

Supplementing Biology Instruction at Purnell Swett High School:  
A Service-Learning Project

Senior Project

In partial fulfillment of the requirements for  
The Esther G. Maynor Honors College  
University of North Carolina at Pembroke

By

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I would like to extend my gratitude and thanks to Mrs. A. Michelle Hardin, Purnell Swett High School administration and staff, and Robeson County Public Schools for allowing me the opportunity to complete my service-learning project at Purnell Swett High School in a biology classroom and bring students to campus at the University of North Carolina at Pembroke.

Lastly, I would like to thank Dr. Mark Milewicz, Dr. Teagan Decker, and the Esther G. Maynor Honors College at the University of North Carolina at Pembroke for the opportunity, support, and encouragement to give back to local community and local public school system.

## Abstract

Through the support of the University of North Carolina at Pembroke and Purnell Swett High School, I completed my senior service learning project. At Purnell Swett High School, I tutored tenth grade students in biology. Many of the students that attended the tutoring sessions each week were experiencing difficulty in the course material. My goals of the tutoring sessions were the following: enhance the understanding of the biology course material, assist in test preparation and End of Course preparation, demonstrate and discuss study strategies, and encourage students to strive toward higher education. Many Purnell Swett High School tenth grade students were able to come to UNCP campus to participate in a few abbreviated laboratory experiments. In the chemistry lab, I designed an acid and base laboratory protocol that consisted of a few mini-experiments. The goals of the hands-on laboratory experiments were to allow the students to experience a college laboratory, learn about acid base reactions, relate acid and base reactions to the human biochemistry, and become prepared and excited for eleventh grade chemistry. Overall, the goal of this service-learning project was to positively impact the local community of Pembroke, Purnell Swett High School students, and strengthen the relationship between the UNCP and local public schools.

## Supplementing Biology Instruction at Purnell Swett High School: A Service-Learning Project

The University of North Carolina at Pembroke defines service learning as a “service to the community that takes place within the curriculum. That is a teaching and learning strategy that integrates meaningful community service with instruction and reflections to enrich the learning experience, teach civic responsibility, and strengthen communities” (“Service-Learning”). Through the completion of my service learning project, I combined the biology course curriculum information that I have gained throughout my undergraduate studies and my passion for service to the local community. For my service learning project I supplemented biology instruction at Purnell Swett High School in Pembroke, North Carolina.

I define service as performing a civic duty to one’s community and the members of the community. Service should impact both the one completing the service and the individual(s) the service is for in a positive way. Prior to attending the University of North Carolina at Pembroke, I was passionate for service. However, during my undergraduate studies I became more involved in service and organized service projects for the organizations I am a part of. When deciding on a service learning project, I contemplated project ideas that combined my science background and would help the community. I choose to tutor tenth-grade students in Biology at Purnell Swett High School. As a previous Biology Supplemental Instructor, peer tutor for Organic Chemistry I and Organic Chemistry II, and as Peer Academic Leader, I have learned to present information in various formats to meet an individual student’s needs for understanding and have taught students different

study techniques and habits that lead towards success. Due to my past experiences, I was prepared to tutor and supplement biology instruction to tenth-grade students.

For my service learning project, I volunteered at Purnell Swett High School during the Spring 2017 semester. I led review sessions and tutored tenth-grade students twice a week. All students that participated were in biology classes, and most of the students in the sessions were struggling with the biology topics discussed in class. My goals of the tutoring sessions were the following: enhance the understanding of the biology course material, assist in test preparation and End of Course preparation, demonstrate and discuss study strategies, and encourage students to strive toward higher education.

During the course of my academic career, I have had the continuous support and encouragement of my teachers and professors to pursue my dreams. Reflecting back on high school, a few teachers stand out in my mind and all have one common characteristic: they demonstrated support to all students and helped students see the potential in themselves that was not being recognized. One of my goals for the service learning project was to help students see the potential in themselves and recognize that they can accomplish any goal they set their mind on.

When I began to volunteer, I met Mrs. Michelle Hardin, a biology teacher at Purnell Swett High School. She was extremely helpful and provided me with a copy of the interactive notebook that all biology classes utilize at Purnell Swett. Additionally, Mrs. Hardin provided me with copies of review questions, study guides, and topics that she noticed many students were experiencing difficulty with. Mrs. Hardin expressed gratitude each review sessions. She told me on multiple

occasions that the mnemonics I utilized and explanations helped the students see the same information in a different format and she believed it was helpful to the students. All the materials I needed to adequately hold review sessions were provided by Purnell Swett High School. The materials used included: dry-erase boards, dry-erase markers, the projector, and iPads. When reviewing biology it is helpful to utilize technology to allow students to see cells and complex processes in clear illustrations. The following topics were reviewed over the course of the service-learning project: animal cells, plant cells, organelles, hypotonic, hypertonic, isotonic environments, mitosis, meiosis, DNA, RNA, replication, transcription, translation, nucleotides, photosynthesis, cellular respiration, ATP production, leaf anatomy, genetics (dominance, recessive, Punnett squares, blood types, codominance, chromosomes), and many others.

In addition to reviewing information with students at Purnell Swett High School, many students had the opportunity to come to the University of North Carolina at Pembroke campus to gain hands-on learning. I worked closely with Dr. Sivanadane Mandjiny, the Department Chair of Chemistry and Physics, to create chemistry and biochemistry miniature lab experiments for the tenth-grade students to participate in. Additionally, Caleb Smith, a fellow Honors College student, Dr. Dennis McCracken, a biology professor, Dr. Velinda Worriax, Department Chair of Biology, worked to create a biology lab experiment for the students to conduct as well.

On April 12, 2017, 23 tenth-grade students arrived at the Oxendine Science Building at UNCP. The students were greeted by UNCP's admissions office. The

students were provided lab coats and safety gasses to wear when in the laboratories. First, the students went to the biochemistry lab. I led a class discussion of acid base chemistry. With the assistance of Caleb Smith and Dr. Mandjiny, we worked with each group of students as they conducted abbreviated experiments. The students learned about acids, bases, the pH scale, utilized the pH meter, utilized the pH indicator to determine an acid from a base without the use of a pH meter, related acid and base reactions to the gastrointestinal tract of the human body and the treatment acid reflux, and overall became more prepared to enter eleventh-grade chemistry (see Appendix 1 – chemistry handout).

Next, the students went to a biology laboratory. In the biology laboratory, Caleb Smith led the discussion and worked closely with Dr. McCracken and Dr. Worix. I assisted Caleb in the biology lab. The students learned the components of a microscope, learned how to properly use a microscope, viewed a fluorescent microscope, viewed samples under dissecting microscopes, and created slides with various pond water samples to view numerous microorganisms. The overall goal of the campus visit was to give the students the opportunity to learn about biology and chemistry in the shoes of a science major, learn about the admissions process for UNCP, and encourage them to pursue higher education (see Appendix 2 – trip photographs).

I had several overall goals for my service learning project. After conducting research on the NC Report Card and the United State Census information, I realized that that the need for tutoring was needed, as well as the encouragement of the pursuit towards higher education. According the 2015 and 2016 North Carolina

Report Card, 66.9 percent of Purnell Swett High School students are scoring levels one and two on Biology End-of-Course exams. Students scoring levels one and two are considered to be performing below grade level. Through service-learning and supplementing biology instruction, hopefully more PSHS students will score levels three, four, and five on End-of-Course exams (North Carolina School Report Card). The United States Census reported (2011-2015) that 75.1 percent of Robeson County resident older than 25 years old had graduated high school, while only 12.8 percent had obtained a Bachelor's degree or higher (US Census Bureau). Once the data was observed, I became very motivated to make a change in the community that has become my second home during my four years of college. Overall my goals were to improve End-of-Course scores for biology, inspire students to pursue higher education, prepare the students for chemistry, and ultimately help the students become more excited about learning.

For future honors college students planning to complete a similar project, I would like to make a few recommendations that I have learned. Always use positive feedback every time a student gets an answer or concept correct, because they will become more confident and participate more. Start early: I will miss tutoring the students once I graduate, and wish I would have started tutoring earlier in my junior year. Also, if you start early you may be able to compare a few years of NC Report Card data and observe improvement. If possible, bring the students to campus: the students enjoyed going a field trip and having hands-on activities. They learned a lot in one afternoon on campus as well. When designing a laboratory experiment



make sure that it is simple and straight forward. Overall, find a need that you are passionate about and be innovative when working to meet that need.

To conclude, service learning affects all involved in positive manner. Through supplementing biology instruction at Purnell Swett High School, and hosting students at UNCP for an afternoon of interactive laboratory experiments, I hope that students experience improved End-of-Course exam scores in biology, are excited about chemistry, pursue higher education, and chase their dreams.

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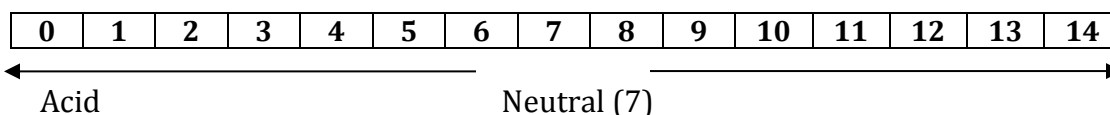
## Appendix 1

### Acid and Base Reactions

The University of North Carolina at Pembroke  
 Maynor Honors College – Service Learning Project  
 Senior: Amanda Bowman, Mentor: Dr. Mandjiny  
 April 12, 2017

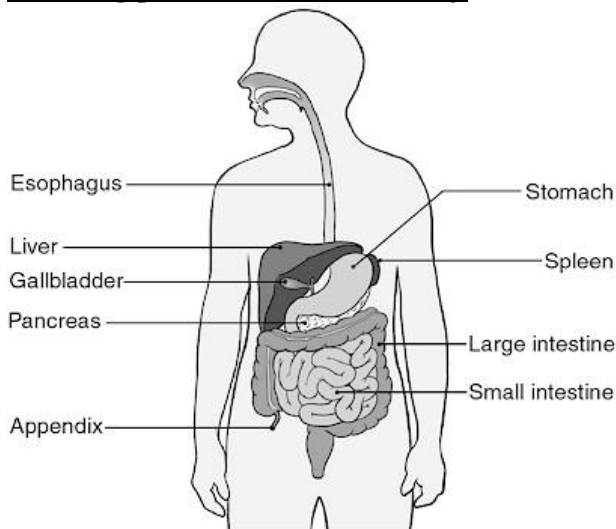
## Background

### pH Scale:



- Pure water has a pH of 7. Acidic solutions have pH values less than 7. For an environment to become more acidic, the environment must experience an increase in hydrogen ions (H<sup>+</sup>). Basic solutions have pH values greater than 7. For an environment to become more basic, it must experience an increase in hydroxyl ions (OH<sup>-</sup>).
- The pH scale is logarithmic scale, which means that each value is either ten times more basic/alkaline or ten times more acidic compared to the value next to it. For example, a pH of 5 is 10 times more acidic compared to a pH of 6. A pH of 4 is 100 times more acidic compared to a pH of 6. Meanwhile, a pH of 10 is 10 times more basic/alkaline compared to a pH of 9.
- When acidic and basic solutions are combined, they react and are neutralized.

### Relating pH to the Human Body:



Retrieved from: [www.cpmc.org](http://www.cpmc.org)

- The pH of the esophagus is close to neutral (7). Most people have an esophagus pH between 4 and 6.
- The pH of the stomach is typically 1.5 to 3.5 (acidic).

### Acid Reflux:

- Acid reflux occurs when the stomach acid is regurgitated into the esophagus.
- When stomach acid is present in the esophagus the pH of the esophagus is lowered and becomes more acidic.
- When someone experiences acid reflux the pH of their esophagus drops from near neutral to less than 4.

### Treating Acid Reflux:

- Alka-Seltzer tablets are often used to treat acid reflux and other stomach issues.
- Alka-Seltzer tablets have a pH of 9.2 (basic).

- Since an Alka-Seltzer is basic, when it is added to the acidic environment the Alka-Seltzer neutralizes the acid.

## Procedures

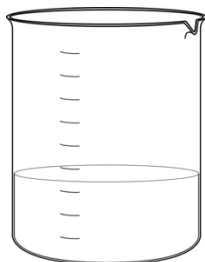
### I. Using a pH meter to determine if a solution is an acid or base.



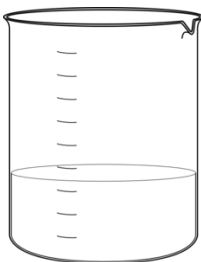
1. Before you are three beakers, each beaker has a different solution. You also have a pH meter.
2. Follow along with Amanda, as you measure the pH of each beaker.
3. You will have a beaker that has water ( $H_2O$ ), acid ( $HCl$ ), and base ( $NaOH$ ).
4. Once you measure the pH of each beaker, you will know which solution is found in each.

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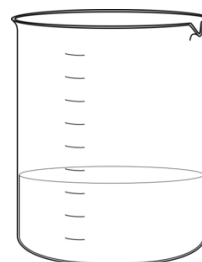
**Label each beaker with the correct pH and solution type.** The pH can be:  $pH > 7$ ,  $pH < 7$ , or  $pH = 7$ . Solution type can be: acid, base, or water.



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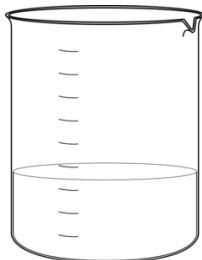


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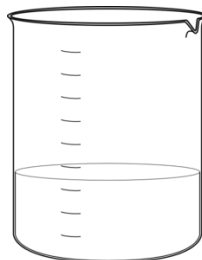
pH: \_\_\_\_\_      pH: \_\_\_\_\_      pH: \_\_\_\_\_  
 Solution type: \_\_\_\_\_      Solution type: \_\_\_\_\_      Solution type: \_\_\_\_\_

### II. How to determine which beaker is an acid and which beaker is a base without a pH meter?

1. Phenolphthalein indicator is used to indicate if a solution is acidic or basic.
2. Add one drop of the phenolphthalein indicator to the two beakers. *(If the beaker has an acidic solution the solution will be colorless. If the beaker has a basic solution a color change will occur.)*
3. Record the color you see once the phenolphthalein indicator is added. Record the solution type (acid or base).



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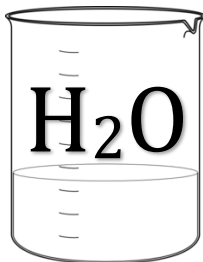
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Color: \_\_\_\_\_  
 Solution Type: \_\_\_\_\_

Color: \_\_\_\_\_  
 Solution Type: \_\_\_\_\_

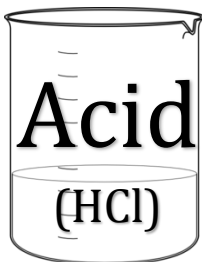
**III. Alka-Seltzer tablets are made up of citric acid and sodium bicarbonate. Observe what bicarbonate does in each solution.**

1. Add sodium bicarbonate to one solution at a time and observe what happens.



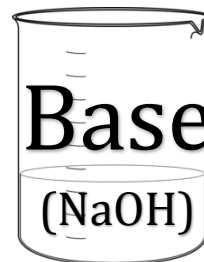
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What happens when you add sodium bicarbonate to H<sub>2</sub>O?



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What happens when you add sodium bicarbonate to acid?



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What happens when you add sodium bicarbonate to base?

**IV. Relating sodium bicarbonate and baking.**

Baking soda is sodium bicarbonate. Baking soda is used to leaven breads and cakes.

When bread and cakes are in the oven at a certain temperature sodium carbonate in the batter is able to react. This reaction causes the release of CO<sub>2</sub>, which causes air bubbles in the batter and the batter rises.

**V. Concluding Points:**

Acid	Neutral	Base
pH < 7	pH = 7	pH > 7
Example: HCl	Example: Pure Water	Example: NaOH, sodium bicarbonate
H <sup>+</sup> ions		OH <sup>-</sup> ions
Proton donor		Proton acceptor

- When acids and bases are added together they neutralize one another.
- Phenolphthalein indicator causes a color change in bases, but does not cause a color change in acids.
- Sodium bicarbonate releases CO<sub>2</sub> when added to an acid solution. Sodium bicarbonate reacts with base solutions once a certain temperature is reached, and causes CO<sub>2</sub> to release.

**Sources:**

"Beaker." Web. <[https://img.clipartfest.com/0476fa08dd5fbb78f458abead6451daa\\_white-beaker-clip-art-beaker-clipart-black-and-white\\_231-297.png](https://img.clipartfest.com/0476fa08dd5fbb78f458abead6451daa_white-beaker-clip-art-beaker-clipart-black-and-white_231-297.png)>.

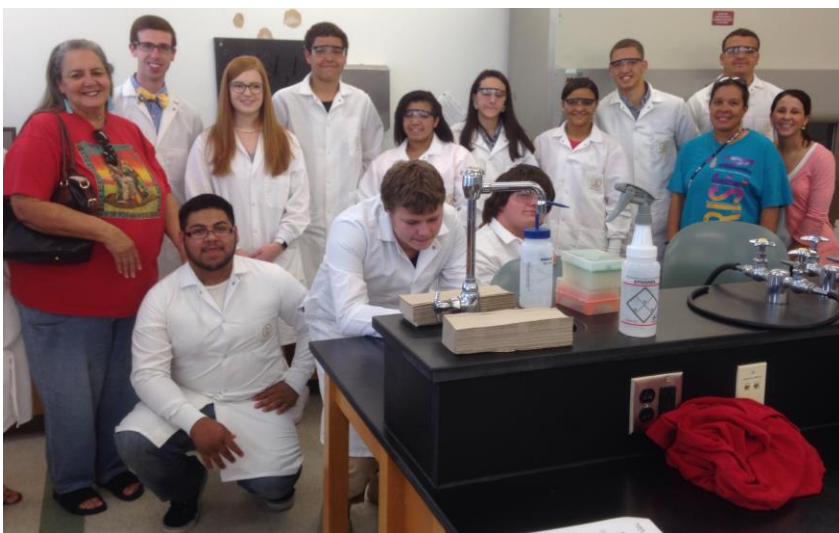
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"PH Meter." Web. <[http://static.coleparmer.com/large\\_images/99855\\_26.jpg](http://static.coleparmer.com/large_images/99855_26.jpg)>.

## Appendix 2



The admissions office greeted Purnell Swett High School Students.



The image above and the image to the left are the two group photographs of the students that came to campus to conduct experiments in chemistry and biology laboratories.





PSHS students conducting an acid-base reaction experiment in Dr. Mandjiny's laboratory with Dr. Mandjiny's help.



PSHS students observing pond water samples under the microscope in Dr. Woriac's laboratory.



Dr. Woriac assisting students find microorganisms in the pond water samples.



PSHS preparing pond water sample slides to observe under the microscope.