Stormwater Runoff Education and Environmental Stewardship: Supplemental Information

Part of An Interactive Qualifying Project Final Report
In Partial Fulfillment of the Requirements for the
Degree of Bachelor of Science

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Table of Contents

List of Tables

List of Figures

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Section	Primary Author	Primary Editor
Abstract	Cielo S. and Mike C.	Mike C.
Stormwater & Environmental Education	All	All
The Fresh Water Crisis	Thomas K.	All
Common Pollutants	Thomas K.	All
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The Guide to Effective Education	Sean B.	All
Fitchburg, Massachusetts	Cielo S.	All
Project Goal	Sean B.	All
Methods	Cielo S., Thomas K, Mike C.	Sean B.
Phase I: Research on Curriculum and MS4 Permit	Mike C.	Sean B.
Phase II: Development of Effective Stormwater Program	Cielo S.	Sean B.
Phase III: Implementation of Education Program	Thomas K.	Sean B.
Findings & Deliverables	Cielo S.	Sean B.
Educator Resource Guide	Cielo S.	Sean B.
Curriculum Guide	Cielo S.	Sean B.
Community Resources Index	Cielo S.	Sean B.
Educational Support Index	Cielo S.	Sean B.
Lesson Development Index	Cielo S.	Sean B.
The Importance of Hands-On, Outdoor Education	Cielo S.	Sean B.
Student Workbook	Cielo S.	Sean B.
Accessible Vocabulary	Cielo S.	Sean B.
Interdisciplinary Chapter Content	Cielo S.	Sean B.
Critical Thinking Activities	Cielo S.	Sean B.
Educational Video	Sean B.	Sean B.
Recommendations and Conclusions	Sean B.	Cielo S.
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Supplemental Information	Sean B. and Mike C.	Sean B. and Mike C.

Data Collection Instruments

Appendix A: Interview Questions for STEM Specialist

Interviewee: Jessica Stodulski

These interview questions were used to gain an understanding of the science curriculum taught within Fitchburg Public Schools. These questions specifically targeted the 2016 Massachusetts Science, Technology, and Engineering Frameworks as well as the connection between public schools and local outreach organizations within Fitchburg.

Preamble

We are a group of four students from Worcester Polytechnic Institute working to improve the Fitchburg Department of Public Works' compliance with the 2016 Municipal Separate Storm Sewer System (MS4) Permit. We are seeking to interview you to improve our understanding of the Science, Technology, and Engineering (STE) Frameworks followed by the Fitchburg Public Schools. Your participation is completely voluntary and you can stop the interview at anytime you may choose. We will be more than happy to keep your responses confidential if you desire. The project sponsors, Worcester Polytechnic Institute and the Fitchburg Department of Public Works, as well as our team appreciate your participation.

Questions

1. Can you explain your role within the Fitchburg Public School System?
2. Is the Fitchburg science and engineering curriculum consistent with the Massachusetts State STE Frameworks?
3. How are students currently educated about the water cycle?
4. Can you explain the STE Frameworks for fifth grade?
5. Can you explain the STE Frameworks for sixth grade?
6. How strong is the connection between Fitchburg Public Schools and local environmental outreach organizations, such as the Nashua River Watershed Association?
7. Can you identify any specialists that deal with the education of underprivileged, English-as-Second-Language (ESL), or special needs students?

Appendix B: Interview Questions for English Language Learner Director

Interviewee: Bonnie Baer-Simahk

These interview questions were used to better understand the educational obstacles facing the English Language Learner (ELL) population within Fitchburg Public Schools. By understanding the challenges that ELL students face, we were better able to create a stormwater program that catered to this student population.

Preamble

We are a group of four students from Worcester Polytechnic Institute's Massachusetts Water Resource Outreach Center working to improve the Fitchburg Department of Public Works' compliance with the 2016 Municipal Separate Storm Sewer System (MS4) Permit. We are seeking to interview you to better understand the techniques used to educate English Language Learner (ELL) students within the Fitchburg Public Schools. Your participation is completely voluntary and you can stop the interview at anytime you may choose. If you would like, we are happy to keep your responses confidential. The project sponsors, Worcester Polytechnic Institute and the Fitchburg Department of Public Works, as well as our team appreciate your participation.

Questions

1. We understand that you are the ELL Director for FPS. Can you explain your roles as the ELL Director?
    a. How did you become the ELL Director of FPS?
    b. How long have you been the ELL Director of FPS?
    c. Are the students native speakers of one specific language?
    d. How many students are you responsible for?

2. Our group has performed initial research on the tenets that education must draw upon in order to be compatible with ELL students. However, these tenets (life experiences, culture, motivation) are quite broad and generalized. Based on your teaching experience, can you describe specific methods that are fundamental for teaching to ELL students?
    a. We understand this is a difficult question because each ELL student has a different learning style. However, are there any common teaching approaches used to teach ELL students?
    b. Please describe what about these methods makes them so effective.

3. Your teaching experience has undoubtedly given you insight into the learning styles of ELL students. Please identify the biggest challenge that non-native English speakers face in Massachusetts Public School education.
    a. Which subjects do your students have the most trouble understanding?

4. The goal of our project is to develop a new science program for 5th graders about stormwater runoff and water quality. This program will include a science handbook as well as informal, outdoor activities. Do you have any recommendations for elements that could be incorporated in the handbook or outdoor activities to make them:
    a. More usable for ELL teachers?
    b. More compatible for ELL students?

Appendix C: Interview Questions for Special Education Educator

Interviewee: Kristin Gallo

These interview questions were used to better understand the educational obstacles facing the Special Education population within Fitchburg Public Schools. By understanding the challenges that Special Education students face, we were better able to create a stormwater program that catered to this student population.

Preamble

We are a group of four students from Worcester Polytechnic Institute's Massachusetts Water Resource Outreach Center working to improve the Fitchburg Department of Public Works' compliance with the 2016 Municipal Separate Storm Sewer System (MS4) Permit. We are seeking to interview you to better understand the techniques used to educate Special Education students within the Fitchburg Public Schools. Your participation is completely voluntary and you can stop the interview at anytime you may choose. If you would like, we are happy to keep your responses confidential. The project sponsors, Worcester Polytechnic Institute and the Fitchburg Department of Public Works, as well as our team appreciate your participation.

Questions

1. We understand that you are a Special Education teacher at McKay Arts Academy. Can you explain your role as a Special Education teacher within the Fitchburg Public School System?
    a. How did you become a Special Education teacher?
    b. Can you describe the range of disabilities that you are certified to teach?
    c. How many students are you responsible for?

2. Our group has performed initial research on the tenets that education must draw upon in order to be compatible with Special Education students. However, these tenets (life experiences, culture, motivation) are quite broad. Furthermore we understand that the Fitchburg Public Schools caters to is a wide spectrum of special needs. As a result it may be difficult to answer this question, but can you describe specific methods that are fundamental for teaching to Special Education students?
    a. Please describe what about these methods makes them so effective.

3. Your teaching experience has undoubtedly given you insight into the learning styles of Special Education students. Please identify the biggest challenge that your students face in Fitchburg Public Schools.

4. The goal of our project is to develop a new science lesson for 5th graders about stormwater runoff and water quality. This lesson will include a science handbook as well as informal, outdoor activities. Do you have any recommendations for elements that could be incorporated in the handbook or outdoor activities to make them:
    a. More usable for Special Education teachers?
    b. More compatible for Special Education students?

Appendix D: Interview Questions for State Stormwater Official

Interviewee: Frederick Civian

These interview questions were used to better understand the statewide requirements of the 2016 Municipal Separate Storm Sewer System (MS4) Permit. Furthermore, these questions provided insight regarding the already established educational programming across the state of Massachusetts.

Preamble

We are a group of four students from Worcester Polytechnic Institute's Water Resource Outreach Center and we are working to improve the Fitchburg Department of Public Works' compliance with the 2016 Municipal Separate Storm Sewer System (MS4) Permit. We are seeking to interview you to improve our understanding of the internal workings of the permit as well as stormwater education in Massachusetts. Your participation is completely voluntary and you can stop the interview at anytime you may choose. Are you comfortable if we use your name in our final project material, which will be published, or would you prefer we keep your name confidential? The project sponsors, Worcester Polytechnic Institute and the Fitchburg Department of Public Works, as well as our team appreciate your participation.

Questions

1. We understand you are the Massachusetts DEP Stormwater Coordinator and are involved with the state's MS4 and NPDES permits. This must be a very busy job, particularly for one individual. Can you explain the variety of roles you complete as the Stormwater Coordinator for the state of Massachusetts?

2. Given the breadth of your experience, what do you see as the primary stormwater issues facing Massachusetts municipalities?

3. Out of all six control measures defined in the MS4 Permit, the first measure "Public Education and Outreach" is the most prevalent to our project. As per our understanding, it mandates municipalities to implement educational programming that increases stormwater knowledge and facilitates behavior changes among the public. Can you help us better understand the specific requirements of the MS4 Permit's first control measure?

4. Education must be an essential part of your job, especially in terms of getting designers and developers to abide by the stormwater regulations put forth in the Massachusetts Stormwater Standards. In what ways will public school youth education help improve compliance with these standards or the overall MS4 Permit?
    a. Can you describe your stormwater education experiences with students?

5. Do you have any recommendations as to what items or information we could include in the Fitchburg handbook in order to comply with the MS4 Permit's first control measure?
    a. Please tell us about any existing stormwater education plans or presentations produced by the MassDEP.
    b. Can you please provide your existing public outreach presentations?
    c. Are there any resources that you recommend we reference for this project?

Appendix E: Interview Questions for Fitchburg Stormwater Official

Interviewee: Nick Erickson

These interview questions were used to better understand the specific implications of the 2016 Municipal Separate Storm Sewer System (MS4) Permit for Fitchburg, Massachusetts. Additionally, these questions provided insight regarding the already established educational programming present within the City of Fitchburg.

Preamble

We are a group of four students from Worcester Polytechnic Institute's Water Resource Outreach Center and we are working to improve the Fitchburg Department of Public Works' compliance with the 2016 Municipal Separate Storm Sewer System (MS4) Permit. We are seeking to interview you to improve our understanding of the internal workings of the permit as well as the stormwater issues within Fitchburg. Your participation is completely voluntary and you can stop the interview at anytime you may choose. Are you comfortable if we use your name in our final project material, which will be published, or would you prefer we keep your name confidential? The project sponsors, Worcester Polytechnic Institute and the Fitchburg Department of Public Works, as well as our team appreciate your participation.

Questions

1. We understand you are a Civil Engineer for the City of Fitchburg Department of Public Works. Can you explain the variety of roles you complete as a Civil Engineer for DPW?
    a. What are the variety of projects you have worked on?
    b. How does stormwater mitigation regulations affect your projects?

2. Given your experience, what do you see as the primary stormwater issue facing Fitchburg?

3. Education must be an essential part of your job, especially in terms of getting designers and developers to abide by the stormwater regulations put forth in the Massachusetts Stormwater Standards. In what ways will public school youth education help improve compliance with these standards or the overall MS4 Permit?
    a. (Note: Students are not included as one of the four audiences mentioned in the first control measure)
    b. Can you describe your stormwater education experiences with students?
    c. What was it like to involve the youth with such a project?

4. Do you have any recommendations as to what items or information we could include in the Fitchburg handbook in order to comply with the MS4 Permit's first control measure?

Appendix F: Interview Questions for Local Outreach Organizations

These interview questions were used to understand and evaluate the stormwater programs provided by local environmental outreach organizations. From these interviews, our team was able to understand the essential elements of outreach programs, and infuse the most desirable elements into the stormwater program developed during this project.

Preamble

We are a group of four students from Worcester Polytechnic Institute's Water Resource Outreach Center and we are seeking to interview you to improve our understanding the stormwater education programs led by [organization name]. Your participation is completely voluntary and you can stop the interview at anytime you may choose. Are you comfortable if we use your name in our final project material, which will be published, or would you prefer we keep your name confidential? The project sponsors, Worcester Polytechnic Institute and the Fitchburg Department of Public Works, as well as our team appreciate your participation.

Questions

1. We understand that you are the Education Coordinator at [organization name]. Can you explain the variety of roles you complete as the Education Coordinator?

2. The central mission of [organization name] is to protect nature in Massachusetts, and public education is a critical element to achieving this mission. We understand that you've developed and perhaps delivered educational programs to 5th grade and middle school students. Please tell us a bit about these educational programs and how they work.
    a. Can you describe highlights from these programs?
    b. Do you have any accompanying activities, such as a workbook, for students? And if so, what topics are covered, and can we have access to them?
    c. Are there any programs or activities specifically geared towards stormwater and runoff pollution?
    d. Is your program compatible with ELL or special education students?

3. What has been your favorite part about conducting these educational programs?

4. Does your organization have a process for assessing the success of an educational program?
    a. Have these programs been successful in conveying knowledge to the students?
    b. What types of positive changes have you noticed in students?

    c. What types of improvements have you seen in the environment?

5. Now we would like to switch gears a bit and seek your insights on our project. We are trying to create an informal education program about stormwater for 5th grade students in Fitchburg. Do you have any suggestions on how we might accomplish this or examples from your own experience of how this might be accomplished?
    a. How did you take into account students values, morals, and beliefs into your programs?

6. Lastly, can you recommend any additional resources that we might look at, or people we might speak to that you think would have valuable insights on stormwater education?

Appendix G: Classroom Observation Evaluation Matrix #1

This Classroom Observation Evaluation Matrix served as a template for recording direct observations of student-teacher interactions. The matrix evaluates student involvement, teaching methods, and learning styles. This template provided observers with a starting point for observations. Following the observation sessions, the observers collaborated to share and compile data which is presented later in this document.

Table 1: *Direct Observation Evaluation Matrix #1*

	Direct Observation Evaluation Criteria				
	Student	***"Effective" Criteria***			
Class	Involvement	Conveys Knowledge	Develops "Locus"	Addresses Values	Develops Attitudes
Scale	**1 - 5** 1: Minimal 5: Exceptional	**1 - 3** 1: Failure 3: Success	**1 - 3** 1: Failure 3: Success	**1 - 3** 1: Failure 3: Success	**1 - 3** 1: Failure 3: Success

Direct Observation Evaluation Criteria (continued)					
Teaching Method			***Learning Styles***		
Lecture-Based	Experimental	Interactive	Auditory	Visual	Kinesthetic
Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No

Appendix H: Classroom Observation Evaluation Matrix #2

This Classroom Observation Evaluation Matrix evaluated teaching methods based on compliance to the 2016 Massachusetts State Eight Science and Engineering Practices. During observation sessions, observers identified which principles were satisfied and which were not. Observers then used the table to explain their observations. Following the observation sessions, observers shared and compiled their results and a consensus was reached regarding the class' compliance to the Science and Engineering Practices.

Table 2: *Direct Observation Evaluation Matrix #2*

Practices	Observations
Practice 1: Asking Questions and Defining Problems	
Practice 2: Developing and Using Models	
Practice 3: Planning and Carrying Out Investigations	
Practice 4: Analyzing and Interpreting Data	
Practice 5: Using Mathematics and Computational Thinking	
Practice 6: Constructing Explanations and Designing Solutions	
Practice 7: Engaging in Argument from Evidence	
Practice 8: Obtaining, Evaluating, and Communicating Information	

Appendix I: Classroom Observation Guide to Science and Engineering Principles

The following material served as a guide to the Eight Science and Engineering Practices established by the 2016 Massachusetts Science, Technology, and Engineering (STE) Frameworks. Prior to conducting classroom observations, our team synthesized the STE Frameworks and put together this document to explain each of the practices. In addition, our team included specific indicators or "look fors" for each principle. Overall, this document prepared our team with knowledge of the practices prior to conducting classroom observation.

Practice 1: Asking Questions and Defining Problems

Science is driven by preliminary questions about natural phenomenon. Through observations of nature, models, theories, or findings, students can develop curiosity of phenomena and begin to question the supporting evidence behind them. On the other hand, engineering begins with the definition of a problem. Questions can be asked to better define the problem; however the problem is what drives engineering.

Look for: What's driving the students to ask the questions? Are the students asking scientific (testable) questions? Can the students design a simple problem that can be solved through a scientific process?

Practice 2: Developing and Using Models

A model is a useful tool to approximate the real world in a classroom setting. Models help students develop questions and answers, generate data, and convey ideas to others. Other models can be used for testing and analysis purposes. However they are only approximations and their limitations must be understood.

Look for: What kinds of models are used in Fitchburg Public School classrooms? Do students understand the limitations of the models? Can the students develop a model to represent/describe a principle?

Practice 3: Planning and Carrying Out Investigations

Students need to investigate phenomenon, theories, and models. The critical elements of a systematic investigation are: 1) stating the goal; 2) predicting outcomes; 3) generate data; and 4) develop conclusions supported with evidence.

Look for: Can the students plan and conduct an investigation with all of these elements? Can the students predict what would happen if a variable changed?

Practice 4: Analyzing and Interpreting Data

Students need to analyze data before arriving at a conclusion. This can be done through tabulation, graphical representation, visualization, and statistical analysis. Through these analysis tools, students can identify and interpret data patterns and features.

Look for: How are the students analyzing the data (tables, graphs, figures)? Are they identifying features and patterns? Can the students compare and contrast data?

Practice 5: Using Mathematics and Computational Thinking

Students are expected to use mathematics to represent physical variables, and develop mathematical relationships and predictions between these variables. Mathematical logic shall be used in combination with computers to perform calculations and identify meaningful patterns.

Look for: Can the students decide between using qualitative and quantitative data? Can the students organize data into tables/charts to reveal patterns? Can the students measure, estimate, or graph quantities such as volume, weight, and time?

Practice 6: Constructing Explanations and Designing Solutions

The purpose of science is to provide explanations for certain phenomena. Students will be exposed to standard explanations, but will need to make their own explanations as well. Within these explanations, students need to relate one variable to another. In cases when students are addressing engineering problems, they need to produce a solution rather than an explanation.

Look for: Can the students provide an explanation of their observations? Can the students design a solution to a defined problem? Can the students compare multiple solutions?

Practice 7: Engaging in Argument from Evidence

An explanation to a phenomena or solution to a problem is not complete without an argument supported by evidence. Explanations and design solutions are only accepted by the scientific/engineering community if they are supported by evidence and reasoning.

Look for: Are the students citing relevant evidence? Can the student distinguish between facts, reasoning, and speculation? Can the students construct/support an argument with evidence, data, or a model?

Practice 8: Obtaining, Evaluating, and Communicating Information

The ability to communicate clearly and persuasively is essential to science and engineering. Students need to become critical consumers of information and distinguish between arguments and explanations. Effective communication is done through a variety of modes, including tables, diagrams, graphs, and models as well as through math, writing, and speech.

Look for: Can the students summarize and obtain important ideas from scientific texts? Can the students combine information from text with tables, diagrams, and charts to formulate an argument? Can the students communicate scientific information through speech and writing?

Appendix J: Free-Listing Activity Teacher Directions

The following set of directions was developed to standardize the manner in which the free-listing activity was administered to fifth graders within Fitchburg Public Schools. Standardization is an essential element of data collection, and these directions helped achieve the highest level of standardization with the free-listing activity. The directions are provided below.

Please read the following prompt aloud in front of the class prior to handing out the student questionnaires. "A group of four students from Worcester Polytechnic Institute are working with the Fitchburg Public Schools to create new science lessons for 5th Graders. This is a voluntary questionnaire that will help give the WPI students useful information about your science knowledge. You will not be graded on your answers, so please provide as many answers as possible to each question. The WPI team is happy to have you participate in this project."

Please hand out the following questionnaire to your students during Advisory. The students are encouraged to provide as many answers as they want to each question. The students can be expected to answer the first 10 questions independently.

The 11th question is meant to be an immersive question, where the teacher reads aloud a description of three environmental education classes and the students choose which class they find most appealing. Please find the directions for this activity below.

> Please stop the students once they have completed the first 10 questions. Once all students have completed the first 10 questions, read the following script to the class:
>
> "I will read aloud three descriptions. Each description is meant to tell you about a fun science class. Please close your eyes and imagine yourself in these classes. Once I have read all three options, please select your favorite one.
>
> The first option: The River Classroom. Imagine it a sunny day in the middle of September. You and your class are canoeing down the Nashua River. It is hot, but the water from the river splashes up against the side of the canoe and cools you down. Using a small net, you scoop small critters out of the river and count them. Based on your counts, you can tell if the Nashua River has acceptable or unacceptable water quality.

The second option: Nature-Based Classroom. Imagine you are out in the Broad Meadow Brook Wildlife Sanctuary. There are tall trees for as far as your eyes can see. The leaves are gently rustling from the soft wind. You walk down to a stream and take water samples from the flowing water. You and your classmates then use a water testing kit to see if the water is contaminated with nitrogen and phosphorous.

The third option: Hands-On Classroom. Imagine you and your classmates are sitting a classroom table. On the table is a model of a small town. The model has all sorts of houses, streets, bridges, and hills on it. You and your friends sprinkle fertilizers on all the yards, salt on the streets, and oil on driveways. Then, you use a spray bottle to rain on the small town to investigate where the fertilizers go.

Now that I have read the three options aloud, please select your favorite one on your answer sheet. Once you have finished all the questions, please hand in your questionnaires to me."

Once the students have answered all questions, please collect the answer sheets and send an email to fitchburg18@wpi.edu. One of our team members will coordinate a time to stop by and pick up the answer sheets.

Thank you!

Sean Burke
Mike Cooke
Tom Kouttron
Cielo Sharkus

Appendix K: Free-Listing Activity Student Questions

The free-listing activity contained 11 total questions, largely consisting of short answer questions. The first three questions within this activity were simple questions geared to get students thinking about their connection with the environment. Then, the remainder of the questions measured the students' knowledge of stormwater runoff and pollution, in order of increasing difficulty. The purpose of this activity was to identify the students' baseline knowledge of stormwater runoff and pollution.

Please provide as many answers as you can to each question.

1. Please list your favorite outdoor activities.
2. Please list the outdoor activities you can do near your home.
3. Please list some local water bodies near your home.
4. Where does rain go when it hits the ground?
5. Can you list common water pollutants?
6. Can you list sources of these water pollutants?
7. Have you heard of stormwater before?
    a. Yes
    b. No
8. Can you explain what stormwater runoff is? If you have never heard of stormwater, leave this answer blank.
9. What are some ways to prevent stormwater pollution? If you have never heard of stormwater, leave this answer blank.
10. Have you learned about the effects that stormwater has on the environment?
    a. Yes
    b. No

STOP: PLEASE WAIT FOR THE TEACHER'S DIRECTION BEFORE ANSWERING QUESTION 11.

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11. Please indicate which classroom description was your favorite.
    - ❑ River Classroom
    - ❑ Nature-Based Classroom
    - ❑ Hands-On Classroom

Appendix L: Student Feedback Form

The following questions were used to obtain feedback from the pilot of the stormwater program at the Boys and Girls Club of Fitchburg and Leominster. Once a student completed the activities at our team's science station, we asked them the three following questions. The responses to these questions were used to later evaluate and revise the stormwater program.

1. Check your favorite activity.
    - ❑ Ecosystem and Pollution Poster
    - ❑ Paper Mountain
    - ❑ Surface Model

2. What did you find challenging about these activities?

3. What is one thing you learned from these activities?

Appendix M: Parent Feedback Form

The following questions were used to obtain feedback from the pilot of the stormwater program at the Boys and Girls Club of Fitchburg and Leominster. Once a family completed the activities at our team's science station, we asked the parents the following four questions. The responses to these questions were used to later evaluate and revise the stormwater program.

1. Was your child (children) interested in the activities?

2. Have you ever heard of stormwater before today?

3. Do you currently know about or have any Green Infrastructure at your residence? (Green Infrastructure can include rain gardens, rainwater collection barrels, permeable pavements, etc.)

4. Thank you for working with us today! Please feel free to share any other comments or ask us any questions regarding this questionnaire or our project.

Raw Data

Appendix N: Classroom Observation Evaluation Matrix #1

Table 3: *Results for Direct Observation Evaluation Matrix #1*

Class	Direct Observation Evaluation Criteria				
	Student Involvement	*"Effective" Criteria*			
		Conveys Knowledge	Develops "Locus"	Addresses Values	Develops Attitudes
Scale	**1 - 5** 1: Minimal 5: Exceptional	**1 - 3** 1: Failure 3: Success	**1 - 3** 1: Failure 3: Success	**1 - 3** 1: Failure 3: Success	**1 - 3** 1: Failure 3: Success
5th Grade AALI (Observer 1)	5	3	1	1	1
5th Grade AALI (Observer 2)	4	2	1	1	1

Direct Observation Evaluation Criteria (continued)					
Teaching Method			*Learning Styles*		
Lecture-Based	Experimental	Interactive	Auditory	Visual	Kinesthetic
Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
5th Grade AALI (Observer 1)	Yes	Yes; students were fully interacting with the building and coding of the robot.	Yes; students were assisting one another through speech in addition to the teacher giving instructions/help through speech.	Yes; students used picture-based instruction book to build robots.	Yes; there was hands-on buildings of the robot.
5th Grade AALI (Observer 2)	Yes	Yes; students worked well in groups.	Yes; teacher instructed students at the beginning of the class.	Yes; students used picture instructions to construct their robot.	Yes; there was hands-on construction of the robot.

Appendix O: Classroom Observation Evaluation Matrix #2

Table 4: *Results for Direct Observation Evaluation Matrix #2*

Practices	**Observations (5th Grade AALI - Observer 1)**	**Observations (5th Grade AALI - Observer 2)**
Practice 1: Asking Questions and Defining Problems	Students discussed problems, functions, and parts for steering controls to experiment with a program to make the robot perform various movements.	Students connected classroom theory to direct application through subsequent questions.
Practice 2: Developing and Using Models	Students used lego robot models and Mindstorms for coding software.	Students used coding models to carry out investigations; students also used lego models to test their codings.
Practice 3: Planning and Carrying Out Investigations	Students investigated which design worked best for their group's robot.	Students used experimentation and natural disorder to make self-discoveries.
Practice 4: Analyzing and Interpreting Data	Not satisfied.	Not satisfied.
Practice 5: Using Mathematics and Computational Thinking	Students used Mindstorm systems for coding and controls.	Students used Mindstorm coding, which allowed them to create their own "code" or instructions for the robot to carry out.
Practice 6: Constructing Explanations and Designing Solutions	Students constructed robots and discussed design solutions for their models during their initial drive tests.	Not satisfied.
Practice 7: Engaging in Argument from Evidence	Not satisfied.	Not satisfied.
Practice 8: Obtaining, Evaluating, and Communicating Information	Not satisfied.	Not satisfied.

Appendix P: Student Feedback Analysis

Table 5: *Student Feedback Results from Boys and Girls Club Pilot*

Student #	What was your favorite activity?	What did you find challenging about the activities?	What is one thing you learned from these activities?
1	Paper Mountain	No Challenges	Water flows off asphalt
2	Paper Mountain	No Challenges	Water flows down a mountainside
3	Paper Mountain	Couldn't Hear	Asphalt is not absorbent
4	Paper Mountain	No Challenges	Dirt and sand absorbs more than roads
5	All	Crumpling paper was hard	Dog waste and trash should not go in ponds
6	Paper Mountain	No Challenges	Don't throw plastic into storm drains; bacteria end up in rivers
7	Surface Model	No Challenges	Pollution is bad
8	Ecosystem Pollution Model	No Challenges	The difference between storm drains and sewer system
9	Surface Model	No Challenges	Where water goes and how not to pollute water
10	All	No Challenges	Learned about surface runoff
11	Paper Mountain	No Challenges	Runoff ends up in rivers
12	All	No Challenges	Stormwater ends up in rivers and lakes
13	Paper Mountain	No Challenges	Water ends up in rivers
14	Paper Mountain	No Challenges	Water runs off pavement and takes pollutants into rivers/streams
15	Paper Mountain	Big Concepts	Storm drains don't go into the ocean
16	N/A	No Challenges	N/A

Appendix Q: Parent Feedback Analysis

Table 6: *Parent Feedback Results from Boys and Girls Club Pilot*

Parent #	Was Your Child Interested in the Activities?	Have You Heard of Stormwater Before Today?	Do You Have Green Infrastructure at Residence?	Comments
1	N/A	N/A	N/A	N/A
2	N/A	N/A	N/A	N/A
3	N/A	N/A	N/A	N/A
4	N/A	N/A	N/A	Liked educational speech and hands-on activities
5	Yes, hands on science	No	No	N/A
6	Yes	No	No	Eye-opening presentation
7	Yes	Yes	Yes	N/A
8	Yes	Yes	No	Thanks for coming
9	Yes, interactive display	Yes, in schools	Yes, rain gardens	Great display
10	Yes, a lot of info to digest	Yes	Rain Barrels, solar (Many GI examples)	N/A
11	N/A	N/A	N/A	N/A
12	Yes	Yes	No	WPI students were knowledgeable and friendly
13	N/A	N/A	N/A	N/A
14	N/A	N/A	N/A	N/A
15	N/A	N/A	N/A	N/A
16	Yes	Yes	Rain Barrel/Compost Bin	N/A

Appendix R: Free-Listing Activity Data Analysis

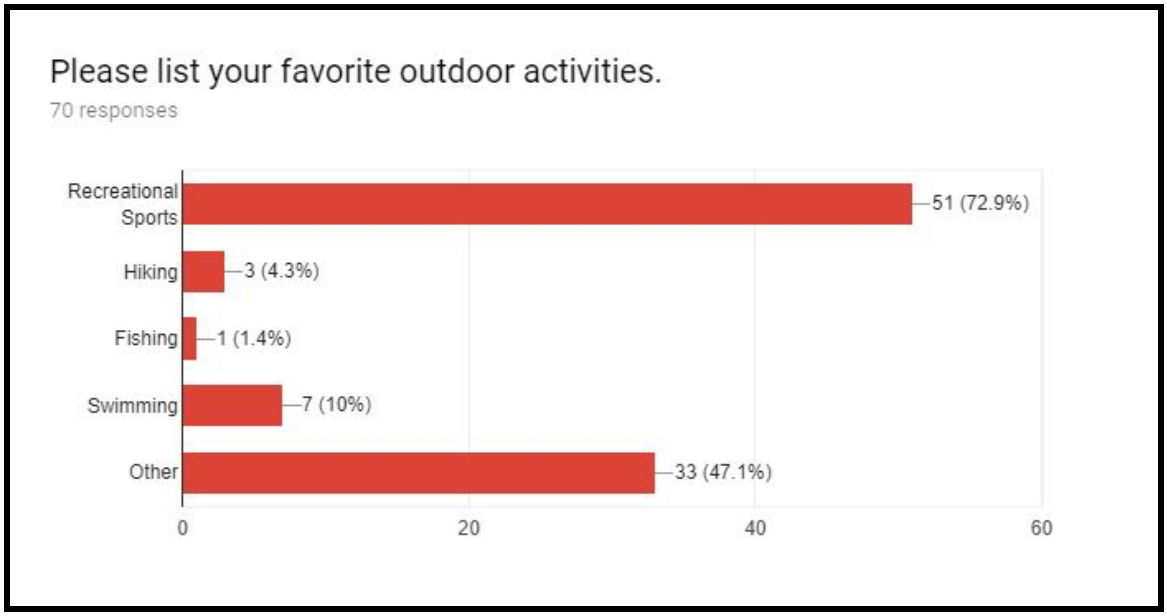

Figure 1: *Free-Listing Responses to Question 1*

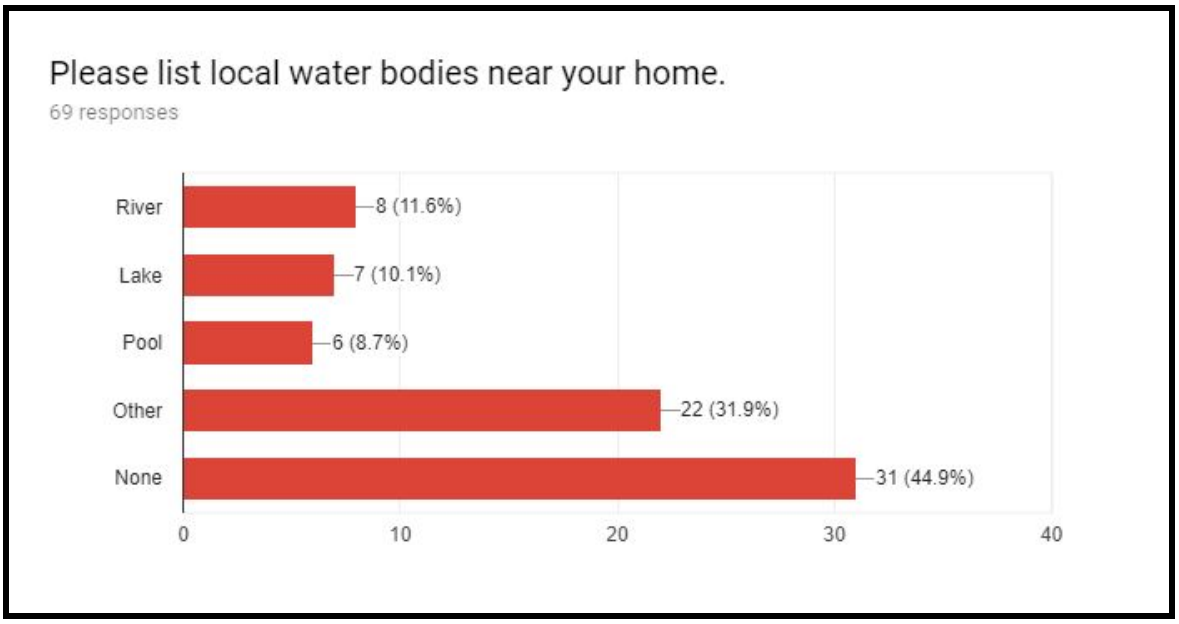

Figure 2: *Free-Listing Responses to Question 3*

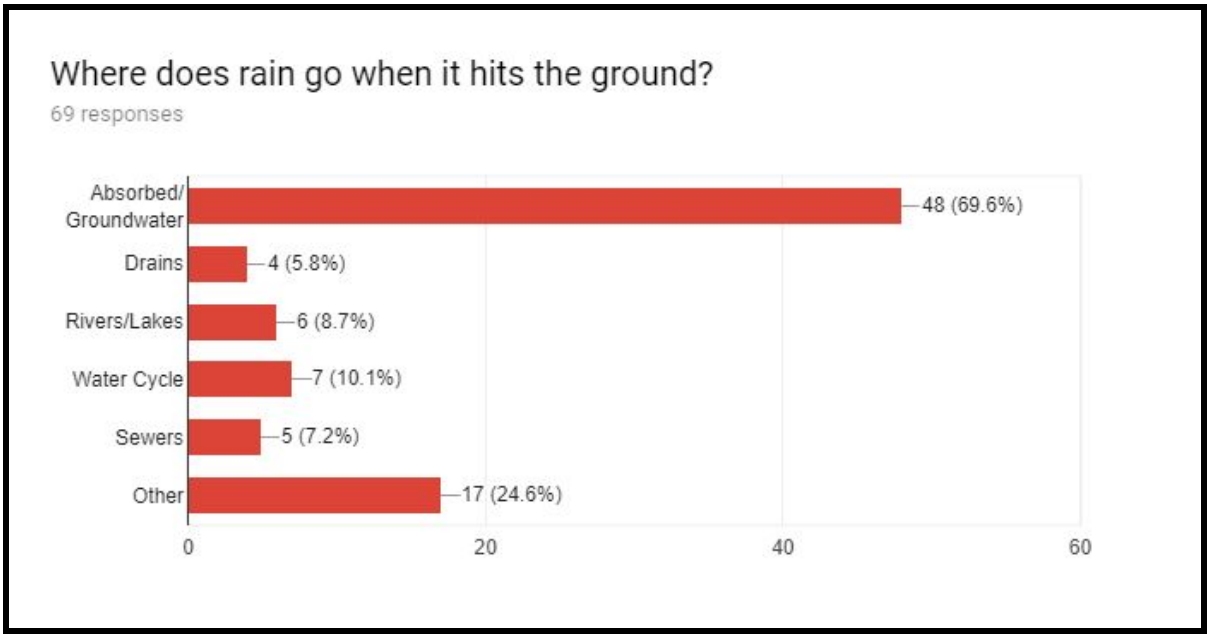

Figure 3: *Free-Listing Responses to Question 4*

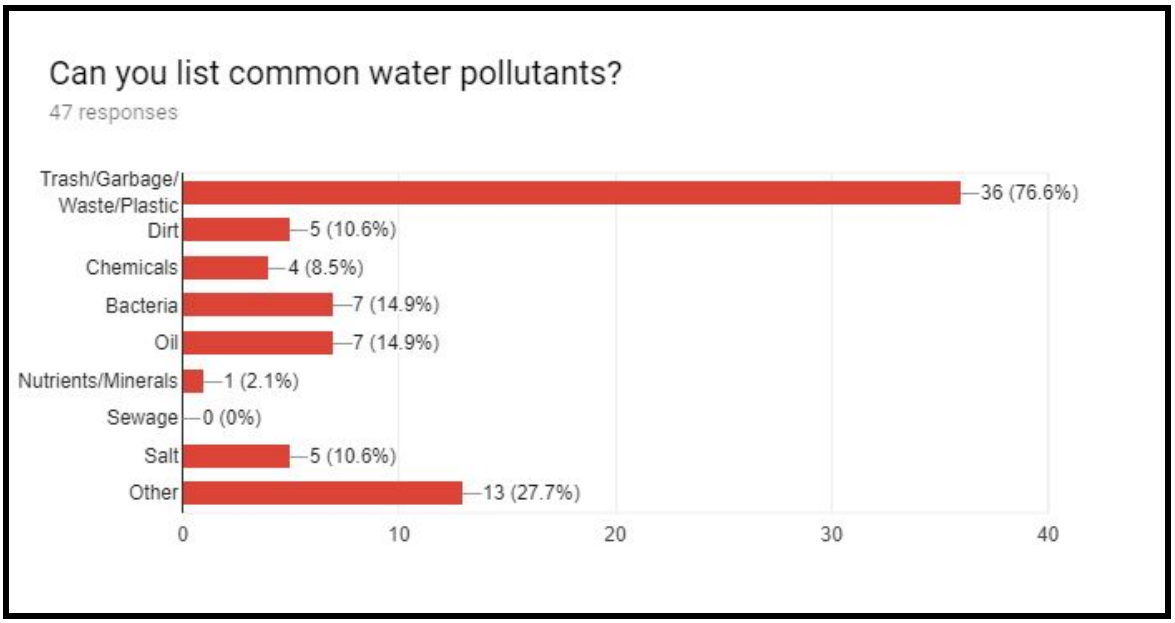

Figure 4: *Free-Listing Responses to Question 5*

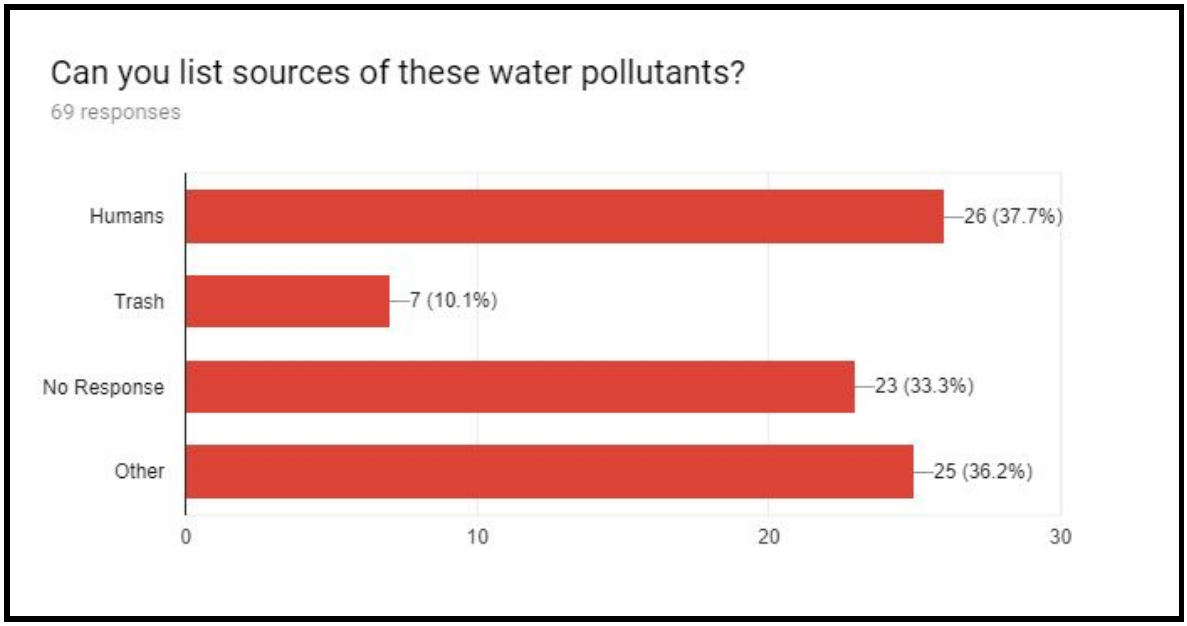

Figure 5: *Free-Listing Responses to Question 6*

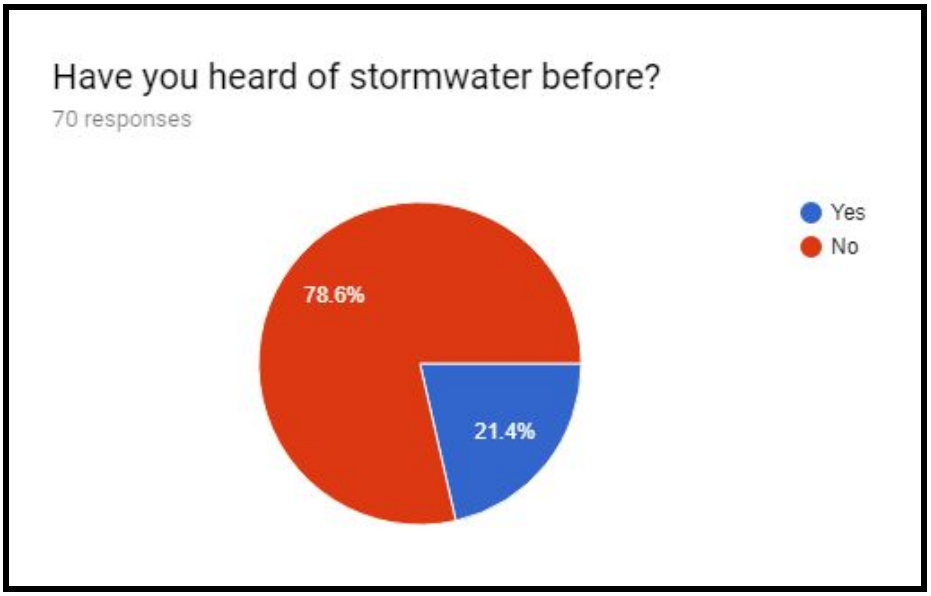

Figure 6: *Free-Listing Responses to Question 7*