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Guidelines for Promoting a Fifth Grade Stormwater Curriculum for Central Massachusetts Schools

An Interactive Qualifying Project
Submitted to the faculty of

WORCESTER POLYTECHNIC INSTITUTE

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Abstract

There is a need to increase awareness and better educate the public, particularly youth, regarding the issues with stormwater runoff. The goal of this project was to find ways to implement a watershed curriculum that would increase awareness of 5th grade students, and make recommendations on professional development programs for teachers. This goal was accomplished through interviews and surveys for school coordinators, teachers, and directors of schools in Massachusetts to find the best way to successfully implement this curriculum. The recommendations addressed the presentability and provided assistance for the Massachusetts Department of Environmental Protection, Central Massachusetts Regional Stormwater Coalition, and 5th grade teachers in Massachusetts.

Acknowledgment

This project was majorly influenced by the contributions of several individuals whom we wish to acknowledge. We would like to start off by thanking our sponsor, the Central Massachusetts Regional Stormwater Coalition for the opportunity to work on this project and the support they have provided us throughout our journey. Without the guidance, tools, and personnel provided to us, this project would have not been possible.

We would also like to thank Ms. Andrea Briggs, a Deputy Regional Director at Massachusetts Department of Environmental Protection for all of her help along the way. Our group was brand new to learning about the process of creating a new curriculum and what goes into implementing it. Ms. Briggs helped us get accustomed to the project and provided us with contacts of STEM coordinators and teachers who have helped this project progress and become successful.

We would also like to thank Ms. Angela Panaccione, a Conservation Agent and Stormwater Coordinator from the town of Palmer for all of her help along the way. Ms. Panaccione gave us a headstart on the project by providing us with the correct tools to go about the project in the right direction.

We would also like to thank Ms. Kerry Reed, a Senior Stormwater & Environmental Engineer at the City of Framingham for all of her help along the way. Ms. Reed provided us with a background of evaluating and modeling existing storm and surface water systems.

Finally, we would like to thank our advisor, Professor Mathisen for his guidance throughout the project and his suggestions/improvements he has recommended for this paper. Professor Mathisen's comments challenged our group to continuously improve our paper and the project overall.

Authorship

Each team member filled in a specific role throughout the whole report, whether it be drafting, editing, expanding, etc. Each section of the report was worked on by team members simultaneously and each team member had a main role they filled for the report. The following sections show the contributions and role each person filled for the report.

William DiCroce

He did his share of the research part of the report, which was his major role for the project. He also did some drafting for some sections, as well as expanding on several initial drafts.

Kahleb Downing

He did a good amount of research that went into this report. His main role for this report was drafting up several different sections, as well as doing some editing for his drafts, and found appropriate visuals along with creating the table full of each interviewees name, organization, and reason for the interview.

Jake Needleman

He did a good share of the research for this report. His main role was drafting up the first and second drafts within various sections. In addition, he edited the first and second drafts and worked on the flow chart along with gathering visuals and placing them in the report where he saw fit.

Jonathan Shiery

He did a major part of the editing process when the initial drafts were done, as well as expanding them with more details. He did some of the initial drafts, but his major role for the report was expanding on the drafts that other team members set out. He also worked on managing the citations for the whole project.

Executive Summary

This report provides a set of recommendations on how to incorporate a watershed education STEM curriculum into schools, specifically in 5th grade classrooms. These recommendations are for a watershed curriculum provided by our sponsors. The watershed curriculum focuses on educating 5th grade students about freshwater collection and distribution, watershed conservation, stormwater runoff, stormwater pollution, and ways to minimize and prevent harm to the environment through in-class activities and demonstrations. There is a need for this curriculum because it is important to educate the youth about the emergence of STEM, specifically the effects of stormwater runoff has on the environment.

For this project, our goal is to encourage teachers to adopt this watershed education curriculum. In order to achieve this goal, we set up the following objectives:

1. Gain an understanding of the requirements for teachers to integrate a new curriculum program
2. Find out what teachers want from a watershed curriculum
3. Create guidelines for a development program that helps teachers learn how to incorporate the new curriculum into the classroom

Our approach to successfully accomplish our objective was completed through semi-structured interviews via Zoom with people involved with the curriculum process, research on case studies and on past implementations of other curricula, and additional surveys for our interviewees. Our interviews were most successful because each individual who was interviewed was once a teacher and knew what it was like teaching 5th grade students. In addition to teaching, most have gone through the process of a new curriculum being implemented as well as having observed and participated in its adoption process.

Through these methods, our group discovered that teachers play a crucial part of the implementation process for curriculum. Although the schools make the ultimate decision in deciding the curriculum, the teachers have an influence on the curriculum they teach. Also, there

are many factors when choosing to adopt a curriculum, such as the quality of material in it (does it comply with the Next Generation Science Standards), how current the information is, and the deciding factor of price to adopt it. Next, we found out that teachers are more likely to choose a curriculum if it is easily able to be updated, if the information relates to the Massachusetts Comprehensive Assessment System (MCAS), has lessons with real-world problems, keeps teachers engaged during its development program, and is engaging for the students. Overall, a curriculum will be chosen if it is easy for teachers to use and easy for them to update.

From our findings, we came up with recommendations to further the process of implementing this watershed education curriculum. Our group suggested that there should be various additions and changes to the curriculum to make it more appealing to teachers. This can be accomplished by incorporating more real-world examples, visual elements (PowerPoints for each lesson), combining subjects into the curriculum, and having a before and after quiz to observe each student's progress. Another recommendation was to make it more engaging for the students by having more visuals to look at, hands-on activities, group work, and projects. Our last recommendation is for teachers to go through a two-day curriculum program. This program will be led by a STEM coordinator who is very experienced in teaching STEM and will focus on two different phases. The first phase will focus on teachers buying into the curriculum and wanting to teach it and the second will be learning the curriculum with the end goal of becoming more comfortable when teaching the curriculum.

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Chapter 1.0: Introduction

Stormwater education, like climate change, is becoming a growing issue in our communities over the past decade. The close connection between climate change and stormwater is not something that many people are familiar with. Because of this, last year's WPI Inter Qualifying Project (IQP) team was tasked to create a new stormwater curriculum that complies with Massachusetts state regulations and the Next Generation Science Standards. Lessons within this curriculum include hands-on activities, lab work, visual learning, and essential vocabulary. These methods will provide ways for students to stay actively engaged throughout the duration of their class.

This watershed education curriculum is designed to teach students about the role that water plays in the community, the effects that pollution has on stormwater, and how to prevent pollutants from spreading. It is essential that this curriculum both educates and instructs students on ways to approach these problems and then come up with effective solutions. Our IQP team used the newly built stormwater curriculum to create teacher development programs to guide as many 5th grade teachers as possible to effectively use the curriculum.

In order to best reach these students, the curriculum is presented in an easy to understand way. It focuses on engaging and entertaining the students so that they will be more likely to retain what they are taught. The effectiveness of the curriculum will be far-reaching as the goal is for these students to remember the curriculum for years to come so that they are more likely to contribute to their communities.

The educational potential that the watershed education curriculum will provide to communities is one of the main objectives for the Central Massachusetts Regional Stormwater Coalition. This coalition, also known as CMRSWC, was founded to facilitate better organization of municipal stormwater management in communities across the state. They are our sponsor and are working side-by-side with them in hopes to develop awareness within the community about the importance of stormwater management so that towns undertake group efforts towards long-term conservation of this resource (CMRSWC). One way they try to accomplish this task is through youth watershed education programs in which students will learn about the problems

with water quality and come up with solutions. For this project, the CMRSWC has tasked our team to design teacher development programs on watershed education curriculum so that teachers are able to successfully and efficiently use the developed curriculum in their classrooms.

The ultimate goal of this project is for the watershed education curriculum to be recognized as essential and be incorporated into as many school districts as possible. If this issue is treated as seriously as, for example, climate change, it could potentially end up being included in state testing. To achieve this goal, we are creating professional development programs so that teachers are well supported in their efforts to incorporate this curriculum into their classrooms. Figure 1 is an overview of what a watershed looks like in society.

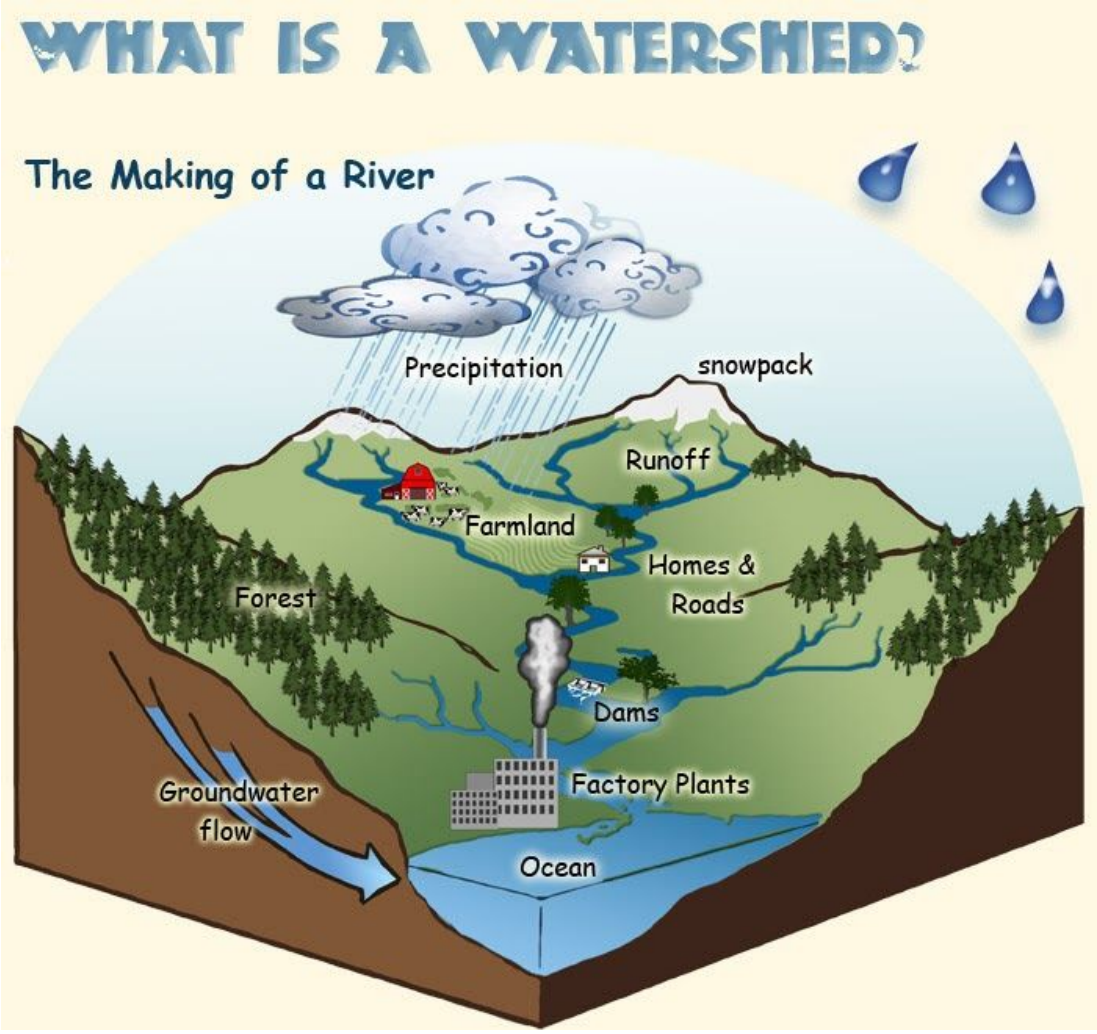

Figure 1: An Overview of the Watershed (A. Vicente, U.S. Forest Service)

Chapter 2.0: Background/ Literature Review

This chapter presents the background and context for our project. The goal of this project is to improve teachers' understanding and utilization of a watershed education curriculum developed by a previous WPI student project. First, we have to understand the importance of stormwater management and the challenges one may face when encountering stormwater pollution. We discuss the purpose behind the curriculum as well as the problems that have arisen with previous attempts to implement the curriculum. We also discuss the Next Generation Science Standards and how science curricula adhere to them. A brief overview of our sponsors and stakeholders is also provided in this chapter. Finally, we have examined and researched two different reports related to curriculum implementation in a Pennsylvania community and an Indiana community. First, we identified what the authors of the Pennsylvania report did to get their new curriculum incorporated in their classes. Next, in the Indiana report, we identify what improvements a development program should have on teachers. Specifically, these cases identify what aspects of a professional development program are the most important and therefore most effective for teaching young students.

2.1: Understanding the Importance of Stormwater Management

At first glance, stormwater pollution sounds like a simple problem with simple solutions. However, this assumption is inaccurate, as stormwater pollution can ruin entire freshwater reservoirs, spread pollutants to places they would not naturally go; such as animal pens, playgrounds, or public parks.

Stormwater pollution occurs when normal rainwater falls onto buildings or roads, collecting numerous pollutants such as animal waste, garbage, salt, pesticides, oil, among others, and then distributing these pollutants over a large area (Juliet Grable, 2019). This can cause serious problems as animal waste and garbage can cause disease to spread, which will negatively affect entire communities. Some of the other pollutants such as oil or gas from roadways can be distributed over large areas and make roads much more dangerous for drivers as they might not be able to see slick areas until they hit them, lose control and crash their vehicle. Figure 2 below illustrates how stormwater pollution can be combated to prevent these types of problems from

occurring in the future. An example of one of the main forms of stormwater pollution is the redistribution of fertilizers, which contaminates animal enclosures as well as water reservoirs (American Rivers Organization, 2019). The majority of farmers across the country use fertilizers to some extent in order to boost the yield of their crops as well as increase the fertility of their farmland. Most of these farms also have animals however, with many of the animal pens being located downhill of the farmland. Whenever storms occur, even if quick and small, many of the fertilizers present above can be carried down into the animal pens. This leads to animals becoming sick or even death in certain cases as they ingest fertilizers that were not meant to be ingested (American Rivers Organization, 2019). However, in even more cases the pollution does not stop there as the animals may not show obvious signs of ingesting the fertilizers and any products coming from them may be sold to consumers, who may become sick or ill after eating tainted products. In addition to this problem, the infecting of animal enclosures is another main issue due to the fact that a large portion of food contains farm animal products, therefore if infected these products will no longer be effective and thus be completely void (American Rivers Organization, 2019).

Another way that stormwater pollution negatively impacts the environment is through contamination of open bodies of water, such as ponds or lakes, and in some cases entire freshwater reservoirs. Whenever it rains, stormwater will inevitably end up in these open bodies of water, bringing with them large amounts of microorganisms and bacteria. Even though this remains a natural process, the stormwater runoff also collects pollutants from roads or fields such as salt, oil, and fertilizers. The combination of the bacteria and the pollutants can lead to much more severe problems on open bodies of water, as natural processes such as algae blooms can have unseen consequences due to pollutants.

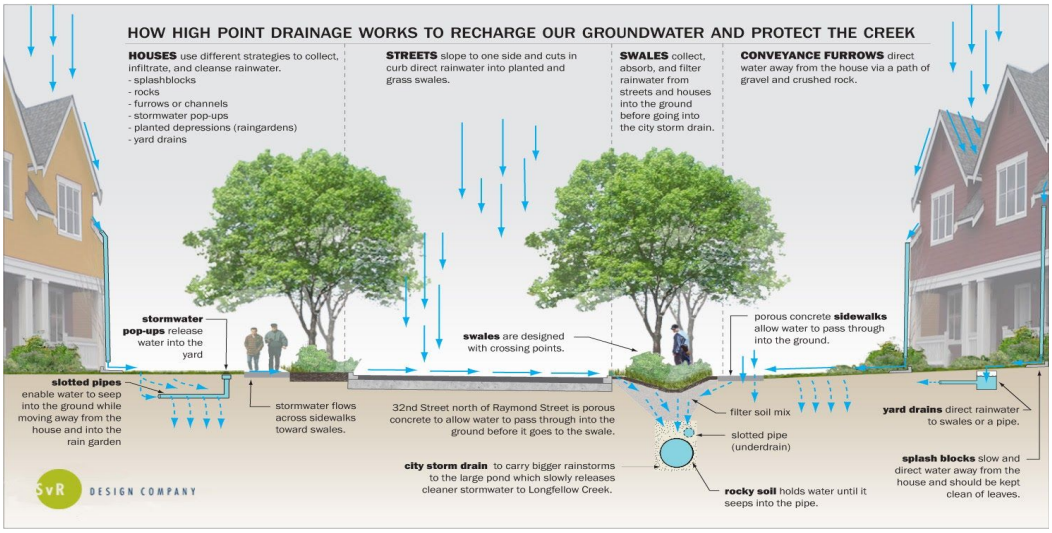

Figure 2: Example of a Stormwater Solution (High Point, 2020)

2.2: Challenges of Stormwater Pollution

One valuable way of addressing the challenge of stormwater pollution, before it becomes a larger issue in society, is through the educational curriculum. The future of stormwater pollution can only be changed if future generations are aware of its consequences. It is highly important that grade-school students are educated so that they are able to understand and solve these problems with methods to prevent these problems from building up and growing more prevalent and widespread.

In order to best prepare children and teenagers to take action against stormwater pollution, it is the duty of teachers to show kids the importance of stormwater management in a simple enough way that it is understood, however complicated enough that the severity of the problem is not missed. There are countless approaches to teaching kids about important world issues. However, in the scope of this project, we will be focusing on narrowing down these approaches to find the most effective for the topic and targeted age group. In the classrooms of most 4th and 5th grade students, STEM topics are often taught using small lab exercises or physical presentations. Teachers must rely on shorter and more succinct exercises since elementary school students typically have shorter attention spans than adults, and are unable to retain information if it is taught in long stretches (Brian Balance, 2019). Now when it comes to

emphasizing the importance of proper stormwater management, hands-on exercises that demonstrate how water picks up different materials as it crosses a surface is the first step. This would show the students how even if there is very little visible change to the composition of the water, it may contain various materials that were never meant to be spread out to certain areas

2.3: Background on Watershed Education Curriculum

In order to best inform communities of the importance of stormwater, the recently created water education curriculum must be placed in schools. Some of the most common harmful effects of stormwater pollution reduce the usability of waterways - thus harming the ability to go boating, drink fresh water, go fishing and swimming, and the overall lifespan of aquatic life. Having this knowledge taught to young children will have great benefits in the future as the children grow up knowing the importance of water and knowing how to fix problems that arise.

In order to better understand the stormwater education curriculum that our IQP group is implementing, the team analyzed a previous IQP that was created for the Central Massachusetts Regional Stormwater Coalition (CMRSWC, WPI IQP Team 2019). The "Stormwater Curricula for Central Massachusetts 5th Graders," is the curriculum that we are implementing into school systems around Massachusetts. This curriculum contains numerous lessons focused on preserving the environment through water conservation. One of the lessons, for example, is designed to show students the lack of availability of freshwater around the world. The lesson delves into the salinity of different water sources, thus showing how most of the water in the world is not drinking water unless heavily treated, which in turn can cause pollution and is not a sustainable future practice. The end goal of this particular lesson is to display the importance of water conservation efforts around the world. However, this curriculum was not implemented by the previous IQP group because of several key factors.

To start, there seems to be a considerable amount of push back from teachers who are uncomfortable teaching STEM-related classes. During our first meeting with our sponsors, we were informed that these teachers, many of whom specialize in teaching kids how to read or write, feel completely out of their comfort zone when asked to teach a water education lesson. In order to prepare teachers, our group has read through several sources that describe successful

methods of teaching kids STEM-related topics, and the most common methods involved hands-on or visual exercises. One such method was the use of a fabricated model of a city, the top contained buildings, streetcars, and other small details. However, the most interesting part was how students could pour water on the model, and then watch how the water traveled once it hit the ground through a system of tubes. By adding food coloring, these students could see exactly where pollution occurs and how it spreads.

2.3.1: Setting up Teachers for Success

Implementing a new curriculum is a difficult task for school systems to expect of their teachers. Based on past research, most teachers are comfortable teaching old curricula rather than a new one which is unfamiliar to them. This is why it is crucial to have proper professional development programs that set up teachers for success (Gibson & Brooks, 2012). Creating a successful atmosphere such as preparing teachers and creating programs for them is crucial since it helps increase educators' knowledge which in turn is proven to help students retain information better (Gore and Ladwig, 2006). If the program is too vague and is unrealistic within the limitations of the class it is taught in, then the program will be unsuccessful (Gore and Ladwig, 2006). Top educational programs are easily understood and connect to the school's goals and other program opportunities. In addition, these programs highlight the curriculum, are based on teacher's needs, and are received through relevant education such as active learning, modeling, and feedback (Stohlmann, Moore, & Roehrig, 2012).

In addition, when implementing a STEM curriculum, an effective method is "using an interdisciplinary or integrated curriculum provides more opportunities for more relevant, less fragmented, and more stimulating experience for learners" (Furner & Kumar, 2007). This method helps students better understand and remember the material that is taught. By using this integrated approach, we will be able to improve a student's ability to learn while allowing them to use their prior skills and prior knowledge of the material, which will keep them more engaged when learning new material (Fillis & Fouts, 2001). For this method to work, the most important part of this to be successful is the teacher's desire to learn and want to teach the material. The more educated and dedicated a teacher is about the material, the better the learning outcome it

has on the students. According to research, this increases a student's motivation and self-esteem as well as increases their ability to retain information for extended periods of time (Stohlmann, Moore, & Roehrig, 2012).

The implementation of the STEM curriculum can be rewarding to students since it can improve their problem-solving skills which can be translated into real-world problems. This will benefit them as they grow older and wiser (Stohlmann, Moore, & Roehrig, 2012). This can be made possible if the curriculum is taught properly and this is why having the correct programs that inform teachers on how to teach STEM is essential.

2.4: Next Generation Science Standards

The Next Generation Science Standards (NGSS) is a set of standards that was created by numerous states with the purpose of providing a set of expectations for K-12 schools to follow in relation to the science curriculum. These standards contain a large composition of expectations, from example classroom tasks and rubrics for class lessons to course mapping and evidence statements. While creating the watershed education last year, the previous IQP Group made sure to adhere to the NGSS so that the curriculum would not need extensive revision to meet them. Since the curriculum meets the NGSS, our group does not have to make alterations, thus providing us the opportunity to direct all of our efforts towards working with teachers. In order to implement these standards into the curriculum across the state, the NGSS plans to utilize a three-dimensional approach. The three-dimensional approach entails of, first, the inclusion of disciplinary core ideas (content), then the addition of scientific and engineering practices, and finally the use of cross-cutting concepts which span between several different topics (NGSS, 2019). Overall, this three-dimensional approach will require a large amount of collaboration between schools, teachers, and students in order to implement new standards effectively and efficiently.

The watershed education curriculum completely adheres to all of these standards, thus making it ready to be implemented, which would, therefore, make it easier to sell to various school districts because they would be receiving science benefits due to teaching a Next Generation Science

Standards curriculum. Figure 3 describes a process on how to connect students and their interpretations and how most effectively to teach them for them to understand the material.

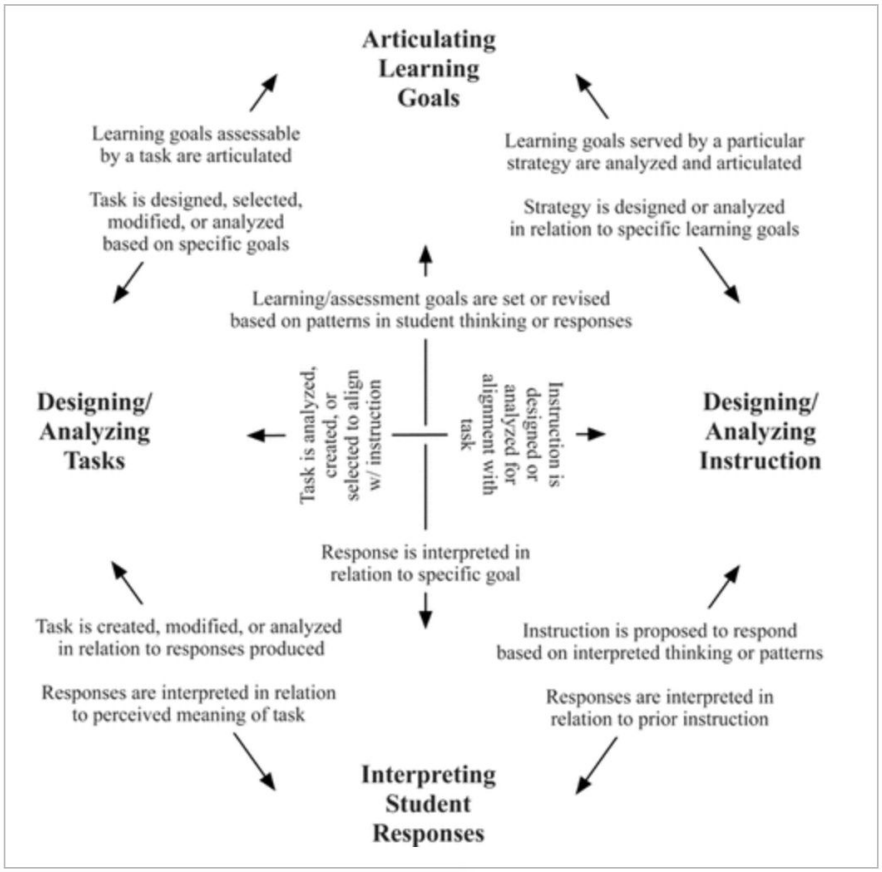

Figure 3: Formative assessment framework and with labeled connections (Falk, 2012)

2.5: MassDEP - Resources Guides

One of the organizations or stakeholders helping spread awareness to young students on the effects of stormwater in the community is the Massachusetts Department of Environmental Protection (MassDEP). The MassDEP are guiding us with the necessary resources to encourage teachers to adopt the recently made curriculum and help to get it in more classrooms in the community. Their goal is to enforce laws that "protect the air, land, and water. [They] help local cities and towns with local environmental issues. (Mass.gov/DEP, 2019)."

The MassDEP has created numerous resources on their webpage that teaches the community about stormwater and its standards. They have created a handbook that includes 3 volumes on stormwater management standards and the legal framework behind stormwater.

Figure 4: The logo for MassDEP (Mass.gov/DEP)

2.6: Massachusetts Community under Central Massachusetts Regional Stormwater Coalition

The sponsoring agency helping to spread awareness to communities in Massachusetts on stormwater pollution is the CMRSWC. Their mission is to issue important information to residents, businesses, and other stakeholders located in 30 different towns in Massachusetts (CMRSWC). These 30 communities share surface water resources, stormwater systems, and the need to ensure the long-term protection of these resources. That is why all communities need to be on the same page when talking about stormwater education.

Figure 5: The banner and logo for CMRSWC (www.centralstormwater.org)

The CMRSWC was formed in 2012 with only 13 towns involved. These towns were between the towns of Leicester and Spencer because they all shared a common watershed. The agency has now grown to 30 communities all throughout Worcester county, with some communities outside it. Since being founded, the CMRSWC has completed numerous tasks from creating a website with a toolkit and hosting workshops/training on stormwater management plans, to an annual summary for regulatory reports. It is in the CMRSWC's best interest to create educational materials that they can distribute to surrounding towns that spread awareness of the dangers of stormwater runoff. The goal of their organization is to assist the 30 town municipalities in Central Massachusetts in compliance with the 2016 *Municipal Separate Storm Sewer System (MS4)* permit while also educating residents on stormwater and its management. They will be working in collaboration with the MassDEP to achieve this goal.

2.7: Watersheds in Youth Education - Case Studies

We examined stormwater education for youth by a number of organizations. Important considerations include support at the state level and professional development. This chapter includes 2 case studies that illustrate different aspects of implementing a watershed curriculum. The first one involved the implementation of a watershed curriculum for teachers in Pennsylvania, while the second studies the anticipated impact that a development program should have on the teachers.

2.7.1: Engaging Pennsylvania Teachers in Watershed Education

In 2008, a study was conducted by research professors Joshua Gruver and A. E. Luloff in Pennsylvania related to a decision made by Pennsylvania's Department of Education in 2002. This decision required watershed education to be taught in Pennsylvania's public schools. The authors wanted to learn how science teachers throughout Pennsylvania taught students about watershed education and how the teachers used watershed curricula. To accomplish this, they analyzed a mail survey conducted in 2004 where 400 Pennsylvania teachers were randomly

sampled about how they used a watershed curriculum and how they taught watershed education (J. Gruver & A. E. Luloff, 2008).

After analyzing this information, the authors of this study had concluded that teachers lack consistent and accessible curricula, similar to the struggle our sponsors have communicated to us. Instead, the curricula that teachers use are national curricula found on the internet or in textbooks. Based on the previously mentioned mail surveys, they wanted to find out how the teacher's confidence, based on classroom confidence, teaching effectiveness, and watershed knowledge, influenced their use of curricula. Through these surveys, they concluded that the teacher's effectiveness in teaching the subject was the main factor for a teacher to use a curriculum. Teachers who believed they understood watershed concepts enough to teach their students about them would be more inclined to use the curriculum (J. Gruver & A. E. Luloff, 2008).

Their conclusion for curricula developers was to make curricula that the teachers had confidence in. Teachers will only use a curriculum if they are familiar with its topics. To help build teacher confidence, the Pennsylvania Department of the Conservation of Natural Resources specifically designed their curriculum to enhance teacher confidence, as well as providing a 2-day training session to give the teachers hands-on experience with the curriculum. However, the problem of keeping Pennsylvania teachers engaged with the program occurred. This team figured out why a teacher would use a curriculum, but not how to get teachers to use the curriculum (J. Gruver & A. E. Luloff, 2008).

2.7.2: Impact of Development Programs on Indiana College Teachers

Another relevant study in 2002 reports about a professional development program designed to engage teachers. It was conducted by various education professionals and focuses on the development programs they have made and what impact those programs have on teachers. The programs being studied were implemented for teachers at Purdue University, West Lafayette, IN, and Indiana University Purdue University, Indianapolis, IN. Although the methods for teaching a curriculum for university-level teachers and grade-school level teachers are vastly different, there are some important tactics used at the university level that can be applied to the

grade school level. For example, the education professionals added assessments about the teacher's current knowledge of watershed education before the program and after the program. They wanted to know how the program changed the teacher's knowledge on the topic of watershed education. Instead of focusing on adding to a teacher's knowledge of watershed education, they designed their programs to change their perception of them. By using this before and after assessment, they also learned what needed to be added to future development programs (Shepardson, D. P., Harbor, J., Cooper, B., & Mcdonald, J., 2002).

2.8: Summary

In conclusion, we have determined that literature shows us that professional development programs are a necessity for teachers. These programs should be designed to set teachers up to succeed in teaching watershed education. By properly preparing the teachers, we can prepare the students about the importance of watershed education. The literature has also shown different ways we could implement the curriculum by looking at the specific case studies. These case studies helped us determine that, in order for this new curriculum to be implemented, we need to find a way to convince the teachers to use it. The main concern for the project is figuring out the best approach to get the curriculum implemented into school districts, specifically on how to best market the curriculum to teachers so that it is both appealing and intriguing. The curriculum can also be integrated into existing programs. By getting our curriculum integrated into this program, it both proves the quality of the curriculum, as well as make it simpler for schools to adopt. If teachers are willing to use this curriculum, our professional development programs will be effective in teaching the said curriculum.

Chapter 3.0: Methodology

The goal of this project was to encourage teachers to adopt the watershed education curriculum so that it can be more widely incorporated into educational programs by the teachers. More specifically, we developed a professional development program to support teachers in their efforts to incorporate this curriculum. In order to achieve our goals, we created the following objectives:

1. Gain an understanding of the requirements for teachers to integrate a new curriculum program
2. Find out what teachers want from a watershed curriculum
3. Create guidelines for a development program that helps teachers learn how to incorporate the new curriculum into the classroom

3.1: Gain an understanding of the requirements for teachers to integrate a new curriculum program

The first objective for this portion of the project was to gather an understanding of the requirements for teachers to integrate a new curriculum program. Major ideas included in completing this objective are interviews and researching recent cases. We reached out to teachers in school districts within Massachusetts and interviewed them on the topic of the watershed education curriculum. Specifically, we needed to interview teachers about what they already know about the watershed curriculum and what they hoped to achieve by using the curriculum. Our team also researched recent examples of curriculum implementations to discover how the curriculum was implemented into school districts. By studying these examples, we were able to gather different techniques for how to make teachers understand and learn about the curriculum, which , in turn, gave us ways to encourage teachers to adopt our curriculum. This comparative information gave us a better understanding of how context influences the success of an intervention (Goodrick, 2019). This approach determined which strategies are the most effective and therefore, which strategies should be used.

After researching the curriculum implementation examples, the team completed several semi-structured interviews with school officials and teachers. The questions for the interviews

can be found in Appendix A. For the first set of interview questions, they were geared towards the specific teachers' experience with various types of curriculum as well as their interactions with their students. Through the collection of this information, we were able to best plan a strategy to encourage teachers of all different backgrounds to adopt and try the curriculum. Understanding how each teachers' interactions with their students differ from classroom to classroom was also very important information as it demonstrates how different teaching styles may or may not have the same effect on their students.

Second, for all interviews focused on curriculum coordinators, the interview questions were focused on where the new curriculum is acquired, how it is distributed, and how often is the new curriculum added to schools. The answers to the first question, where the new curriculum comes from, was arguably the most important question asked because it directly relates to how our sponsor organization could best reach out to schools with the Watershed Curriculum. The questions of how a new curriculum is distributed and how often were also very important. For instance, if a new curriculum is added in bulk every couple of years, the watershed curriculum could be mass distributed at the same time, thus reducing the impact on schools and increasing how many schools adopt it.

Third, for all interviews focused on school executives, such as principals or superintendents, the interview questions revolved around how decisions are made in regards to the new curriculum. These questions ranged from how new curricula are chosen, how they are approved by the school, and what role principals and superintendents serve in this process? These questions aided us with planning effective ways of reaching out to principals and superintendents in a way that maximizes the chance of the watershed education curriculum being adopted.

These interviews helped us gather information about the level of knowledge that 5th grade students have, ways that teachers teach STEM topics, and what STEM programs they teach. Gathering this information gave us an understanding of the classroom environment as well as helped us create a development program. This information helped us to design different education methods to put in the program. These methods were designed to help teachers with using the curriculum in their classes so that they are best able to relate water education to their

students in a manner that they will remember. Models in the sense of classroom observation and recommendations in what is the most effective and efficient. Figure 6 is an example of how we had to conduct all of our interviews remotely because of the COVID-19 pandemic.

Figure 6: An ad emphasizing how we conducted our interviews (Perino, 2020)

3.1.1: List of Interviewees

For our project, we conducted six interviews shown in Table 1. The people interviewed are a part of different education systems and were asked a set of questions about curricula and how they are discovered. We then asked questions relating to areas of STEM. The goal of our interviews was to gain more insight into how a curriculum can get introduced to different organizations and people with various titles such as teachers and curriculum coordinators. From here, we learned about other existing programs that host curricula, as well as how a curriculum is taught to both educators and students.

Table 1: List of Interviewees

Name	Organization	Reason for Interview	Day of Interview
Wendy Marino	Project Lead the Way	Insight into Project Lead the Way	4/15
Andreina Parisi-Amon	Mass STEM Hub	Insight into the STEM Hub	4/15
Jessica Regan	Abby Kelley Foster Charter Public School	Insight into the curriculum process	4/6
Jennifer DiMeglio	Swanson Road Intermediate School	Insight of a STEM teacher	4/13
Meg Tabacsko	Mass Water Resources Authority	Insight of curriculum process	4/22
Donna Taylor	STEM Education Center at WPI	Insight of STEM background	4/17

3.2: Find out what teachers want from a watershed curriculum

The second objective for this portion of the project was to assess various watershed curricula currently taught in schools and discover which aspects are the most useful for teachers. In order to meet this objective, we first evaluated the interview responses obtained from the previous objective. We analyzed various methods used by different STEM teachers and compared the results to see which methods of teaching would be most effective. Through these interviews, our team narrowed down the most effective ways to teach the curriculum. Next, our team created a short virtual survey for teachers in Massachusetts, to be taken at the Mass STEM Summit this upcoming fall. We created and adjusted these survey questions based on feedback from our interviewees. This virtual survey includes questions about 5th grade students' knowledge level and which teaching method they learn best from, from examples such as hands-on learning, group exercises, verbal discussions, and presentations. The survey questions will be analyzed at a later date since the Mass STEM Summit got pushed back to later in the year. Based on the results of the survey, potential revisions to the curriculum will be considered in order to best incentivize teachers who want certain changes, to adopt the new curriculum. Lastly, we compiled and analyzed the results of our interviews to discover trends and shared methods of teaching.

3.3: Guidelines for a Teacher Professional Development Program

The third objective for this portion of the project was to create guidelines for a development program to assist teachers in learning the contents of the new curriculum. Once teachers become aware of the new STEM curriculum, and our team learns what the teachers want to be incorporated, the next step is to provide "pre-service teacher education programs" for the curriculum to be a success (Cunningham, 2009; Custer & Daugherty, 2009; Hardy, Howes, Spendlove, & Wake, 2008). Our education program was specifically designed for teachers in the Massachusetts area. By learning about what teachers want from our curriculum, we could more effectively tailor the program to the teachers' needs.

The research was done by Lantz, who utilizes an adaptive expertise approach, a method of finding solutions to new problems in a timely manner, which was identified as one of the most effective approaches due to the fact that it helps ease the curriculum for teachers. We used this approach because we wanted to come up with various solutions to the limited learning of stormwater education in youth education. This method helps increase the knowledge of the educators, informs them on educational practices, and sheds a positive attitude toward STEM (Lee, Kar-Tin & Nason, Rod, 2012). In order to achieve this, we need to fully understand the curriculum ourselves and determine the best course of action for teaching new information. Our professional education program needs to be designed not just on the information in the curriculum, but also on its importance to communities as a whole and how to incorporate it into the classroom. At this point, we do not know the current knowledge that teachers have on watershed education. In order to not make any assumptions, the program should be designed in a way to share new watershed information and replace any misinformation about watershed education, rather than building upon a weak foundation.

Chapter 4.0: Findings & Analysis

The goal of this project was to find ways to implement an already created watershed curriculum to increase awareness for 5th grade students, as well as make recommendations for professional development programs designed for teachers to get comfortable with this curriculum which complies with the Next Generation Science Standards. The question we are called upon to answer is, why is the watershed education curriculum currently not being implemented? Based on interviews with teachers, curriculum coordinators, and STEM directors we have discovered several reasons why watershed curricula have not been implemented, as well as several ways to encourage teachers to use them. With this research, we have created supplementary materials in order to assist our sponsors with the curriculum implementation. In the following sections, we present our key findings for the project, as well as our deliverables and our group's recommendations.

4.1 Requirements for a New Curriculum to be Implemented

To discover how a new curriculum gets implemented, we conducted interviews with various individuals who have been involved with the curriculum implementation process. Throughout these interviews, we asked each interviewee "how does a new curriculum get chosen in schools?" The overall consensus from each interviewee aligned with each other in saying that a curriculum has to be supported at all levels to be implemented at the school. It may be a teacher or a principal that is interested in a curriculum, but it needs the support of the school as a whole (Parisi-Amon, 2020). However, teachers have the most influence on the curriculum process, since they are the ones that have to teach it. They know the current state of education and modify the chosen curriculum to make it their own, so they have the most knowledge of what a curriculum needs to be (Marino, 2020). A curriculum is usually chosen by how relevant it is to current circumstances in the world. It is more likely to be chosen if it is designed to be cutting-edge at the time, rather than designed to be timeless (Parisi-Amon, 2020). However, this does not mean that a brand new curriculum has to be constantly chosen. Instead, teachers usually update their pre-existing curricula, not only to make it more relevant but also to meet any new Massachusetts standards (Parisi-Amon, 2020).

Many schools face certain restraints when choosing a new curriculum to implement. The first is the cost of adopting a new curriculum (DiMeglio, 2020). These costs include the amount in acquiring the curriculum, the materials and equipment needed for each lesson, the possibility of bringing in guest speakers, and the professional development programs. Schools sometimes simply do not have the funds to afford all of the components of curriculum implementation, especially public schools. In addition, it is important to acknowledge that each school dedicates different amounts of time to STEM. This plays an important factor in how much a school is willing to spend on a new curriculum that focuses on watershed education. These were the limitations our group and our sponsors had recognized we would be presented with.

4.2 Requirements for a Curriculum to be Useful from a Teacher's Perspective

Because of the important role that teachers play in curriculum implementation, it is important to know which aspects of a curriculum are most important from their perspective. The primary aspects that a curriculum should have from a teacher's perspective are relevancy, how engaging and useful it is, and ability to be continuously updated. A relevant curriculum would include valuable information inside the curricula such as its capability to relate to the Massachusetts Comprehensive Assessment System (MCAS) and including real-world issues so students can relate the information learned in the classroom to the real-world experiences (Marino, 2020). By including real-world experiences, it will help each student along with each teacher relate to the issue being taught and at the same time become creative to come up with real solutions.

Next, all of our interviewees agreed that the curriculum should be engaging based on their own experience. Each student learns differently so therefore, each teacher has to put their own "flavor" on how they teach by including different teaching methods such as hands-on activities, group work, projects, etc. (Marino, 2020). The curriculum needs to engage each student in their own way, whether it be how it is taught or even the topics that it teaches. A bonus that teachers look for in a curriculum is if it can include elements of other subjects such as reading, writing, and math skills that are considered "essential" and "more important" (Taylor,

2020). By appealing to more than just STEM topics, the usefulness of the curriculum for teachers would increase.

Lastly, a curriculum needs to be easily updatable so it can meet any new requirements. It should be treated as if it is a living, breathing document, so its ability to be updated each year is key (Regan, 2020). If any new changes are made to the Next Generation Science Standards, the curriculum needs to be updated to meet those new standards, no matter the circumstance. Because of this, it is important for teachers to find a curriculum that is easy to update, not just for their own personal touches, but to meet any new state requirements in the future.

4.3 Necessary Components of a Professional Development Program

The most effective way to be successful when implementing a new curriculum is by having a professional development program that helps introduce educators to the new information. From the interviews we held, we came to the conclusion that these programs will only be a success if they are broken down into three different phases. The three phases are planning, training, and follow-ups. Within each phase, it is broken down into sections. One of the first sections that are crucial is convincing teachers to want to learn the material, also known as the buy-in section (Marino, 2020). If teachers do not want to buy into the material and accept it, the program will go to waste. After that has been successfully completed, then comes the part where teachers actually learn the information in the curriculum and get trained to teach it. Here is where teachers connect with the material. Once connected with the material, they can start to make it their own and adapt it and add in their own "flavor" and can add additional components as they wish when they eventually start to teach it (Tabacsko, 2020). The last section will be follow-ups, which include evaluating the curriculum and giving feedback on it. All these sections are essential components for a successful professional development program.

All three phases are introduced with the main goal of getting teachers more comfortable with the material. Professional development programs are designed to make sure teachers are comfortable with the curriculum and are key when implementing a new curriculum (Parisi-Amon, 2020). Teachers want to teach a curriculum that they are familiar and comfortable

with. The planning, training, and follow-up phases also give teachers the opportunity to meet and talk to the professionals who are most familiar with the curriculum.

4.4 Summary of Key Findings

From the project, our team concluded that both teachers and school curriculum coordinators play a crucial role in the implementation of any curriculum that a school decides to use. The schools themselves generally choose the curricula, with heavy influence from the teachers. There is no singular way that a school chooses a curriculum and there are other factors besides curriculum quality that would affect a school's decision, such as cost. These curricula do not need to be replaced every year but instead are usually updated to stay relevant. New, more relevant data is always being created and the curriculum should reflect that new data (Regan, 2020). There are various necessities that a curriculum needs to have before it can be adopted. These necessities include its capability to relate to the MCAS and to have real-world problems/situations. In addition, the curricula should be engaging for students and include hands-on learning, visuals (PowerPoints and videos), group work, and class/group discussions since each student learns in different ways.

After a school decides to implement a curriculum, it needs to have professional development programs in order to train teachers with the curriculum. Based on our research, we concluded that to best help teachers become more familiar with the curriculum, it should be taught in a development program by previous educators, since the teachers would be more willing to learn from a teacher with similar experiences. The main objective of the development programs can't be achieved if it feels patronizing to the teachers. The overall goals of these development programs are for educators to buy into the curriculum and the willingness to teach it. The other is for them to learn about the curriculum and the importance of it, in order to effectively teach it. Figure 7 pictured below is an example of a stormwater plan of action.

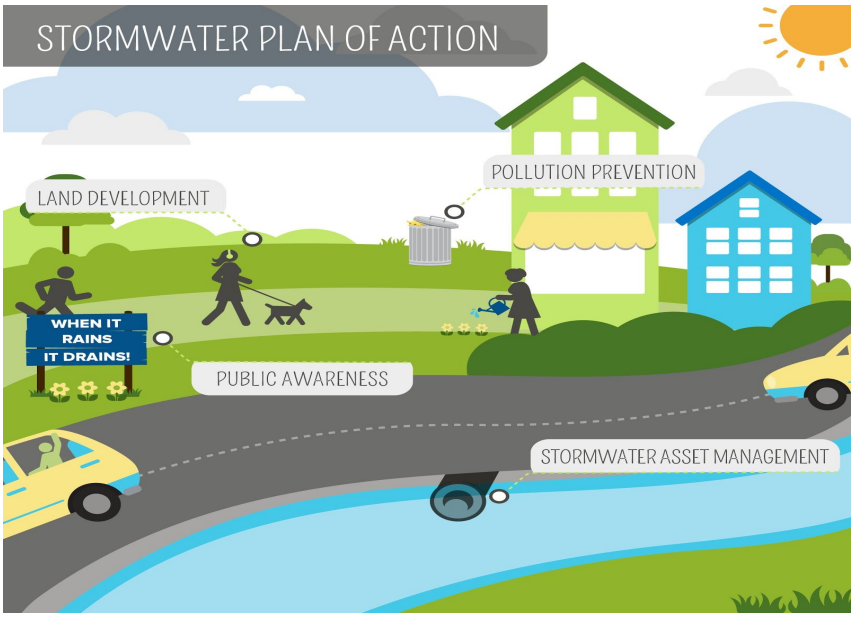

Figure 7: Stormwater Plan of Action (NorthGeorgiaWater, 2019)

Chapter 5.0 Recommendations & Conclusion

5.1 Recommendations

Throughout the process of interviews and surveys, we gathered an abundance of recommendations on ways to implement this curriculum effectively into school systems. Our interviewees gave us valuable insight into their experience with implementing a curriculum and the best ways to achieve our goal. The team also came up with recommendations for ways to get the curriculum out and in the hands of teachers.

Spreading the curriculum by word of mouth will only benefit us in trying to get the curriculum into classrooms. The more popular the curriculum is, the more people will look at it and take a chance on it. By getting a teacher to be our "golden hero," we believe the snowball effect will occur. Meaning, if one teacher takes a leap of faith and uses the new curriculum, they can then recommend it to other local teachers.

Another recommendation we created was a teacher development program week. This would be a 2-day program that involves lessons on ways teachers can get comfortable with the curriculum. Multiple interviewees mentioned that teachers have to feel comfortable teaching the curriculum they are given for it to be effective. We would have a STEM teacher with experience teaching the program. On day one we would breakdown the importance of stormwater and the benefits of students learning about the topic. The lesson will contain diagrams, pictures, and graphs to display the importance of what the world will look like if nothing is done and how the youth can improve watershed. During the second part of day one, we would breakdown what STEM is now and how each subject is evolving. View Appendix D to get a full glance of the activities and step by step process that will be held throughout the full 2-day program.

Guest speakers can bring energy to the class that will get students more involved and engaged. We suggested that bringing in guest speakers throughout the term of teaching the curriculum will give students something to look forward to while learning. Guest speakers have the chance to change lives because of how much of an impact they have.

Something that a future group could work on would be a website to host the curriculum itself. Alongside this website would be several other resources to help teachers ease into the curriculum, as well as allow them to ask questions about the curriculum. Having the curriculum

on a website will be a free source of marketing and an easy way for the community to access it. Also, this can be seen as a public service announcement for the community about the importance of stormwater.

In Figure 8 below, we created a flowchart that shows the process of possible routes to go about in implementing the watershed education curriculum.

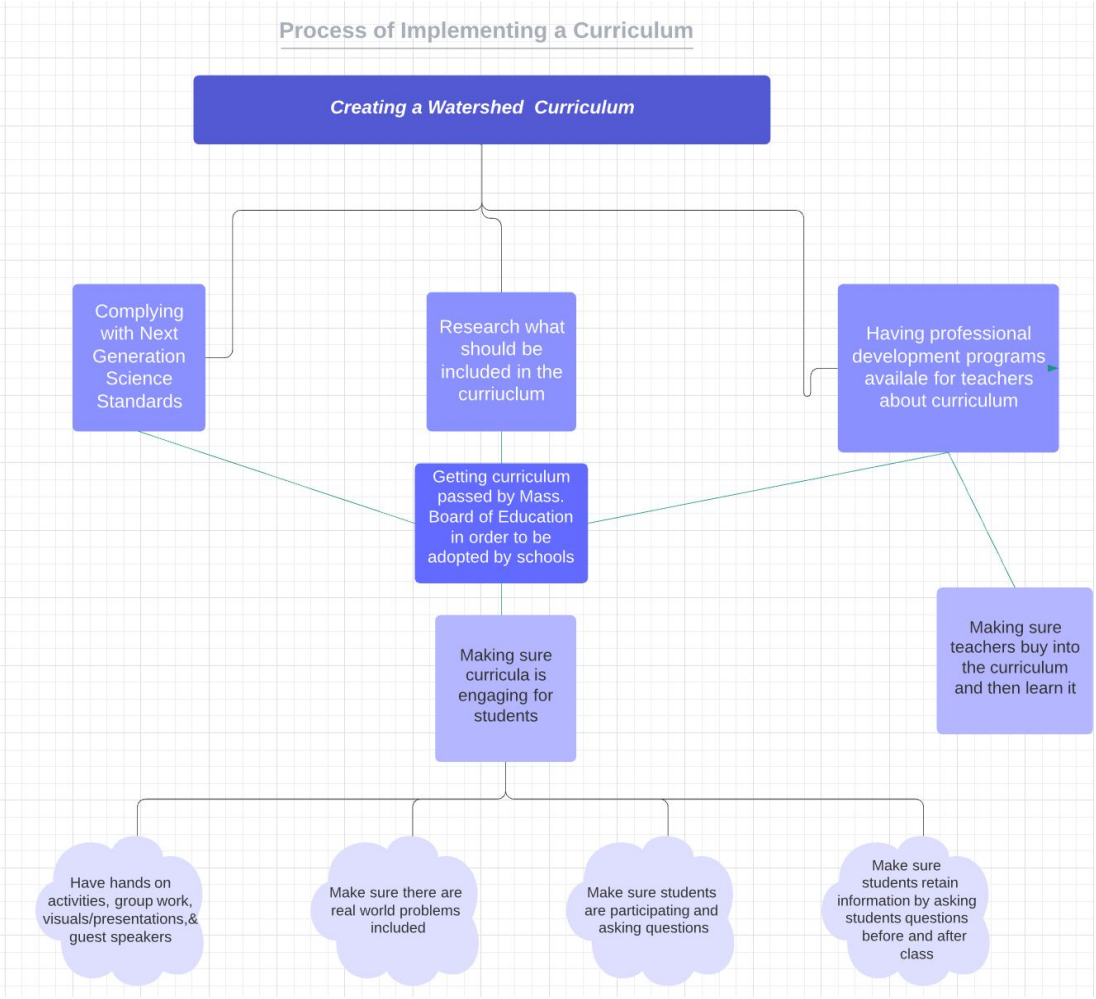

Figure 8: Flow Chart for Process of Implementing a Curriculum

5.1.1 Improvements for the Curriculum

The curriculum given to our team was especially well-crafted that the curriculum itself does not need much adjustment. However, the curriculum is not able to stand on its own; it needs supplemental materials. More specifically, it needs visual elements to assist in teaching the

curriculum. This can be accomplished by providing example PowerPoint presentations for each lesson. Since each teacher and school adjusts the curriculum in various ways to make it their own, these presentations do not have to be the definitive way of showing the curriculum, rather, they are simply examples for the teachers. An example of one of these presentations is provided as one of our group's deliverables.

In terms of the curriculum itself, it should include more examples that can be applicable to real-life, such as climate change and global warming. The problem of stormwater is not immediately understandable when the topic is brought up, which is why the curriculum should sprinkle in these familiar topics. By doing this, the curriculum will both be easier to digest, as well as make the curriculum more attention-grabbing to teachers and students. In addition, the curriculum should include a pre-lesson quiz and an exit quiz. This means creating a quiz to be conducted before the curriculum is taught and after the curriculum is taught in order to see how effective the curriculum is in teaching its contents. Finally, components of subjects outside of science should be added to the curriculum, since science is on the lower end of priority for middle schools. English, writing, and math have a higher priority in 5th grade classes than science, so including these would improve the relevancy to the curriculum's target audience.

5.2 Conclusion

In conclusion, the next steps that our sponsors should take with their curriculum are making the curriculum presentable. This includes creating a professional development program to host the curriculum, as well as creating additional curriculum materials like presentations for teachers to use. If this project is preceded by another IQP group, their main goal would be creating a website to host both the curriculum as well as these extra materials for the curriculum. In addition, the best way to get the word out about this curriculum would be via word of mouth, which can be achieved by getting a key teacher to be a prime example of the effectiveness of the curriculum.

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Appendix A: Interview Questions for Teachers

1. What is your concentration/focus? As in what are you trained in teaching? (English, Reading, History, etc.)
2. How long have you been a teacher?
3. Do you decide on the curriculum you teach at your school?
    a. Is the curriculum decided by departments?
    b. How do you prepare for the new curriculum
    c. Are there state requirements?
4. (If not STEM) Do you have any interest in teaching a STEM-related topic even though it is not in your area of expertise?
    a. (If yes) Are there any particular STEM topics that you are interested in?
    b. (If no) May we ask for reasons why not?
        i. Is it because you are uncomfortable teaching outside of your focus?
        ii. Is it too complicated? As in too much for the students to learn at once?
5. If you are using a curriculum for a class, how do you go about learning the said curriculum?
6. What is the most effective way you have found to teach your students the material? (hands-on labs, verbal discussions, presentations, etc.)Have you heard about our Watershed Education Curriculum that was developed last year for CMRSWC?
    a. (If yes) How did you learn about it?
    b. (If no) Have you heard of environmental curricula in general?
        i. (If no) How do you usually learn about new curricula?

7. Are you interested in using this new curriculum? If you were to use it, what would be needed to be in the curriculum?
8. Do you want to be a part of our team's focus group to further help us in our project?

Appendix B: Interview Questions for Directors/Stem Coordinators

1. How did you get your start for the position: Director of Partnerships for the Mass STEM Hub?
2. How long have you been the director there?
    a. What made you want to take on this role?
3. How do you decide what curriculum gets to be taught in schools?
    a. Is the curriculum decided by what the MCAS covers? (email Ms. Briggs to confirm this is the name of the testing for students)
        i. (If yes) What are the criteria for choosing a curriculum over another? Is there anything specific, like relevancy?
        ii. (If no) How does a curriculum get decided? Is it based on relevancy or some other main factor?
    b. Are there specific state requirements? If so, what are they?
4. Are the accepted curricula designed to be easy for educators to get familiar with?
5. Do curricula vary between public schools? If so, why and how is that determined?
6. Is the type of curriculum chosen affected by the fact that the school has a STEM Coordinator?
    a. (If yes) How so?
    b. (If no) How much more difficult is it for the school to adopt a STEM curriculum without a STEM Coordinator?
7. How long is a curriculum intended to last for? How long on average does it take to get outdated?
8. Have you heard about our Watershed Education Curriculum that was developed last year for CMRSWC?

   a. (If yes) How did you learn about it?
   b. (If no) Have you heard of environmental curricula in general?
      i. (If no) How do you usually learn about new curricula?
9. Are you interested in using this new curriculum? If you were to use it, what would be needed to be in the curriculum?
10. Do you want to be a part of our team's focus group to further help us in our project?

Appendix C: Survey Questions

1. What is your professional title?
   a. _____
2. Have you ever taught a STEM topic before?
   a. Yes
   b. No
3. How attentive do you think your students are during lessons?
   a. Not attentive
   b. Somewhat attentive
   c. Attentive
   d. Very attentive and ask questions
   e. N/A
4. How do you keep your students engaged? (select all that apply)
   a. Group work
   b. Presentations
   c. Hands-on activities
   d. Other: _____
   e. N/A
5. How much interactivity do your students have with the lessons?
   a. Don't participate/ask any questions
   b. Participate very little and rarely ask questions

c. Frequently participating and asking questions
d. Constantly participating and asking questions
e. Depends on the lesson and their prior knowledge of the lesson
f. N/A

6. What activities do your students tend to enjoy the most? (select all that apply)
    a. Group work
    b. Presentations
    c. Hands-on exercises
    d. Other: _____
    e. N/A
7. How long is each class period in your school?
    a. 40-60 minutes
    b. 60-80 minutes
    c. Longer than 80 minutes
    d. Other: _____
    e. N/A
8. How often is Science/STEM taught at your school?
    a. 1 time a week
    b. 2-3 times a week
    c. 4-5 times a week
    d. Other: _____
    e. N/A
9. How much time is dedicated to science/STEM each week?
    a. 40-60 minutes
    b. 60-80 minutes
    c. Longer than 80 minutes
    d. Other: _____
    e. N/A

10. How long on average does it take to teach one lesson to your class within your class period?
    a. Less than a class period
    b. About 1 class period
    c. About 2 class periods
    d. About 3 class periods
    e. Other: _____
    f. N/A
11. Is there a dedicated STEM teacher at your school?
    a. Yes
    b. No
12. What type of subject/curriculum are you most comfortable teaching?
    a. Math
    b. English/Writing
    c. Science/STEM
    d. Social Science
    e. All equally
    f. N/A
13. (ONLY IF you are a teacher) How much input if any input do you have in the curriculum you teach?
    a. None
    b. Very little
    c. A decent amount
    d. Very involved
14. (ONLY IF you are an administrator/curriculum coordinator) How does your school choose its curriculum?
    a. From other recognized organizations (e.g. Project Lead the Way (PLTW))
    b. We base it off of the MCAS
    c. We usually just follow the Next Generation Science Standards

d. Other: _____

15. What are ways that you have taught or been taught a new curriculum?
    a. _____
16. In a sentence or two, what is the most difficult aspect of choosing a new curriculum for you?
    a. _____
17. How do you find out about a new curriculum?
    a. _____
18. How long did it take you to complete this survey?*
    a. 1-2 minutes
    b. 3-4 minutes
    c. 5-6 minutes
    d. 7-8 minutes
    e. 9-10 minutes
    f. 10+ minutes
19. Are there any important questions that would be helpful in adding or changing in this survey?*
    a. If so, which questions and how can we rephrase/change them?
        i. _____
        ii. _____

*Question 18 & 19 are only for the original test survey sent to people via email and are not included in the survey for the Mass STEM Summit

Appendix D: 2-Day Program Recommendation

This is an example of what the watershed education curriculum program could look like. This step by step program includes 3 different phases, planning, training, and follow-up. The program characteristics are subject to change/modification based on this watershed curriculum.

Model Components	Program Characteristics
Planning:	
1. Provide concrete, teacher specific and extended training.	1. Program topics included: national, state and local science standards; personal beliefs about science teaching; cooperative learning; equity in science teaching and learning, the nature of science, constructivism, multiple learning and teaching styles, class discussion and questioning strategies, science activity design — curriculum and teaching models, science-technology-society, science topic integration, community resources and the use of field trips; science assessment and; reflective teaching practices.
2. Schedule regular project meetings that focus on practical issues.	2. Program met for 32 weekly meetings of 3-4 hour duration over a one-year period.
3. Include a teacher leadership team.	3. Two local school district science teachers served as members of instructional staff.
4. Include a critical mass of teacher/school.	4. Participants applied in 2-4 member school/district based teams.
5. Include building principal and extend the principals role to project evaluation.	5. Principals provided written letters of support for their teachers to participate in the program.
6. Allow for teacher participation in project decisions.	6. Ongoing feedback via journal entries focused on participant programmatic needs and resulted in altering the programs' delivery and content.
Training:	
7. Identify teacher beliefs.	7. STEBI-A, reflective journal entries and focused class discussions identified and help to analyze participant self-efficacy beliefs.
8. Provide teachers with awareness of reform goals.	8. By their application, participation in project activities and evaluation of the program, the participants were made aware of the overall goal of the MUSI program, the goals of the professional development program, and the goals of the BSCS curriculum.

Model Components	Program Characteristics
9. Provide teachers with theoretical understanding of reform goals.	9. Teachers participated in a number of course projects that required them to analyze readings, activities, videotaped teaching episodes focusing on the underlying theories behind reforming the science instruction and curriculum in their classroom and school.
10. Include activities that allow teachers to pilot sample project materials during the training sessions and in the classroom.	10. In many course activities the teachers participated in-class as students, tried the activity with their own students and then reflected on and modified the process of instruction. The MPS activities were used extensively as well.
11. Include reflective analysis activities in the training process.	11. Through the use of group work, reflective journal writings, class discussion, videotapes, and action plans, the participants analyzed their own (and other teachers) teaching behaviors.
12. Include activities for teacher observation of similar projects in other classrooms, schools or districts.	12. Many of the course activities included the instructional staff modeling teaching behaviors and using various forms of curricular materials. Action Plans and videotapes were shared and many teachers worked as both instructional and evaluation school based teams, observing each other and co-teaching.
13. Include local development of project materials	13. Through curriculum-based action plans participants examined their grade-level MPS curriculum standards and activities, altered those activities and added other resources to complete a written thematic unit they would latter use in their classrooms.
Follow-up:	
14. Provide for classroom assistance from local staff (teacher leaders).	14. Classroom assistance by the project staff was indirectly accomplished through whole class discussion, small group work and responses to reflective journal assignments. Teachers often worked as instructional teams at their schools to complete assignments or action plans.
15. Include evaluative feedback (principal, pear, self).	15. Feedback to participants was provided via ongoing assessments of the course assignments, class participation and reflective journal writings and discussions. Some participants also provided each other feedback as they team taught and field tested instructional techniques or activities.
16. Schedule regular follow-up meetings that focus on needs-based issues.	16. All meetings were conducted during the one-year duration of the program. Project staff meetings and regular feedback from participants helped to modify the program during implementation. No meetings with

Figure 9: Example of a potential set-up for a professional development program (Posnanski, 2002)

Appendix E: Survey Results from our Interviewees

These are results from our survey we sent out to our interviewees after we completed our interview with each person. These surveys were completed by only three interviewees and were intended to be a sample survey in preparation for the Mass STEM Summit that our sponsors are attending this upcoming fall.

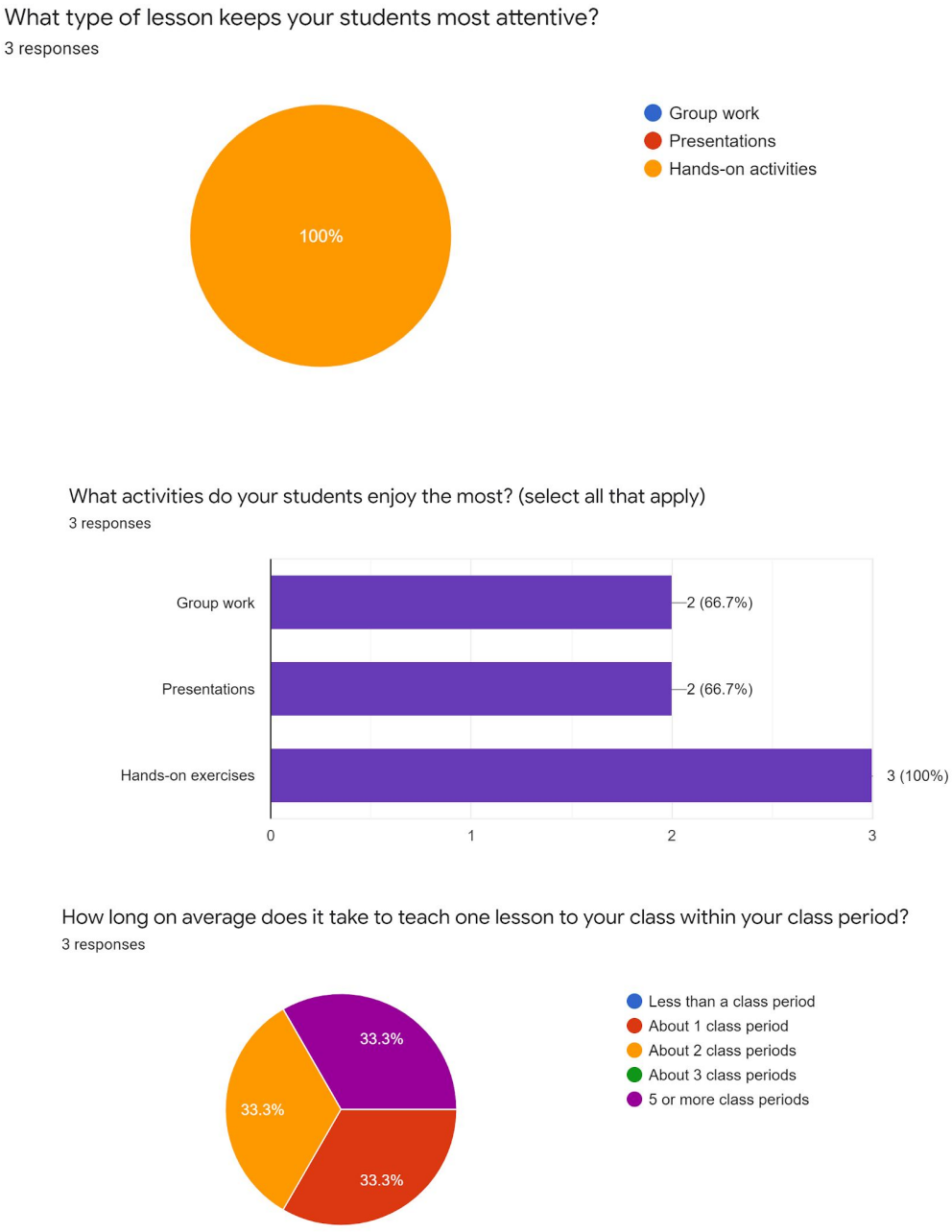

Figure 10, 11, 12: Some survey results from the Google Forms survey