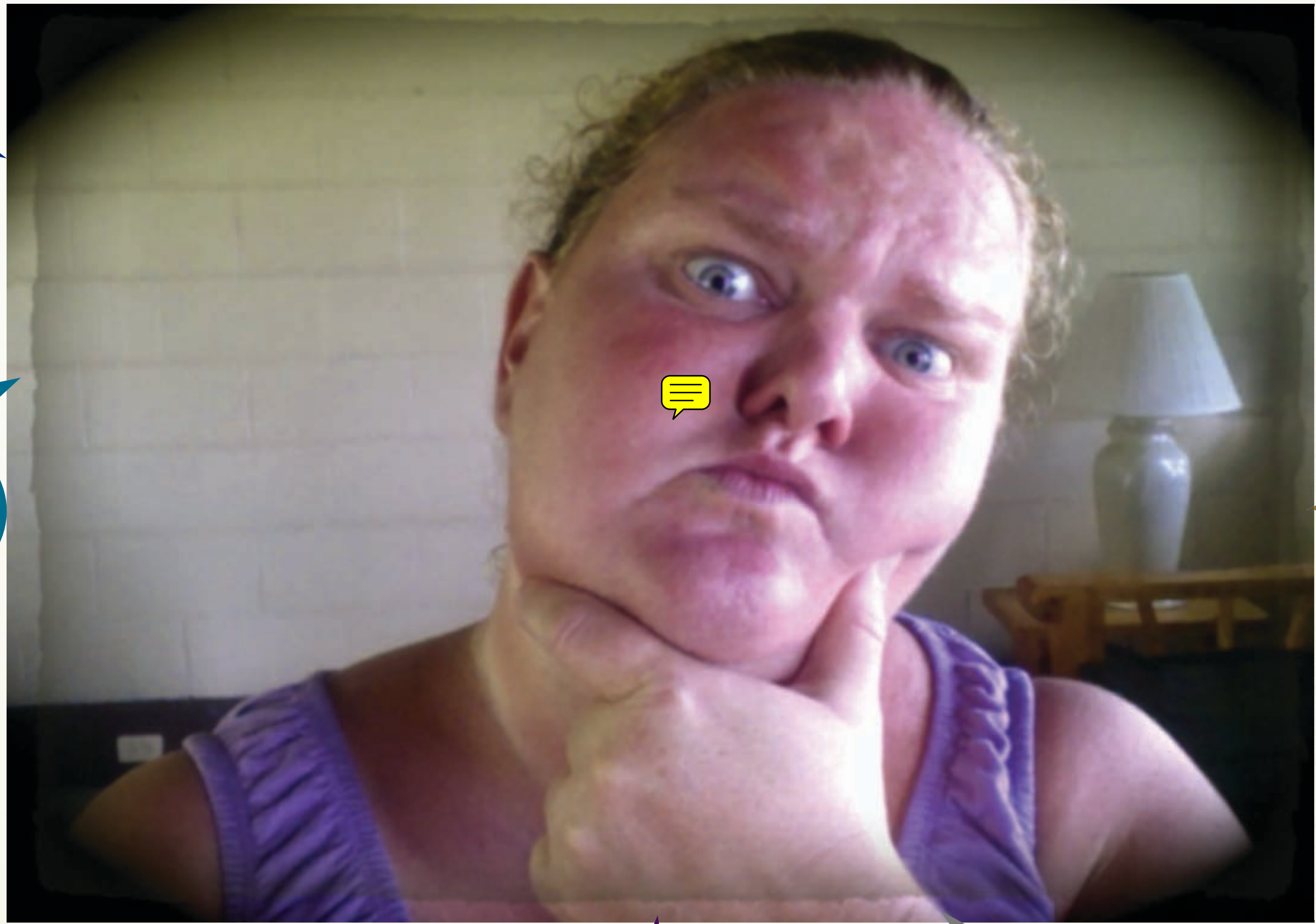


How
good are the test kits
that I purchased?

How
is tap water across
the US different?

How
does US tap
water compare to
American Samoa
tap water?

Can
I taste a difference
in the tap



Why
can’t I drink my
water? Is it just
bacteria?

I’ve
heard that New York has some of
the best water in the US. What is so great
about it?

What
are we really
drinking?

What
are dangerous
levels of “stuff” in
the water?

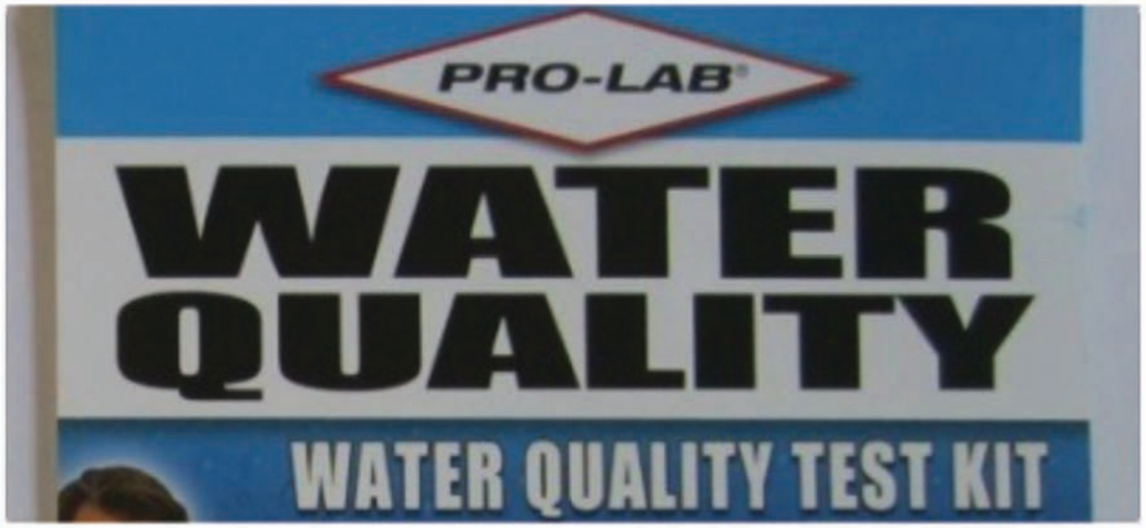
Which
place has the
best quailty
water?

WATER QUALITY INQUIRY PROJECT

PROJECT OVERVIEW

What makes tap water drinkable? Is it more than the bacterial content?

For the past three years, I have been advised not to drink the tap water. Living in American Samoa and Guatemala, bacteria in the water is a concern. I am curious to find out what other factors contribute to tap water quality and how water across the US tests.



List of Sites

1. 3117 Lucero Court, Santa Rosa, CA
2. 581 Academy St. Apt. 5G New York, NY
3. 6 Monticello Dr. East Lyme, CT (tap & well water)
4. Lions Camp Makoshika St. Park Glendive, MT

• Overview •

Test Sites

Sites for this inquiry project were chosen to fit my travel plans for the summer. I was curious to find out how similar the quality of water would be in each location.

The first location (1) is my mother's house in Santa Rosa, California. She lives in an area known as Bennet Valley, at the edges of Santa Rosa. It is a planned neighborhood with a combination of single-family homes and townhouses. My mother's unit is a townhouse, located on the end of a row of 5 at the back of the complex. They are connected to Santa Rosa city water.

The second location (2) is my best friend's condo in New York City. She lives in Upper Manhattan, in a neighborhood known as Inwood. Inwood is located north of the George Washington Bridge, and borders the North Bronx. The apartment building has five floors and approximately 35 units. Her apartment is located on the top floor. They are all connected to New York City water.

The third location (3) is my cousin's house in East Lyme, CT. The area is an older planned neighborhood with single-family homes on large lots. East Lyme has two water sources. The tap water is town water, treated with chlorine, and is the only source of water available inside the home. The well water is untreated water and is only available through faucets outside the home.

The fourth location (4) is a rustic camp inside the borders of Makoshika State Park outside of Glendive in eastern Montana. The local Lion's Club owns the property and maintains a large house on a hill for special events and a small camp in the valley. The camp has several converted railroad cars for cabins, none of which are fitted for water. The bathroom and kitchen facilities both have running water, sourced by a well. The photo on page four is of the bathroom facilities and outdoor sink at Lion's Camp.

• Overview •

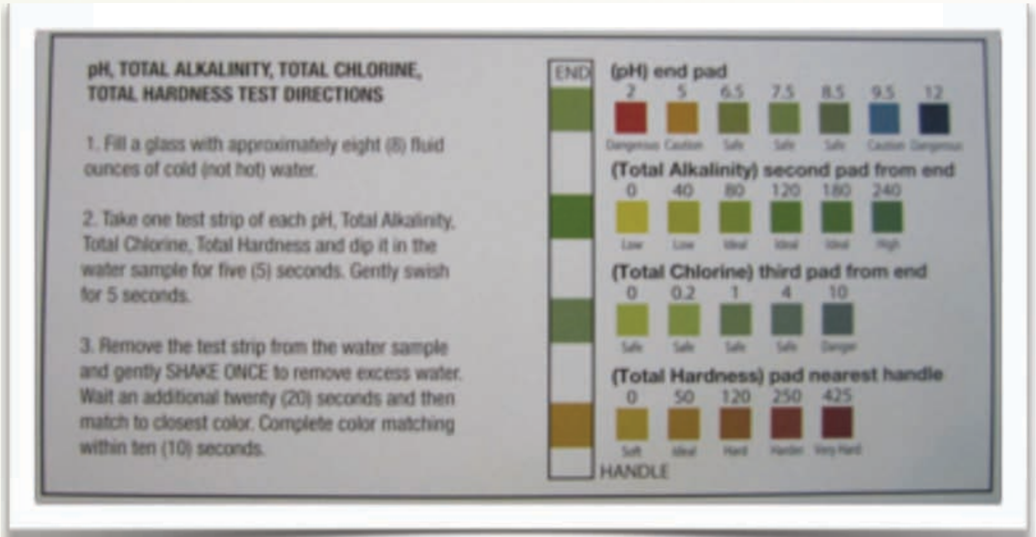
Selection Process

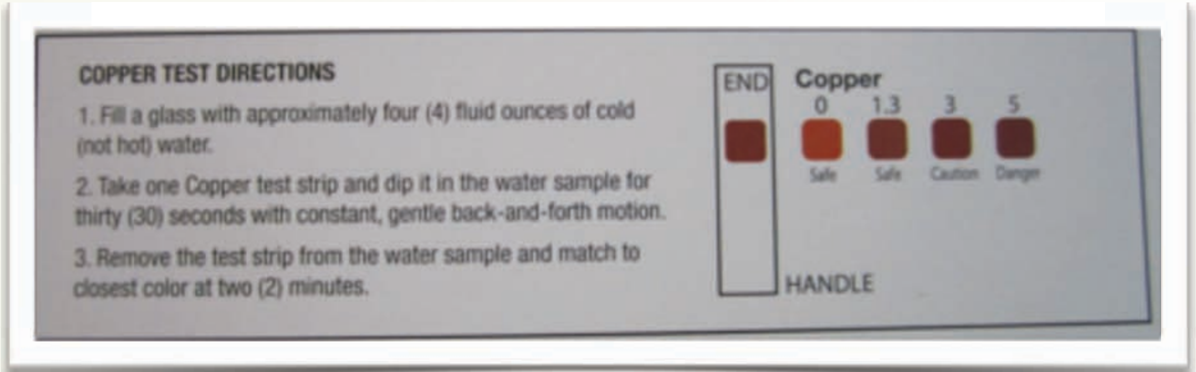
1. I researched various water quality tests online.
2. I chose a kit that was affordable and locally available.
3. I purchased three kits at Home Depot in Santa Rosa, CA.

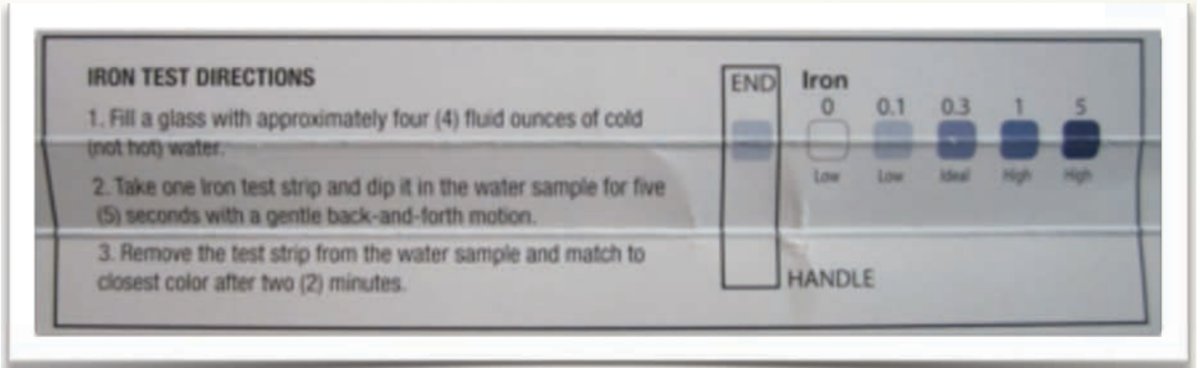
Test Kit Contents and Directions

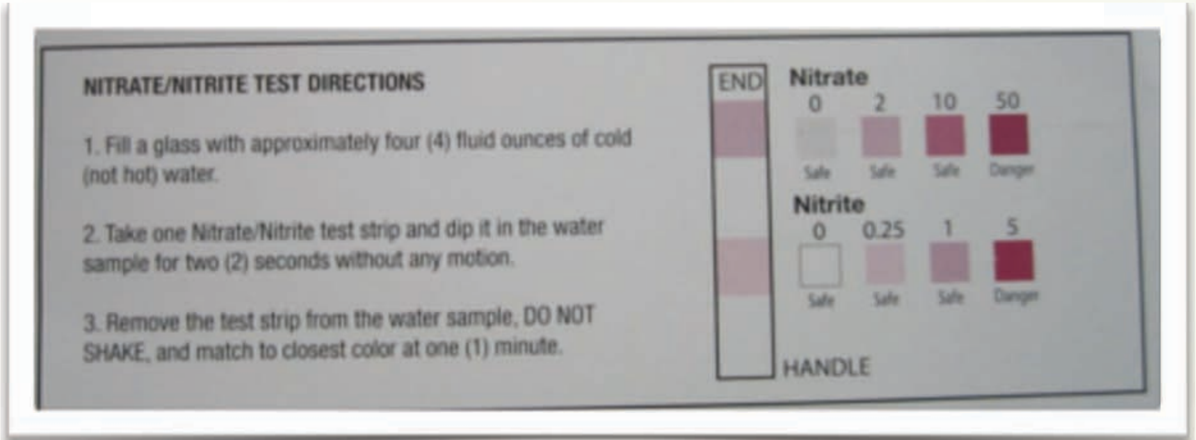
Two of each test:

* pH
* Total Alkalinity
* Total Chlorine
* Total Hardness
* Iron
* Copper
* Nitrates
* Nitrites





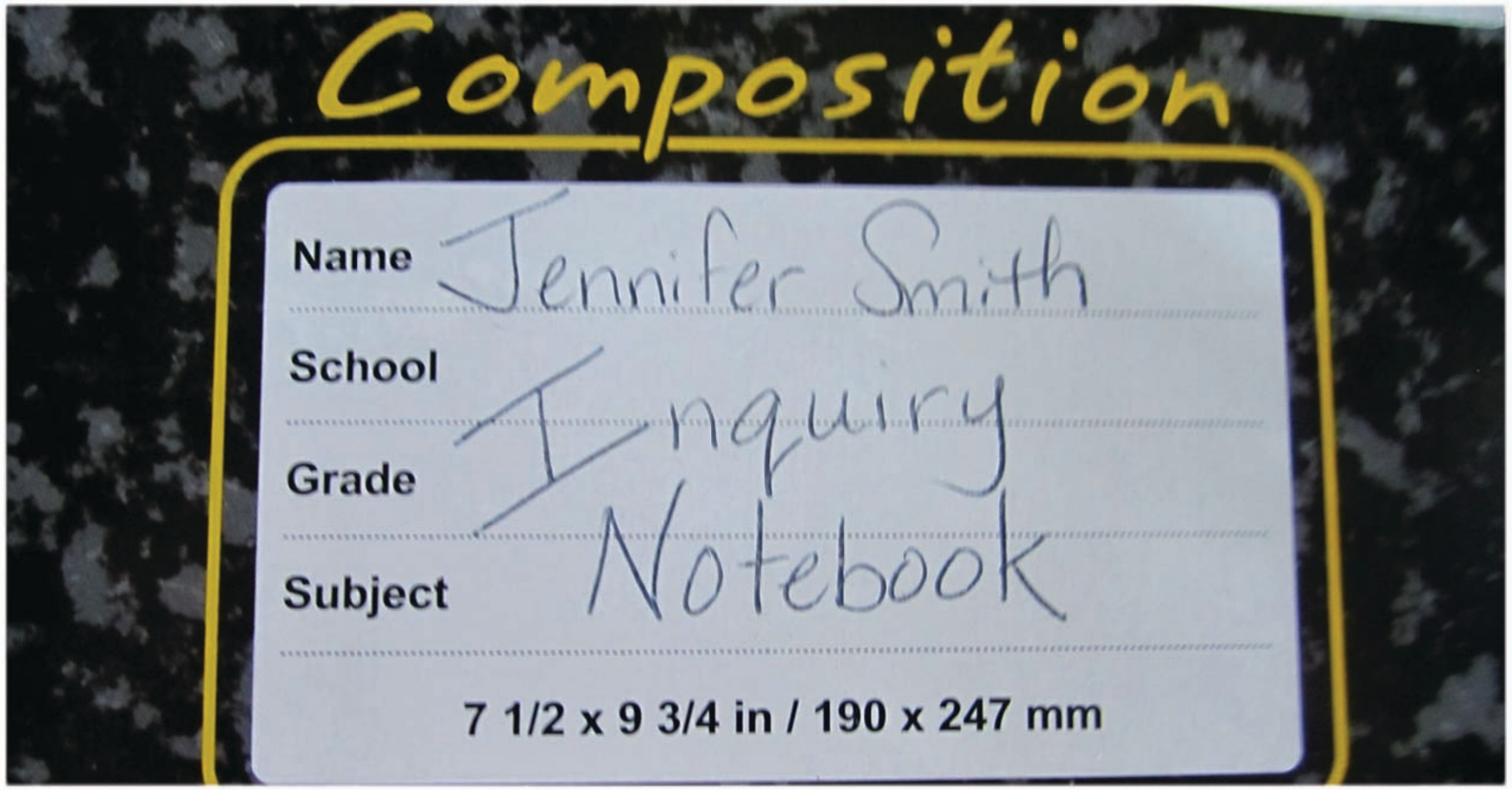




<u>Reflection on Kit Selection</u>

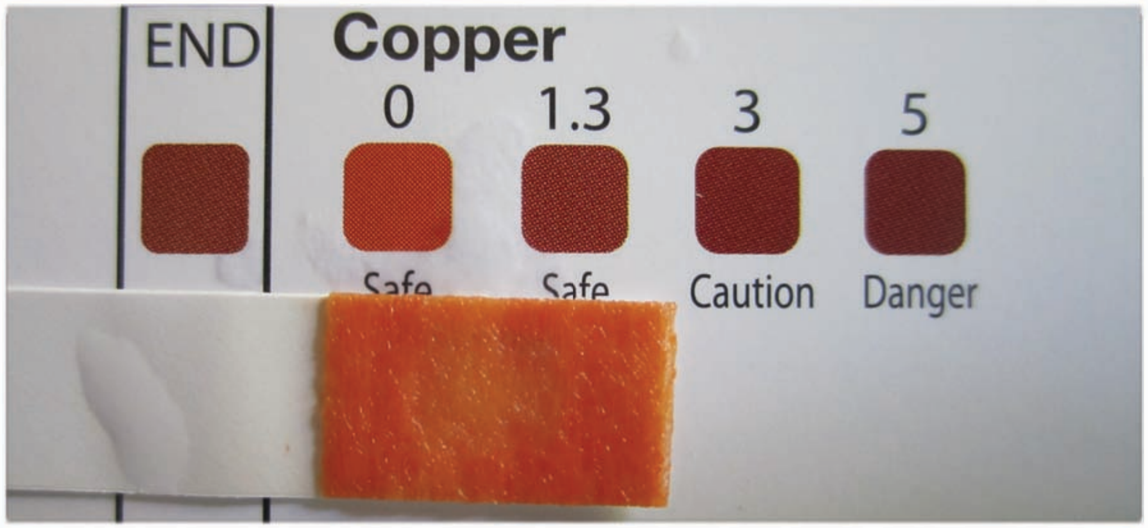
This kit is a very basic kit sold at home improvement stores. It had a mix of ratings online at amazon.com. Most of the poor reviews had to do with the iron bacteria test, which I did not do. I chose this test kit because of its affordability and availability. Due to my travel schedule, I did not have time to wait for a kit to be delivered. If I were to conduct this test again, I would be sure to buy a kit that included a bacteria test, since this is one of the concerns about my own water.

THE LEARNING



What science process skills were used in this activity? What science and engineering practices were met?

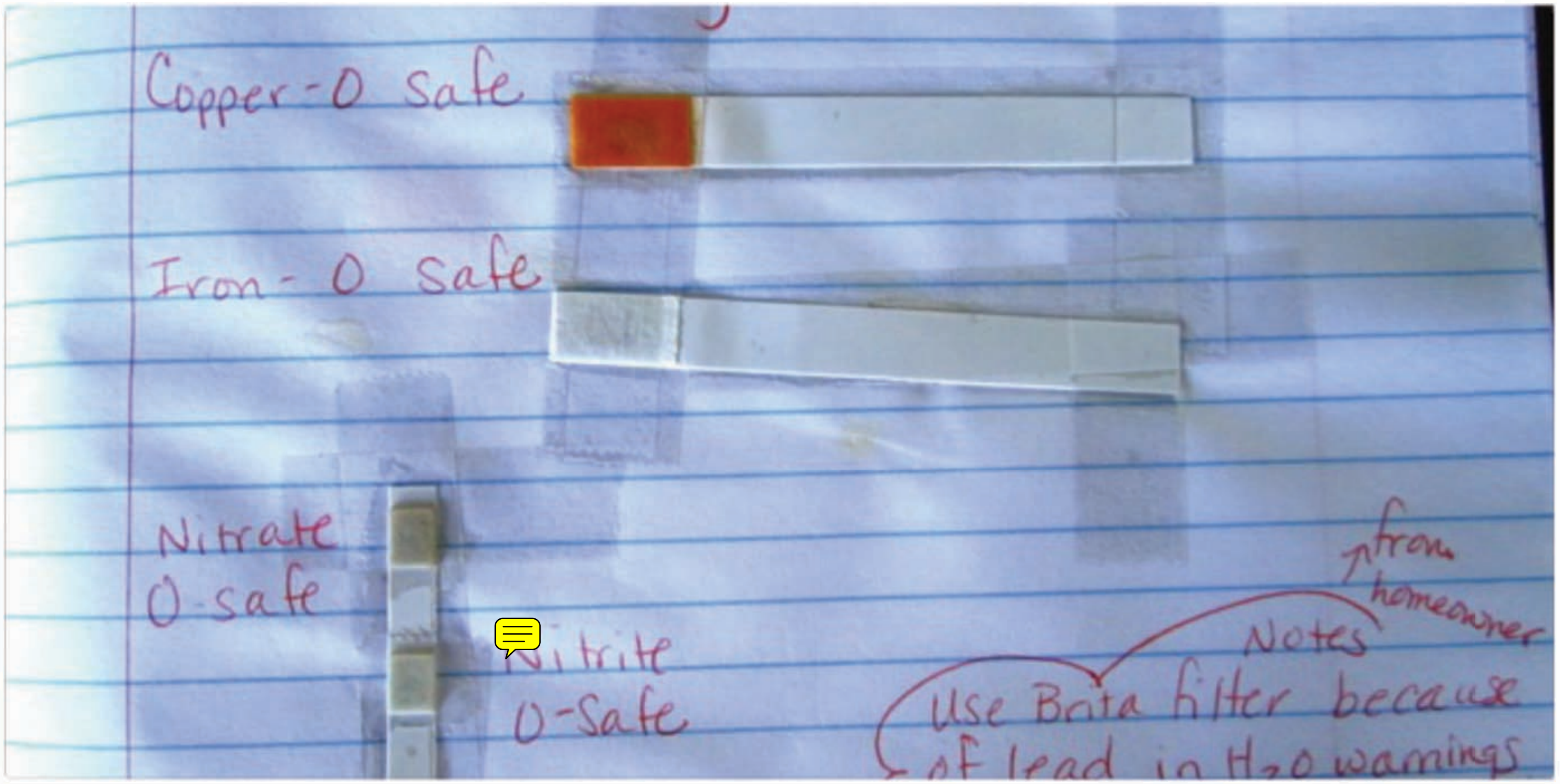
As an educator, it is important to reflect upon an activity to ensure its educational soundness. In this section, I will explain the learning behind this inquiry project.



Process Skill Categories*

1. Acquisitive
2. Organizational
3. Creative
4. Manipulative
5. Communicative

*categories taken from "Building Science Process Skills." *The Science Teacher*. January 2006



Science Process Skills

Though simple, this project relied upon many skills scientists use every day. In "Building Science Process Skills," an article published in the January 2006 edition of *The Science Teacher*, science process skills are presented in five categories: acquisitive, organizational, creative, manipulative, and communicative. Each category of process skills were used in this inquiry project.

Acquisitive: listening, observing, searching, inquiring, investigating, gathering data, researching

The very nature of this project being inquiry-based means that it used acquisitive skills. In addition to inquiring and investigating, I listened to homeowners describe their observations of the water. I observed the water myself. Using the test kit, I gathered data. I could extend this project to do more research on the topic of water quality. My limited internet access prevented me from doing so for the purpose of this class.

Organizational: *recording, comparing, contrasting, classifying, organizing, outlining, reviewing, evaluating, analyzing*

In this project, I recorded my data primarily in a science notebook. After I collected all of the data, I organized it into a table in Microsoft Word. I compared the results of each water test with the color indicator chart provided in the test kit to analyze the water quality. Using the information provided in the kit, I was able to use the data to evaluate what might be causing the observed water conditions. Throughout the process, I was comparing the water quality in one location to another. Particularly in East Lyme, I was able to compare and contrast the water from the tap and the well. When I discovered that the well water surprisingly had a higher chlorine content, I did further research to determine the cause.

Creative: *planning ahead, designing, inventing, synthesizing*

In order to complete this project, I was required to come up with my own question to test and to design a project around it. The very nature of the assignment led to the use of creative process skills. My travel schedule required me to plan ahead in order to have enough test kits to test the water at each location and enough time to complete the assignment.

Manipulative: *using instruments, demonstrating, experimenting, constructing, calibrating*

The test kits I used required manipulative skills. Though not a typical instrument, the test strips were means by which I got the data for my project. I was able to demonstrate the use of the test strips to my four-year-old assistant, Eli F., in New York.

Communicative: *questioning, discussing, explaining, reporting, writing, criticizing, graphing, teaching*

This project is communicative at its core. Since I was testing the water of family and friends, they were all curious as to the results. From the onset, we discussed what they observed about their water and what each household's particular water source was. Their curiosity led me to explain the testing process, as well as to report my interpretation of the results. I reported all results in a Prezi presentation, including a table and graphs to compare the data at each site

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skills taken from "Building Science Process Skills." *The Science Teacher*. January 2006

The Practices *

1. Asking questions
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

*taken from *A Framework for K-12 Science Education*. National Academy of Sciences. 2012

Science & Engineering Practices

The creators of the Next Generation Science Standards have included a set of science and engineering practices as part of their framework. These practices are what students should be engaged in during scientific study. During this inquiry project, I was engaged in almost all of the science practices.

Asking Questions - This project began with a question: How is tap water from around the United States different? Throughout the experiment, from conversations with homeowners, I came to ask more "why" questions about the condition of the water at various sites. The culmination of the project does not leave me with a firm result. Rather, I have more questions about how my water in American Samoa compares to the water in the mainland. I also want to know more about how each of the tested qualities affects the water itself.

Developing and Using Models - This is the one science practice that I did not directly address in this inquiry project. I could extend my understanding of the project by creating a model of the water system for a given site, showing the water source and the path the water takes to get to the tap. This could hdlp to explain some of the qualities found in the water.

Planning and Carrying Out Investigations - Since the project was self-designed, this practice was completely met. I had to develop a question to test as well as the procedure to follow. I then was able to carry out the investigation over several weeks.

Analyzing and Interpreting Data - This project required me to read test strips to determine whether certain levels were safe. After following the kit directions, I compared the color of the test strip to a color indicator chart included in the test kit. From there, I was able to determine whether that quality was within the range of safe levels. I was also able to read more about each quality to determine the cause of observed qualities of the water. For example, the water in Santa Rosa causes dry skin, which may be a result of high alkalinity.

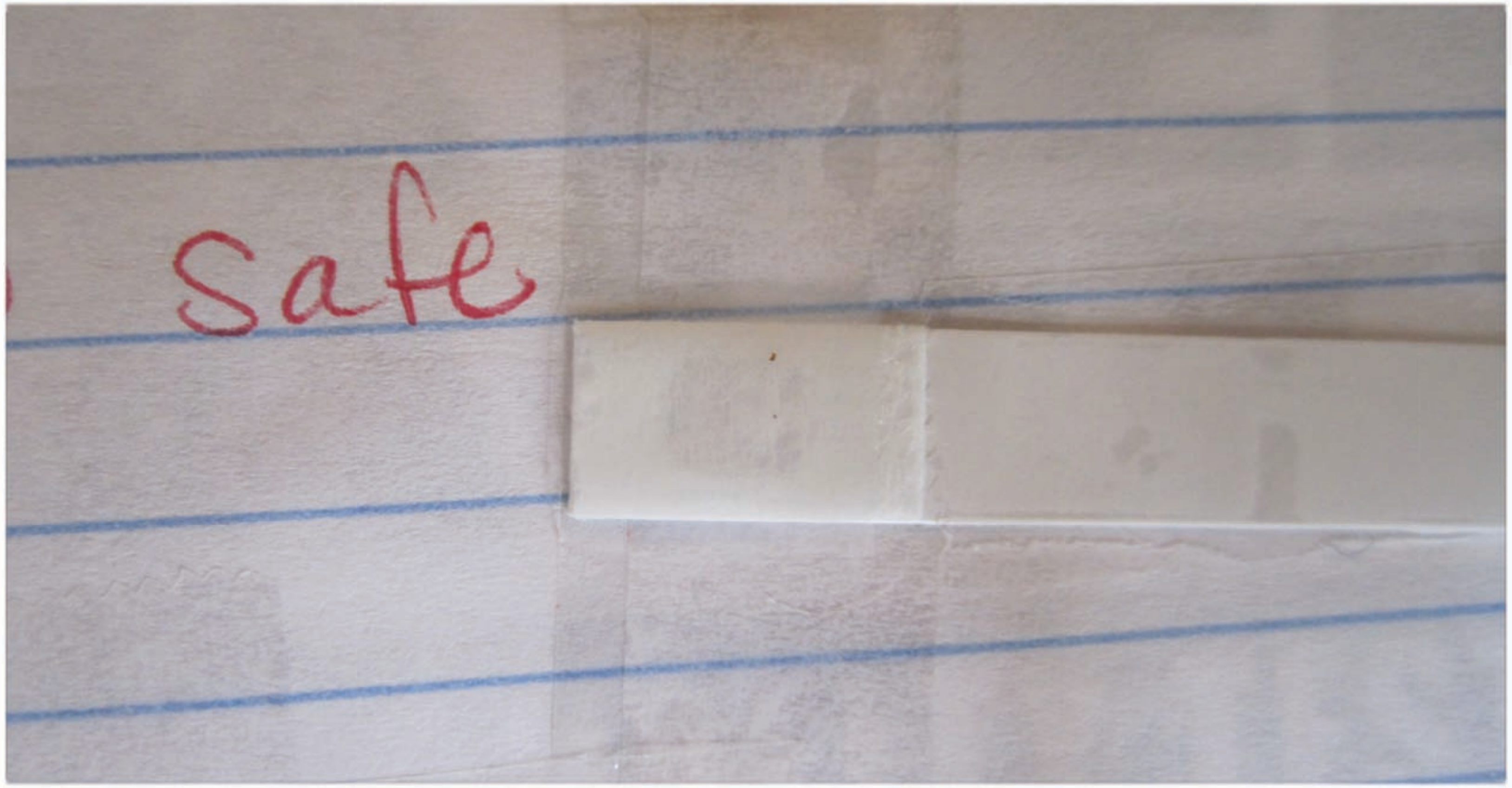
Using Mathematical and Computational Thinking - Though there was no computation involved in this activity, the logical thinking required for mathematics was put into practice. I created tables and graphs to display my data in a logical fashion. I also was able to compare the levels of each tested quality.

Constructing Explanations - Based on the gathered data and information provided in the test kit, I was able to construct explanations for the more observable qualities of the water. This happened at each site, and it was highlighted most in Santa Rosa, New York, and East Lyme. At each of those sites, the homeowners reported qualities of the water which I was able to explain after interpreting the results of the test.

Engaging in Argument from Evidence - After constructing the explanation for the observable water qualities, I had to use the information I knew about each quality to defend my interpretations. I could have done further research for each of the qualities to strengthen my defense.

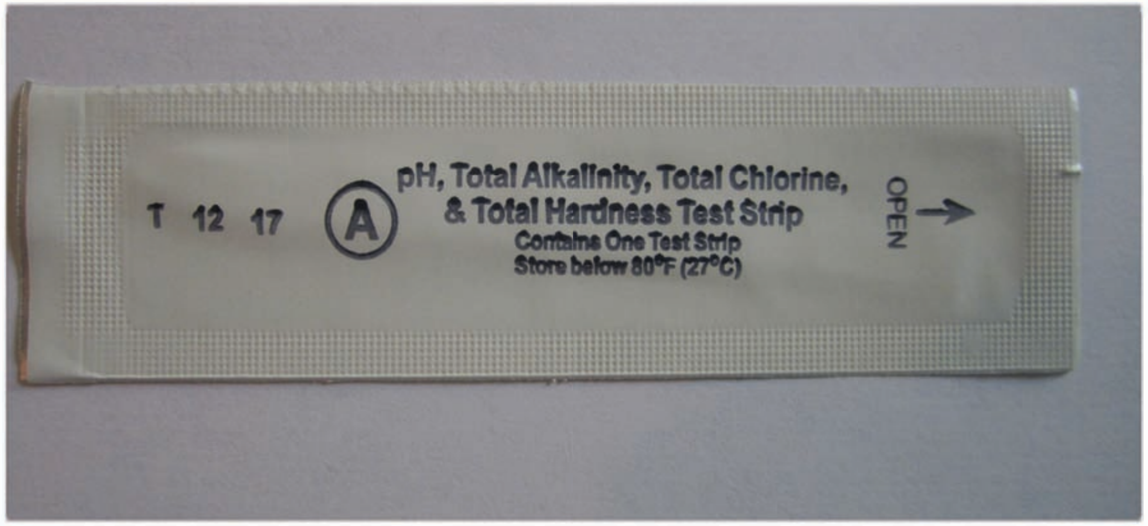
Obtaining, Evaluating, and Communicating Information - This practice fully describes the nature of my inquiry project. I collected data from sites by performing tests on the water, interpreted the collected data to evaluate the water quality, and communicated the results and interpretation both to the homeowners and in a Prezi presentation for the purposes of this class.

REFLECTION



What did I learn from this activity? How can I use inquiry in my classroom?

This project has provided a hands-on experience into the world of inquiry. The open-ended nature of the assignment allowed me to choose a topic I was interested in. This naturally led to high motivation to complete the project.



What makes this an inquiry project?

According to Llewellyn (2007), inquiry can be defined as,"the scientific process of active exploration by which we use critical, logical, and creative thinking skills to raise and engage in questions of personal interest." This water quality project was developed from my own experiences with water. Throughout my childhood, I always lived in areas in which we drank the tap water. During the last three years, I have been advised against that practice. My initial curiosity was to know what made the water in American Samoa different from the water in the mainland such that it was non-potable. Beginning with that question, I developed a project in which I would test and compare water samples from taps across the mainland.

What challenges did I face in completing this project?

I designed the project to travel with me, as I had plans to visit family and friends throughout the six weeks I would be on the mainland. When my travel plans changed unexpectedly, I was able to adapt the project without trouble. In the design of the project, I came across two major challenges.

First, due to the timing of this course, I had to adjust my initial question. The final project deadline coincided with the weekend I was set to return to American Samoa. Therefore, I would not be able to compare the water in the mainland to that of American Samoa until after the deadline. I was still determined to do the project for my own knowledge. In fact, I have one last set of test strips ready to test the water of American Samoa when I have the opportunity.

Second, I could not find a test kit in my price range that tested bacteria levels. Since my plan was to test the water at several sites, I either needed multiple test kits or a test kit that provided enough testing supplies for multiple tests. Since I was only at my first destination for 10 days, I was unable to purchase a kit online. I was limited to the resources available at the local home improvement stores. After visiting several stores in the area, I was finally able to find three Pro-Lab Water Quality Test Kits at Home Depot. I had researched this online, and I was satisfied with the kit. Though, it did not include a test for bacteria. I guess this leaves me with an unanswered question that I will be able to test at a future date.

What did I learn from this project?

My natural instinct as a teacher is very inquiry-oriented. I like my students to explore their interests, and I get excited along with them when we find out something new. Before this course, I described my classroom as dynamic, cooperative, and creative, with students engaged in discovery-based learning experiences whenever possible. I have learned that my discovery-based classroom is in the developing stages of an inquiry classroom.

This project has given me first-hand experience with the intrinsic motivation of designing my own project and following my interests. I think that a completely open-ended inquiry project like this would be a very interesting way to end a unit of study or the school year. My goal is to be able to do an open-ended inquiry project at the end of the upcoming school year.

In my current teaching situation, I will need to ensure the availability of resources, and we will need to dedicate a good amount of class time to the design process. I also think the project will be most successful completed in groups of the students' choosing, rather than independently.

To prepare my students for this investigation, I will need to plan my year carefully. I look forward to the next few weeks to have the time and space to think about this design more carefully, but I can share my thoughts for the moment.

I want to begin the year with a unit to get the students' attention. I envision this unit consisting of exploring discrepant events, beginning with teacher demonstrations and continuing with student explorations. During this unit, I will be able to set the tone for science class. Students will become used to questioning what they think they already know. They will become comfortable with using science notebooks to record their observations and reflections. We will also be able to set safety, behavior, and academic guidelines for the year. I would love to end this unit with a "Science Magic" assembly for the younger grades.

Following this introductory unit, I hope to use a gradual inquiry development described in Llewellyn (2007). Beginning each unit with more teacher-controlled investigations will allow me to model scientific thought and practices for my students. Most of my students have not been exposed to sound scientific practice and have not been encouraged to think like scientists in their previous schooling. After teacher demonstrations, I would like to engage students in guided activities. These activities would have students follow a set of directions and probably lead to similar outcomes across the class. Next, I hope to initiate an inquiry investigation in which students will work in groups to investigate a question that either I have chosen or we have collectively chosen. In this way, I will be able to control the materials available and ensure we have the resources to carry out the investigation. If each unit follows this pattern, my students will be prepared to design an investigation of their own at the end of the year.

Where Am I on the Inquiry Spectrum?

After reading "Becoming an Inquiry Teacher" (Llewellyn, 2007), I revisited my reflective journal from week 1 of our course. I am pleased to see that I see progress after completing the course. This course has given me the opportunity to verbalize the image of my ideal self, assess my real self, and begin a professional development plan and think of how to continue. The professional development step is ongoing, so I do not think of it as checked off the list. Right now, I feel very prepared to set up my classroom in a more inquiry-based manner. I am excited with the confidence I have gained knowing that my instincts as a teacher have sound theory behind them. I am ready to defend my teaching approach and to begin to use the NGSS to approach my curriculum design. My personal assessment lands me at the fourth stage of inquiry development. I have begun to reach out to people to build a support system. I met some amazing teachers during my weeks on-campus this summer, and I aim to keep in touch with them, especially regarding implementing inquiry-based approaches in the classroom. Though I am a far way from a true inquiry classroom, I feel that I am definitely on the right path.

REFERENCES

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