Monitoring the Quality of the James River, Lynchburg, VA from September to December
By: Caroline Wood-class of 2015

Abstract
The purpose of this experiment was to determine whether the James River in Lynchburg, VA was healthy enough for recreational use and for aquatic organisms. Water tests to analyze water parameters were performed from September to December at three different sites on the river; the tests analyzed dissolved oxygen, turbidity, conductivity, and temperature. All equipment used was manufactured by HACH or Vernier. Coliform was collected four times, and the last three collections were diluted by 100. The optimal value for dissolved oxygen was 6 and 7 milligrams per liter (mg/L), maximum temperature 20°C, a low turbidity 10 NTU, and optimal conductivity range is between 50 and 1500 µS/cm. An alpha value of 0.05 was used when conducting one sample t-tests to determine the health of the river. Coliform should not exceed 14 mg/L, according to the EPA. P-values produced for dissolved oxygen were 1.272E-05, 2.318E-06, and 6.671E-05. P-values produced for temperature were 8.433E-06, 0.028, and 0.031. P-values produced for turbidity were 1.699E-13, 1.147E-10, and 3.719E-13. P-values produced for conductivity were 1.512E-24, 6.554E-11, and 4.734E-14. For coliform, p-values produced were 0.063, 0.153, and 0.118. The research hypothesis was partly supported because of statistical differences between dissolved oxygen, temperature, turbidity, and conductivity. However, the amount of *E. coli* was not statistically different than the restriction set forth by the EPA. More experiments should be performed similar to this one to monitor the health of the James River.

Pertinent Information to share with a future researcher
1. Be sure to calibrate the equipment properly, and frequently make sure the equipment works properly. Check pH solutions often to make sure they are clean.
3. The Environmental Protection Agency (EPA) has immense amounts of information on water quality.

Future Research Ideas
1. The James River should be monitored more closely such as every week instead of every other week. This will ensure that the river is healthy and safe for recreational use.
2. More sites should be monitored along the river to track *E. coli* trends further down the river.
3. I would recommend analyzing the water turbidity more to ensure that the water quality is safe for organisms as well.
# The effect of organic pollutants on the growth of *Lemna minor* in an aquatic environment.
By: Caymen Rexrode-Class of 2015

## Abstract

The purpose of this research was to determine the effect of organic pollutants on the growth of *Lemna minor*. This organism was acquired from Carolina Biological Supply and groups were subjected to the pollutants DEET or Triclosan as the change in surface area was measured over the course of 24 days. The surface area was calculated using Image J, image processing and analysis, and aerial view photos for each group. The data collected through this method were analyzed using a one-way ANOVA, resulting in a p-value of 0.4091 using an alpha value of 0.05. The null hypothesis demonstrated no significant difference between the growths in surface area of *L. minor* that were exposed to pollutants and those that were not exposed. The final change in surface area for the average of six samples from the DEET, Triclosan, and control groups were 0.8125 cm\(^2\), 0.3698 cm\(^2\), and 0.4357 cm\(^2\) respectively. This supports the original research hypothesis in that the DEET group experienced the most growth. In conclusion, exposure to pollutants did not have a significant impact on the growth measured in surface area (cm\(^2\)) of *L. minor*. This implies that *Lemna* minor is resilient to pollutants, and grows just as well in an environment affected by smaller concentrations of pollutants as it would in a typical healthy environment. For future studies, the concentration of the pollutants over time should be measured to show the effect that *L. minor* growth has on reducing pollutant concentration, demonstrating its bioremediation potential.

## Future Research Ideas

1. The concentration of the pollutant should be measured throughout the experiment to identify any quantitative change in its presence.
2. The pollutants should also be present at higher concentrations

## Pertinent Information to share with a future researcher

1. I went through several trials to find the proper growing conditions for *Lemna minor*. I found that they grew the best at room temperature, exposed to 780 lux of light, and receiving fresh water two times a week.
2. A foundational paper to read for this study is:
The effect of *Acacia* Gum Arabic on seed germination of Kudzu (*Pueraria lobata*)
By Daniel Oliver Class of 2015

**Abstract**

The purpose of this experiment was to find an environmentally safe herbicide using a representative chemical *Acacia* Gum Arabic Solution (from the *Acacia sengal* tree) to serve as the environmentally safe chemical to use against a representative invasive plant species (*Pueraria lobata* (Kudzu)). *Pueraria lobata* seeds were placed into a petri dish and were grown on filter paper soaked with either a three, six or ten percent of an *Acacia* Gum Arabic solution. The control was watered with 100 percent water. Seed germination was measured over the course of five weeks. The results of the study revealed germination in: eight seeds (for the control) five seeds (for the ten and six percent groups) and two seeds (for the three percent group). An one-way ANOVA test was performed. A p-value of 0.16253 (alpha value being 0.05) revealed no statistical difference between groups, therefore, the null hypothesis was retained. The experiment resulted in a non-significant difference between groups. The research hypothesis that, If *Pueraria lobata* seeds were treated in a ten percent solution of the Gum Arabic extract compared to a six percent solution and a three percent solution, then *Pueraria lobata* seed germination and seedling growth compared to the control group would decrease, was not supported. In conclusion Gum Arabic does not appear to greatly decrease *Pueraria lobata* seed germination.

**Future Research Ideas**

1. The use of a different model organism to show the effectiveness of allelopathy as an herbicide.
2. The use of different allelopathic plants against model invasive plant species.
3. The use of Allelopathic plants on insects as a safe insecticide as well

**Helpful Information**

1. All project Ideas are possible! You may have to think outside the box for a more viable solution, but whatever you feel like researching, is possible.
The Abundance and Diversity of Benthic Macroinvertebrates at Ivy Creek Park, Lynchburg, VA
By: Lucas Longo Class of 2015

Abstract
The purpose of this study was to determine whether the water quality of a riparian stream at Ivy Creek Park accurately reflected the amount of pollution tolerant and intolerant benthic macroinvertebrates found in the stream, and to see if Clemmons Lake had a negative impact on the invertebrate life found in the outflow stream as compared to the inflow stream. In this study, water quality samples were collected at three locations in a local stream with a Hach multimeter and a turbidity sensor. Invertebrates were also collected from rocks and from a ceramic benthic sampling device. All invertebrates found were captured and released on site. The water quality data at all three sites were found to be clean and pollution free. This was supported by the benthic macroinvertebrate findings; large numbers of pollution intolerant organisms were found at all three sites. Thus the research hypothesis, “if the benthic invertebrates found in the inflow stream are found to be more pollution intolerant, then the water for that section of the stream will be cleaner --as reflected by water quality parameters-- than that of the outflow stream,” was not supported because high numbers of pollution intolerant invertebrates were found in the stream before and after it entered Clemmons Lake. Benthic macroinvertebrates were accurate indicators of the stream’s water quality.

Future Research
- Future research could be done on the seasonal effects on invertebrates.
- Other sites around the Central Virginia could be looked at in addition to Ivy Creek Park.
- The Shannon Diversity Index could then be used to compare the seasonal levels and/or the diversity of different sites.

Suggestions for a Future Researcher
- Become proficient with water quality meters.
- Spend time becoming acquainted with the different types of benthic macroinvertebrates.
- Take lots of pictures to document procedures, sites, and materials.
The Effect of Cows on the Water Quality of a Branch of Button Creek, Rustburg, Virginia
By Tyler Williams-Class of 2015

Abstract
This study was designed in order to gain further knowledge on the impact of cattle on streams. About fifteen cattle varying in age were present in a pasture that allowed access to a stream in a pasture in Rustburg, Virginia. Three different sites were chosen along the stream in order to have a control area, one where the cows tended to enter the stream and one downstream. On six dates in October through December, water was collected on a two week cycle and broken into two groups: three dates with cattle and three dates without cattle. Samples were taken from each site to measure E. coli and non-E. coli coliform counts, turbidity, pH, and conductivity. To qualify as a healthy stream, coliform counts should be around 15 CFUs, turbidity around 10 NTUs, pH at seven, a conductivity between 50 to 1500 µs/cm, a water temperature of 20°C, and a dissolved oxygen of 6 mg/L. On testing dates, a HACH multimeter was carried on site to measure temperature and dissolved oxygen. These areas are categorized as water quality indicators, meaning that each of these measurements indicate the overall health of the water being tested. Many parameters stayed consistent such as temperature and turbidity. With these trends, most water quality parameters met healthy standards, except for dissolved oxygen and E. coli counts on the first two sampling dates with cows.

Future Research
1. Water studies with an interest in run-off would be interesting and it is a controversial topic.
2. Rain effects many water quality indicators, a study looking at rain could be very interesting.
3. Looking at different animals could be a great project, because different animals produce very different amounts of fecal material.

Suggestions
1. In your study, make sure you are staying organized.
2. In water studies, you have to have a decent understanding of the water parameters before you start your paper/methods.
3. The EPA’s website is a very key tool in water studies. The parameters for healthy streams are set by this government agency, so use this as much as possible for reliable information on any question you may have.
The Effects of Motor Oil Exposure on the Hatch Rate, Maturation, and Behavior of *Artemia salina*
By Kathryn Grachan Class of 2015

The experiment was designed to simulate an oil spill by using Advanced Auto Parts SAE 30 motor oil, which is similar to the oil found in oil spills. Artemia salina were used as model organisms. The experimental group and control group were separated and grown in two different 2.00 liter soda bottles with ganger systems for four days. The experimental group was exposed to .0463 g/250mL of oil. On the fourth day, pictures were captured of both groups under a microscope by using a Moticam Solution 2500 camera. Eight 15mL environmental cultures were used to calculate the hatch rates. The average hatch rate for the control group was 933 from 2500 eggs (37.32%), and the experimental group was 466 from 2500 eggs (18.64%). To analyze the hatch rate, a two-sample t-test was used with an alpha value of .05. A significant p-value of .0213 resulted. The p-value supported the original hypothesis, if Artemia salina are exposed to Advanced Auto Parts SAE 30 motor oil, then those exposed will have significant differences of hatch rate, morphology, and behavior compared to the normally developed Artemia salina. In conclusion, the exposing of Artemia salina to motor oil had a significant effect on growth and development.

Future Research Ideas

- The experimental groups could be further studies for a time factor. Dividing the groups into a 12 hour, 24 hour, and no exposure.
- A different zooplankton organism could be used to determine if the *Artemia salina* had an effect on the resulting data.

Suggestions to a future researcher

1. Determine the set-up early and run many trials to ensure that the apparatus will function to the specifications on the project.
2. Manage the group’s food and aeration daily so that the data will be as accurate as possible.
3. Set-up the experimental apparatus so that the aeration will keep any particles from settling on the bottom of the 2.0 liter bottles.
Having a Bad Air Day?
Analysis of Weekly Particle Size Distributions Surrounding a Major Highway System in Virginia.
By Matthew Hazelwood, Class of 2015

Abstract
The purpose of this study was to collect airborne particulate samples surrounding US 29 and determine whether there was a significant difference between the particle counts, distribution, and average size during the week, versus the weekend. The collection period of this study took place during November, 2013, at three locations throughout the highway. A constructed model was used to capture particles onto a 47mm Teflon filter. Samples were collected from Monday through Friday, and from Saturday through Sunday. Pictures were, then, taken of each sample and analyzed using the Image J software, which measured particle size, count, and distribution. After conducting four two-sample t-tests along with three two-way ANOVA tests, a p-value of 0.0122 retained the alternate hypothesis in that there was a significant difference in particle count, but only within the 15 yard group. Likewise, a p-value of 0.0334 supported the alternate hypothesis, that there was a significant difference in average particle size, but only within the 30 yard group. There were no other significant values pulled from these tests. An alpha value of 0.05 was used during all tests. In short, the different collection periods, in part, significantly affected the particulate count and size within the samples.

Future Research
An analysis of weekly particle size distributions can be further understood if concentrations of such particles were analyzed along with testing for the effects of diverse weather patterns on the particulate distribution.

Suggestions to a future researcher
1. Collect a larger set of data values to create a heavier Two way Analysis of Variance.
2. Use materials that are more consistent, specifically an electronic air sampler, when collecting data.
3. Analyze results by using a microbalance. This will give you more concrete values, which can also be directly related to prior research.
The Effects of Varying Photoperiods on Hypocotyl Lengths of *Arabidopsis thaliana*
Tim Burnette, Class of 2015

Abstract
The purpose of this study was to determine the effects varying photoperiods of zero, six, 12, and 16 hours have on hypocotyl lengths of *Arabidopsis thaliana*. In this experiment, seeds were placed on 1x Murashige and Skoog agar plates in groups of 18, with two plates per photoperiod, and germinated for one week in their photoperiod. After one week, images were taken of the germinating seeds under a microscope with a Moticam attachment, and also by using a Cannon SuperShot N camera, and then the hypocotyls were measured in centimeters using a ruler. The 36 seeds’ hypocotyl lengths were then averaged per group. The 12 hour photoperiod mean was 7.3 mm, the zero average was 10.7 mm, the six average was 8.3 mm, and the 16 average was 4.4 mm. An ANOVA was then used to find significant differences between groups, and produced a p-value of 1.5E-23 (α=0.05). The research hypothesis, predicting that the short, six hour photoperiod would have the longest hypocotyls, was not supported. The zero hour control photoperiod had statistically significantly longer hypocotyls than the test groups, which is supported by the ANOVA and post-hoc Tukey test. It was also supported that during germination plants receiving lesser light will grow longer hypocotyls.

Future Research Ideas
1. Look at the effects temperature has on hypocotyl growth and protein levels in *A. thaliana*. If possible, use Real Time PCR.
2. Look at how varying photoperiods affect protein levels in *A. thaliana*. If possible, use Real Time PCR.
Both of these suggestions have connections to circadian rhythms; google circadian rhythms in plants for articles.

Pertinent Information to share with a future researcher
1. Make sure to annotate and highlight your articles. It will save you time later!