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How Can Water Quality Awareness Be Increased In A Small But Rapidly Increasing City Of New Braunfels, Texas?

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HOW CAN WATER QUALITY AWARENESS BE INCREASED IN A SMALL BUT RAPIDILY INCREASING CITY OF NEW BRAUNFELS, TEXAS?

By

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CHAPTER ONE

Introduction

Motivation

I have always loved to share what I have learned throughout my life so that I can help others. It is an integral part of who I am since I was a small child. No matter what the topic, whether it is a subject like astronomy, chemistry, soils and trees or even something as different as car mechanics or electrical wiring. I love to share that information and help others learn and understand more about the world; if they are willing to listen. Thankfully, I have had a great experience in working at a YMCA camp in the Rocky Mountain National Park in Colorado and that started my journey in working within the environmental field. My original love for water started when I was swimming competitively as a child, then progressed as I started snorkeling and surfing each summer in California, as well as fishing with my family. All this has guided me to focusing on improving the water and water quality awareness in the region of south central Texas. Water sources and water quality have always been the focus of my life.

As I have grown older and focused on working in the general environmental realm of science, I have learned much in the way of watershed management and hydrology over the last 20 years. I have translated my love for hydrology into educating others by teaching at the local college, giving environmental workshops/training presentations and other related outreach activities that typically relate mainly to my direct career experiences. I have also taken an interest in helping my neighbors, co-workers and friends/family with anything

environment or water related, in light of recurring flooding in south Texas.

I have had much success in the last 20 years in specifically sharing the environmental knowledge that I have acquired, with so many diverse groups and people, both colleagues and external citizens in the local community. Through trial and error, I have used many techniques and variations to see what works best, based on the topic and my specific audience. These range from utilizing case studies or local applications versus teaching abstract concepts straight out or a lesson plan.

My overall goal for my research paper is to look at ways to expand local citizens' knowledge of water and water quality. There are many specific areas to focus on, for example: business, recreation and schools. However, I think the best and most effective approach is to start off with outreaching to schools and to look into their existing curriculum, to see what they are learning about water quality, is the first logical step and best approach based on the ease of access to the pure number of students accessible via local schools. I hope to help expand their existing water knowledge and find ways to help them understand ways to improve water quality and keep our water supply clean for many generations to come.

Recently I have tried to utilize standard outreach practices (e.g. - local civic groups, volunteer groups, boy scouts), that have worked for me in the past, to educate the local community in which I now work as a full-time environmental scientist. This educational outreach is environmental and water quality focused, yet I am running into multiple problems where there is no traction or growth after each outreach attempt in various disciplines within the local community. These include no long-term implementation to these local groups to

other venues or other organizations that do not have an environmental awareness. I have attempted to approach and present to groups of varying complexity of educational backgrounds, with little or no long-term interest in the topics that I present.

Background

My focus on educational outreach is in water quality awareness specifically. Water quality is especially important with all the rapid growth for the entire region and extremely quick and rapidly expanding development in my local community. As of current requirements, there are few developmental permits required or specific restrictions in place just yet, thereby increasing the potential on water quality degradation in the entire region. The work that I currently perform is for a small city of just over 50,000 people. The majority of the population is mostly retired and they have definite belief system regarding how things are to be done and not prone to changing their existing way of thinking and how they view the world. Unfortunately, they are unlikely to consider a new approach. Any change from their standard way on how they have known to "do things" is very difficult to change their way of thinking. Forcing the "change" in thinking by creating and enforcing local regulations and/or ordinances is not likely to help the long-term success of spreading water quality awareness either.

Ironically, our small town, is the home of Schlitterbahn, the largest water park in the nation. With Schlitterbahn and adjacent water tubing industry, we are surrounded by industries that depend on healthy water quality. Unfortunately, our population's awareness of water quality is incomprehensibly absent.

The city where I currently work, has 3 new distinct water quality based programs and there are different funding sources and different mandated results needed for each program. Each of these programs has a significant educational outreach component that is required in varying complex levels. These programs focus on involvement of the community and local business to be much more involved and be part of the solution, to help lessen the potential of water quality degradation over time. Community involvement is key as that will help the long-term potential problem find resolution. The main water quality issue involved in all three programs is chemical and bacteria increases, which are directly resulting in increased development in the region.

With the recent explosion of developmental growth, water focused tourism expanding as well and local water quality degrading just as quickly; the local knowledge and understanding of the water quality effects and how to help improve it in your own backyard, is essential for all to understand. This applies to local citizens as well as the huge tourism population that visits the region during the summer months. The last few years, my attempts and overall results have been lackluster at best. I have realized that I have to think smarter, not work harder, in how to get the general populace to bring the water quality mentality to the forefront of their minds as well as into their daily discussions.

Overview

As I attempt to analyze the quantitative and qualitative methods to find the best approach to incorporate as many local citizens as possible, I hope to find a specific approach that works best for the overall community. I will review the research that is based on adult education and outreach that is focused in business development, local civic and non-profit

groups and local educational centers.

My primary plan is to focus on researching the best approaches to educating the local schools, based on their existing science curriculum. I have the potential to expand that existing curriculum with outreach workshops, field trips and potential project based learning class for the local high schools. There are two distinct local independent school districts (ISD) in this region. Each ISD has a similar science curriculum to follow (mandated by the State of Texas). With the local science, agriculture and 4H clubs, there are increased opportunities to also expand water quality awareness into those other arenas.

Sadly, I only really have one shot at this approach to the local schools. If I do achieve success, I am sure that I can approach them again in 3-5 years, but by then it might be too late to achieve true success for my educational requirements mandate for my 3 programs, since there is a mandate each year to achieve some level of outreach success within each program parameter.

Adjacent to the existing school curriculum, the local schools have a joint agreement with the local businesses in education. The largest type of this unique plan is with Schlitterbahn, the largest water park company in the nation (which happens to be headquartered in the city of New Braunfels, where I am planning to conduct my research). I plan to figure out a very specific and creative way to utilize the existing school curriculum and their existing relationship with Schlitterbahn and the local tubing industry (who work together very closely); on how to expand their existing educational program to include water quality awareness. Recently Schlitterbahn has had a large education component become a part of their existing business plan due to a new Habitat Conservation Plan that they are implementing and they are looking to expand their focus on environmental education as well.

If I can acquire a positive relationship with Schlitterbahn to back up and support my mandated educational agenda, then my outreach potential for success at the School and beyond, will have increased by a huge margin toward success.

With my plan of who to approach first and why, it is apparent that I am trying to achieve success in seemingly various groups but all linked and tied together with the local school curriculum as the main guide. This focus is still focused through the local schools and focus on the children in the entire region. With the largest and most powerful group being the water tourism industry, I can hopefully build on to their existing strong relationship between the school and Schlitterbahn to successfully further my own requirements of educating the masses on the topic of water quality. With my review of the existing research and best viable approaches, will I have the best chance of being able to work with them long term and creating water quality education as a mainstream concept based off of the local school curriculum.

I believe that best result is reviewing these types of approaches that have worked in the research that I have gathered so far, and having it backed up with hard facts and positive results from field data and then try it out on a small control group locally in town. I have found that every small town that is the same size has a very different dynamic based on the population layout, educational background and other various factors, so it will be hard to compare “apples to apples”, even if I find a similar town with similar layouts in citizens, businesses and population. Those variables also have to be analyzed for similarities that seem to work with my own region and incorporate them into the analysis in order to maximize a potential positive outcome.

Over the next several chapters, I will approach several topics on what is best for the

success of my educational outreach into the community. Only by the involvement of the local students and children of the region, which will result in connection to the overall community; will I ever hope to have a positive result on improving water quality in a short amount of time.

CHAPTER TWO

Literature Review

Population growth

Within the last few years in Texas, many quickly growing satellite cities of just over 50,000 people, has experienced a significant growing environmental need due to the population growth spurred by development and commercial expansion of adjacent larger metro cities like Dallas, San Antonio and Houston which consists of over 2 million people in their respective metro areas.

The recent expansion of population in smaller cities in Texas has generated a mandate by the State of Texas to increase local interest and involvement in water quality, water quantity and state and federal level interest in flooding and drainage. The State of Texas recently granted many of these growing cities with a permit that mandates public education and outreach in water quality and drainage as directed by their federally mandated permit. This is directed by the Municipal Separate Storm Sewer System (MS4). The MS4 program is a nationwide program that is delegated to the States, which delegate those requirements to cities over 50,000 people. One of the main focal points of the MS4 program is to provide education and outreach to the local citizens in the realm of water quality improvement and stopping environmental degradation. Many of these cities have contracts or connections with

local environmental quality agencies like local Aquifer Authorities, River Authorities or Water Utilities as well as governmental agencies like the Texas Commission on Environmental Quality (TCEQ, 2016) and United States Fish and Wildlife Service (USFWS). For example, the USFWS has approved multiple environmental permits across Texas to implement a long-term plan in which to improve the regional water quality and ecosystems that has environmental education as a significant part of the permit. Further, many growing cities have acquired an Environmental Protection Agency (EPA, 2015) grant to analyze the overall watershed and find ways to improve environmental quality, due to rising levels of pollutants in the local streams. Environmental education and overall environmental quality awareness is a mandatory part of most EPA grants as well.

There is a need in these growing communities for education and outreach within all water-quality focused programs to foster increased involvement throughout the local community, local schools and businesses. The Natural Science and Environmental Education (NSEE) degree plan at Hamline University requires a capstone and research which can potentially help to realize a better approach to reaching out to the local community and schools, with regard to the decreasing environmental degradation of many local regions in Texas. There are cities in Texas that present water quality programs posted on their respective website (City of New Braunfels, 2016) as well as posted information in local papers (Texas A&M Agri-life, 2016) to support and encourage outreach and education. These websites and environmental papers are a start in the right direction, but does not have enough of an impact in the surrounding community compared to the exponential growth currently happening in the region. With the expansion of population in Texas, many smaller cities which are satellite cities around much larger metro regions are expanding in size to

handle the increased population migration to Texas and as a result, increased building of homes and businesses. This increased growth of infrastructure has been shown to directly increase degradation in water quality based on numerous factors (TCEQ 2016). Kollmuss & Agyeman (2002) state that increasing the understanding of this dynamic system and how growth directly affects the overall ecosystem is the primary reason for this research. Once finalized, it should provide examples on how to give strength on how best to increase educational interaction with local students and the local community.

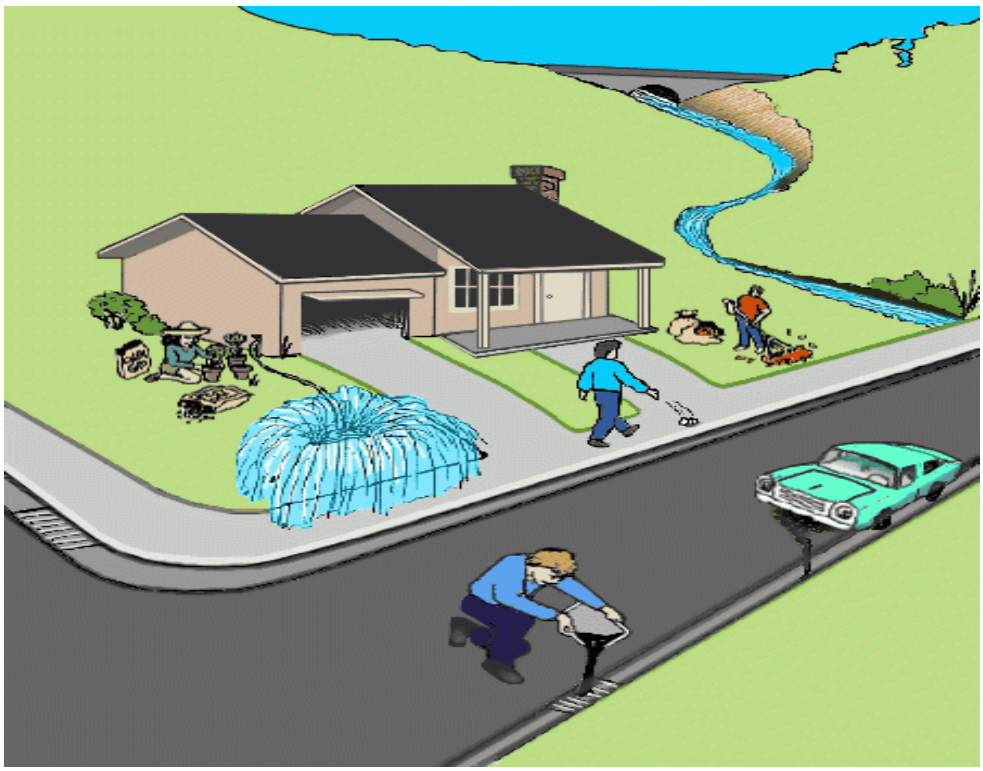
Preview

This chapter begins with some general overview in which I will try to reduce down to a more direct focus on how to potentially achieve a better response and involvement from the local schools in these growing communities. Ideas will be discussed on community approaches, utilizing existing school programs and City of New Braunfels (2015) shows that intertwining with local governmental regulations with education could possibly assist in a better understanding and appreciation for environmental issues and general water quality.

I plan to show different ways of effectively trying to approach the best way to gain involvement from the local students. These approaches are environmental practice strategies, professional development and training to local schools and informal environmental education. Each section of this paper discusses approaches that have solid validity. Hauk (2015) shows this in their results and has a proven track record over several population groups.

Environmental Practice Strategies

There is a general standard operating procedure (SOP) regarding environmental procedures across the board in business that should be well understood by the local community and schools as well. There are standards that are meant to be followed at the city, county, state and federal levels of government that cover a wide range of environmental and safety issues. Generally, these SOP's are similar across a wide range of the population spectrum, but in a general sense, these SOP's are not known in the general populace or in schools (Staats, Harland &Wilke, 2004). There seems to be little understanding of basic environmental concepts from local schools to home environmental practices as to the general understanding of what should be done in society regarding positive environmental practices. According to Kelly (2012) this conundrum is perplexing and not well understood in adult education fields.



EPA 2015. What You Can Do: In your Classroom – Online educational resources from EPA and other federal agencies

The picture above is a typical example on how to help the environment for the general populace or schools on what to do and what not to do. There are a multitude of negative concepts that can stir up discussion and alternatives that can be done to remedy problem issues. These items in this picture are typically against local city, county, state and federal law, yet rarely enforced by local authorities. These types of educational posters are sparingly used in local Texas schools or community programs that could potentially help educate local citizens as well as local companies.

Professional Development and Training

The approach to add a stronger environmental and ecology understanding to the existing science curriculum at local schools with environmental programs is a logical step. Eun-Ji & Kim (2014) have shown that there are several regions in North America that have much stronger focus on environmental and ecology based programs as part of their basic science curriculum. The research focus is to see where I can fit a stronger environmental and ecological focus into their existing science curriculum. An additional challenge is to train existing teachers who show an interest in teaching this added subject matter. Showing a true interest in spreading environmental knowledge shows passion and drive, which would further stimulate students and the overall learning process. Perhaps creating an environmental certification program just for teachers in Texas might also create additional interest, thus making it more desirable for teachers to participate. Bennett (2005) has shown that a certification program does incite interest as well as provide much needed environmental

training to existing teachers in local schools. However, the local school district superintendent is the key to helping make this issue become a realization on how important environmental programs are for the community and should allow some flexibility into the local schools based on new programs and permits that have educational education mandates. Knowing that it might take a few years to slowly incorporate my outreach initiatives into the school, the challenge is to try to find suitable ways in which to train additional teachers in the realm of water quality and overall environmental education. There has been discussion for this very topic in the growing cities of south central Texas, to propose a supportive workshop or lesson plan given to multiple classes and that might work well into the existing curriculum at the local high school. City of San Marcos and Texas State University (2016) have started such programs in their local school systems that touch on a variety of environmental subjects to show positive outcomes. However, the main hurdle that I believe that I will face is the attitude and ambition of existing teachers that want to teach environmental education. Ko and Lee (2003) state that the attitude and willingness of the existing teachers should believe in what they are teaching fully to achieve the highest success in passing along that information to the students. If there is not a willingness and positive viewpoint of environmental education from the teaching staff, then the teaching of environmental education will be much reduced in effectiveness and long term absorption and application by the local students.

Harrell (2010) has proposed that there is a possibility of also working into the local elementary and middle school environmental awareness and education considering that they already have an environmental topic that is discussed at grades 1-6 and grades 7-10. Even though the primary focus in this research is to approach local high schools in Texas, the approach can be modified or reduced in scope to also approach lower grades with less

complexity surrounding the environmental ecosystem as a whole. Additionally, considering that there is a large faction of minority students in Texas, it is important to consider that culture when increasing environmental awareness and education into the curriculum. Assessing the different cultures have to be taken into account to have a truly effective distribution of knowledge regarding environmental issues. Moseley and Taylor (2011) suggest that having culture training as part of environmental training is just as important to maximize effective outreach to all students.

The main strategy is to have the correct focus when approaching schools and adding to existing curriculum to hopefully accentuate what is already presented, so as not to disturb the existing flow of science based information. Trying to just teach facts and figures will most likely not be as effective. Oliveria et al's (2009) shows that assessing how students interpret and apply what is learned is a better path to approach when presenting environmental topics. Based on each region of school systems and their existing curriculum, the list that Littledyke (1997) presented below would be a good start to find out which items are most important to local students and teachers. These topics listed below are part of the increased approach that other states and Canada, incorporate into their base existing science curriculum, but not so heavily in Texas education curriculum (Texas Education Agency).

- Waste recycling
- School grounds wildlife study
- Local study of the living pollution
- Local study of the built environment
- Renewable and non-renewable energy sources
- Energy conservation
- Endangered species

- Conservation of foreign ecosystems, e.g. rainforest, coral
- Climate (global warming, acid rain, ozone)
- Transport and the environment
- Animal welfare issues
- Population
- Conservation of local ecosystems

(Littledyke 1997)

Furthermore, Copley (2009) shows that obtaining a mascot or iconic image within any program is always a positive way to expand a new idea or program. Environmental programs can be far more receptive, especially with students, if they have a mascot of some kind like the City of New Braunfels (2016) with their Recycle Raccoon. Many existing programs that incorporate and promote environmental education have a stable mascot currently, like Sally the Salamander in San Marcos, Texas (2016). Sally represents multiple things for multiple programs, but the overall image of Sally is that she is alive due to good water quality and a solid ecosystem that supports her lifestyle. Showing a correlation to a cleaner overall environment will keep Sally alive and well.

(City of San Marcos. Sally the Salamander. 2016)

These mascots can encompass a positive first step in outreach and education across many ages and disciplines as well. Since the main objective here is to reach the younger age group, a mascot peaks the initial interest in children and they seek out to learn more about it, since it seems to be fun and playful. Abruscato (2000) supports that the mascot theme is a recurring theme in many environmental programs and it seems to do very well across the spectrum.

Also, branding is another avenue in which should be explored since branding is a marketing ploy that works in many venues, why not in the education realm? While considering a potential crossing over into commercialized chains, local stores and businesses as well as local neighborhood to see how effective creating a "brand" would be for my many

growing regions; approaching the local schools are the first priority. There already many larger markets that have environmental mandates and policies like Wal-Mart, Target, Home Depot, etc.

HEB Environmental

A regional supermarket in Texas has a strong environmental stance and is well respected in many environmental realms as well as a leader in food business in south Texas and Northern Mexico. (HEB, 2016). This growing grocery chain was started by Howard Edward Butt and the grocery chain is called H.E.B., for his initials.

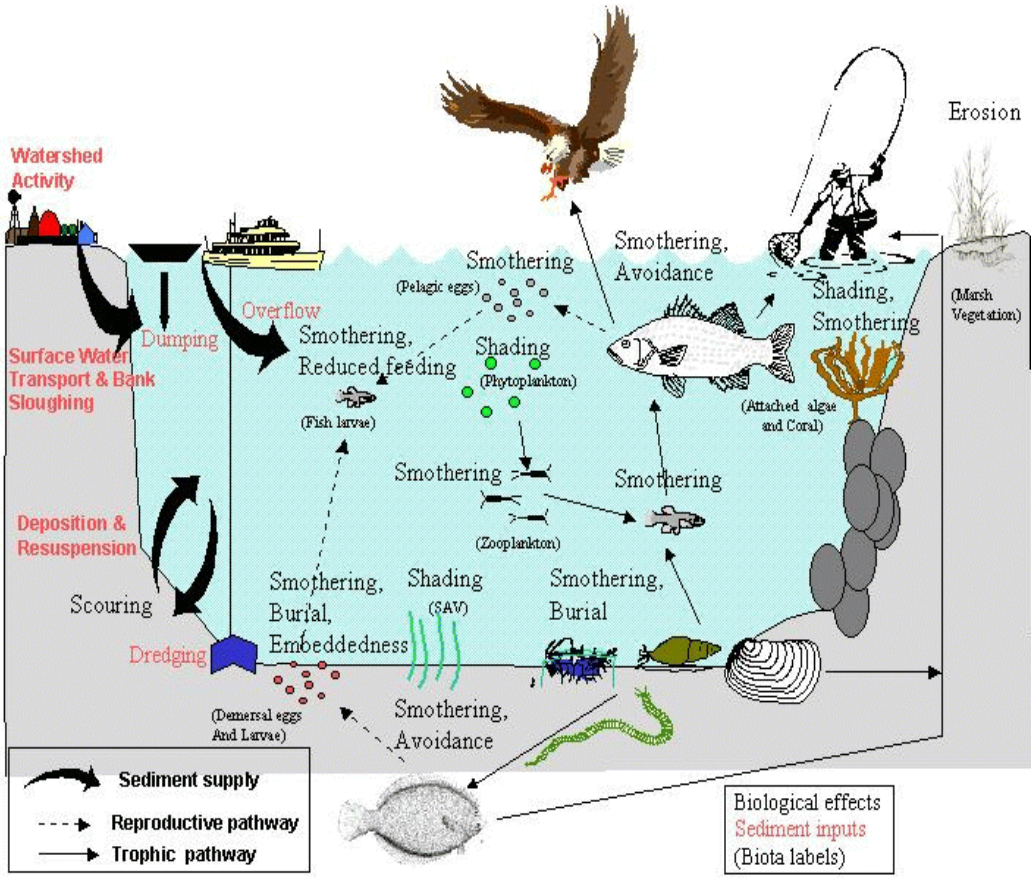
Considering that HEB has grown to be a very strong competitor against Albertsons, Kroger and Randalls grocery chains in south Texas over the last few decades; shows the company's strength and its overall stance and endurance in the Texas community. HEB (2016) has a strong component within the local school systems and has several learning programs sponsored in larger south Texas cities already.

Considering that HEB has many educational related programs with local schools, expanding that brand into the environmental realm is a possibility to pursue. It seems to be a natural progression in this specific instance, that HEB has a growing interest in environmental issues and a growing interest in their local community and local school children. Combining those 2 aspects together seems to be a logical next step.

Environmental Education

General environmental education can be portrayed in a variety of forms. Many of these education approaches start in the schools, but community involvement as Kollmuss & Agymeman (2002) has said, is just as important but not well established in many communities.

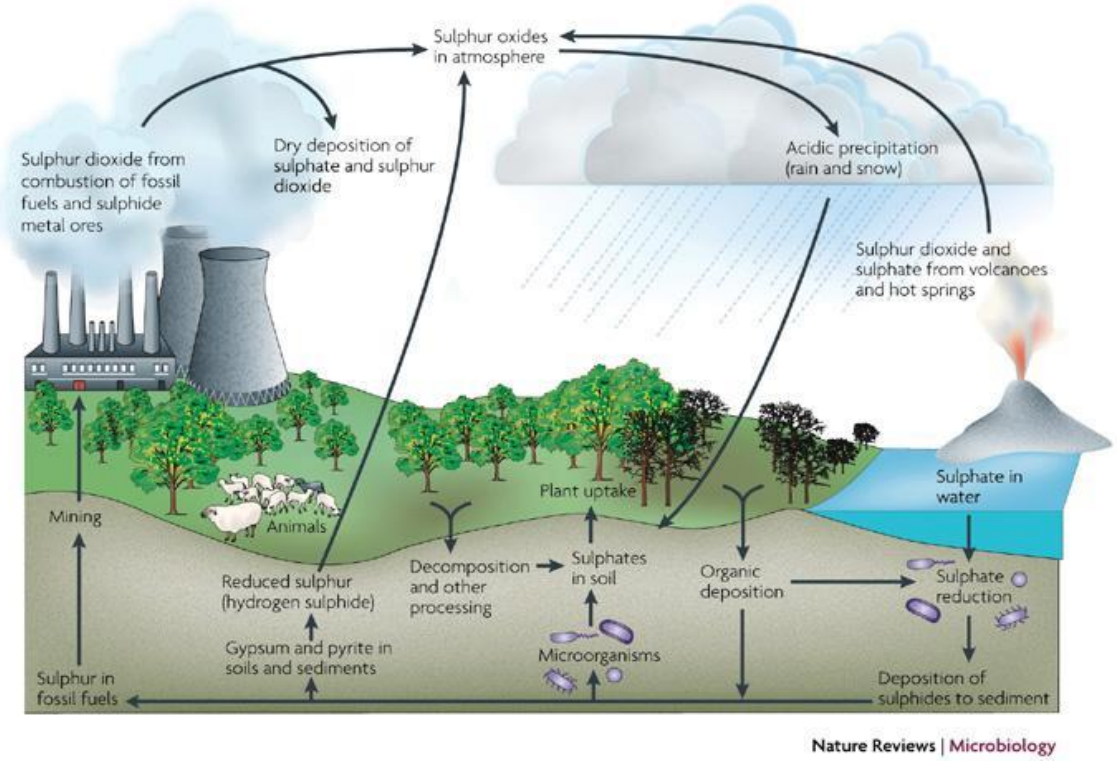
Many environmental education outreach programs and/or lesson plans typically have a "big picture" diagram like the one provided by the Munns (2006) at the EPA. There is a general overview of environmental quality issues represented and multiple variables are presented that interact and affect each other within various complexities.



Munns, W. 2006. EPA Fact Sheet: Framework for Developing Suspended and Bedded Sediment (SABS) Water Quality Criteria

These types of diagrams are a great representation of what is going on in a general sense, in the local environment and how outside influences affect them and change the overall dynamic. Pictures like these are great ways to let the student review and learn multiple interactions on their own and begin to understand the overall system as Eberbach & Crowley (2009) stated in their research. These diagrams also help all ranges of society understand the overall dynamic of the negatives and positives that affect the ecosystem. Showing the human element and how it affects the environment and how it can be helped is essential to the long term outreach based on findings from the American Forest Foundation (2015). The presentation of information shown in diagram format showing multiple interactions are typical in many northern United States as stated by Eun-Ji, & Liliane (2014), and even Canada. However, Texas has similar classes that have such detail, but only in their more advanced classes, well above the standard science curriculum for all students. Texas is one of a few states that has a lower standard in showing the complexities of ecology and environmental interaction in the environment. Northern US states and Canada have an advanced (compared to Texas) programs in delving deeper into the intricacies of the environmental cycle and ecological impacts.

Another way to show the overall dynamic of the environment is a diagram like the one listed below.



Gerard & Alfons, 2008

This type of overall picture can be shown to nearly all levels of ages with the same resounding effect of increasing environmental awareness across many spectrum's. It's a simple diagram for any level at school and easy to understand, but focuses more intently on the overall chemistry exchange that occurs within the system. It shows a different interaction that is at a different level of observation; one that is often overlooked. Wray-Lake, Flanagan & Osgood (2009) stated that adolescent environmental awareness is taught to children by the parents and people around them. It is harder to change their understanding of the environment if not approached from multiple angles and reinforced. However, in Texas, these types of diagrams and basic understanding is rarely discussed at length or with any depth, application or recurrence. Scott (1998) explains that teaching environmental values

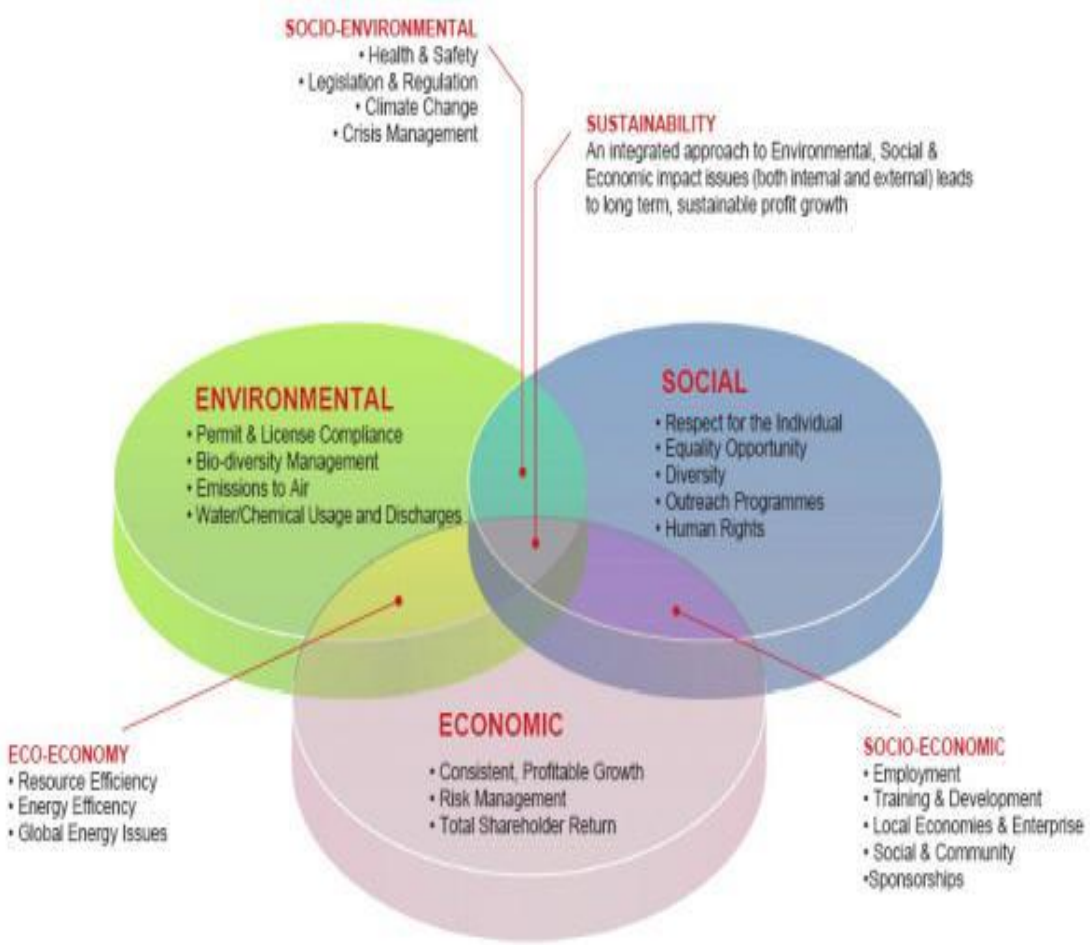
and awareness can overlap into many other areas of the curriculum. Having an ability to apply environmental awareness into multiple disciplines is something that should be considered heavily, so its not just one class that is taken each year.

Application of environmental awareness is very important as well. Le (2010) states that field assessment that focuses on observation and degradation of the local ecosystem is imperative for students to understand. Seeing and applying hwat you have learned in the field is a strong measure in encoding environmental awareness and interaction across the wider spectrum. However, on the other hand, Jickling (1992) suggests that teaching such a broad topic as environmental or sustainable development is complicated. Such terminology is confusing to students and depending on who is teaching the course, many different perceptions can be taught and absorbed in different ways depending on what phrases are used and attitudes are presented.

Summary

So, what does it all mean? The research and direction of this paper is showing that there are precise and methodological ways to approach local schools, to increase environmental education exposure and to ensure the maximum response for student and local community involvement. The reasoning that Texas schools are far more lacking in overall environmental awareness and understanding coincides with the greater picture of a lackluster environmental enforcement across the State of Texas. Throughout the nation, many States in America are far ahead of Texas in the environmental realm, in a general sense, not just education. This lack of attention and focus translates down to Texas education as well. This type of reduced

awareness of environmental understanding will continue to exist, if not fixed at the local school level, thus changing the paradigm for the entire state. There appears to be many opportunities waiting to be discovered and utilized in the local school system and if left alone, they might be quite naturally realized over the span of a few decades. However, I wish to attempt to push that span to a closer and faster result of a few years, instead of decades. I believe that by approaching multiple angles to increase student involvement and give a better environmental understanding through local schools and community outreach could ultimately lead to local training and potential scholarships for all involved. This could also expand into a potential creation of a new brand and perhaps incorporating onto an existing company's brand into local schools. HEB already has many programs in Texas schools that promote increased reading and healthy eating; while providing education grants to underprivileged children. Can HEB expand those grants into environmental and outreach programs? Would combining as Mascot and Brand together into local school increase the chances of increased environmental awareness and stronger support for adding environmental and ecology knowledge to the existing curriculum? The answer is yes. The research and programs in other regions in North America, Canada and Europe, show that very example of social, commercial, educational overlaps works well. Pieters (1990) shows how the interaction of multiple systems can work well with each other by solid education and communication.



(Sustainability 2015)

There are many pie charts that show various environmental concepts to schools and communities so that they start thinking and formulating an equitable solution to a long term sustainable plan so that all entities can work together and benefit accordingly based on what Moroye (2009) states in his research. The pie chart above is essentially the same concepts and ideas but in different layouts that show natural overlapping. I believe that multiple chart designs are necessary to make sure that a presenter or teacher conveys the same message to all attending parties and start to see the bigger picture in how many (seemingly) different systems do indeed interact and need to work together for long term sustainability.

The visual message that you utilize to spread environmental education has to reach a multitude of people and outreach and is uniquely understood by every single person. Knowing that there is no one perfect way to send a message, having a multitude of visual messages, all saying the same general concept or information, is the best approach in spreading your message (Visualizing Sustainability 2015).

Based on the environmental education research that is available, using various techniques listed above, there should be a much better chance to significantly improve environmental applications and overall awareness in the local school system at multiple levels. Using visual techniques and diagrams (e.g. mascots or environmental relationships) seem to have the most impact and a higher success for improvement overall (TCEQ 2016).

The end goal is achieving increased environmental awareness and student involvement as well as trying to increase environmental quality for this entire region. Research has shown that using these few methods just discussed, has shown a much better chance of success across a wide range of students in various levels of education. While this approach has success in the school systems outside of Texas, there are ample ways an

d additional programs that can be used to augment this first step in expanding awareness and involvement for Texas students and families alike.

CHAPTER THREE

Methods

The overall purpose of this capstone project is to expand the awareness of water quality knowledge in the local community. I believe that this has to start with children in the local community beginning at the school level. As many have said in the past, "The children are our future" is correct in this specific instance. The only way to ensure long term change and overall increase in water quality awareness is by educating our youth. This project is focused on beefing up existing curriculum in local schools to focus primarily on local water quality and how it affects each person individually or as an overall community. This project is grounded in expanding off the existing science curriculum and including project based lessons that are locally oriented to establish a strong value of attachment to the local area for each student.

Chapter 3 works to introduce the proposed concepts in which to introduce water quality awareness and expose the local students to learning more about the local environment and its interactions. One focus question of the entire capstone is, "What do local students truly understand about the local water quality and how can they help or hinder its dynamic?"

Rationale

The latest research suggests that many people are more intrigued by the overall environment if they are actually out in the real environment, touching things and see the relationship directly. If there is a lesson plan that is only taught in the classroom with no direct application to the learning material, there is a much lower chance of the information being retained and utilized in the future. This capstone project seeks to stimulate the mind in

an interactive way and increase the interest of the local school children, so that they have a core understanding of the world around them, Introducing the children to applicable ways in which to interact with the world around them in a positive manner and learn steps to improve the overall environmental, will help them to properly teach others or directly improve the environment with simple measures or actions.

There will be a survey given to all participating students in this class exercise to determine how much knowledge and awareness that has absorbed and understood about the overall watershed and water quality variables.

The survey is open ended and entirely written to gather the student's perspective on water quality and perception on what is or what is not bad for the environment.

The survey that Curry (2010) presented is listed below.

Rate the questions between 1-5 (1=Strongly Agree 5=Not at all agree)

- My actions affect the quality of the water in my watershed.
- My actions affect the quality of water in other watersheds.
- Clean, fresh water must be used in moderation.
- It is safe to drink the water from any faucet.
- Water is a renewable resource.
- All individuals have access to clean water.
- Only bottled or properly disinfected water should be used for cooking, brushing teeth, and drinking.
- Contaminated surface water and poor sanitation contribute to the transmission of water borne disease.
- Impervious surfaces typically have the highest rates of runoff.
- Boiling water can eliminate the chance of water borne disease.
- Water borne disease can be eliminated by boiling water.
- By treating water with chlorine and iodine, water borne disease can be eliminated.
- Some germs and chemicals occur naturally in water.
- Standing water creates a breeding ground for disease carrying mosquitoes.
- The Clean Water Industry plays a vital role in my daily life.
- The Clean Water Industry plays a vital role in the daily lives of individuals around the world.
- There are many career opportunities in the Clean Water Industry

(Curry 2010)

Lesson Plan

The process used to develop an outreaching education lesson plan is found in which the curriculum designed is focused on interaction and project based learning. The purpose of identification of various water quality related items in the local environmental is only the first step to the entire process. The overall concept is how things interact with each other on a big picture in regard to conceptual framework. With a short field trip with a small list of items in which to identify, label and focus on, will the start of understanding will be started. This is a project based lesson plan that accentuates and bolsters the existing science curriculum at the local schools. Even though there is a standard of 5 to10 elements that can be identified in the environment, there are a number of other items that possibly are not related to improving or decaying water quality. Those items will not be focused on at length, and the overall process will stay on track with the actual results that work towards a positive direction on improving water quality, in our current understanding of science and water quality interaction.

Additionally, to observational and identification of various elements in the environment, there will be water quality testing that are crucial to overall water quality health. There can be many other variables to be analyzed but it is best to focus on only the top items to keep it simple and direct in the students learning capability and overall understanding.

Setting and Participants

The curriculum guide is written for use by high school students at this first stage in overall understanding of water quality. Additional classes and age groups can be adjusted into the project as time goes on. The ideal setting is to bring the students out into the local water body that is nearest to the school.

Guide layout

Water purity is essential to all life continuing and staying healthy. How can we make sure our water quality is maintained in our city? Who can affect it and/or change the quality of our surface water? This class exercise will focus on understanding observing underground springs and surface water runoff that drains into the local lake and river.

Problem statement

With everyone moving into town and new buildings and homes being built every day, the increase of storm water runoff is increasing. All storm water runoff either drains to the Lake or infiltrates into the ground and comes out of these springs that feed the Lake.

Class will break apart into small groups for the analysis part of the class assignment.

There is a large amount of water data that will be presented and multiple field trips for the students to formulate their theories about what is or what is not happening in this small, but very important water body.

Topic focus

The multi-faceted course will begin to help you understand the importance of water quality and water sources in the nearby streams and lake

During the next week, multiple field trips will discuss water sources and water quality issues.

Curriculum Links

This week long workshop can be placed in / around the Physical Geography aspect of Science classes. This activity can be included in with the Water Cycle and/or Atmosphere education portion of any Science class, thus relating it to groundwater, rainstorms, chemical use and/or biology topics (fish, plants, etc...)

Center for Biological Diversity. http://www.biologicaldiversity.org/species/invertebrates/

Edwards Habitat Conservation Plan . http://www.eahcp.org/

United States Geological Survey - Water Quality. http://water.usgs.gov/owq/

Objectives

With learning what the "experts" have discussed during their 2 visits to class to explain the critters, their habitat and how they exist, as well as discussing overall water quality; the students will be able to:

- Understand the obvious and not so obvious water quality issues while on their field trip, doing analysis
- Collaborate with others to understand the long-term ramifications to the overall water quality in the Lake and River system
- Apply these new concepts learned to other science areas related to water quality
- Institute / Suggest one change to a positive outcome for the Landa Lake/ Comal river region and/or habitat

Materials

- Access to the internet
- Camera
- Paper to take notes on what is observed in the field
- Class buddies to discuss what you learn over the next week

Time

The workshop will take one week, at one hour per day of class. The high school is only 1 mile from class and a van will bus everyone to the site location and/or they can walk.

Scope and Sequence

Day 1 - Water Quality presentation(s) for the Lake and River system

Visiting Lecture / presentations from local water quality organizations (governmental).

Day 2 - Field trip to the Lake / Park to assess and apply what was discussed in the previous 2 lectures on water quality and spring flow.

- See the water level gauges
- See the springs and where they are located in relation to the Lake and River.
- See how the topography of region all flows down to this specific area

Day 3 - Discussion/Presentation on aquifer and associated river systems (big picture)

Visiting lecture or presentation from Guadalupe Blanco River Authority (GBRA)

Day 4 - Field trip to the Lake / Park to apply new information on what was discussed in the previous 4 presentations and incorporate all that information together

- Look at the springs again and understand the connective nature of local / regional water flow and infiltration
- Look at the river again and see the overall ecology combining with the water quality

Day 5 - Research all the available information, see what could harm an ecosystem like this one. Break off into 5 groups.

Discuss :

- What you observed (field / classroom)
- What could be applied to fixing any problems you might have found (field / classroom)
- What did your water samples tell you/?
- How can we fix any issues you found with the water sample report?

Tasks

- Make list of pollutants that could harm this system (vegetation, biology or ??). You have up to 5 pollutants to choose, to have checked
- Obtain 2 water samples (one from the Lake and one from mouth of the springs)
- Present (as a group) to the class:

- What issues you found in the found
- What pollutants are you going to have analyzed and why
- How could the species become healthier utilizing better water quality

Summary

The overall learning concept is for students to observe their surroundings as well as the subject focus which is water quality. The overall concept will be for them to incorporate the obvious water quality (e.g. point source) and the not so obvious (e.g. non point source) pollutants in a real world setting.

After the "experts" visit the classroom and explain what the overall system has in it and how water quality affects it, the students can visit the field and make their assessments noticing the most obvious items that should make a difference and also to think outside the box as to what could ALSO make a difference in water quality

Evaluation of the lesson

Feedback from other teachers and/ or resident experts (presenters)

My final thoughts are that this project could be given at any age level in public school and/or local colleges. I think that with continued education and exposure, this class and similar educational presentations / workshops, can help with multiple programs that the local city, county and multifaceted environmental programs are attempting to do for this region.

Conclusion

Chapter 3 defines the overall interactive project with the local school participants and it written in a simple format to create a foundation on understand the larger picture of water quality interaction regarding the local environment. Since there are many variables involved, and could be quite complex, it is best to start simply and go over the basic variables first and then grow in understanding from those basic participles.

Chapter 4 will focus on my conclusions for bolstering water quality awareness, education and what is means to the community as well each individual person. Since there are so many variables on how water quality affects each person, it will focus on drinking water and daily water use for the local community. These issues will be brought up in more specifics in Chapter 4 to explain the simple dynamic in which drinking water quality is essential to basic life and simple ways to achieve that goal.

Chapter 4

Conclusions

My overall goal for my research paper is to look at ways to expand local citizens' knowledge of water quantity and water quality. There are many specific areas to focus on, for example: business, recreation and schools. As discussed previously, the most effective approach is to start off with outreaching to schools and to look into their existing curriculum, and to bolster their water quality knowledge. I am working to help expand their existing water awareness and find ways to help incorporate ways to improve water quality and keep our water supply clean for themselves and for the overall region.

Considering that there are so many moving parts to the educational requirements of the city multiple water quality programs, I had to approach this challenge using a multi-dimensional approach to achieve the highest potential for outreach across a wide spectrum. The local schools seemed to be the most logical start as it will domino into so many other venues. Only by instilling this knowledge and awareness in the local students, will changes be made in the mindset of current and future citizens.

The biggest challenge is to address how to effectively change behavior as that is extremely difficult. Using a water based analogy like "planting the seed" will be significant in promoting change over a wide spectrum of the population. The children will ultimately bring home this knowledge to their parents and also bring it to their grandparents. Additionally, there are multiple programs that have been discussed that can be beneficial to promoting this overall awareness at other locations using different methods listed in this

project.

Additionally, with this whole region is prone to flooding and water quality degradation due to continued development, increased impervious cover, stagnant regulation improvement; approaching the local student population with water quality awareness is the most strategic and effective measure.

With this specific town of New Braunfels, there seems to be much resistance to accepting changes for environmental improvements with the majority of the local (aging) population. The younger generation are generally more open to learning new things and seeing the region in a new perspective when presented with new information. From my direct experience with governmental and private industry experience, I find that showing case studies and real-world applications is key to a program like this have any hope of success.

Reflections

As I have worked through this process of research and discovery, I expected much more acceptance and willingness to do the right thing for the overall community. However, there are many factors like culture, education and family history, that I had missed in my initial assessment of trying to improve water quality through education. One of my most unexpected outcomes in this process was that the aging population is uncaring of the water quality since it "looked" the same as it did 2 generations ago. In my experience, people seem to look only at the superficial, even though water quality degradation and water tests that show determents in dissolved oxygen, bacteria, nitrates and sediments are well established. These types of items are hard to see to any casual observer, since you must dig a bit deeper.

Only through water tests can you determine there are problems issues. However, even when the population was presented with this new data, they are still uncaring and unsympathetic. The aging population did not want to change their worldview of what they grew up with in their youth. To this specific population, the superficial look of the water system is the same as when they were children, nearly 70 years ago.

Research supported

Before I gathered my research and read through the literature, I thought that I had plenty of well-established knowledge and a strong approach starting out in the beginning. I had worked with different communities before as well as other schools in neighboring larger cities. However, as I began to read through the literature, I learned different approaches and subtleties in which to tweak my initial approaches in my overall education program; so that I can maximize the potential result. I learned many things in the environmental education realm from different sources like Caduto, M. (1985) which showed some significant strides in school related science curriculums and subtle approaches like what is presented in Hauk, (2015), on how to show interlocking relationships between seemingly unrelated items. These types of seemingly subtle, yet very significant approaches really helped me understand the gravity of my challenges that I have ahead of me. In trying to encompass a broad audience takes a very strategic approach so that many different types of personalities and backgrounds are encompassing the information and utilizing it as well; as discussed in Littledyke, M. (1997). Even after reading through Moroye, C., (2009) on his ecology minded teachers, I thought that I had a strong grasp on that topic already, but combined with other research, like Copely, L. (2009) in fostering a sustainability mindset, conjoined the two different research

articles to help me see a better overall approach, opening up different frames of awareness utilizing different angles; to maximize the overall end result of water quality education absorption.

Also, based on the City mandate for the water quality guidelines to support the new State of Texas permit, water quality education is mandated throughout the region and improvements are expected but not mandated. However, the overall approach is the same as with the public school and hopefully with enough different approaches as well as updates to the city code of ordinances, water quality improvements will slowly begin to occur. Consequently, many of the limitations of this new aggressive approach to improve water quality awareness and education is hindered by the city's city council and city manager not having a strong environmental stance. Even with the mandate from the TCEQ, the attitude is still lackluster, at best, with regard to city funding or employee resources utilized to achieve these goals. Tourism will always take the front seat to any other concerns. Even with educating the city council, city manager and mayor on the new requirements for the TCEQ permit, there is still not enough continuous focus on water quality. Again, changing behavior is hard at all levels.

Once the educational programs are put in place and implemented at the local schools, I will continue to provide local workshops to businesses and local community groups, even without extra funding. I think over time, once the students start to incorporate this new knowledge and awareness, it will translate up to the parents and grandparents; then eventually to the local city council, mayor and city manager. After this occurs, then I can use these advancements to widen the scope of water quality education to the surrounding schools

further out into the county region; thus, improving the larger watershed which flows into the city and water system. Also, once the added educational awareness starts to take effect, then the funding might increase and more staffing and an increased budget can be allotted for the water quality program. With the potential establishment of this new water quality educational program, it can also create new direction on many other levels with environmental mascots to larger companies, environmental internships in these same companies, bolster the local colleges to increase their water quality options in their curriculum and many other opportunities yet to be determined.

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