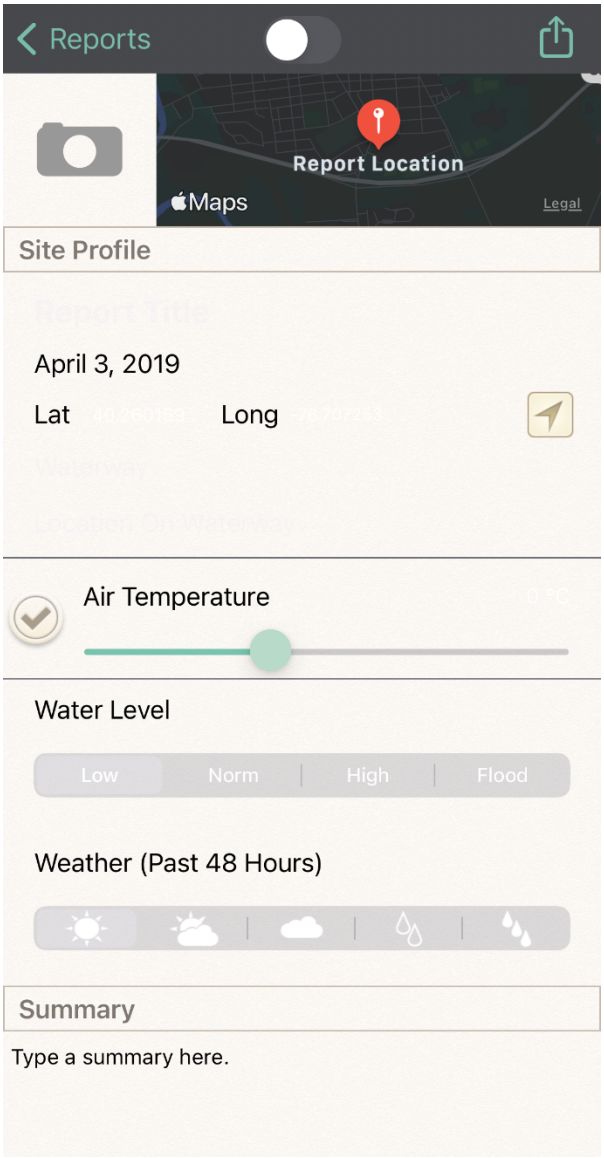
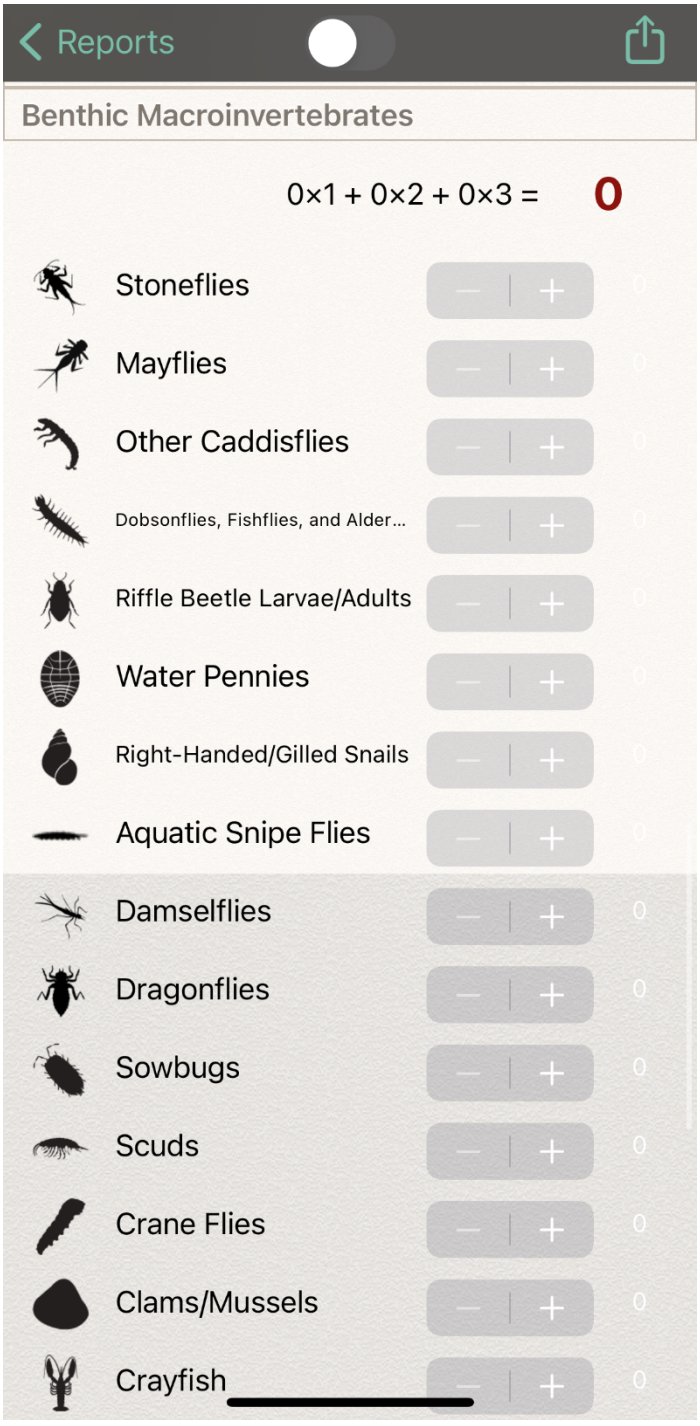
Supplemental Figures & Images

Fig 1. Snapshot of Blank Report for Water Quality App



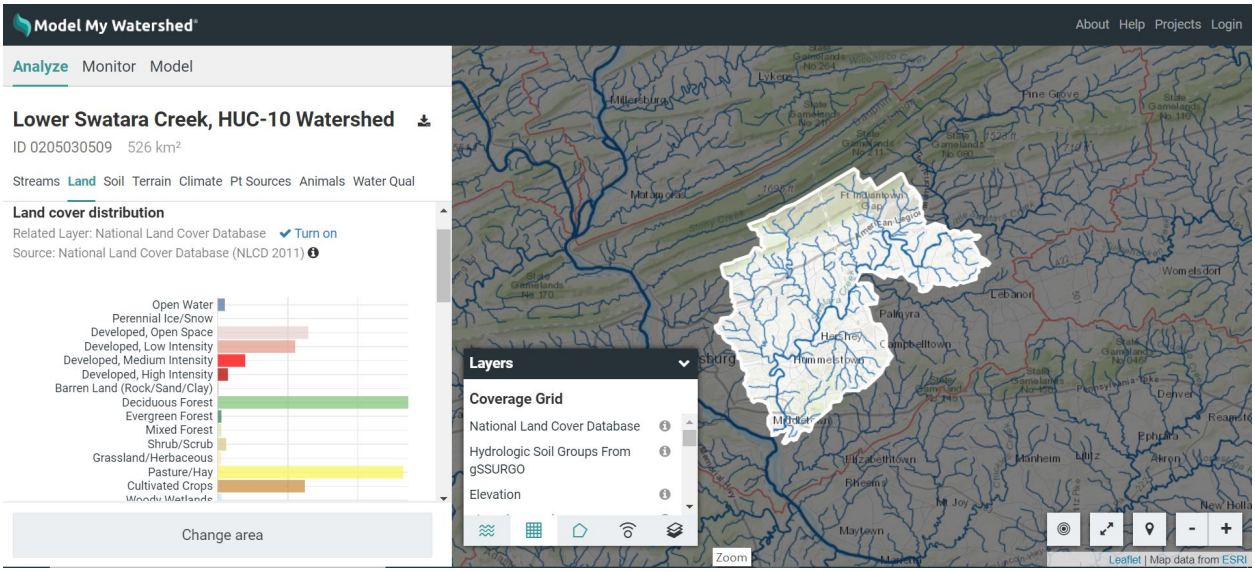
Data collected about the stream, including specific location and physical, chemical and biological test results can be inputted into a report on the app.

Fig 2. Snapshot of Macroinvertebrate Table on Water Quality App



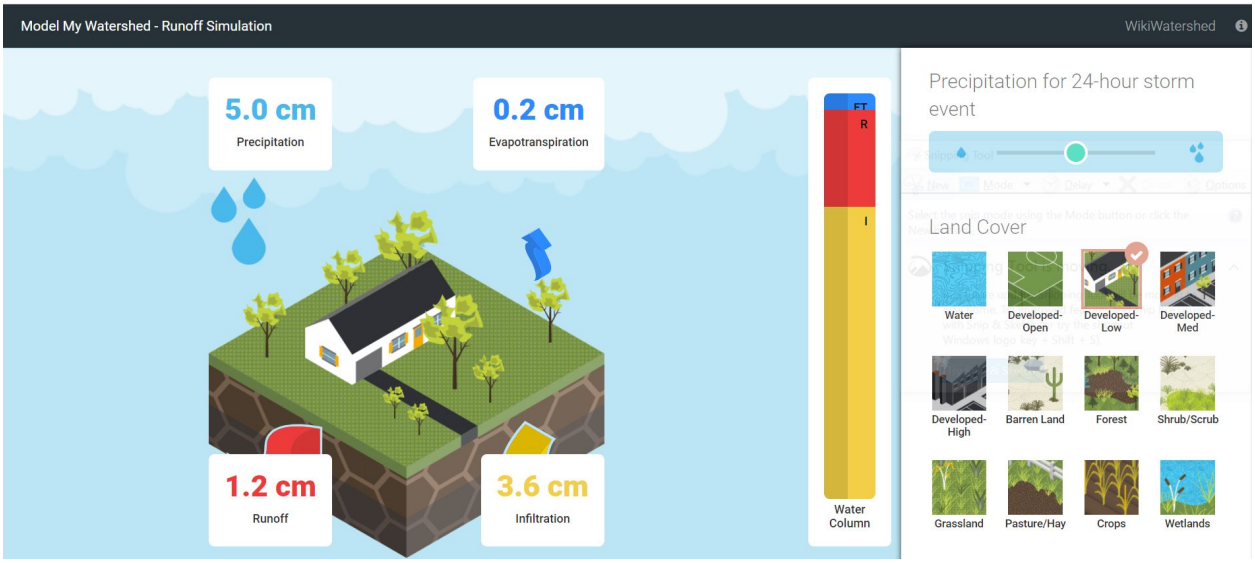
The Water Quality app tabulates the “health score” of the stream based on the number of macroinvertebrates collected and their sensitivity to pollution.

Fig 3. Snapshot of WikiWatershed App Model My Watershed



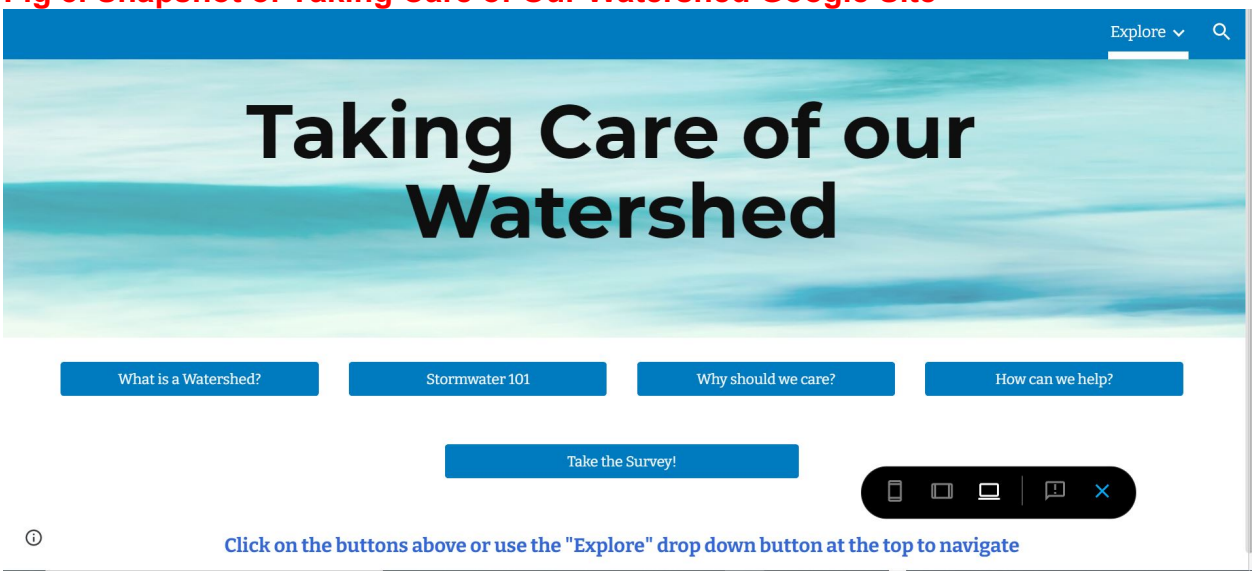
The WikiWatershed app allows users to select a specific location and use the tabs to explore land use, soil type, terrain, animals etc.

Fig 4. Snapshot of WikiWatershed Runoff Simulation



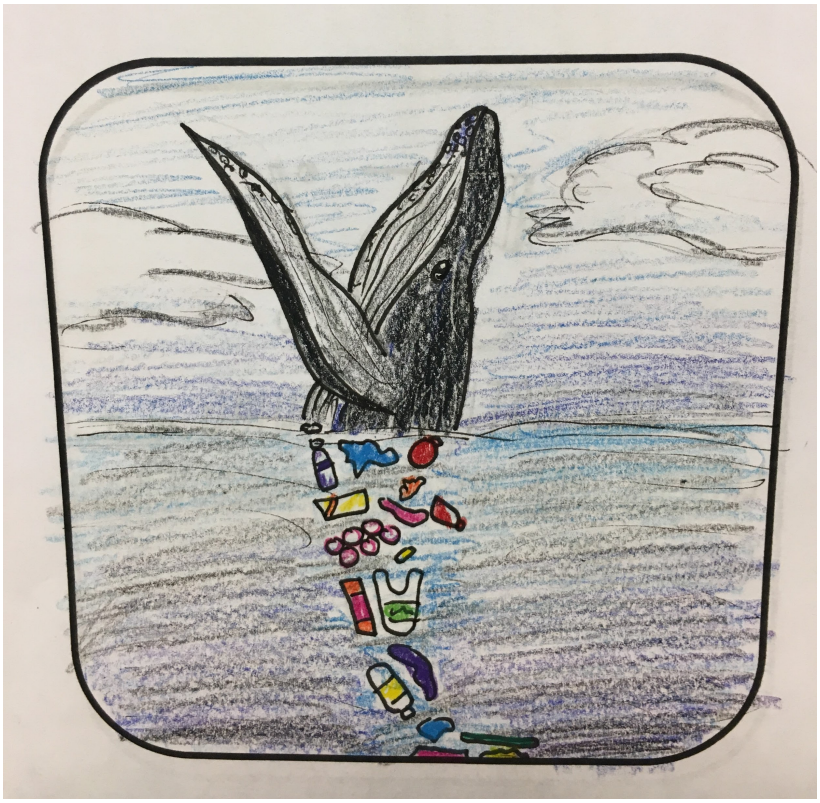
Caption: This app allows users to see the difference in stormwater runoff based on type of land cover and amount of precipitation.

Fig 5. Snapshot of Taking Care of Our Watershed Google Site



A Google site was created for student and community use during the MWEE and social media campaign.

Fig 6. Winning Coaster Designed by a 9th Grade Student



As part of the action project, coasters were manufactured using the NOAA grant and made available to patrons at a local restaurant in the community.

Fig 7. Station Guide

Field Stations (at local stream) *	**Classroom Stations (at school)**
1. Physical Station: - Stream Width/Depth - Stream Velocity - Stream Slope - Stream & Air Temperature 2. Biological Station: - Macroinvertebrate Collection & Identification 3. Chemical Station: - Nitrates - Phosphates - pH - Chlorine Content - Dissolved Oxygen (Concentration) - Water Hardness **Each station was set up at 2 different locations, an upstream and downstream. All students visited both locations*	1. Model My Watershed (WikiWatershed App) 2. Stormwater Runoff Simulation (WikiWatershed App) 3. School Yard Report Card 4. Drinkability Water Filter 5. Issue/Data/Solution Cards 6. Action Project – Coaster Design

The stations can be removed or modified based on time and resource availability

Fig 8. Physical Data (t-test - Upstream vs Downstream)

	slope	temperature in air in C	Temperature of stream in C	width (m)	depth (m)	velocity m/sec
p value	4.74×10^{-6}	0.051	0.267	0.2	0.08	0.29
Significant ?	Yes	No	No	No	No	No

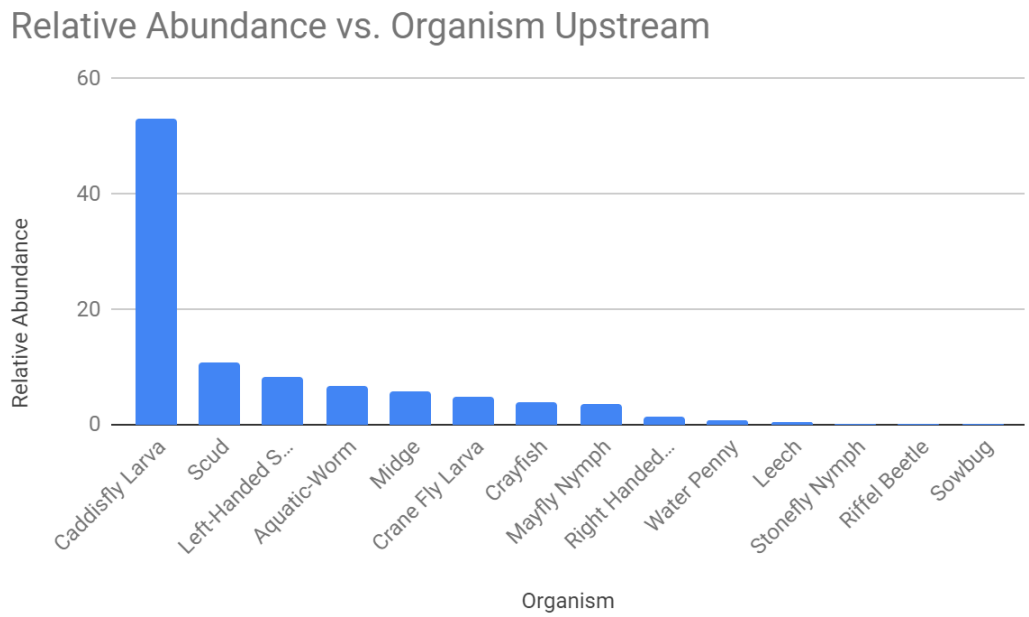
A p-value less than 0.05 indicates there is a significant difference in the findings between the two data sets. This data demonstrates the slope was significantly different between the upstream portion of the stream and the downstream (pond).

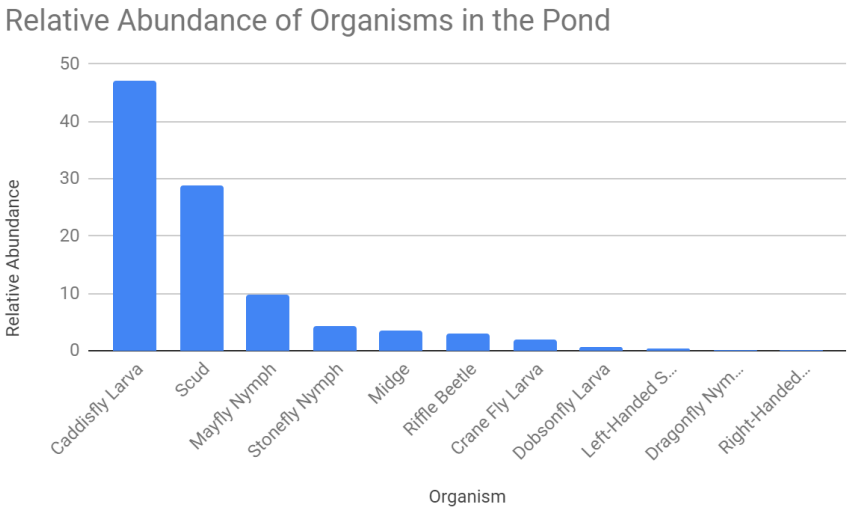
Fig 9. Chemical Data (t-test - Upstream vs Downstream)

	p-value	Significant?
D.O.	0.25	
pH	4.38×10^{-4}	There is sig. difference between pH with Pond (downstream) having higher
Phosphates	1.29×10^{-5}	There is sig. difference between phosphates with Pond (downstream) being higher
Nitrates	0.1	
Hardness	0.127	
Chloride	0.104	

A p-value less than 0.05 indicates there is a significant difference in the findings between the two data sets. This data demonstrates the pond had a significantly higher pH and phosphate concentration, compared to the upstream location.

Fig 10. Biological Data (Upstream vs Downstream)





The relative abundance histogram demonstrates community richness and diversity. A longer curve in the graph indicates greater community richness while a steep short curve indicates lower diversity.

Fig 11. Conclusion Questions with Student Answers

With reference to the physical and chemical factors you measured at the various sites, what environmental factors may explain the patterns of abundance or of diversity that you observed?

Student #1: Fertilizer run-off is a factor that could explain some of the chemical differences in how they support life. Fertilizer lowers pH and adds phosphates to the water stream.

Student #2: … Erosion and damage from flooding last summer and over the years could have had a great impact on the land and waterways. From running along the pond and stream the past couple years, I have seen the land change greatly. Some sections of the path have caved in due to flooding...

What recommendations would you make to improve the overall quality of the stream and the pond?

Student #3: Add natural water-purifying plants to the stream or pond such as bulrushes and rushes. Plant trees to slow water and minimize sediment deposition and chemical runoff into ponds and streams

Fig 12. Students Collecting Macroinvertebrates for Biological Data Analysis

Fig 13. Students Identifying Macroinvertebrates for Biological Data

Various dichotomous keys (with images) were available to identify the species collected.

Supplemental Documents

1. Data Driven Stream Health Lab

Pre-Lab
Complete all aspects of the informal pre-lab. You will need to have a null and alternative hypothesis comparing the health of the pond vs the health of the stream. You will also need to a null and alternative hypothesis comparing the community diversity of the pond vs the stream.

Data
Data will be collected at the stream and pond locations and imported in the Stroud's water quality app. The following variables will be tested at each site:

Physical: Air temp, water level, water temp
Chemical: D.O. Saturation & concentration, pH, phosphates, nitrates
Biological: Macroinvertebrates

Data Analysis

1. Export data from the Water Quality App
2. Combine the information from each of the 3 tests (Physical, Chemical & Biological) to create a chart with the following data
    a. Day 1 Site 1: Stream
    b. Day 1 Site 2: Pond
    c. Day 2 Site 1: Stream
    d. Day 2 Site 2: Pond

3. Mean, SD, SE: Calculate the mean for each of the Physical and Chemical values by combining Day 1 and Day 2 data for stream and Day 1 and Day 2 data for pond. From here, calculate the standard deviation and standard error.

4. Student's t-test: Calculate a student's T-test to compare the two sites for each of the following Chemical variables (D.O Concentration, pH, Phosphates & Nitrates)

5. Pollution Tolerance Range: Calculate the mean benthic macroinvertebrate pollution tolerance range by averaging the Day 1 & Day 2 Stream & Day 1 & 2 Pond Biological Data.

6. Macroinvertebrate Relative Abundance: Combine your Biological Data for Day 1 and 2 for the stream and Day 1 and 2 for the pond. Calculate the **Relative abundance** of each type of organism for the stream and for the pond using the following equation (Vawter, Pens & Walker, 2008):

7. Community Diversity: Rank the types of organisms from most abundant to least abundant for both the stream and the pond. Construct a bar graph comparing the organism type and relative abundance. To determine the

community richness (number of different types of organisms) examine the length of the resulting curve in your graph. To determine the **community dominance** (number of individuals of each type of organism) examine the curve. A steep, short curve indicates a community with high dominance and low richness (=low diversity); a gentle, long curve indicates a community with a low dominance and high richness (high diversity) (Vawter, Pens & Walker, 2008). Determine the diversity of the stream vs the pond.

Conclusion Questions

1. Which of the sites was most productive (include evidence of how you determined this) and why?
2. With reference to the physical and chemical factors you measured at the various sites, what environmental factors may explain the patterns of abundance or of diversity that you observed?
3. What recommendations would you make to improve the overall quality of the stream and the pond

2. Informal Lab Report

Lab partner(s)Name

Title of Lab

Date(s) Completed

The following should be completed PRIOR to the lab:

Objective: (What is the purpose of the lab, in my own words? What question am I seeking to answer through experimentation?)

Hypothesis: (After reading the lab and having an understanding of its purpose, what do I think will happen? Format should be "If…then…because or when" statement. It needs to be testable)

Procedure:

Control group: (What am I comparing my results to?)

Experimental group(s): (What is being experimented on?)

Independent variable: (What variable is being changed between the

control and experimental groups?)

Dependent variable: (What is being measured?)

Constants: (What other variables are remaining constant between the

control and experimental groups?)

** Methods**:

FOR INQUIRY LABS ONLY** : What procedures will be followed, What purposes do they serve? What materials & equipment will be used? ** This section may be completed before or during the lab – but NOT after!

The following should be completed DURING the lab:

Data: (Tables, graphs, calculations, descriptive statistics (mean, median, mode, standard deviation, standard error, chi-squared – if applicable) Properly label everything (title, axes, charts)

Errors: (What human errors were made during the lab? Keep in mind – something that may seem insignificant at first, can alter data in the end.)

The following should be completed immediately AFTER the experiment:

Conclusion: (Does the data show a pattern? Are the results expected? Does the data support or reject my hypothesis? Explain USING SPECIFIC DATA (Claim, Evidence, Reasoning). Did any of the errors affect my results? How could I change this experiment to expand my research?). The conclusion will be written in paragraph form and should use the impersonal tone (rather than: “We believe”… write, “It was found).

Analysis Questions: (Answer all analysis/conclusion questions in the lab)

Category	4	3	2	1
Objective	The purpose of the lab or the question to be answered during the lab is clearly identified and stated.	The purpose of the lab or the question to be answered during the lab is identified, but is stated in a somewhat unclear manner.	The purpose of the lab or the question to be answered during the lab is partially identified, and is stated in a somewhat unclear manner.	The purpose of the lab or the question to be answered during the lab is erroneous, irrelevant, or missing.
Hypothesis	The hypothesis is written in "if..then" format, including variables and is testable	The hypothesis is written in the correct format, but is missing variables or is untestable	The hypothesis is either written in improper format or is missing variables and is untestable	The hypothesis is written improperly, missing variables and is untestable
Procedure	Both groups, variables and constants are written clearly and are accurate	One of the requirements is inaccurate or several are somewhat unclear	Two of the requirements are inaccurate or all are somewhat unclear	Three or more of the requirements are inaccurate.
Data/Errors (Points x2)	Data tables and/or graphs are properly labeled, Calculations are accurate include axes labels, title and key. Errors are listed and are appropriate	Data tables and/or graphs are improperly labeled or Errors are inappropriate or errors in calculations have occurred.	Data tables and/or graphs are significantly unlabeled	Data tables and/graphs are unlabeled and errors are inappropriate and or missing
Conclusion/ Analysis Questions (Points x2)	Includes whether the hypothesis is supported or rejected, explains the data including appropriate trends/patterns	Does not include whether hypothesis is supported or inaccurately explains data or analysis questions are incorrect	Either conclusion, analysis or questions are missing	More than one section is missing or is significantly inaccurate
Spelling/ Grammar/ Style	There are no errors in grammar, spelling	There are 2-3 errors in grammar, spelling or the writing style is not scientific	There are 4-5 errors in grammar, spelling and the style is unclear	There are multiple errors or the writing is inappropriate.

3. Informal Lab Rubric