Implementation of High School Water Science Fairs in Albania

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BY

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Abstract

Despite the abundance of water within Albania's borders, the country faces challenges associated with water management and distribution. The goal of this project was to spark students' interest in pursuing careers to resolve these issues. Working with the Water Supply and Sewerage Association of Albania and high schools in five major cities, our team established a national science fair focusing on water. The science fair program was received with enthusiasm, and the students started to work eagerly on their projects. Plans are for the science fair to expand and involve more schools, providing greater awareness of water issues for the students and the Albanian community as a whole.

Executive Summary

The small country of Albania in Europe's Balkan region has many resources. One of these is its abundance of water, divided into river basins, lakes, and rivers. Per capita, the country has a much greater amount of freshwater than the world average. Because of issues with water management, however, the people do not have adequate access to these water resources. In many cases, the full supply of water simply cannot reach them. In the capital city of Tirana, more than half of the water that flows through the piping network is lost in transit. The network throughout the city is composed of outdated piping and is in need of repair. The water utilities, however, do not have adequate funding to support such a project. Illegal water connections also decrease the amount of water available. Many residents of the capital city have times during the day where no water is available to them. In an attempt to remedy the situation, some people have installed water tanks on their roofs. In rural areas only twenty-four percent of households have running water and only fifty-two percent have access to any sort of public water supply system. These residents rely on wells to supply their water. Overall, the issues that the country faces with regard to water cause severe problems for people throughout the country.

One organization that has made it their mission to improve the water management is the Water Supply and Sewerage Association of Albania (WSSAA). They have created programs to focus the Albanian people's attention on the issues of water management. These programs are aimed at educating students. The idea is to get students interested in pursuing a career dealing with water and eventually work toward solving the water-related issues. The water sector requires more people to work at water utilities and related companies. These students are the ones who could eventually be a part of the solution. WSSAA has four programs currently in place— one for third graders, eighth graders, university students, and graduates. All of these programs focus on raising overall awareness to foster a desire to solve the water problems.

While the programs currently in place have worked toward awareness at many grade levels, there remains a gap in high school water education. Our team of Worcester Polytechnic Institute (WPI) students implemented a program to fill the gap. We built off the project completed during the previous year by another team of WPI students. Their pilot

program introduced a water science fair at the Harry Fultz Technical High School in Tirana and they mentored students through the process. We expanded their project and introduced the water science fair to five public high schools in different cities across Albania, namely Tirana, Durres, Shkodra, Berat, and Korca. Working with a group created by WSSAA called the Young Water Professionals, we met with administrators, teachers, and students to explain the process for the science fair. The water science fair projects focus on three phases: background research, experimentation, and presentation of results. These projects will be presented and scored at a science fair at each high school, prior to the national science fair. The judges will use a rubric we created to standardize the process. The top two project teams, consisting of up to four students per team, from each high school will then advance to a national competition on World Water Day on March 22, 2015. While working on these projects, we expect that students will enhance their researching and experimental skills while also having the opportunity to collaborate with the Young Water Professionals, specialists in the field of water management.

From our visits to each of the high schools, we were able to draw conclusions and make recommendations for WSSAA in their plans for expansion of the water science fair. In each school, there were differing approaches to conducting the science fairs. Some of the teachers and students had experience in similar projects and had ideas about how to approach the science fair. Others that did not have as much experience were unsure how begin their projects. They required a bit more guidance from us as we moved forward. In the future, the Young Water Professionals can provide this guidance. We have devised an organizational structure to distribute the responsibilities associated with the planning the science fairs. An important aspect of it is the creation of a group of Regional Coordinators that will expand and advise the program. To aid in this expansion, we also suggest that our website be continued as a valuable resource for everyone involved. To increase overall awareness, we recommend that community members and all students be invited to the local science fairs. Our final recommendation to WSSAA is to find educational sponsors for the national science fair to cover the cost for the students. By involving students in research and hands-on projects, we aim to inspire them to pursue careers in the water sector and thus work towards fixing the water issues for the people of Albania.

Authorship

We divided the writing of this project equally among all the members of the group. We then performed edits of the entire document together to ensure clarity in our objectives. This method allowed us to ensure that all members contributed equally to the final report.

Acknowledgements

We would not have been able to complete this project without assistance from many sources. First, our advisor Professor Peter Christopher not only assisted us with the technical details of providing comments on multiple drafts of our report, but he also made this project possible by guiding us while in the country of Albania. We would also like to thank Professor Robert Hersh for his assistance in the background research and preparation phase of this project. During this phase, we also had research help from librarian Rebecca Zinno, who we would like to thank for taking time out of her schedule to assist us whenever we needed help.

While in Albania, representatives from our project's sponsor The Water Supply and Sewerage Association of Albania helped us immensely both with project guidance and cultural understanding. We would specifically like to thank Philip Giantris, Elisabeta Poci, and Olta Ceca for their assistance. Associated with our sponsor, we would like to thank the many Young Water Professionals: Viola Saliasi, Ilirjan Kumaraku, Kasem Bejko, Valbona Paja, Ediola Osman, and Erald Shahini. They not only helped us while visiting the high schools, but also will serve as mentors to the students as they complete these projects. Finally, this project would not have had nearly as much success without the enthusiasm from school directors, teachers and students to research and complete these projects. Thank you to everyone involved.

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1. Introduction

Although Albania is endowed with abundant water resources, the country experiences significant challenges with water management and water distribution. In the capital city of Tirana alone, access to water is a major problem for Albanian citizens as around 60% of water is lost in transit, resulting in insufficient availability of potable water (Pojani, 2009). Water accessibility is an even more problematic issue in some rural areas, as residents can only access clean drinking water for four to six hours per day (Pojani, 2009). Throughout the country, there are significant issues with water pollution because of rapid urbanization as well as inadequate and decaying infrastructure that is unable to meet the needs of the population. These are issues that not only must be addressed but also must be brought to the public's knowledge in order to achieve significant progress and enable Albania, as a whole, to develop.

While Albania is currently dealing with significant water management related issues, there is a major disconnect between identifying the problems and addressing the concerns. The Albanian government has taken steps to strengthen the authority of local water councils but has struggled with enforcement of regulations (Manjani et al., 2011). The government's focus lies in empowering local water utilities and their consumers in order to increase accountability for the current state of water management (Rohde, Konishi, & Janakiram, 2004). With this need for improvement, there is a growing demand for Albanians to pursue careers in the water sector (Poci, Giantris, & Ceca 2014). One key method of gaining the required interest in careers in the water sector is through improving and expanding the education of water issues (Singh, 2012).

One of the primary goals of the Water Supply and Sewerage Association of Albania (WSSAA) is to increase water issue awareness of students in order to increase the number of Albanians who pursue a career in the water sector (Poci et al., 2014). The organization has developed educational programs at the third grade, eighth grade, university, and graduate levels. There is a void, however, for high school students that needs to be addressed. Based on the results of last year's WPI Interactive Qualifying Project, "Developing a Water Education Program in Albanian High Schools," water-related science

fairs proved to be an effective method of piquing the interest of students at the Harry Fultz High School in Tirana (Miralda, Morse, Mucolli, & Williams, 2014). A science fair is a competition in which students present experiments and research that they have completed in teams. As a result of this success, WSSAA plans on continuing and expanding the science fair program.

Our goal for this project was to implement water-related science fairs in five pre-selected Albanian public high schools located in the cities of Tirana, Durres, Shkodra, Berat, and Korca. As we pursued our project, we communicated with a number of groups and organizations, including the Young Water Professionals and various water utilities throughout the country. These organizations helped us to better understand the water issues and provided us with information on how we could better involve the community in our project. Following the initial interviews, we visited each of the selected schools on two separate occasions. At the schools, we introduced the science fairs, encouraged teacher and student involvement, and worked with the Young Water Professionals to ensure the program's continuation. The moment we introduced the idea of a national competition, the students' eyes brightened and they began working on their projects within weeks of our initial visit. Although we were not able to directly work with the students frequently, we did provide them with multiple resources to complete their projects. These resources included an informational handout, a sample project, a scoring rubric, and a calendar describing potential due dates of different tasks. Students and teachers could find all of these resources on the website that we created. With this guidance, they created projects studying topics such as the chemistry of water, methods of extracting energy from the oceans' waves, and a multitude of other ideas. Throughout this phase of the project, we also determined recommendations for the future expansion of the science fair program.

Overall, we aimed to spark and maintain the interest of students in different areas of water management in order to increase their understanding of water issues through the science fairs. We also wanted to increase the awareness of entire communities – students, family members, and teachers – of the water issues directly affecting them by involving them in the science fair process. We have already seen the heightened student interest and are looking forward to seeing how they approach their projects. Our goal to develop student enthusiasm has been realized at these five high schools and we have made

recommendations for the future expansion of the entire program. Ultimately, the goal of the national science fair program is to encourage students to take action and become inspired to pursue careers in the Albanian water sector.

2. Background

2.1: Introduction

Albania is fortunate to have a large amount of available water resources. There are a number of different sources of freshwater including river basins, rivers, lakes, and groundwater. Despite this, the country faces challenges related to water management because of factors such as pollution, urbanization, and inadequate water infrastructure. Many organizations, including the Ministry of Public Works and Transport, have attempted to devise solutions for the water issues but have not experienced significant success. According to Enkelejda Gjinali of the Water Supply and Sanitation Sector of Albania, the water sector requires at least six hundred additional employees and one hundred and fifty additional managers (Gjinali, 2014). One effective way to increase the number of professionals working in water management is by educating students about water issues and, in turn, inspiring them to pursue careers in the water sector (Poci et al., 2014). In order to accomplish this, the Water Supply and Sewerage Association of Albania has already taken steps to increase student interest in the form of hands-on programs for different grade levels. One method of increasing student interest is through science fairs, which provide participants with an important level of environmental awareness while giving them a chance to experience a hands-on learning activity (Friedrichsen & Dana, 2004).

2.2: Water Resources in Albania

Albania is characterized by a large amount of available water resources located throughout the country. The country has 9,601 cubic meters of internal freshwater resources per capita, significantly higher than the world average of 6,156 cubic meters per capita (World Bank, 2012). In addition, the country is divided into six river basins, as shown below in Figure 2.1, and has several large rivers. These rivers, the Drini, Valbona, Buna, Mati, Erzen, and Osumi, all flow from east to west.

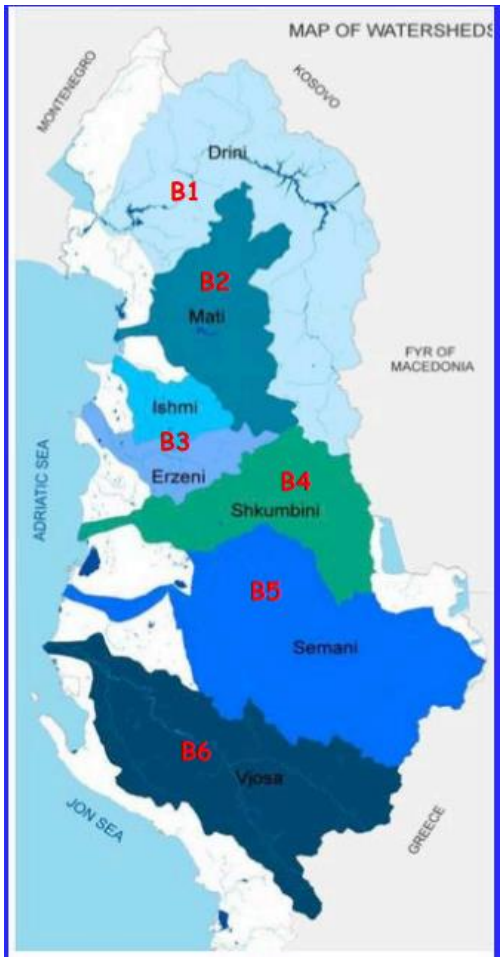

Figure 2.1: Watersheds in Albania (Mukaj, 2010)

The Drini River, the longest in Albania with a length of 335 kilometers, constitutes over half of Albania's annual water flow and has two main distributaries, one into the Adriatic Sea and the other into the Buna River (Islami, Kamberi, Bruci, & Fida, 2009). In addition, the annual total volume of water flow is just under forty billion cubic meters (Islami et al., 2009). Albania's water resources are primarily used for irrigation, drinking water, and electric power production. Approximately one billion cubic meters of the water supply in Albania is used for irrigation, coming from a combination of reservoirs, rivers and lakes, and underground water (Islami et al., 2009).

Twenty-three percent of the yearly water flow in Albania comes from underground water. Aquifers cover approximately 6500 square kilometers of Albanian territory with a total of 110 scattered throughout the country, as shown in Figure 2.2. These underground sources of water represent a significant amount of Albania's plentiful water resources.

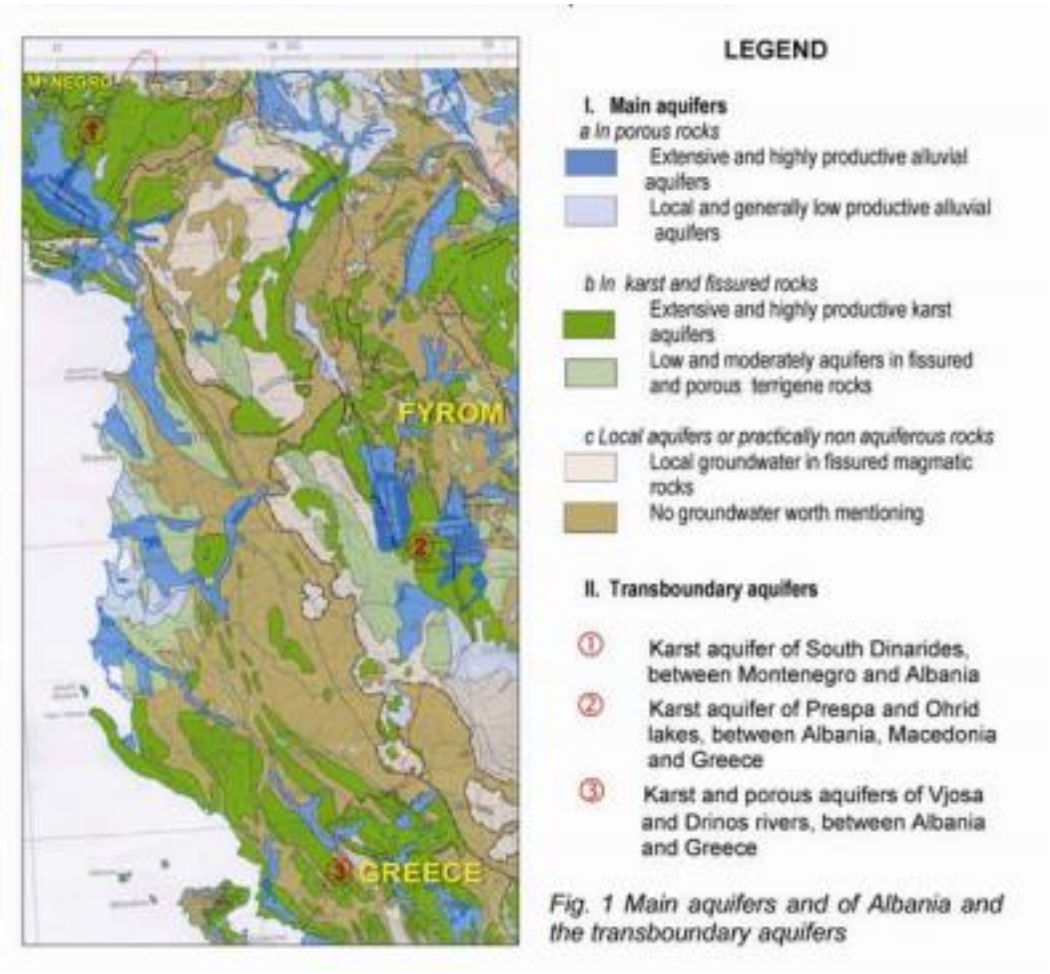

Figure 2.2: Underground water in Albania (Eftimi, 2005)

In addition to surface water and underground resources, the annual rainfall rate in Albania amounts to approximately 1300 mm per year in the south and 2000 mm per year in the north (Cullaj et al., 2005). Water flow in Albania is characterized by a wet period, a dry period, and a transitional period. The wet period lasts from October through May in which 86% of the annual water flow is discharged while 8% is discharged during the dry period spanning from July to September and 6% during the transitional period in June (Islami et al., 2009).

Overall, river basins, rivers, lakes, and groundwater provide a significant amount of water to the country. With proper distribution, Albanians should have access to a constant supply of water to meet their needs.

2.3: Water Management Issues

Despite the availability of water in Albania, the country struggles with water management. Rapid urbanization has led to increased pollution of freshwater resources, limiting the amount of water suitable for consumption. The influx of people from rural areas into cities also strains the water distribution infrastructure, which is already in desperate need of repair due to its age. These challenges present major obstacles to the availability of water in Albania.

2.3.1: Urbanization

In order to understand how the growth of urban areas affects water usage in Albania, it is important to consider the population trends of the country. Over three million people currently live in Albania. (The World Factbook, 2014). This number is expected to increase to almost four million by 2025 (Massoud, Scrimshaw, & Lester, 2003). In addition, the proportion of the population living in urban areas has increased from 35.7% in the year 2000 (Massoud et al. 2003) to 53.4% in 2014 and will continue to increase (The World Factbook, 2014). Since the fall of Communism in 1991, Tirana itself has doubled in population as people left rural areas to seek out more economic opportunity in the city (Pojani, 2009). This trend is displayed below in Figure 2.6, which visualizes Albania's internal immigration and emigration trends from 1981 to 2001. The rapid growth of urban centers in the post-communist era has strained the dated water infrastructure to the point where many people simply do not have access to an adequate and reliable supply of water.

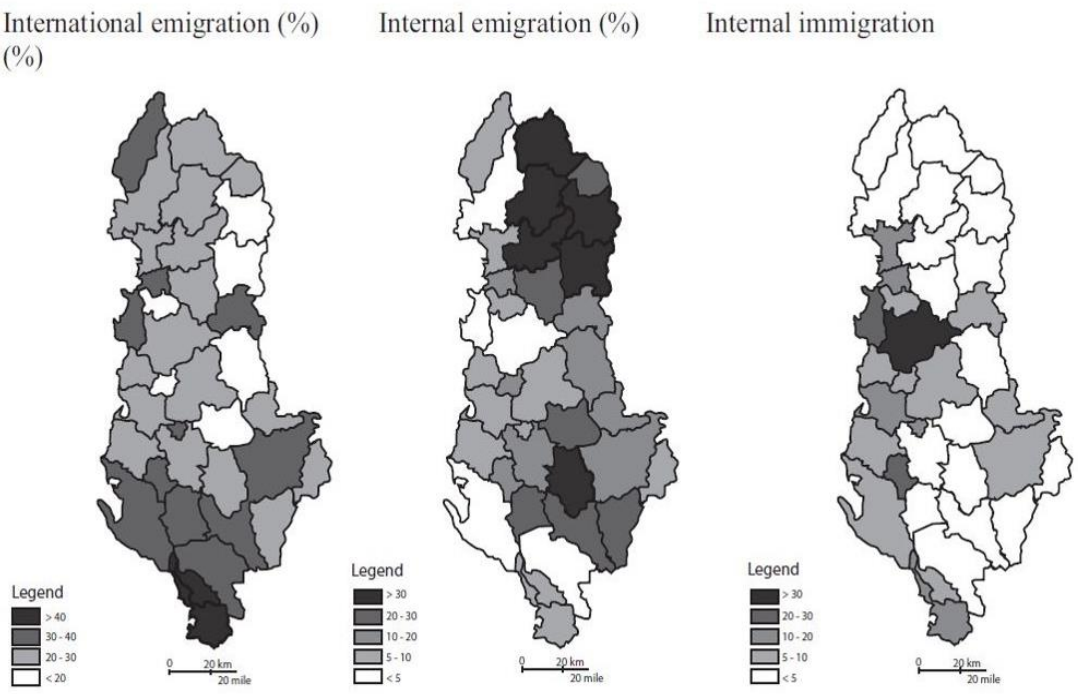

Figure 2.6: Urbanization in Albania (Agorastakis & Sidiropoulos, 2007)

As people moved into cities, they overused environmental resources, including water (Cullaj et al., 2005). This led to a strain on the water distribution system, resulting in issues with piped water and waste disposal (Pojani, 2009). Currently, people living in urban areas do not have adequate access to water. It is considered a luxury in major cities to have access to running water for more than eleven hours per day (Pojani, 2009). With increases in population and urbanization comes a greater stress on the water distribution networks.

2.3.2: Water Pollution

Compounding the problems associated with rapid urbanization, pollution of the water resources also reduces the amount of water suitable for human consumption. There are many deeply rooted factors that contribute to water pollution in Albania. After the fall of Communism, land became privately owned and investors quickly capitalized on this by industrializing and farming the new lands, adversely affecting the surrounding environment. In Shkumbini, Tirana, Gjanica, and Semani there are high levels of

ammonium and nitrite in the nearby rivers from liquid and solid waste, a symptom of the large amount of organic material in the water from fertilizer runoff, which greatly reduces quality (Cullaj et al., 2005). This material finds its way into rivers and other water sources because illegal trash dumping sites are located near rivers (Cullaj et al., 2005).

Along with farming, industrialization also contributes to pollution of the main waterways in Albania. According to the map shown in Appendix A, many rivers and seas in Albania have fallen victim to pollution. Of the fifteen major rivers in Albania, two are heavily polluted with industrial waste and four are polluted with organic waste.

The Mati River, which is the main water supply for 240,000 people living around Klos, Lezhë, and Burrel, is a key example of the damage caused by pollution. Mining and smelting nearby cause pollution of copper and chromium in the river, limiting its ability to reliably provide potable water (Kumanova, 2014). Another important water source impacted by industrial pollution is Ohrid Lake, which provides water to the 100,000 people living around Ohrid, Struga, and Pogradeci. As untreated wastewater is deposited into the lake, heavy metals and minerals contaminate this important source of water, which is also one of the oldest freshwater lakes in the world (Bozo & Ikonomo, 2009). The locations of these bodies of water are shown in Figure 2.5.

Figure 2.5: Map of Albania (http://www.sitesatlas.com/Maps/Maps/520.htm)

Ultimately, this widespread pollution not only limits the availability of water but it jeopardizes public health as it can even lead to epidemics of waterborne pathogens such as cholera and poliomyelitis (Massoud et al., 2003). This health hazard has proven to be very real for Albania as outbreaks of disease are not rare occurrences. One study conducted by the International Water Association involving waterborne diseases determined that 80 percent of these outbreaks are due to the lack of treatment and poor distribution of water (Villena et al., 2003).

2.3.3: Infrastructure

As cities have grown in size, the methods of transporting water have not been able to keep up with demand. The water infrastructure currently in place in Tirana, built in the 1950s, has not been adequately maintained (Rohde et al., 2004). In 2003, engineers

determined that this infrastructure had reached the end of its useful life and there existed no cost effective method of repair (Rohde et al., 2004). The water networks have yet to be replaced due to a lack of available resources (Poci & Ceca, 2014). As a result of this degradation of the infrastructure, sixty percent of the water that travels through the networks in Tirana is lost in transit (Gjinali, 2014). In addition, people throughout Albania illegally tap into water networks, further presenting a severe water management problem (Manjani et al., 2011). This represents an additional loss of water in transit that cannot be accounted for and only magnifies the infrastructure problems. Another issue involving water utilities is that only forty-five percent of connections are metered and Albania primarily uses flat rates, resulting in abuse of the system where some customers use water that far exceeds their appropriate amount (Manjani et al., 2011). Coupled with a growing population and urbanization, the loss of water throughout the distribution process poses a major obstacle to sufficient access to water. Overall, Albania's poor water infrastructure is a multidimensional problem that results in serious negative consequences.

In other areas of Albania, there are different infrastructure related issues. Infrastructure in rural areas is even less efficient, where only twenty-four percent of households have access to running water and only fifty-two percent have access to any sort of public water supply system (Pojani, 2009). Since most of these people do not have connections to water, they rely on wells, tanker trucks carrying water, and the physical transportation of water by use of buckets to obtain water (Penelope & Cowen, 1998).

2.3.4: Energy Usage

Not only does the inefficient infrastructure limit access to water, but it also creates a situation in which much of the energy required to pump water through the networks is wasted (Poci & Ceca, 2014). Instead of the common international practice of requiring 0.5 kilowatt hours to pump one cubic meter of water, Albania uses 1.1 kilowatt hours per cubic meter (Behnsen et al., 2014). Not only does this represent inefficiency but it directly translates into unnecessary and avoidable expense.. The resources lost through network inefficiencies could be avoided with the updating of the water networks. Water treatment and transport also comprises one of the largest sources of energy consumption in the country (Behnsen et al., 2014). There are also costs associated with treating and delivering

the water to the people of Albania. Most of the utility companies in Albania do not see a return in revenue from the operational costs for the water and must rely on government subsidies (Paja, 2014). Another issue water utilities face is that some people refuse to pay their water and electricity bills, claiming that the poor state of both services is justification for the lack of payment (Pojani, 2009). The current bill collection rate is as low as 65% throughout the country, limiting the funds that can be invested into the eventual improvement of the infrastructure (Behnsen et al., 2014). Several factors associated with water management require attention in order to improve access.

2.4: Organizations Responsible for Water Management

Albania's water sector is currently in a state of transition. Its past involves a number of changes, both positive and negative, that were largely a result of the country's political climate. Today, the water sector continues to face challenges with the infrastructure and overall ability to successfully distribute water to people throughout the country. As Albania seeks to gain entrance into the European Union, the water sector is one of the main priorities as its inability to reliably distribute water is one key factor that does not meet EU standards (Giantris & Johnson, 2014). The government has and continues to make changes and improvements to the water sector in order to both comply with international standards and, most importantly, meet the needs of the Albanian people. Currently, there are a number of efforts in place to increase the effectiveness of the water distribution networks (Saliasi, 2014).

2.4.1: History of Albania's Water Sector

The history of Albania's water sector can be divided into five different phases. The first phase involves the introduction of water infrastructure in the 1930s. During this period, Italian companies built aqueducts and implemented small water networks which provided limited amounts of water to major cities in Albania (Rhode et al., 2004). Following this period was one comprised of extraordinary progress and expansion. As communism began to take hold, Albania adopted a central planning system with the help of other eastern European countries and China (Rhode et al., 2004). During this time,

the country updated water infrastructure and improved overall access to water and plumbing.

Albania's political climate continued to have a significant impact on the water sector once the country began to adopt an international policy characterized by strict isolationism. As a result, Albania received virtually no foreign aid, forcing the government to enact severe budget cuts (Rhode et al., 2004). As a result of these budget cuts, the water sector suffered. There was a significant decline in maintenance of the water infrastructure, leading to deterioration of the networks in addition to a decreased ability to collect payment for water services (Rhode et al., 2004). These new issues resulted in not only a reduction of services but also an increased risk of water supply contamination. Following the fall of communism, water utilities could not address these new issues despite increases in the government funding and available resources (Rhode et al., 2004).

2.4.2: Current State of Albania's Water Sector

In an effort to improve the country's water sector, one of the most significant initiatives taken by Albania's government is decentralization. The motivation behind this action is the belief that giving local governments and water utilities control over the water sector in a certain area will put more pressure on the water utilities. Ultimately, this will provide the incentive to continually improve service (Gjinali, 2014). Currently, there are 58 water and wastewater utilities in Albania which are joint-stock companies partially owned by local authorities (World Bank, 2012).

According to the water utilities draft statute, put into Albanian law in October of 2007, the legal responsibility of water supply and sewerage joint-stock companies is "to ensure and sell the service of potable water supply and sanitation, production and/or purchase of water" for customers (Manjani et al., 2011). This law provides a definitive description of the water utilities' role in the water sector and provides a stronger legal framework for the improvement of the sector as a whole. In addition to the fifty-eight water utilities, the Water Regulatory Authority (WRA) was established in 1996. Law number 9915, formally recognized in May 2008, affirms the WRA's role as "the independent body that has the exclusive right to set tariffs and license operators in the water sector" (Manjani et al., 2011). The WRA is the only authority in Albania that has the

power to issue licenses to any company or persons acting within the water supply and sewerage sector (Manjani et al., 2011). This relationship between the water utilities and the WRA allows for a system of checks and balances while defining clear roles and responsibilities within the water sector as important reforms are put into place.

In 2009, Albania formally applied for membership in the European Union (EU) and is currently recognized as a potential candidate for membership (European Commission, 2014). In order for Albania to be granted membership into the EU, it must continue displaying developmental improvements, especially in the water sector. There are a number of water sector performance and regulation standards that must be improved in order to meet EU standards. Some of the most significant issues the water sector is facing today include the lack of reliability of the water networks and the large percentage of non-revenue water Non-revenue water is defined as water that has been produced and lost either through water network deficiencies or theft by illegal connections (World Bank, 2012). In order to meet EU benchmarks, Albania must reduce the percentage of non-revenue water from sixty percent to twenty percent, ensure chlorine levels in drinking water are acceptable throughout the country, and ensure 24/7 access to potable water (World Bank, 2012).

One of the most important initiatives set forth by the Albanian central government is the encouragement of private sector participation in the water sector. In a country where the government has a very limited amount of money to invest in a wide variety of public reforms, one of the key goals behind private sector participation is that it reduces the financial burden placed upon the central government (Manjani et al., 2011). In addition, while there are risks with involving private companies in water sector reforms, this method can limit political intervention and provide a competitive option in a naturally monopolistic sector (Manjani et al., 2011). One of the most important pieces of legislation that regulates the private sector's involvement is law number 9663, implemented in December 2006. This law allows for the development of public service projects, some of which relate to water management (Manjani et al., 2011). Essentially, this law provides strict procedures for awarding public works projects to private sector companies.

The vision statement of Albania's water sector is to "develop proper policies and commit sufficient resources to improve the provision of water supply and sewerage

services" while moving toward compliance with EU standards (Manjani et al., 2011). In order to make this vision a reality, a five mission objectives, which can be seen below in Figure 2.7.

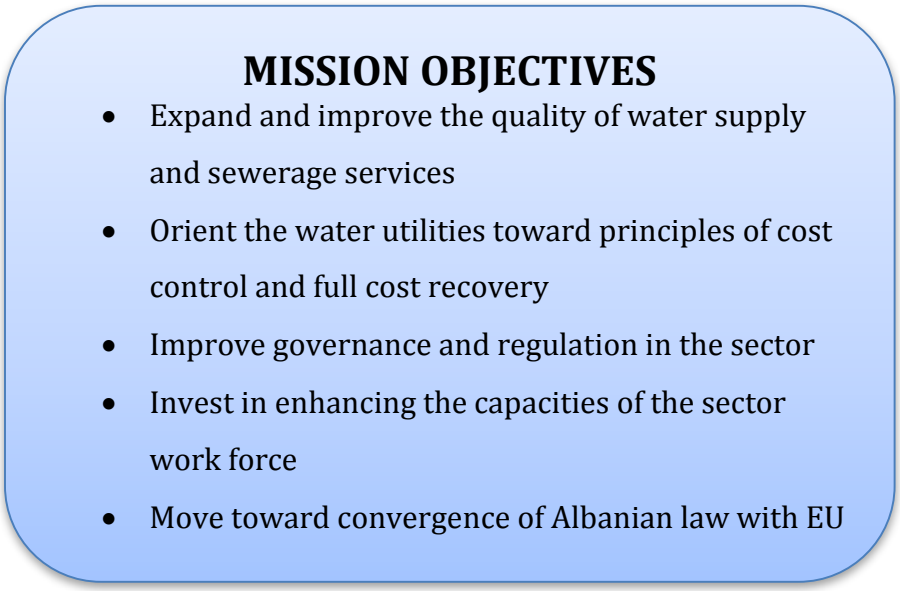

Figure 2.5 Water Sector Mission Objectives (Manjani et al., 2011)

While the government has set these mission objectives, organizations also developed plans of actions in order to accomplish each objective. While, realistically, these goals may not be met in the predicted seven years, the program has begun to and will continue to improve the water sector for Albanian citizens. . Overall, these goals are putting the water sector on track to meet EU standards in the future and, ultimately, aid Albania in its mission to become a member state of the European Union.

2.5: The Water Supply and Sewerage Association of Albania

One of Albania's most important and influential organizations aiming to improve the country's troubled water sector is the Water Supply and Sewerage Association of Albania (WSSAA), known in the Albanian language as SHUKALB. Since its founding in 2000, the organization has grown tremendously and has put in place a number of different programs to enhance the knowledge and awareness of water management issues. Their overall mission is to develop policies and commit resources to the improvement of water services while also targeting compliance with European Union standards (Giantris, 2012). This

vision drives all of their programs, which have a wide scope from establishing training programs for professionals in the water sector to teaching children about water resources.

2.5.1: History

The Water Supply and Sewerage Association of Albania has taken various steps to increase water issue awareness in Albania. WSSAA is a non-profit organization based in Tirana, the country's capital, which focuses on developing the water and sewerage services in Albania. The company was founded by a group of representatives from eight water supply and sewerage enterprises in Albania (Giantris, 2012). The organization continues to make strides in public awareness as well as in efforts to improve the physical water networks. WSSAA also holds an annual conference focused on issues pertaining to the water sector in the entire Balkan region. Attendees include water utility representatives from countries throughout the Balkans in addition to other private sector water-related companies. This year, the conference was held in Tirana from November 5th to the 7th where the primary theme was the natural interdependence between the water and energy sectors.

2.5.2: Mission

WSSAA's main vision involves consistently moving Albania "toward compliance with EU standards" (Giantris & Johnson, 2014). With this vision comes the absolute need to create a strong foundation for which water management issues can be addressed and, ultimately, solved. Each of WSSAA's five main mission objectives is related to improving the quality and availability of water in Albania to its residents. The first objective specifically applies to the quality of the water and to the treatment of sewerage. Both urban and rural populations need access to what the organization tries to provide and one of their goals is to ensure this access. The second objective relates to cost control and full cost recovery. This objective will allow for efficiency of the technology and associated planning that will be instituted in the country. In order to meet most of the objectives, the organization has to be sure that proper legislation is in place, which WSSAA presents as their third objective. They want to focus on strengthening the power of the governing bodies to ensure that companies and citizens follow guidelines they put in place. Following the guidelines requires enhancing the ability of people to understand the purpose and function of water

utilities, mission objective number four. This objective focuses on training the proper workforce that will combat the issues facing Albania. Finally, the fifth objective is to align Albanian law with EU Water Directives. This objective is important to the country as it broadens the importance of what WSSAA is doing. It brings the organization's efforts into an international context, which is vital to the future political success of the country.

2.5.3: Training Activities for Water Sector Professionals

A strong foundation starts with training, and it is WSSAA's goal to create a self-sustainable training program for professionals in the water sector. In November of 2014, WSSAA received a $1.3 million grant from USAID to fund the implementation of a training program aimed at ultimately improving the quality of the water sector in Albania as well as throughout the entire Balkan region (Giantris & Johnson, 2014).

This grant, the largest in the association's history, allows for a project that will implement the proper training necessary for optimal use of the Balkan region's vast water resources. The training program will involve cooperation from the entire Balkan region and will positively influence Albania (Giantris & Johnson, 2014). This project is the first step for WSSAA to reach its goal of a sustainable training program. The contract allows for the development of forty fully documented training programs over the course of three years. Representatives from different water utilities will be instructed as to how to head different training sessions for water sector employees.

2.5.4: Education and Awareness Programs

Not only does WSSAA focus on training, but they have also implemented a number of programs designed to improve water issue education among Albanian students. In 2007, the Friends of Water program was instituted for third grade students (Poci et al., 2014). This event involves education on the importance of water issues followed by the students' creations of drawings. The best of these drawings are presented at a gallery exhibit in Tirana. Judges choose the twelve best drawings to be featured in a calendar. WSSAA then sells this calendar to different companies and utilities, allowing for the financial sustainability of the program (Poci et al., 2014). Photos from this event can be found in Appendix B. By introducing water education at younger grades, WSSAA has managed to

increase both student and family interest in the water issues plaguing Albania (Miralda et al., 2013).

WSSAA also has water education programs in place for older students. Each year, on September 18th, eighth grade students are given water monitoring test kits (Poci et al., 2014). The purpose of their experiment is to test local bodies of water for contaminants. Results of the students' tests are published on the World Water Monitoring Day website, which essentially compiles a database of the results gathered by students from North America, South America, Asia, Africa, and Europe. This gives the students a chance to see the water issues in their area and to see how they can take steps to correct them (Poci et al., 2014).

For students at the university level, WSSAA has implemented an internship program for students in civil, environmental, and hydrotechnic engineering programs where they are provided with a two-month summer internship with companies in the water sector (Poci et al., 2014). Many of these interns move on to work in the water sector and become Young Water Professionals, a program established in 2010 (Poci et al., 2014). These are recent graduates who work in water-related industries in Albania and are located throughout the country. They attend water related events and talk with professionals in the field in order to network with as many people as possible to gain an understanding of the water issues in their country (Poci et al., 2014). The goal of this program is to maintain interest in the water sector through projects and opportunities (Poci et al., 2014). Figure 2.8 displays WSSAA's different educational programs that have been developed since their founding. One striking fact about these programs is that there is a gap between eighth grade and the university level, signifying a pressing need for a high school level program.

Targeted Age Group	Program	Goal
Third Grade	Children's Water Day	Educate students about the importance of water resources
Eighth Grade	Water Monitoring Day	Introduce students to the main water issues and to methods for testing water
University	Summer Internship Program	Provides students with experience working in the water sector
Graduates	Young Water Professionals	Give recent graduates the opportunity to network with other professionals

Figure 2.6 Water Education in Albanian Schools (Poci et al., 2014)

The six-year gap in between World Water Monitoring Day and the summer internship program is problematic, especially because it is during the time period when students begin to determine career interests. As a result of this lack of attention in such important years, WSSAA has proposed the design and implementation of a program that will provide high school students with further education and exploration of Albania's water issues.

2.6: Enhancing Awareness Through Science Fairs

With Albania's increasing desire to better manage water resources, it is necessary to ensure that the population's actions and beliefs are conducive to these goals. In order for this to happen, the citizens of Albania must be educated about the issues related to water resources and the environment. One way to reach a large number of people is by involving this education in the schooling of Albanians. By actively engaging students in solving issues in their community, teachers can broaden the students' understanding of environmental problems (Singh, 2012). With this knowledge, we considered science fairs as a potential strategy to increase interest and awareness in water management issues. Science fairs not

only teach students science but they also help develop an ethical view on environmentalism, an essential aspect of our program's goals (Friedrichsen & Dana, 2004). Through research, students will investigate environmental issues in their country and with a greater awareness and understanding of the issues also comes a desire to fix them.

A science fair is a program where groups of students work together to research a particular question. They then design an experiment in the context of their research and present their findings in a creative manner to judges. These judges score the entire project based on set criteria.

2.6.1: Benefits of Science Fairs

In addition to enhancing students' understanding of environmental issues, science fairs teach students to think creatively and generate original ideas by synthesizing many different thoughts, which is one of the most important skills in the current world of constant innovation (Daud, Omar, Turiman, & Osman, 2011). This is vital to the current atmosphere of science because students need to be able to think of different ways to approach problems in order to solve them.

Science fairs are one of the most effective ways for students to learn because they involve hands on, self-directed tasks for them to complete (McComas, 2011). Students are able to pick their own projects, meaning they will study topics that interest them (Friedrichsen & Dana, 2004). By working in teams, students are able to communicate with and teach one another about their projects, increasing the amount of total information gathered. Throughout the process, students complete inquiry-based learning tasks through active research, enabling them to identify and solve problems on their own. Through this research, the students follow through with the three main steps of scientific inquiry: proposing a problem, designing the research method, and making sense of the data (McComas, 2011). This inquiry method closely resembles the scientific method, which teaches students to think more like scientists. Students who complete these inquiry-based tasks are more motivated in their learning and will thus be more responsible for their own learning (Dionne et al., 2012).

In addition, science fairs enable students to take action beyond simply learning through textbooks and lectures. "Researching a problem in their community gives students

real purpose in terms of their study" and provides a much more in-depth and stronger understanding and appreciation of the issues (Singh, 2012). Also, guidance and mentoring from the Young Water Professionals further enhances the educational aspect of the program. Working closely with community members on very real problems has been shown to increase students' emotional understanding of problems (Singh, 2012). Essentially, this creates an even greater investment in their projects that transcends beyond extrinsic motivation and makes the issues more personal (Singh, 2012).

2.7: Implementing Science Fairs in Albania

Implementing science fairs in schools yields many benefits to the students that participate. It also accomplishes WSSAA's goal to create a program for another age group and raising the awareness of the students. Last year, WSSAA worked with a team of students from Worcester Polytechnic Institute (WPI) to implement a science fair at the Harry Fultz Technical High School in Tirana. The team found that there were a few limitations but many positive aspects in conducting these science fairs. The team mentored four different groups of students on projects including the impact of temperature on the quality of water, quality and cost assessment of different water sources, filtration of river water, and hydropower (Miralda et al., 2013). In addition to implementing the first water science fair at the Harry Fultz School, the team prepared a handbook that went into detail about how to carry out science fairs. A key section of this handbook discusses guiding the students to ensure the completion of their projects. We realized that the success of this project warranted many questions—could the science fairs be implemented at other schools throughout the country and what are the challenges associated? These are the questions we aim to answer. Using the valuable information supplied last year and our own research, we implemented science fairs in public schools in five cities in Albania, building upon and expanding the WPI project done at the private school in Tirana last year.

2.7.1: Limitations of Science Fairs

The findings of the 2013 WPI team illuminated many aspects of the feasibility of science fairs in Albania. First, the team discussed the lack of resources at each of the schools and how that affected the implementation of science fairs. Because of limited

laboratory facilities and resources, the students were not able to have hands-on science experiences (Miralda et al., 2013). This lack of resources needed to be taken into account when managing schools outside of the capital city as well.

Another potential limitation is that many students require guidance while working on their projects (Miralda et al., 2013). This guidance was achieved by having teachers model the proper experiments. The WPI students also served as mentors to the students. One recommendation that the WPI team made was to have the Young Water Professionals (YWP) serve as mentors to the students in the high schools (Miralda et al., 2013).

2.7.2: Positive Outcomes from the 2013 Project

According to last year's WPI team, despite the many limitations that teachers and students faced, they were still both very interested in participating in science fairs (Miralda et al., 2013). Students seemed to respond more positively when they were able to choose their own project groups and topics and were able to complete more hands on tasks (Miralda et al., 2013). Overall, the team determined that the projects were a rewarding experience for everyone involved (Miralda et al., 2013). Most of the students surveyed were very enthusiastic about the project experience as 79% of them said that they enjoyed working on the project "very much" (Miralda et al., 2013). Many students also responded to a survey by saying that they would be very likely to participate in a science fair in the future (Miralda et al., 2013). The previous success of the students gives us confidence in the future success of similar projects.

Regarding the costs associated with the materials, the WPI team concluded that the science fairs were relatively low cost for the school (Miralda et al., 2013). The many common items used for science fair projects such as beakers, water testing chemicals, and safety equipment, amounted to a cost of around US$140 for each school (Miralda et al., 2013). Even under a tight budget, this would be a reasonable expense for a high school, even in Albania. When the team examined other potential costs such as awards and laboratory chemicals, they concluded that the Ministry of Education offered to cover the cost of these materials (Miralda et al., 2013).

2.7.3: Building Upon the Pilot Program

The 2013 WPI team also prepared a handbook discussing the implementation of science fairs. The most valuable aspect of this handbook for our use is the initial information about mentoring students in their projects. The group found that factors contributing to student success were the ability of students to choose their own teams and potential projects (Miralda et al., 2013). In addition, in order to keep the science fair participants on track, the team proposed a schedule that was concrete and manageable for the students to have adequate time for their experiments and to prepare for the science fair (Miralda et al., 2013). Many different model projects as well as sample student reports are also proposed in the handbook, which help students understand everything that is expected out of their projects.

Overall, the pilot program at the Harry Fultz School established a strong foundation that we built upon throughout our implementation process. Our project furthers WSSAA's goal of a national water science fair by introducing a science fair to public schools located in Tirana, Durres, Berat, Shkodra, and Korca. An interesting aspect of these cities is that they all experience a range of water challenges. In Tirana, the water networks are old and deteriorating, requiring major updates which the water utility alone is unable to afford (Saliasi, 2014). A similar problem faces Durres, where pumping costs for water transport severely impact the water utility's budget (Bejko, 2014). In Shkodra, the water network is not as degraded but there is no wastewater treatment plant to process waste generated within the city (Paja, 2014). Berat's primary issue is that it does not have a treatment plant so it deposits most of the untreated water into the Osumi River (Kumaraku, 2014). Almost one hundred kilometers away, Korca does not experience severe water problems because the city's wastewater treatment plant is located in a valley and drinking water is obtained from groundwater (Osman, 2014). Instead, Korca's primary focus is on bill collection and dismantling illegal connections to its water network (Osman, 2014). Each of these cities face distinct challenges that students at the high school level can research in depth. WSSAA chose the participating high schools based on merit and director enthusiasm for participation.

Although the pilot program proved successful at one private school, it has not yet been assessed at public schools. Expanding the program to schools across the country

involved very different obstacles to overcome. In the pilot program, the WPI team had frequent communication with the students. Because of distance restrictions for this project, constant communication with the students by a single group was not feasible. In addition, the national science fair is scheduled to be held on Albania's National Water Day on March 22nd. As a result, we also worked with the local Young Water Professionals at each school to ensure the program's ultimate success. For the students involved in the science fairs, the Young Water Professionals will serve as the mentors and first line of communication, aside from teachers. Overall, while last year's implementation of the science fair at the Harry Fultz High School has and will continue to be a valuable resource for our project, there are other challenges to address when expanding the fair across the country.

3. Methodology

The goal of our project was to expand the water science fair program in Albania to five public high schools located in the cities of Tirana, Korca, Shkodra, Berat, and Durres. We worked with WSSAA, five local Young Water Professionals, school administrators, teachers, and students. Overall, we wanted to use these science fairs to increase awareness and general knowledge of the water management issues in Albania. In order to achieve this goal, we set and completed the following objectives:

1. Researched the water issues in the country as a whole and in the five cities we visited in order to narrow our focus.
2. Developed resources to assist the students and teachers throughout the science fair process.
3. Formulated a plan to implement the science fairs at each school while considering the resources available to each student
4. Provided a schedule to students, Young Water Professionals, and teachers for milestones in completing the students' projects.
5. Assessed the progress of the science fairs in order to provide recommendations for the continuing success of the science fair program.

In this chapter, we discuss how we met each objective.

3.1: Initial Interviews

Objective (1): Researched the water issues in the country as a whole and in the five cities we visited in order to narrow our focus.

Before determining our initial steps, we consulted with several people and groups in order to narrow our focus. Our initial contact was with our project sponsor, the Water Supply and Sewerage Association of Albania. We talked with Elisabeta Poci, the associate director of WSSAA, and Olta Ceca, the educational program manager. We conducted a formal interview and asked questions that can be found in Appendix C. Through this discussion, we learned valuable information about the organization as a whole and gained further insight into Albania's many water-related issues.

After talking with WSSAA's representatives, we had the good fortune to attend the Balkans Joint Conference and Exhibition on Water and Energy held from November 5th to the 7th. Each year, WSSAA organizes a water conference with the Water Supply and Sewerage Association of Kosovo in which water-related companies and organizations based in countries throughout the Balkans participate. This year, the conference was held in Tirana, Albania. While viewing different presentations at the conference, we gathered valuable background information that helped us better frame the water issues both for our own understanding and for the students participating in science fairs.

Before visiting each school, we met with local Young Water Professionals in order to seek additional information about water issues pertinent to each area. These interview questions can be found in Appendix D. We also explained the goals and methods of the project to each Young Water Professional so that they could successfully take over as mentors to the students after our role in the project was complete. In many cases, the Young Water Professionals showed us around the city, explaining not only some of the main issues in the area but showing us different water-related facilities managed by the water utilities.

3.2: Developing Project Resources

Objective (2): Developed resources to assist the students and teachers throughout the science fair process

To ensure that the program would succeed after we left Albania, we generated resources for students and teachers. We created deliverables including a sample experiment, handout, and a project scoring rubric, all of which are housed on a website we designed. These resources served to guide the students throughout their projects.

3.2.1: Sample Experiment

One resource the students found valuable was the sample experiment. This sample, found in Appendix G, clearly displays the steps required for the creation of an experiment— from the research question to the results and conclusions. The experiment we provided to the students outlines the testing of different filtration methods. It highlights

the use of control and experimental variables in order to test a hypothesis and form conclusions based on the results.

3.2.2: Science Fair Handout

The science fair handout was the first resource we gave to the schools upon each visit. Shown in Appendix F, this handout provides background information on the science fair program and includes information to start the project. The handout was written in both English and Albanian in order to maximize its value. It includes a brief description of the program, a step-by-step guide, and sample project topics. It gave the teachers a clear idea of what would be expected from the program and helped to give the students a basis to begin working on their projects.

3.2.3: Project Judging Criteria

The project judging criteria, displayed in Appendix I, was another resource that helped clarify the entire project process. Originally designed as a tool for the science fair judges to score the projects and determine winners, sharing this rubric with the students and teachers further established the goals of this project. In order to ensure that the students gained as much educational value as possible from the science fairs, we divided the scoring into three different categories. The first category discussed background research because an essential aspect of the science fair program was increasing the students' education and awareness of water issues. Scoring the maximum amount of points in the research section requires the students to clearly define a water-related research question and then answer this question by consulting a variety of sources. In the second category, judges will focus on the actual experiment—design and testing. The experimental design must be set up to effectively answer the research question. The projects are also judged on how the students address the experiment's results. We encourage students to truly think about the meaning behind any results they gather. The third and final judging category was the presentation. In order to earn full points, students must include all results from the experiment and make a strong attempt to answer the research question. Students must also display creativity in order to earn full points and ensure that the information is presented clearly. We added the creativity category in an attempt to keep the cost of the actual projects as low as possible.

This judging criteria was also designed to help the project graders by providing clear expectations of the projects. By standardizing the grading process, it ensured fairness. Overall, the rubric served as an important guide throughout the entire project process as it helped ensure the educational value of the science fair while providing students, teachers, and judges with clear project goals.

3.2.4: Website

While we developed a number of different resources to help guide the entire science fair process, one issue that presented itself very early was access to these resources. To solve this problem, we created a website, which houses a wealth of information about the science fair program.

Figure 3.1: Website Home Page

Figure 3.1, as seen above, displays the home page of our website. It included seven different navigation links, directing visitors to the student Facebook page, a list of important Albania-related water facts, contact information, project objectives, schedules, and a sample experiment. Through this easy to navigate site, we provided information and facilitated communication.

Along with all the resources discussed, the website also included a link to a Facebook group that we created. Here, every student participating in the fair was encouraged to join and discuss their projects and the science fair program as a whole. It also gave us another way to quickly communicate with the students.

The water facts page of the website was an important resource for information and statistics regarding the water management issues in Albania. The purpose of this page was not only to provide the participating students with educational material but also to introduce other visitors to some of the striking issues that the water sector faces. Each of the facts on this page was accompanied by a citation, providing the students with additional resources to consult as they performed their background research. The water facts also served as a way to encourage students to think about the issues and determine their own idea for their science fair project. The website was one of the most useful tools throughout the completion of this project.

3.3: Visiting the High Schools

Objective (3): Formulated a plan to implement science fairs at each school while considering the resources available to each student

We visited each of the high schools at least two times. Some of them took longer than others to travel to, such as the school in Korca, which was an eight hour round trip journey. Upon our first visit to each high school, we met with the director and a science teacher. In most cases, this was a chemistry teacher. At these meetings, we asked questions, found in Appendix E, about the feasibility of the program in each school and about any previous experiences with similar projects. We also addressed any questions about the implementation of the fair posed by the directors and teachers.

To introduce the program, we presented the teachers with the handout shown in Appendix F. On the handout, we provided a flow chart of the steps of the scientific method for the students to follow throughout the execution of their projects. During our initial meeting at each school, we gave copies of this handout to the teacher and director to help describe our proposed agenda for the science fair. We asked them to open the competition up to all students and gauge their interest. The only potential limitation was total number

of students, as this depended on teacher involvement. The interested students then formed groups and chose their project topics. We included a list of possible project topics on the handout while encouraging students to propose their own project topics.

To prepare for our next visit, we asked that the students form teams for their projects and choose their topics. Moving forward, the students' focus was on background research in order to satisfy the primary goal of the program – to increase awareness and education of the water issues in order to motivate students to pursue a career in the water sector. The background research enabled students to connect their project with the water issues in the whole country.

Our second visit to each school was more focused on the students and helping them to move forward with their science fair projects. At most schools, we met with the group of students interested in participating in the science fair and held a workshop with them to explain exactly what we were looking for in their projects. We inquired about their knowledge of water issues before the project had started and their experience with projects of this type. The questions we asked can be found in Appendix H. In many cases, students had already started their projects under their teachers' guidance so we took note of the progress that the students had made. We continued to answer questions asked by the students and helped them complete their background research. We also asked about the proposed design of their experiments to get an idea of the level of complexity and creativity.

We also encouraged students to ask any questions they had about the fair in general, ensuring their understanding of the program. In case any questions came up later in the process, we directed students to our website and gave them our contact information. Within a few days of this visit, we sent each student an email to their personal email address to encourage them to seek help if necessary.

Another important aspect of this second visit to each school was an assessment of student and teacher suggestions. We asked about what we could have done better in both the introduction and project development phase. In terms of the website, we asked if there were any additional resources that we could provide to aid the students. By asking questions about what the students had found difficult and what they were able to

successfully complete, we analyzed the progress made up to this point and made suggestions for the future expansion and development of the program.

3.4: Developing a Schedule

Objective (4): Developed a schedule of key milestones in the project development for the science fair teams

Based on the plan we created to implement the science fairs at each school, we developed a schedule of key project milestones leading up to the fair. This calendar is presented in Appendix J. We presented this schedule to the Young Water Professionals, teachers, and students as a reference and included it on the website that we created in order to make it more accessible. After researching other science fair timetables and referencing last year's pilot program, we determined a realistic schedule that provided adequate time for each component of the project to be completed.

The primary task for the students was to begin background research on their topic after determining a research question. Once this was completed, they were tasked with forming a hypothesis related to their research topic. We included a sample hypothesis in the experiment that we posted on the website to ensure the formatting was correct. Many steps to the projects will be completed after we leave Albania. After compiling their research and outlining their findings, students will submit a draft of their experiment design. This design is unique to each group and determined solely by the students. It requires a problem-solving mindset, which encourages the students to determine unique procedures to test their hypotheses. The experiments will be conducted and their results outlined and drafted for submittal. After receiving feedback from their teachers on all of their submitted work, the work will be revised and submitted about a week before the individual school science fairs held on March 6, 2015. At the school's science fair, students will create a poster or a PowerPoint presentation to show their findings. We chose the date of March 6th to provide enough time for the students to prepare for the national science fair, which will take place on March 22, 2015. The top two teams at each of the local fairs will travel to Tirana on March 22, World Water Day for the national water science fair.

3.5: Providing Recommendations

Objective (5): Provide recommendations for the future success of the fair.

We assessed the progress of the science fairs by talking with the students, teachers and Young Water Professionals. The feedback we received about the science fair progress after our second visit to each school provided us with the necessary information to make recommendations for the future of the water science fair program.

As discussed on our second visit, the teachers, administrators and local Young Water Professionals attended a training session in which they learned about the guidelines for the judging the projects. We created a rubric, which provides criteria necessary for each project to meet that would reflect sound research and effective experimental design. The criteria are divided into three categories: research, experiment, and presentation. Each section has a possible 3 points earned depending on how well the project met the set criteria. Each school director, one teacher who helped facilitate the science fair program, and a local Young Water Professional will act as the three judges at each of the school-wide fairs. For the national fair, three representatives from WSSAA will judge the projects and ultimately select the winner.

The training session also discussed the necessity of supplies for the students to complete the project. The use of lab space is necessary for the experimental phase of the project. However, students are always encouraged to obtain supplies on their own either through materials found in their homes or purchased at hardware stores. The local fairs were set to take place at each high school while the national science fair was arranged to be held in Tirana.

Ultimately, the goal of this project was to introduce students to the water issues that are so prevalent throughout Albania and to inspire them to pursue a career in the water sector to meet the employee demand necessary to fix these problems. From initial interviews, we personalized our presentation of these issues to each individual group of students. We then created a plan with clear assignments for the students to complete in order to succeed in their water science fair projects. From the information gathered along the way, primarily through teacher and student feedback, we made recommendations for

the local and national science fairs. We also provided recommendations for the successful expansion of the science fair program. Through this hands-on approach to science, we expect that students gained a better understanding of the water issues in Albania and realized the necessity of solving these issues in order to allow the country to continue to develop.

4. Results

4.1: Research on Water Issues

Objective 1: Research water issues in five cities.

Through our discussions with various organizations and individuals, we gathered information about water issues that we had not originally considered. We compiled and analyzed the following information about each city based on interviews with the Young Water Professionals in each area. They explained different aspects relating to their water utility, such as the state of wastewater treatment plants. Our Young Water Professionals were Viola Saliasi, Ilirjan Kumaraku, Kasem Bejko, Valbona Paja, Ediola Osman, and Erald Shahini.

4.1.1: Legal Action Against Debtors

Throughout Albania, citizens refuse to pay for water, forcing water utilities to take action against them.

In cities and towns throughout the country, residents steal water because of the severe water scarcity and the fact that it is simple enough to do. Some people illegally tap into the water network while others refuse to pay their bills. To combat this issue, water utilities have taken many steps. In Durres and Shkodra, the water utilities begin by sending a notice informing the offenders of their current debt and demanding payment. If the debtors do not comply with these notices, there are two options. If the building has a water meter, the utility can block access to water at the meter by installing a device. In larger buildings without a meter, the utility is forced to involve the courts, which is a long, costly process. In the case of those who illegally tap into the water networks, the utilities rarely have alternative options aside from bringing the offenders to court because of private property laws. While there is a long way to go, many of the water utilities have begun to take appropriate steps to address the stealing of water.

4.1.2: Effect of Urbanization

Urbanization strains water resources, affecting the amount of water available for each person.

As city populations grow, the total amount of water stolen in Albania also increases. With more people gaining access to water, it has become more difficult for water utilities to monitor water usage. In Korca, the water utility has installed additional water meters so that the billing of water for all people is based on actual usage rather as opposed to a flat rate. Korca was able to do this because it has not experienced a high an extremely high population growth rate. In other cities throughout the country such as Shkodra, the installation of water meters does not extend to large buildings. With a growing population and the need for larger buildings, cities like Shkodra have a difficult time monitoring water usage.

4.1.3: Insufficient Number of Wastewater Treatment Plants

There are not enough wastewater treatment plants in Albania to handle the urban population growth.

We visited wastewater treatment plants in both Korca and Durres. In Korca, the plant was located outside the city. Because of Korca's location in a valley surrounded by mountains, there is no pumping required to transport the water to the treatment plant. This greatly reduces the overall costs associated with treating the water. In Durres, however, the location does not provide this efficiency. Durres is a coastal town and most of the city rests at sea level, making it necessary for wastewater to be pumped to the treatment plant, resulting in a heavy cost for the utility.

Not only does location play a role in cost, but population is also an important factor. In Shkodra, the wastewater treatment plant can only handle a water supply for a population of around 2,000 people. This number is significantly lower than Shkodra's current population of around 217,000 people. The plant was built in an attempt to protect Lake Shkodra, the body of water into which much of the excess wastewater enters. By building the small treatment plant, the county has taken steps toward environmental

protection. In Berat, however, the city does not have a wastewater treatment plant. Much of the wastewater is dumped into the Osumi River. The city's water utility is awaiting a grant to complete their project of developing and building a wastewater treatment plant for the area.

4.1.4: Wastewater Treatment Plant Self-Sufficiency

The wastewater treatment plants are working toward self-sufficiency by using various innovative methods.

At the wastewater treatment plants that we visited, one primary focus is on self-sufficiency. Our discussion with the treatment plant's director gave us insight into the process. Korca's plant, which was built just two years ago, installed solar panels to eventually will supply its entire power demand. In addition, sludge is built up throughout the wastewater treatment process at the plant in Korca. This sludge contains phosphates and nitrites, important chemicals in fertilizers. The director plans on giving the sludge to local farmers to use as fertilizer in order to test the feasibility of creating a marketable product from the treatment of wastewater. The water utility in Durres also has a wastewater treatment The Durres plant, which has been in operation for five years, has a similar focus on self-sufficiency by producing biodiesel as byproduct of the treatment process. Wastewater treatment plants in Albania focus not only on improving quality of water but also on self-sufficiency.

4.1.5: Water and Energy

The water problems are coupled with energy efficiency because of the nature of water transportation.

The greatest cost for the water sector as a whole is energy. Energy is necessary to pump water through the networks and deliver it to consumers and treatment plants alike. At treatment plants, significant amounts of energy are put into the purification process to both make wastewater suitable for deposit back into the environment and to ensure water is fit for human consumption. At the WSSAA-sponsored conference entitled "Water and Energy" in Tirana held in November of 2014, the strong interdependence between water

and energy was the primary focus. In each of the cities we visited, one major problem the Young Water Professionals discussed was the cost of pumping water. When a large amount of water in the networks is lost, as is the case throughout Albania, the energy and money required for pumping is also lost. This is important for the water sector as the primary reason for the inability to update the water networks is a lack of money. Lack of bill payment and loss of money used for energy prevent the water sector from making the necessary improvements to the water networks.

4.2: Science Fair Implementation

Objective 3: We formulated a plan to implement the science fairs at each school while considering the resources available to each student.

During our visits to the high schools, we discovered valuable information to include in the creation of our science fair plan at each school. In many cases, each visit caused us to reevaluate how we would present the information at future visits. We evaluated feedback from both teachers and students at each school to determine what information we needed to expand upon. Throughout our implementation process, the Young Water Professionals assisted us in explaining the program and mentoring the students at the high schools, helping us to not only ensure the success of the introduction of the program but the continued success after our time in Albania concluded.

4.2.1: Availability of Resources

Availability of resources at each school impacted the projects students could consider.

One factor that impacted student projects was the resources available for the students to perform their experiments. At the high school in Korca, the teachers were concerned about the lack of laboratory materials. We determined that the easiest way to account for the relative lack of resources was to add a "creativity" aspect to the judging rubric. In collaboration with our encouragement of students to use easily accessible

materials, this ensures that students will not be penalized for their school's limited resources.

4.2.2: The Benefits of Our Website

The website we created was beneficial for students, teachers, and Young Water Professionals to access resources for their projects

At the first mention of our website in Durres, the teachers explained that their students enjoy being able to find resources online. This substantiated our original idea of the website as a means to communicate with the students even after our departure from Albania. Not only did it provide the students with easy access to the different resources we created, but it was also a convenient way to connect and share with the students. Throughout the project, our website evolved. It began as a simple location to place handouts for the students so that we would not be required to physically deliver them. After meeting with students and teachers, however, we realized our website could transform into a much more useful tool. We then included a number of other helpful resources including a sample experiment, which allowed students to see what was expected of the experiment they would be designing.

Another aspect of the website is that it does not solely exist for the use of the students. Anyone can access it and discover valuable information about the water issues in Albania and learn more about the science fair program. We have a list of "Water Facts" with sources for anyone interested in learning more about these topics, giving the website the ability to have a more overarching impact. Overall, the website was one of the most important resources we created for our project due to its value to both those directly involved in the science fair projects and to the community as a whole.

4.2.3: Previous Experience of Teachers and Students

Previous experience of teachers and students was beneficial but not required for the understanding of the project expectations.

At some of the schools we visited, we realized that students and teachers had worked on similar projects in the past. In Tirana, because both the students and teachers had completed a similar project the year before, they knew what was expected of them. The director had specifically worked on science fairs while teaching in Germany, allowing her to provide additional input throughout the science fair process. She suggested that we involve the community in the science fair to help raise awareness for the entire city, a suggestion we believed would be very valuable in achieving the goals of the program and something we encouraged the school to do. On the other hand, many students and teachers at the other schools were not familiar with the idea of science fairs. This caused some initial miscommunications about the nature of the science fair projects and of the goals and expectations of the program. We realized, for these schools, that we had to change our explanations slightly. In these schools, we focused on providing with the students with additional potential project ideas to clarify the objectives and expectations of the science fair.

4.2.4: The Help of the Young Water Professionals

The Young Water Professionals were an important resource and necessary for this project.

Throughout the project, the Young Water Professionals (YWPs) were vitally important. Initially, we asked them questions about water issues in the city in which they worked. They provided us with background information that allowed us to better focus the implementation process. During the initial meeting with the teachers and director of each school, the YWP served as a translator for us as well as an aid to explain our project. The language barrier that we experienced at each of the high schools, while significantly greater than we had anticipated, was far from insurmountable with the help of the YWPs. Because we had met with the YWP beforehand, they were each well versed in the particulars of our project.

When we began working with the students, the YWPs served as their local contact. Students went directly to the YWP in each city with any questions about their experiments.

In many cases, the YWPs visited the school and provided mentoring to the students in completing their projects.

After our departure from Albania, the YWPs will continue to help the students with their projects, making sure the projects remain on track for completion before the local and national science fairs. They will also serve as judges for the local science fairs. We explained the process of judging and the rubric at our first meeting in order to clarify exactly how the students would be critiqued on the project. Before leaving Albania, we sent an email, shown in Appendix O, to the YWPs that explained their role moving forward in the program this year. By serving as an essential part of our introduction of the science fairs, the YWPs will continue to fill an important role once we leave by providing the teachers and students with any guidance necessary to ensure the continued progression of the science fair projects.

4.3: Creating a Schedule

Objective 4: Provide a schedule to students, Young Water Professionals, and teachers for milestones in completing the students' projects.

4.3.1: Setting a Schedule

A calendar was required to keep the students on task.

After reviewing the results from the science fair at the Harry Fultz School last year, we decided it was necessary to divide the project into many smaller tasks in order to keep students on task. From this information, we created a calendar of tasks required for success in the project. The full calendar is shown in Appendix J. This schedule has been helpful to both the teachers and students thus far and we expect it to continue to be a valuable resource.

4.3.2: Creating a Grading Rubric

Grading criteria was required to set expectations for both judges and students

In order to clarify the expectations of the science fair projects, we developed a grading rubric for the project. The rubric, which can be found on the science fair website, provided clear criteria that outlines what is expected to earn points at the competition. In addition, this rubric allowed us to ensure that the projects will meet our goals – namely increasing water issue awareness and education. The rubric separates the project into three scored sections: background research, experimentation, and presentation. The background research section specifies that students must gather information from at least five sources and synthesize it into an appropriate introduction for their final report. As far as the experimentation section, the focus is on developing an effective method to test their hypothesis. Finally, the presentation section includes factors such as clear communication and creativity in terms of the final report and presentation. By providing the judges with this rubric, we also ensured standardization of the grading process throughout the five schools. Overall, the rubric helped us to set clear outcomes and goals for the science fair program while also ensuring our focus on raising student awareness of water issues.

4.4: Assessing the Progress

Objective 5: Assess the progress of the science fairs in order to provide recommendations for the continuing success of the science fair program.

During our visits to each school, we varied our method of introduction depending on the availability of the directors and teachers. One aspect which was kept constant throughout the five schools was having an initial meeting with the Young Water Professionals to ensure that they understood the idea of a science fair and the goals of the program. This step helped to reduce the language barrier in our initial meeting with the directors and teachers by allowing for clarification when our initial introductions of the program may not have been fully understood. Differences occurred depending on variations in school schedules and how comfortable each of the Young Water Professionals were with explaining the science fair to the teachers and director.

The following table summarizes the project ideas that students across the five cities have been investigating. This is not a complete list of the topics from all schools because some students have not yet solidified which topic they will choose. They have to take into consideration the availability of resources to gauge their ability to complete their proposed project ideas. As this chart shows, the students chose a wide range of project topics.

Project Topic	Project Description
Hydropower	1. Students are testing how much energy can be produced from the ocean's waves and from flowing rivers.
	2. Students are considering if energy can be generated from rain.
	3. Students will determine the most effective method of generating energy from water resources.
Collecting Rainwater	4. Students will research the process of gathering rainwater and determine the most effective method.
City Layout	5. Students in Tirana are researching the water distribution network in the city and identifying problem areas. They will then propose a new city layout plan to solve some of the distribution issues within the city.
	6. Students will analyze the condition of the drinking water in Selite and Boville, considering how the layout of the city network affects the conditions of the drinking water.
	7. Two student teams in Shkodra will talk to the water utility and discuss how the current water network operates. They will then make recommendations for improving the network.
Chemical Parameters of Water	8. Students are working with a Young Water Professional at the nearby water utility. They will be using testing kits to test turbidity, pH, CO_2 levels, and dissolved O_2 levels of different local bodies of water and comparing them.
Filtration	9. Students are considering ways to cleanse polluted water sources. They will perform experiments based on water filtration
Composting Toilets	10. Students are researching three different types of composting toilets, building models, and simulating compost with appropriate chemicals. They will then assess the effectiveness of each model and conclude which is the best.

Figure 4.1: Student Project Topics

Some project choices surprised us. The first of these was hydropower. We knew that hydropower was very important to energy production in Albania but we did not expect the students to study it with such fervor. The students studying how to use rivers and the ocean's waves for energy had access to a device that converts the movement of water in a small tank into energy. This energy is used to light a small light bulb. They will be able to use this for the experimental phase of their project. Another surprising topic was composting toilets. The students from the school in Shkodra seemed to be very interested in the topic and had already performed interviews and completed their background research when we made our final visit to the school.

The most popular topics were hydropower and proposed city layout, which is understandable as these are the most prevalent water issues throughout the country. In the early weeks of their projects, students had already made significant progress. Upon our second visit, some groups had completed their background research and began to discuss experimental design proposals. Their enthusiasm suggests continuing success as they complete the next phases of their projects.

5. Conclusions

Following the implementation of science fairs at five public schools throughout Albania, we analyzed the results and formulated conclusions. The most significant of these conclusions is that science fairs can be an effective method to raise awareness and increase education of the water issues in Albania. Staff members were excited to involve science fairs in their schools while students displayed excellent motivation in the beginning phases of their projects.

Throughout our visits to the schools, we noted that there were variations in the methods of implementation of the fairs. Since we were only able to visit each school on two or three occasions, we were not so much mentoring the students as we were facilitating the continuation of the projects after introducing the program. As a result, while each of the schools hand-selected a number of students to participate in the fairs, they had different ideas of how the projects would progress. This was, in part, influenced by the past experiences of teachers and administration.

Another observation is that the students in the schools we visited seem strongly motivated to not only participate but to excel in the creation of their projects. Although the limited funding available for project materials did present a possible challenge, we encouraged the students to be creative in their experiment ideas and use a number of household items as well as supplies donated from local companies. Their project ideas, which can be found in Figure 4.1, involve different ideas, varying from harnessing the sea's waves for power to developing a new city plan. Overall, their creativity exceeded our expectations and is essential for keeping this science fair program on a budget.

We presented the teachers and students with a number of resources that proved to be very valuable throughout the project process. Perhaps most important was the website. It not only served as a single location where important project information could be found but also allowed for greater communication between the students and those helping to implement the fair. Within the website, some of the most important resources were the project scoring rubric, the calendar of key milestones, and a sample experiment. These were able to provide both teachers and students with a much clearer understanding of the expectations of the project as well as the ultimate goals of the science fair.

Overall, we envision a bright future for the science fair program. Each of the schools was very willing to take this program on, indicating that this should continue to be the case as the number of schools expands. As the program is still in its beginning stages, we have identified opportunities for improvement and provided recommendations to accomplish further expansion.

6. Recommendations

Based on the results we gathered, we have composed an email to the participating Young Water Professionals to explain the roles of everyone involved after we leave. This email can be found in Appendix P. To ensure future success, we have devised several suggestions for improvement.

6.1 Project Management Organization

Throughout the implementation of the science fairs, the primary difficulty we faced was ensuring that the administration, teachers, and Young Water Professionals had clearly defined roles. Since the level of familiarity with the project differed from school to school, we altered these roles to maximize student interest and participation. In the future, we believe that an organization of Young Water Professionals with pre-defined responsibilities will best remedy this issue and allow for a clear distribution of power. This organizational chart is displayed below in Figure 6.1, with a description of each level's role following.

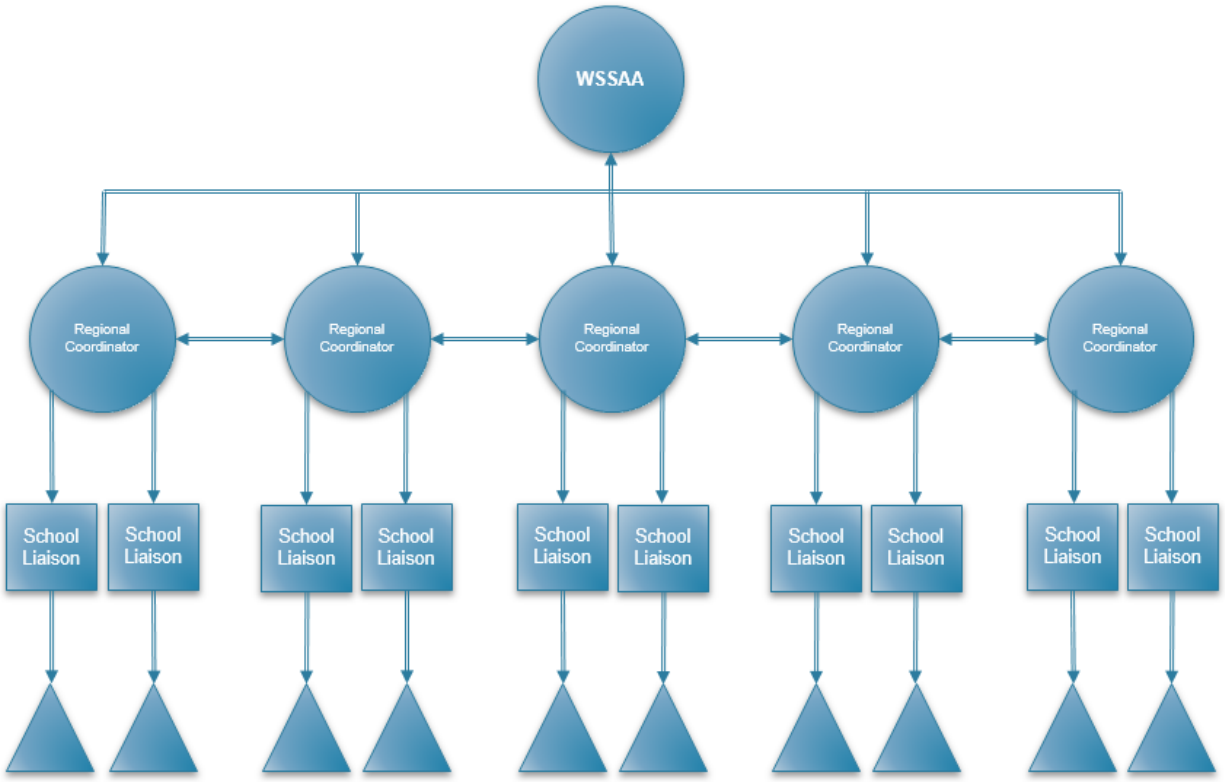

Figure 6.1: Organizational Structure of the Science Fair Program

Our proposed tiered organization is comprised of four different levels, each with their own duties throughout the science fair process. The first level consists of a representative from the Water Supply and Sewerage Association of Albania. This representative will be in charge of overseeing the entire science fair program and will be responsible for the introduction of the science fair. In addition, this representative will be the primary contact for each of the regional coordinators, whose roles will be explained herein. The WSSAA representative will also be responsible for providing the regional coordinators with necessary information about the science fair including the goals of the program, any educational materials, methods of implementation, and the responsibilities of each level of this organizational chart. For the initial explanation of the science fair program, we have created a sample presentation that the WSSAA representative can give to the regional coordinators. This presentation can be found in Appendix L.

The regional coordinators are perhaps the most important link for the science fair program. Ideally, these will be Young Water Professionals with experience as school liaisons in the science fairs or similar programs. These Young Water Professionals will be overseeing the science fair process within their region. They will also be responsible for managing any funds received through donation, which ultimately will be used to procure project materials for students. They will determine whether student and school requests for funding can be approved or denied depending on a number of factors including the total money available and the necessity of the money requested. With their previous experience as well as their training from the WSSAA representative, the regional coordinators will act as advisors for the school liaisons. The regional coordinators will also introduce the science fair program to the liaisons and ensure that the goals of the program are understood. In addition, the coordinators will train the school liaisons to introduce the science fairs at their designated schools and ensure they can be effective mentors to the students. They will also act as the first line of contact for the school liaisons in case of any questions or potential issues. Essentially, the coordinators are the link between the program sponsor, WSSAA, and the individuals responsible for presenting the science fairs to the schools.

The school liaisons are Young Water Professionals who will be introducing the science fairs to designated schools. During the program, they will also act as mentors and resources for the students. As liaisons, they will be working with the administration,

teachers, and students of the school to encourage student participation in the science fair and provide guidance during the entire process. To assist in introducing the program to the schools, we created a sample presentation, found in Appendix K, for the liaisons to give to the schools. We also created a guide, shown in Appendix M, that explains the entire science fair. In essence, the school liaisons have a similar role to the Young Water Professionals in our implementation of science fairs.

At the level represented by triangles in Figure 6.1 are the schools, composed of administration, teachers, and students. The liaison will be in contact with them, primarily to answer student questions and help guide their research and experiments. In addition, the school will be responsible for requesting funding for student projects and submitting these requests to their liaisons. Finally, the schools will host the school-wide science fairs, where students will present their projects to be judged by the school director, one teacher, and the school liaison.

Overall, this organizational structure for the science fairs will provide everyone involved with clear responsibilities. It will allow for a more streamlined process that can easily be expanded upon as the program grows. In addition, this will ensure that there is not an excessive burden on any single individual or group of individuals who have management responsibility within the fair. By providing this structure, we believe it will aid in improving the implementation process by allowing it to run more smoothly and effectively. An entire guide for this organizational structure can be found in Appendix N.

6.2 Enhancing the Educational Value of Science Fairs

In addition, we have further recommendations for increasing the educational value of the science fair. During the preparation phase of the students' projects, we believe that they can benefit from communication among participants in different cities.. To facilitate this communication, we have created a Facebook page where students can discuss projects with one another.

During the local science fair at each high school, we recommend that students who did not participate in the fairs also be invited to see the projects that their classmates completed. We suggest that all students be encouraged to attend the fair, as it will further

increase student awareness. After seeing the work done by the participants in the science fair, more students may be inspired to work on their own projects the next year.

In addition to inviting more students to the science fairs, we also suggest that the schools invite community members. We believe many parents and family members will want to see what the students have done with their projects. We hope to make the science fair more of a community-wide event in future years. Inviting community members will be the first step to reaching this goal. With greater attendance, the fairs will also raise awareness to everyone in the community about the water issues in Albania, which is a major focus of this program.

To ensure that everyone who attends the fairs understands the purpose of the event, we also recommend that each school create an informational brochure to hand out to attendees. This brochure should include a brief description of each project and basic information about the water issues and the goals of the program

6.3: Continuing the Use of the Website

During this initial phase of the program, we found that the website was a significant resource for everyone involved. It allowed us to contact the students and teachers and provide resources to assist with their projects. We used the website to distribute the judging rubric, the calendar of assignments, and the initial handout. It also included our contact information so that any students or teachers working on the projects could contact us directly.

We recommend that this website be kept up to date by the WSSAA representatives. They can use the site to continue posting helpful information for the schools. In addition to being used as a resource for programs, the website can also serve as another way to raise awareness in the community. It includes many facts about water issues throughout Albania. Overall, we believe that the website is vital to the success of the program as it expands throughout the country.

6.4: Organizing a National Science Fair

The national science fair requires a considerable amount of organization in order for it to be a success. This year, the fair will be held at the Ismail Qemali School in Tirana.

We suggest that the WSSAA representatives and the Young Water Professionals coordinate with Ismail Qemali to set up the event. Each of the ten teams will be provided with a space to display their projects. During the event, the three judges will view each project and score them based on the rubric that we created. We suggest that the judges be three WSSAA representatives, Olta Ceca, Eliabeta Poci, and Phillip Giantris or be determined by WSSAA.

We advise that the students participating in the science fair also travel to Tirana a day before to set up their project and display. Students coming from outside of Tirana will need to stay overnight. We are uncertain about how to house the students if their families plan to travel with them. We have discussed housing options with our contacts at WSSAA, and they will make the final decision depending on funding.

In future years, the national fair may need to be set up differently. This year's science fair will yield suggestions and potential modifications for the following years. One suggestion may be moving the science fair to a different venue in order to accommodate an increasing number of participants. We created a detailed guide of suggestions for the expansion of the program. Part B of this guide, as shown in Appendix N, discusses the setup of future national science fairs.

6.5: Finding Educational Sponsors

We suggest that WSSAA considers finding educational sponsors to help sustain the science fair program. Not only can these sponsors provide funding, but they can also be educational resources to the students participating. Due to time constraints, we were not able to meet with a representative from the Ministry of Education. We still believe, however, that a meeting with them would provide a chance to explain the entire program and its educational value. At this meeting, WSSAA can inquire about assistance in supplying materials necessary for the projects, as well as funding to help the national science fair. For the first few years, as funding is a concern, we recommend that the prizes for the national fair be visits to local water utilities and possibly dinner with WSSAA representatives. In the future, scholarship prizes could be awarded to the winners of the national fair. Funding from the Ministry of Education could help support this idea.

Based on our findings at the five high schools in Tirana, Durres, Shkodra, Berat, and Korca, we envision the science fair expanding to many more high schools across the country. With the division of responsibilities as discussed in our organizational chart, the entire process can run smoothly in the growing number of high schools. We look forward to seeing how this year's student participants undertake the task of designing and conducting experiments and will continue to provide them with guidance, as needed, even after we return to the United States.

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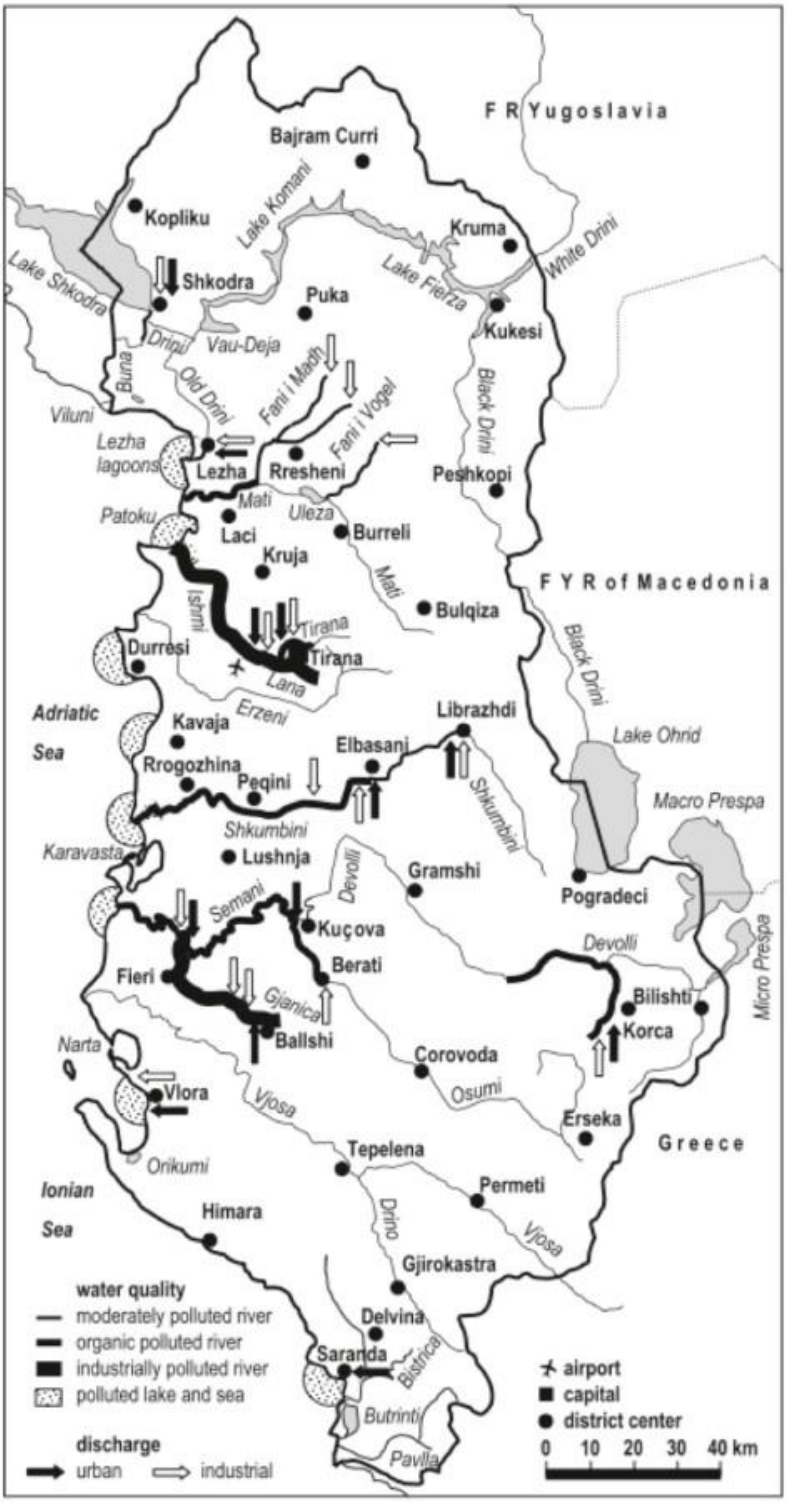
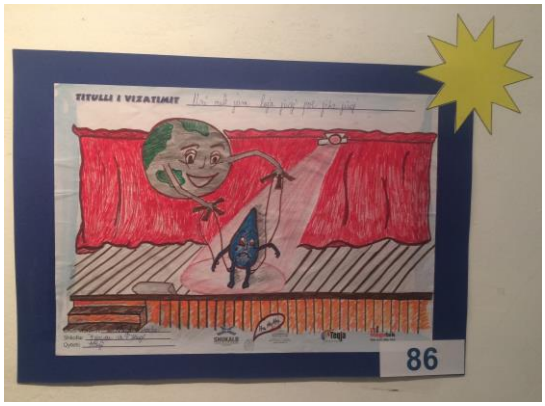
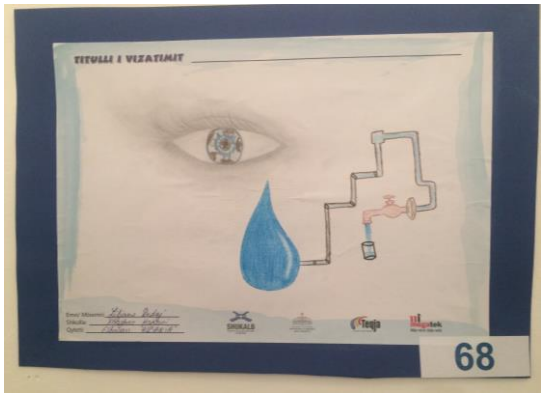
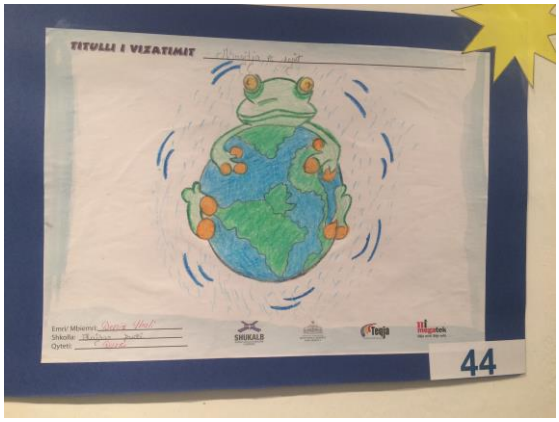
Appendix A: Map of Polluted Rivers in Albania



Appendix B: Photographs from Children's Water Day 2014







Appendix C: Sponsor Interview Plan

Implementing a High School Science Fair

Method: Key Informant Interview

A key informant interview will allow us to get an understanding of what our sponsor, the Water Supply and Sewerage Association of Albania, wants us to accomplish with our project. We need more information on topics such as potential science fair projects, number of schools that we are visiting, and background information. The main goal of this interview is to gain information, which we can accomplish through a key informant interview.

Who: Ms. Ceca or Ms. Poti or possibly Phil Giantris.

When: We will be working from October 25th to December 20th.

Where: Schools throughout Albania, we will determine the exact locations through discussions with our sponsor.

How: We have a multitude of options at our disposal. We could have a phone interview, a skype interview, or an e-mail interview.

Team Member Tasks:

Note Taking: Rebecca Barolli
Introductions: Matthew Fegley
Summary: Seth Kamens
Review: Jessica Orr

Questions:

1. How are you?
    a. How long have you been working at WSSAA?
    b. What have you done since working at WSSAA?
    c. What made you want to work for WSSAA?
2. What are the company's main goals?
    a. Why was WSSAA founded?
3. What do you think the biggest water-related issue is in Albania?
    a. What has WSSAA done to combat these issues?
    b. What are WSSAA's current projects?
4. For our project, what do you see as primary goals for us?
    a. Why have you chosen a science fair as the means by which to educate the students?
    b. What would you like the kids' projects to focus on?
    c. Would it make sense to give the students a list of potential topics as a guide?
    d. Are we mentoring the students or the Young Water Professionals? Will the YWP be mentoring the students after we leave?
    e. How much would you like us to build upon or change the handbook from last year's group?
        i. What did you think of the project from last year?

        ii. Is there anything you would like us to modify?
5. Would it be beneficial to involve community members in this science fair?
    a. How would you suggest we generate public interest?
6. We understand that the plan is for us to meet with ten schools. Why have you chosen these specific schools?
    a. What is our objective when we visit each school?
        i. What will we need to do there?
    b. Can we get some additional information on these schools?
        i. Public vs. private
    c. How willing will the teachers be to work with us to implement the science fairs?
    d. What modes of transportation will we need to get to the different schools?
    e. Will we need a translator?
7. Do you have any data or information that may be helpful to us as we plan the fairs?
    a. Do you have any informational sources we should be looking at in addition to our current research?
    b. Are there any specific research topics you would like us to focus on?
8. Are there any questions you have for us?

Introduction: We would like to introduce ourselves as Rebecca Barolli, Matt Fegely, Seth Kamens and Jessica Orr. We are very excited to be working with you in the coming months. We have been completing preliminary research so far focusing on the current water issues in Albania as well as methods of effective education techniques.To aid us in our preparation, we are wondering if you could help clarify some questions we have about the project.

Appendix D: Young Water Professionals Interview

Method: Key Informant Interview
Who: Local Young Water Professionals
Where: Will likely take place once we first arrive at each of our locations.
How: In Person
Questions:

1. How did you first find out about the Young Water Professionals?
    a. What was it about the group that interested you?
    b. What made you interested in working in a water-related industry?
    c. Do you work with any other organizations as a Young Water Professional?
2. As a Young Water Professional, do you normally get the chance to work with high-school students?
    a. Do you get the chance to work with students of any age?
3. What would you say the biggest water-related issue is in _____ (area we are in)
    a. How does it impact the people who live in the area?
    b. Has anything been done or is anything currently planned to help solve these issues?
4. What are your thoughts about working on this project?
    a. How do you think we can best increase students' motivation?
    b. How can we involve the community in the project?
    c. How can we best publicize the science fairs?
    d. Is there anything you think would be an important aspect of the science fairs?
5. Do you have any questions for us?

Appendix E: Administrator Interview

Administrator's Name: _____
Administrator's School: _____
Date: _____

Water Fair:
1. Would there be any issues with implementing this fair at this school?
2. Do you think that students would be able to benefit from participating in this fair?
    a. Are there any project topics that you would like to see the fair include?

Students:
3. Would there be enough participation from students in the school?
    a. Has there ever been a large scale fair like this before? Was it successful?
    b. Is there a lot of student involvement in this school?
    c. Are students interested in their education at this school?
4. Would students be willing to participate on this outside of normal school hours?
5. Are there any ways that increased participation could be made? Incentives?
    a. Would working in groups help the students to do their work?

Teachers:
6. Would there be teachers able to volunteer to assist in the fair?
7. Can the teachers assist the students in any way?
    a. Should there be anything in their curriculum that applies to the water fair?
    b. Should they teach how to structure a report?

Resources:
8. Would there be supplies/facilities for the students to use for their water fair projects?
9. What might students need available to them to complete this project?
10. Does the school have a location used for larger functions?

Notes:

Appendix F: Student Handout

Water Science Fair Program

This science fair program is designed to increase education and awareness of the water issues in Albania. Students will be working in teams of 1-4 on these projects, which will be completed for the school fair. At this fair, projects will be judged based on creativity and thoughtfulness as well as the clarity and thoughtfulness and overall presentation of the project. The top two teams will be selected to present their projects at the national fair in Tirana on March 22, Albania's National Water Day.

KEY TASKS

Form your science fair project team. Understand that these are the people you will be working with for the next few months.

Create a research question that you will be answering as you complete your project.

Perform background research on your research question. How has this already been addressed? What are some problems you may face?

Create a hypothesis. What do you believe you will learn from your results?

Develop and complete and experiment that will allow you to test your hypothesis. Make sure that you perform multiple trials of your experiment to validate your data.

Review your data and compile it into charts and graphs in order to make it easy to understand what you did. Analyze this data in order to see if your hypothesis was correct.

Summarize your results and draw conclusions from what you learned. If your hypothesis was not correct do not worry – make sure to explain what was incorrect about your initial assumptions.

POSSIBLE PROJECT TOPICS AND IDEAS

- Water Chemistry
- Filtration
- Pollution
- Fertilizer Contamination
- Testing the Hardness of Water
- Effect of pH on Ecosystems
- Proposed City Layout
- Composting Toilets
- Collecting Rainwater
- Testing Surface Water
- Purity by Evaporation
- Hydropower
- Or your own idea!

Programi i panairit per Shkencat Ujore

Ky program, panair shkencor eshte projektuar qe te rrise edukaten dhe ndergjegjjen per problemet ujore ne Shqiperi. Studentet do te punojne ne grupe 1- 4 per keto projekte, qe duhet te perfundojne per panairin ne shkollen. Ne kete panair, projektet do te gjykohen bazuar ne krijimtarine dhe mendimet si dhe qartesine e mendimeve, e mbi te gjitha prezantimin e projektit. Dy skuadrat me te mira do te zgjidhen te prezantojne projektet e tyre ne panairin kombetar ne Tirane, ne 22 Mars, Dita Kombetare e Ujrave Shqiptare.

DETYRAT KRYESORE

Formo skuadren tende per projektin e panairit shkencor. Kupto qe keta jane njerzit qe ti do te punosh per muajt ne vazhdim.

Krijo nje pyetje kerkimore qe ti do ti pergjigjesh kur te perfundosh projektin.

Performo kerkime prapavije per pyetjen tende kerkimore. Si eshte adresuar kjo ceshtje deri tani? Kush jane disa nga problemet qe ju mund te hasni?

Krijo nje hipoteze. C'fare besoni qe ju mund te mesoni nga rezultati juaj?

Zhvillo, perfundo dhe eksperimento qe te arrine te testoni hipotezen tuaj. Behu i sigurt qe ke zbatuar gjykime te shumta per eksperimentin tend per te vertetuar te dhenat e tuaja.

Rishiko te dhenat e tua e perpiloji ne nje tabele, grafik, ne menyre qe ta besh me te thjeshte per te kuptuar se cfare ke bere. Analizo keto te dhena qe te shikosh nese hipoteza jote ishte e drejte .

Permblith rezultatet e tua e nxirr konkluzionin Cfare mesuat. Ne se hipoteza juaj nuk ishte e sakte, mos u shqeteso – behu i sigurt qe ta sqarosh, qe cfare ishte gabim ne supozimet fillestare.

TEMAT E MUNDSHE TE PRJEKTIT DHE IDETE

- Kimistria e ujit
- Filtrimi
- Ndotja
- Pleh Kontaminimi
- Testo fortesine e ujit
- Efektet e pH ne ekosistemet
- Propozimet urbanistike te qytetit
- Kompostimi I tualeteve (WC-ve)
- Grumbullimi I ujrave te shiut
- Testo Paisjet ujore
- Pastertia nga avullimet
- Hidroenergjia
- Ose ideja juaj!

Appendix G: Sample Experiment

Focus Question:

How effectively do the gravel, sand, and charcoal filter the dirty water?

Background Information:

Here, students should do background research on their focus question. In this case, some possible research topics include water filtration techniques, water contaminants, and the costs associated with water filtration.

Hypothesis:

If the gravel, sand, and charcoal effectively filter the water, then there will be a noticeable change in color of the water.

Materials (In this case, as provided in the science kit created by "Green Science." These are items that can be easily found around the house):

- 4 filtration columns
- sand
- charcoal
- gravel
- filter paper
- 3 glasses
- dirt
- water

Procedure:

1. Place filter paper into one of the filter columns
2. Pour charcoal into a different filter column and place on top of the column with filter paper.
3. Pour sand into a different filter column and place on top of the charcoal filter column.
4. Pour gravel into a different filter column and place on top of the sand filter column.
5. Place the entire filter column assembly on top of a glass that will collect the filtered water.
6. Measure out 100 grams of dirt.
7. Place the dirt in 200mL of water.
8. Stir the water and dirt together.
9. Measure out another 200mL of water. This will be the clean water used as the control.

10. Observe the color of the clean water before pouring approximately 10 mL into the filtration column then pour very slowly into the column
11. Observe the color of the water after it passes through the filtration column. In the case of the clean water, it should not have changed. Be sure that this is the case
12. Empty the glass at the bottom of the filtration column.
13. Observe the color of the dirty water before pouring approximately 10mL of dirty water into the filtration column then pour it very slowly into the column.
14. Observe the color of the water after it passes through the column. Note the difference in color between this water and the previous water.

Possible deviations to the project: try it with coffee or tea and observe the differences. Test the pH of the water before and after it is filtered using pH strips.

Results:

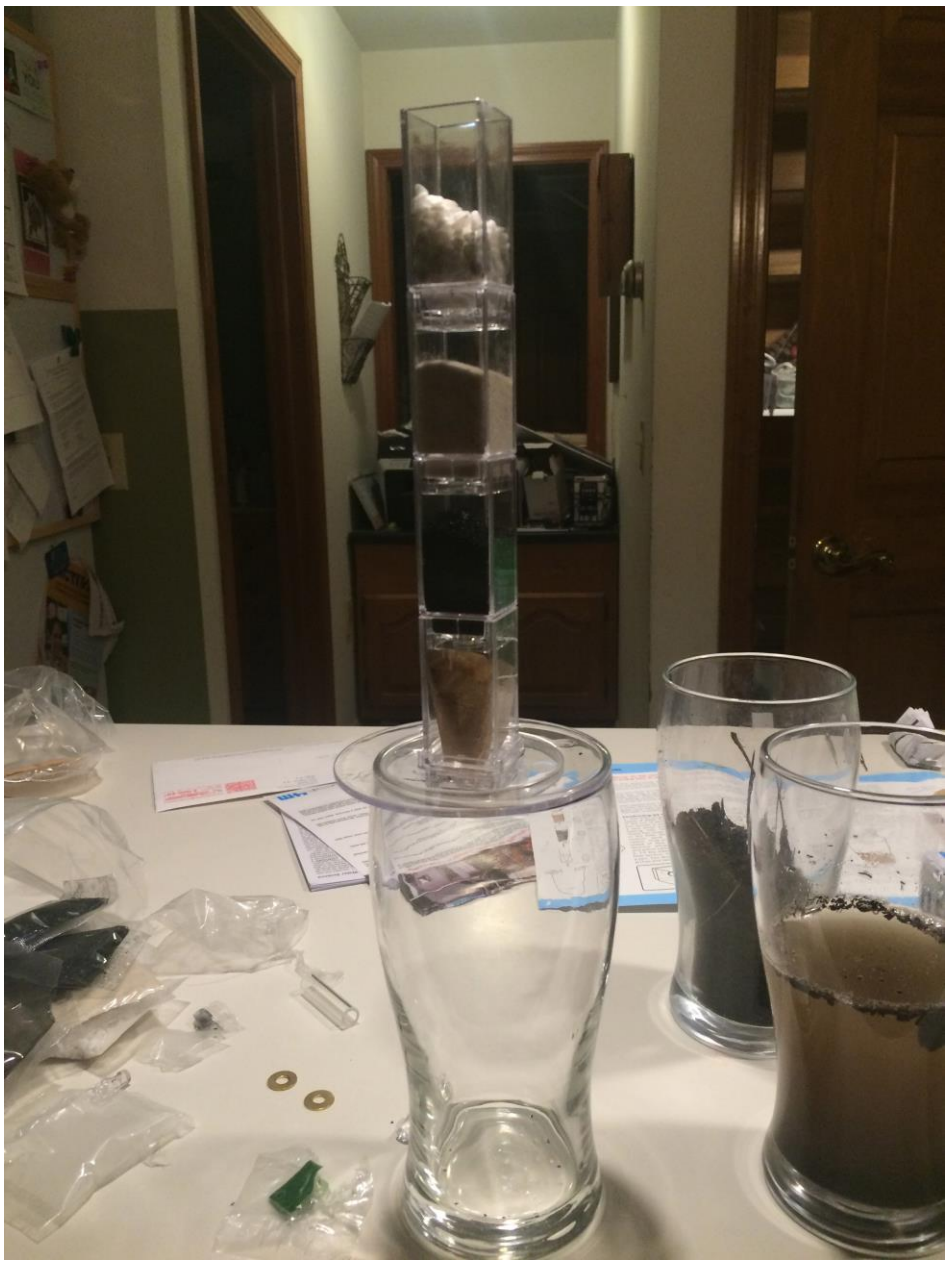
In the case of this sample experiment, the observations were all based on observations. There were no real numbers in the results. This could be modified by testing the pH of the water before and after it is filtered to see the change. Students could also measure the amount of water before and after to see how much water is lost during filtration.

In this results section, students should display their results, perhaps using tables and charts.

Clean Water Before:	Dirty Water Before:
Clean Water After:	Dirty Water After:

Interpretation:

This section will be where students explain the meaning behind their results. They can discuss their reasoning behind the results that they got and the possibilities of errors in their experiments. Here, they should also explain whether their results agreed with or did not agree with their hypothesis and why.



Setup of Filtration Column in Sample Experiment

Appendix H: Student Focus Group

School's Name: _____
Date: _____

Water Issues:
1. Are you aware of the water issues in Albania?
2. Do you think fellow classmates are aware of current water issues in Albania?

Water Fairs:
3. Do you think that a water science fair would be valuable to you as a student?
4. Do you think that a water science fair would raise awareness to these water issues?
5. Would you want to participate in a water science fair?
    a. Would certain topics make you want to participate?
6. Do you think your classmates would like to participate in a water science fair?
7. Would there need to be incentives for you to work on this?
    a. Would you want to participate for the educational value?

Resources:
8. Would you have the time to commit to this water science fair?
    a. Would time in class be better than outside of class?
9. Would you like more hands on work? Or more classroom work?
10. Would you like to work in teams or individually?
11. Do you have any concerns with having a water science fair?

Notes:

Appendix I: Judging Criteria

Criteria	3 Points	2 Points	1 Point
Research (Introduction):			
1. Formulating Research Question	-Has a well-defined question -The question clearly relates to water issues	-Has a research question that is either not clear or does not relate to water issues	-Has a research question that is not clear and does not relate to the water issues
2. Gathering Sources to Answer Research Question	-Consults at least 5 sources and explains why they are relevant to the project -Clearly relates the sources to the research question -Assesses the strengths and limitations of each source -Collects research findings into a well-written introduction to the experiment	- Gathers less than 5 sources -Relates the sources to the research question -Collects sources into an introduction to the experiment	-Gathers an inadequate amount of sources -Does not relate the sources to the research question -Does not have an adequate introduction to the experiment
Experiment (Procedure and Results/ Interpretation):			
3. Design of the Experiment	-The experiment has been designed to answer the research question in the best manner possible -The experiment contains all proper assets (control, independent variable, dependent variable) -The manner of collecting results is clear from the design	-The experiment has been designed well but there might be a better method to answer the research question -The experiment contains most of the proper assets but misses one -The manner of collecting results is clear but requires explanation	- The design of the experiment does not answer the research question -The experiment is missing many of the proper assets. -The manner of collecting results is not clear
4. Results and Interpretation of Experiment	-The student has thoroughly explained all results and has given reasons for them -Presents the information in a clear manner (using charts, graphs, tables, etc) -Unexpected results are explained -Possible sources of error are explained	-The student has explained all results -Presents information in a clear manner -Reasons for unexpected results are proposed but not explained	-The student has not explained all results or has not provided reasons for them -Does not present the information in a clear manner

Presentation:			
5. Information Included	- All information is included in the results in the appropriate section -The information clearly attempts to answer the research question	-Most information is included -The information answers the research question	-Not all appropriate information is included -The information does not lead to answering the research question
6. Creativity	-The student has taken care when preparing the final presentation of the material -The information is presented in a clear and creative manner	-The presentation of the material is clear but only somewhat creative	-The presentation of the material is not clear or is not creative at all
TOTAL	/18		

Appendix J: Calendar of Due Dates

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
November 30	December 1 1) Determine Research Question 2) Begin Background Research	2	3	4	5	6
7	8	9	10	11	12	13
14	15 Hypothesis Due	16	17	18	19	20
21	22 Background Research Outline Due	23	24	25	26	27
28	29	30	31	January 1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19 Draft Experiment Design Due	20	21	22	23	24

25	26 Experiments Conducted This Week	27	28	29	30	31
February 1	2	3	4	5	6	7
8	9 Results Outline Due	10	11	12	13	14
15	16	17	18	19	20	21
22	23 Final Report Draft Due	24	25	26	27	28
March 1	2	3	4	5	6 Individual School Science Fair	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22 World Water Day National Science Fair in Tirana						

Appendix K: Sample Presentation to Administrators, Teachers, and Students

BACKGROUND

- The Water Supply and Sewerage Association of Albania has multiple programs for students, but does not have a program for high school students

Targeted Age Group	Program	Goal
Third Grade	Children's Water Day	Educate students about the importance of water resources
Eighth Grade	Water Monitoring Day	Introduce students to the main water issues and to methods for testing water
University	Summer Internship Program	Provides students with experience working in the water sector
Graduates	Young Water Professionals	Give recent graduates the opportunity to network with other professionals

BACKGROUND ON SCIENCE FAIRS

- Science fair program was started two years prior
  - First established at Harry T. Fultz
  - Expansion to five public schools
- Program is intended to raise awareness of the water related issues in Albania
  - Science fair program includes research, experimentation, and presentation

YOUNG WATER PROFESSIONALS (YWP)

- YWP are professionals that work in the water sector
- Role of the YWP
  - Hold a presentation about career with students
  - Involving the students
    - Mentoring
    - Helping during research
    - Serving as a judge in the final presentations

Appendix L: Sample Presentation to Young Water Professionals

BACKGROUND

- The Water Supply and Sewerage Association of Albania has multiple programs for students, but does not have a program for high school students

Targeted Age Group	Program	Goal
Third Grade	Children's Water Day	Educate students about the importance of water resources
Eighth Grade	Water Monitoring Day	Introduce students to the main water issues and to methods for testing water
University	Summer Internship Program	Provides students with experience working in the water sector
Graduates	Young Water Professionals	Give recent graduates the opportunity to network with other professionals

BACKGROUND ON SCIENCE FAIRS

- Science fair program was started two years prior
  - First established at Harry T. Fultz
  - Expansion to five public schools
- Program is intended to raise awareness of the water related issues in Albania
  - Science fair program includes research, experimentation, and presentation

RESULTS FROM HARRY FULTZ

- Students from Worcester Polytechnic Institute (WPI) established a science fair in the Harry Fultz
  - WPI students mentored the high school students
- Successful in raising interest
  - Students could choose their own projects
  - Students could work in teams

RESULTS FROM IMPLEMENTATION PHASE

- Another team from WPI established a national science fair involving five schools
  - Students benefitted from having a list of topics
  - Sample project helps to show formatting
  - A website provided a central location for all documents
  - Creativity is paramount to the students projects

ROLE OF YOUNG WATER PROFESSIONALS

- Hold a presentation about career with students
- Explain program to teachers and students
- Serve as mentors to students
- Help during research phase
- During the local science fair serve as a judge

Appendix M: Guide for High Schools

Guide to the High School Water Science Fair Program in Albania

Part A: Background of the Science Fair

Despite the abundant amount of water that Albania has within its borders, there are currently multiple challenges associated with its management that are creating issues with the water distribution. One of the primary goals of the Water Supply and Sewerage Association of Albania (WSSAA) is to increase student awareness of these water problems in an attempt to interest them in the water sector. By sparking interest, the organization hopes that students will then pursue careers in the water sector and help the country fix the problems. So far, this program has been implemented at public high schools in Tirana, Durres, Shkodra, Berat, and Korca. To increase the total awareness of students, we advise that this program be implemented in many more public high schools throughout the country.

The purpose of this guide is to explain the methodology, purpose, and setup of the science fair to aid professionals at all levels in completing the science fair program. To help you along the way are local Young Water Professionals (YWP). They are professionals appointed to the science fair program by WSSAA. The YWP will aid students in researching their projects

Part B: Selecting Student Projects

Many factors should be considered when deciding potential project designs. These factors include:

- Available resources at each school. In order to keep the total cost for these programs low, we advise that the designs of the experiments should not

involve any expensive materials. We encourage students to be creative with what they can find in their homes or in their schools already.

- Ability to test the hypothesis. The students should be able to form and test a hypothesis with an experimental design. If the topic is too broad or too narrow, the students may not be able to appropriately create an experiment.
- Connection between topic and water issues. The main goal of this program is to enhance student understanding of water problems in Albania. We advise that their projects have a fairly strong link to a way to solve these water issues.

Some potential topic ideas include:

- Water Chemistry
- Filtration
- Pollution
- Fertilizer
- Testing the Hardness of Water
- Effect of pH on Ecosystems
- Proposed City Layout
- Composting Toilets
- Collecting Rainwater
- Purity by Evaporation

These are just a few topics for students to consider. They should be encouraged to choose their own project topics. They will form groups of 2-4 students, choose a topic, and form a research question.

For their projects, students should place equal emphasis on background research, experimentation, and presentation of results. During the background research phase of the project, we expect that students will find sources to consider about their research question. They will analyze and compile this information into an introduction to their final report. During the experimental phase of the project, students will develop and conduct an

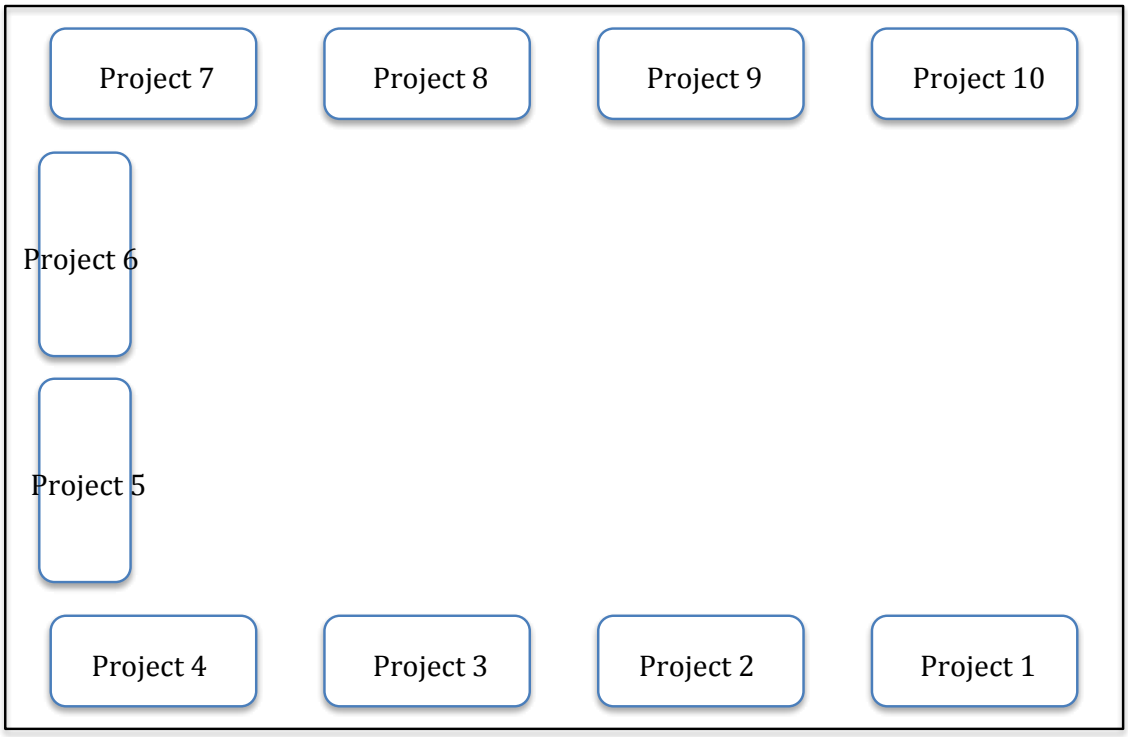
experiment to test the hypothesis that they create. From this, they will analyze all of their data and make conclusions, which will be included in their final presentation. This final product will be either a PowerPoint presentation or a poster detailing their experiment and what they have learned. It will first be shown at a local science fair at the individual high school. Then, the top two scoring teams will advance to a national science fair in Tirana, held on March 22.

For a full schedule to keep students on task, please consult the Calendar of Tasks that can be found at our website www.albaniasciencefair.com

Part C: Mentoring the Students

Throughout the process of the science fair, students will need some assistance. We advise that they have a few people to go to for advice and help. First, the Young Water Professional appointed to each school will be available as a resource if students have questions about their background research. Another important resource for the students will be the teachers at each school. They will be helping them by guiding students through their final reports.

Part D: Setup of the Science Fairs



The above schematic displays the potential layout for the science fair at the local level. We suggest that it be held in the gymnasium at each school or another open area. Each project team will have a table to display their work. On the table, they should include a poster or a laptop with the presentation of their results, any models that they used in their experiment, and a copy of their final lab report.

Part E: Scoring the Projects

During the science fair, one of the most important aspects is the scoring of the projects. We have created a scoring rubric that separates the project into three phases: background research, experimentation, and presentation. The full rubric can be found on our website www.albaniasciencefair.com.

At the local science fair, we suggest that the judges be the Young Water Professional, a teacher, and the director of each school. These judges can change based on availability. Each judge will walk around to the project tables and look at the students' final report and

their experiment and give grades based on the rubric. This process will only work if the grades are given in an impartial manner. The purpose of the rubric is to ensure this unbiased scoring because there are clear expectations for each section.

Based on the scores received, the top two student teams will advance to the National Science Fair that will be held in Tirana.

Part F: Program Expansion Considerations

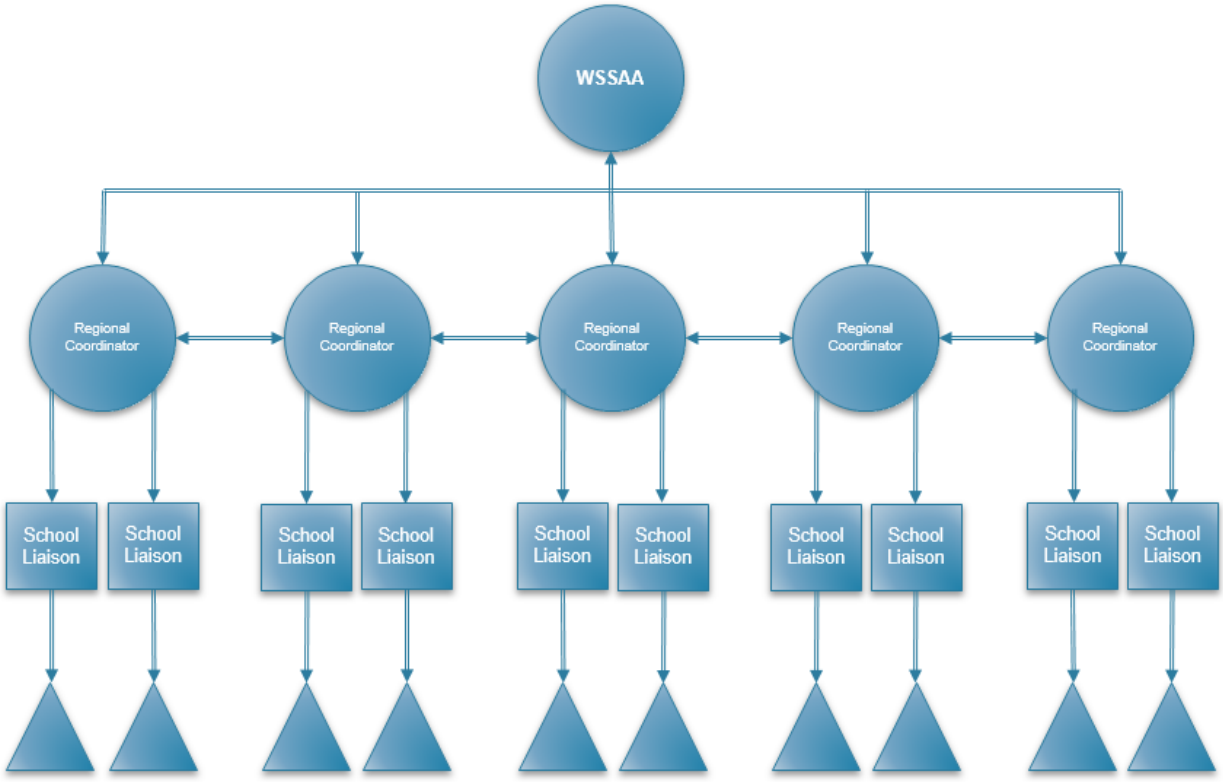
In order to expand this program within the school, we have made a few recommendations. First, we recommend that all students have time allotted to visit the science fair. We believe that this will interest more students in the program and increase the number of participants in future years.

If it is possible for the school, we also recommend that community members, namely parents, be invited to attend the science fair to see what the students have produced.

Appendix N: Guide for WSSAA

Guide to the Water Science Fair Program in Albania

Part A: Creation of a Committee of Regional Coordinators



For this program to work, we recommend that WSSAA create a committee of regional coordinators comprised of five Young Water Professionals. As the program expands, this number may increase.

Responsibilities of WSSAA Representative:

- Overseeing and appointing the regional coordinators
- Providing the regional coordinators with necessary information for the program

Responsibilities of the Regional Coordinators:

- Managing any money received through donation
    - Approving funding for schools based on total money available, necessity of money requested, and amount already received by the school

- Advising school liaisons
    - Providing training programs for school liaisons
    - Ensuring project goals are understood
- Finding other schools to expand the program into

Responsibilities of School Liaisons:

- Introducing the science fair to a high school
    - Presentation to students, teachers, and administrators
- Encouraging student participation in the science fair
- Providing guidance and information to the students during their project

The schools, then will be responsible for choosing students to participate in the science fairs and for holding their own individual science fairs. At these local science fairs, judges will choose the two best-scoring projects to send to the national science fair in Tirana on World Water Day.

Part B: Organization of the National Science Fair

We recommend that the regional coordinators be invited to Tirana the day before the national science fair in order to help WSSAA set up the fair. The fair will be held at the Ismail Qemali School or another suitable location in future years. Each project group will be provided a table, upon which they can place their poster or a laptop with their PowerPoint, any models used in the experimentation process, and a copy of their final report. For advertisement of the fair, we recommend that the regional coordinators create a flyer to put on the website albaniasciencefair.com

As far as scoring the projects at the national fair, we suggest that three representatives from WSSAA be the judges. They will use the same scoring rubric that was used at the high school science fairs to determine the ultimate national science fair winners. The prizes for these winners in the future may be scholarship prizes from local universities but we suggest that WSSAA or the regional coordinators look into this option further.

Students coming from far away cities will need to stay overnight in Tirana the night before the science fair. We are uncertain about how to house the students if their families plan to travel with them. We have discussed different options with our contacts at WSSAA including hotel stays, but they will ultimately make the final decision depending on funding. We suggest that families and members of the Tirana community be invited to this national fair to see what these high school kids are capable of producing. This will raise overall awareness of water issues, one of WSSAA's main goals.

Appendix O: Final Email to Young Water Professionals

Hello,

First off, we would like to say what a pleasure it has been to work with each of you. As we are returning to the United States on December 20th, we wanted to send out a few points to tie up our role in this project. As we stated to each of you, we will be able to be contacted via email in the weeks leading up to the science fair. Based on the visits that we've conducted, we have several recommendations for the ultimate success of the science fair.

Each school has made teams already and chosen project topics. Many have already performed background research and have a proposed experiment plan to test their hypotheses. However, several groups are still unsure about how to go about performing an experiment.

We suggest fairly regular check-in's with the teachers at your designated school to ensure that the project process is going smoothly.

The calendar provided on the website shows the approximate due dates for each part of the project, but these can change at the teachers' discretion.

We came up with the idea for each of you to be one of the judges at the local science fair at each school along with the director of the school and the teacher working with the students on the project. The teachers will determine the date for this science fair.

Feel free to contact us at any time regarding the project at water14@wpi.edu.

Thank you again for all of your time and hard work to make this project possible!

Sincerely,
Rebecca Barolli
Matthew Fegley
Seth Kamens
Jessica Orr