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The effect of extrinsic rewards in the high school classroom

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THE EFFECT OF EXTRINSIC REWARDS IN THE HIGH SCHOOL CLASSROOM

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Abstract

One of the biggest obstacles that a high school teacher faces in the classroom is motivating students to complete work. Traditional ideology focuses on intrinsic rewards as way to encourage students to participate and try in the classroom. Things like valuing education, planning for college, and taking pride in a good report card are used in attempts to motivate. Yet, in the adult world, people expect a concrete extrinsic reward (i.e. a paycheck) for the work that they do. This study takes the idea of extrinsic rewards and brings them into the classroom.

This study was conducted over two academic years at two different schools. Students were split into two groups. Experimental groups were offered a reward of a pizza party if they scored an 80% or above on a unit exam. Control groups were not offered a reward. The students were taught the same material on the same day and given identical assessments.

The data collected from the study showed that offering a reward increased student's test scores during the 2010-2011 school year in East Feliciana Parish. No effect was seen during the 2011-2012 school year at Madison Prep Academy. Males in the experimental group showed no difference when compared to males in the control group. Females in the experimental group in East Feliciana outperformed females in the control group but the results were inconclusive for females at Madison Prep. Differences were seen between genders in experimental groups but there does not seem to be a pattern to which group (males or females) performed higher. Factors such as small sample sizes and school culture may have had an effect on the results.

Introduction

Every student who has been in a high school guidance counselor's office has heard him or her ask, "If you had all of the money in world, what would you do with your time?" The idea behind this question is to discover a student's true passion and inevitably help them decide on a career path. But the idealism behind this inquiry is a far cry from the reality of most people's professional lives. The fact of the matter is, most people work to make money and maintain the life style that they want. I am not saying that it is not possible for a person to enjoy their career, but what percentage of the American population would still do their jobs for free?

As an educator, I love the reward of seeing a child's face light up when he or she finally grasps a concept. I love getting to know the kids and helping them plan their futures. I love fostering an appreciation of science and connections to the world around my students. But would I do all of this for free? Probably, but I certainly wouldn't work as hard or as many days of the week. Despite my passion for what I do, there are more difficult days than easy ones. If I wasn't getting a paycheck at the end of every month, it would be much harder to turn off my alarm and get out of bed on those mornings after the roughest of days.

This idea of expecting a monetary reward for the work we perform in our professional lives is something that most adults take for granted. If that paycheck did not show up on payday, a worker would go out of his or her way to track down their money, probably putting most other things on hold until the mistake is rectified. This reward-based thinking as motivation in the work place is the norm in modern society. Yet, when it comes to students in the classroom, this mindset is nowhere to be found.

From a very young age, children understand the idea of earning rewards. One of my earliest memories is receiving a cookie for helping my mother sweep the kitchen floor. Kids are constantly

bribed with promises of rewards for being good in public, practicing a skill, or helping around the house. Adults and children alike expect to earn something for meeting expectations. So when it comes to school, why do we suddenly expect students to "learn for the sake of learning?" As a child, my grandfather offered all of his grandchildren a dollar for every "A" we earned on a report card. Though the amount was never more than seven or eight dollars, my cousins and I would fight for the most money from Grandpa. That modest extrinsic reward was enough to make one of my cousins earn his first honor roll report card ever. Children expect recognition and reward for hard work just as much as, if not more than, adults.

As an 11th grade chemistry teacher in a low income high school, I see a lack of academic motivation on a daily basis. Too many students do not appear to care about school, do not respect teachers, and do not understand how their daily behavior influences their futures. As a core content teacher in this setting, every day is a battle with so many behavior problems that academics are too often hardly addressed. These same kids that will not sit down and take notes on chemical reactions, however, will get a job after school to pay for their new "kicks," their iPhones, and their weekend activities. These adolescents understand on some level that hard work should bring a reward but they are unwilling or unable to make a connection with school work.

One of my biggest frustrations as a teacher is when I hand out an assignment and a student asks, "What do we get if we do this?" My standard answer is usually, "You *get* a good education. You *get* a chance to go to college. And you *get* the opportunity to do something with your life and make a difference in the world." These statements usually fall on deaf ears. If, however, I offer a bag of chips or a candy bar as a prize for a game my students are practically falling over one another to get the correct answers and win. Perhaps my approach to motivation is all wrong.

The rewards that modern students encounter in their daily lives are extrinsic rewards. They are bombarded with media and pop culture putting an emphasis on "stuff:" new cars, a rapper's bling, or the latest fashions. They understand that doing chores at home will get them an allowance or a later curfew. Students are familiar with the concept that *doing* something means *getting* something. Current academic models, though, expect kids to work for intrinsic rewards only. Their prize for excelling at academics is good grades, critical thinking skills, and a chance to compete in higher education settings. In a world with so much emphasis on owning "stuff," are these traditional academic rewards attractive to most students? Is it reasonable to expect students to want to learn for the sake of learning or might student learning be enhanced by a more materialistic extrinsic rewards system?

This concept is something that I have struggled with during my years teaching in some of the roughest schools in the area. Motivating my students through intrinsic means has not worked well for me. I have attempted to expose my students to the rewards of working hard through things like guest speakers, highlighting a new science career every week, and making real world connections to the content. These tactics have done little to motivate my students to perform in my class. This thesis explores the idea of bringing a structured and visible system of extrinsic rewards into my classroom to attempt to increase students' test scores.

Literature Review

The desire to isolate the factors that motivate students is not a new one. Many studies have attempted to quantify just what it is that pushes a student to excel in an academic setting. A study that takes a look at motivation over diverse cultural backgrounds was conducted by McInerney *et al*. (1997) at the University of Western Sydney. This study examined the motivation of students from different backgrounds and compared students' motivation to academic achievement levels. The overall hypothesis of the study was that, "school motivation and achievement for an individual are the product of a complex set of interacting goals that reflect personal, family, and cultural values." In particular, McInerney *et al*. (1997) looked at those intrinsic motivations that are so often lacking in modern classrooms. The researches in this study sought to answer the following questions:

1) What is the nature of goals held by students from different cultural groups?
2) What is the relative impact on student achievement and motivation of the goals held by these different cultural groups?
3) How compatible are these goals with those promoted within classrooms and schools?

The researchers chose five groups of students from three countries (3 in Australia, 1 in Canada, and 1 in the United States) to complete their study. The sample groups were made up of students from different backgrounds including white, aborigine, Indian, and Navajo. All of the non-white populations had similar high levels of poverty and unemployment and high dropout rates. The research was based on the Inventory of School Motivation (ISM) to discover how the students were motivated across cultures. A totally of 2,684 students were given the ISM and the results were compared. The researchers turned the student's qualitative answers on the ISM into numerical data to compare the results in an

unbiased manner. They concluded that motivations and goals of students were similar across cultures, but non western cultures tend to focus more on motivations from the past and western cultures focus on motivations from the future. Nonwestern cultures use motivators like family honor and making your culture or community proud as incentives for success. Western cultures motivate far more on being successful as an individual and personally contributing to society in the future as ways to increase student investment.

This study on the motivations of students from different cultures is interesting because it focuses on the intrinsic motivations that push kids. The study sheds light on the fact that students have similar goals and drives across different nationalities. This study indicates that motivating students in the United States with ideas of making their family proud would probably not work very well. A better approach would be to put the emphasis on the individual's hopes and wants rather than the community's. I would be very interested to see how this same study would apply to a strictly United States population, looking at students from high and low income rural and urban areas. I would also be interested to see how the results of the Inventory of School Motivation would change if students were provided extrinsic rewards in an academic setting.

The idea of rewarding students with physical things has been a point of huge controversy in the education field. The concept of rewarding students to improve test scores was studied as far back as 1968 when Clark and Walberg (1968) looked at the effect of verbal praise rewards on high risk kids in Chicago. Clark and Walberg tested a group of 110 students ranging in age from 10 to 13 years old. All of the children were 1-4 years behind in reading and were placed in special reading remediation programs. The researchers designed a system in which each child had a card that they would use to record anytime they were given verbal praise from the teacher. Then the cards were collected and tallied. At the end of the research period the experimental group and the control group were given a reading posttest.

Once the data was collected and the results analyzed, Clark and Walberg concluded that the group that received consistent and significant verbal praise from their teacher scored significantly higher on their standardized reading test than the control group. Looking at their raw data, I have to agree. The ranges of scores between the experimental and control groups do not overlap, which leads me to the conclusion that that verbal praise increased test scores. Although the ranges are close, there seems to be some effect on students having increased test scores when they receive praise from the teacher. I can't help but wonder how having kids record the praise themselves rather than by the teacher or an impartial observer affected the results of the study. I would be very curious to see how the results of the same research over a much larger sample size and with varying student demographics.

Surprisingly few studies have been done where students are actually given concrete extrinsic rewards. One such study was done by Fryer (2010) who asked whether paying students for work would affect their standardized test scores. He conducted his experiment on 18,000 students in 4 cities across the United States: Chicago, Dallas, Washington, and New York. A unique model for monetarily rewarding the students was used in each city. Overall, a total of $6.3 million was paid to about 38,000 students in 261 separate schools. A summary of each city's experiments follow:

1) In New York City, 4th and 7th grade students were paid based on a series of assessments given by the New York City Department of Education. The students were tested 10 times throughout the year and paid based on achievement levels.

2) In Chicago, students were paid based on letter grades earned in 5 core courses every 5 weeks

3) In Dallas, second graders were paid $2 a book for every book they read. Students were given a short quiz after the completion of the book to ensure they read it.

4) In Washington D.C, a system of payment was developed based on multiple of factors including attendance, behavior, and academic performance.

The results varied. In New York, paying students for results on standardized test scores had no effect on the student's achievements. In Chicago, the students did improve their grade point averages but not standardized test scores. Paying students to read in Dallas significantly increased their standardized test scores. Students in Washington D.C also showed improvement on their state-given assessments.

In other words, in the cities where students were paid simply for scores (New York and Chicago), there are no significant changes in students' scores. The studies done in New York City, in which 7th and 4th graders were paid based on posttests, yielded numbers that did not show within a 95% confidence interval that the study groups were different from the control group. The experiment done in Chicago in which 9th graders were paid for incremental test scores showed ranges for math and reading scores that overlap, indicating that the results could be the same when the uncertainty is considered. This means that no difference was seen between the study group and the control group.

In Dallas and Washington, where kids were paid based on other factors, there were small improvements in standardized test results. The Dallas study in which second graders were paid per book read showed a statistically significant increase in reading comprehension. The reading comprehension score range fell within a 95% confidence interval, indicating a difference from the control group. The same group's vocabulary and language results did not show significant growth.

The study conducted in Washington D.C. in which students were paid for a myriad of factors that they could control moderately impacted student achievement. Reading scores in these students had ranges that fall within 1 standard deviation of the uncertainty, meeting the researcher's criteria for

marginal significance. Frayer speculates that the Dallas and D.C. studies showed results because students were rewarded on factors that they could easily control. Students paid only on scores do not see those as something in their power to control and lost investment in the incentives.

A study conducted by Angrist *et al*. (2006) at the National Bureau of Economic Research in Canada looked at the idea of monetary incentives in increasing academic achievement and retention in college students at a large public university. The researchers chose 1600 first year undergraduates to participate in the STAR project (Student Achievement and Retention Project). The students were attending a satellite campus of the university and were from similar academic and socioeconomic backgrounds. The students were broken into 3 groups. One group (250 students) was offered only academic support services. These included critical thinking strategies geared for specific courses and mentoring from successful upperclassmen. A second group (250 students) was offered a cash reward for meeting certain GPA criteria. Students who maintained a B average received $5,000 and students who maintained a C+ average received $1,000. The third group (150 students) was offered both the academic support and the monetary incentive. The remaining 1006 students acted as a control group and received neither the academic support nor monetary incentives. All students participating in the study were taking at least 4 courses.

The researchers gathered their data by looking at students' grades at the end of the fall semester and at the end of the academic year. The grades at the end of the fall semester showed that the groups that received monetary incentives and both the academic support and monetary incentives had average grades about 2 points higher than the control group. The group receiving only academic support did not show significant increases in grades. The researchers also broke the results down by gender and saw a difference between males and females. Females who received only monetary incentives had fall grades of about 3.0 points higher than the control and females who had both

academic and monetary support had grades of 3.5 points higher. Males did not show significant differences in any of the programs during the fall semester.

End of the year grades show less of a grade increase for females, but still yield a significant result. Females receiving both monetary gains and academic support showed a grade increase of 3.3 points compared to the control. Females receiving only monetary rewards showed an increase of 1.7 points when compared to the control. Again, males did not show a significant difference in grades in any group.

The present study is based directly on Fryer's suggestion that students will be invested in a rewards system based on factors that they can control. While I designed my study around testing, my tests were teacher-written assessments, not standardized state tests. A reward based on class test scores is something my students feel is directly in their control, far more than a state standardized test. This is because the students are familiar with my test style and the way that I run my class. They believe that they have more control over their test scores in my room than on a random state test. The incentives offered in the Fryer and Angrist studies included substantial financial rewards for students. Because this study is being conducted and funded by a classroom teacher, a reward of pizza will be used to lessen the financial burden. Using pizza allows the study to be manageable and reproducible if a significant effect is seen.

The gender differences highlighted by the Angrist study offer an interesting perspective with which to view my data. Seeing a significant increase in females' grades when an extrinsic reward is offered implies that female students should perform better on unit assessments in experimental groups in my study. Females in control groups should have significantly lower grades than those offered a

reward. If the trends observed by Angrist *et al*. (2006) continue in my study, no differences should be seen in male achievement between control and experimental groups.

Procedures

This study was conducted during the course of two academic years at two different schools. The data collected from the 2010-2011 school year took place at East Feliciana High School, a public high school in the rural parish of East Feliciana. The makeup of the study group is 95% African American, 5% Caucasian which represents the student population as a whole. 97% of the student population receives free or reduced lunch, which also represents the students in the study. The data from the 2011-2012 school year was taken at Madison Preparatory Academy, an urban charter school in Baton Rouge. The student population at MPA is 100% African American with 87% of the student population receiving free or reduced lunch. The school demographics also represent the students who participated in the study.

The idea behind this research was fairly simple. I set out to see if offering students pizza for lunch would improve their test scores. In order to qualify for the reward of pizza, all the students had to do was achieve a score or 80% or better on a unit test. During the 2010-2011 school year, only unit 7 on acids and bases was assessed. This unit was taught during a 60 minute period during a four day school week. (The East Feliciana Parish school system does not have school on Mondays.) The unit lasted 17 days, over the course of four consecutive weeks. The unit covered the concepts of the mole, calculating molality and molarity, the pH scale, identifying and defining acids and bases, and acid and base reactions. Sample lesson materials can be found in appendices H-I. A pretest was given before the unit to test the students' knowledge going into the unit. Pretests were also given before every other unit to ensure that the students were acclimated to the process. The unit began with a Discovery Lab in which students calculated how far a mole of paperclips would stretch into space. The next day, a lecture was given on the mole and students took notes and completed a worksheet to answer questions about the mole. The class then explored molar mass conversions through lecture and classwork practice. Next, I taught them the concepts and equations for calculating molarity and molality, and they demonstrated

their knowledge on a worksheet. Students discovered conjugate acid/base pairs by reading out of their text books and filling in guided reading notes. We then began a practice sheet as a class that was completed individually. The pH scale was introduced next through a powerpoint lecture and notes. This skill was practiced with a worksheet calculating molar concentrations, pH, and pOH. The next day, a lab was done to use litmus paper to identify acids and bases and practice all of the calculations previously taught. Students then rotated through review stations to practice all unit concepts. The students completed study guides practicing all unit skills and played a review game called "trashketball" in which they answered questions correctly for a chance to shoot a ball into the trashcan for points. Finally, the students took the unit 7 exam. A complete unit plan can be found in Appendix D and the assessment used can be found in Appendix B.

My classes were split into two with one group being held as a control and not offered any pizza. The control group consisted of hours 3, 4, and 5 with a total of 32 control subjects. The experimental group involved 6th and 7th hour with a total of 21 experimental subjects. Each group was given a pretest to assess their baseline knowledge. Then, each group was taught the exact same material on the exact same day. They were given identical posttests. The only thing not held constant between the two groups was the offer of pizza for their score.

The same procedure was followed for Unit 7 during 2011-2012 school year. The only difference was that Madison Prep Academy is on a 4x4 block schedule. This means that I taught chemistry for only the first half of the year for a 90 minute block, 5 days a week. The unit itself was impacted in that it was taught in 12 days, or 2 ½ weeks. Identical materials, the chronology of the unit, and the same assessment were used both years. A complete unit plan can be found in Appendix E. The control group used for this year was 3rd block with a total of 23 control subjects. The experimental group was 1st and 2nd block, with a total of 28 subjects.

The 2011-2012 school year at Madison Prep Academy also allowed me to try my experiment on another unit. Unit 3 was tested on the same classes as unit 7. The control and experimental groups were switched during this unit, allowing 3rd block to be offered the reward and 1st and 2nd used as a control. This unit was also taught on the 90 minute block and was taught over the course of 12 days or 2 ½ academic weeks. Unit 3 was testing the concepts of atomic theory and periodic trends. The unit was started with a pretest. Again, students were given pretests before all units to ensure they knew the pretest process, mimicking the previous year. The first concept introduced was metal and nonmetals and this was taught through lecture/notes and a practice worksheet. The next day, knowing the number of protons, neutrons, and electrons in an element was reviewed (should have been taught in 9th grade physical science). This was followed by an "element scavenger hunt" in which the students were given clues to the identity of an element based on its location on the periodic table and number of subatomic particles. Next, Bohr models and periodic trends were taught to students using lecture and worksheets. The students were then given a lecture on how to find the number of valence electrons in an atom and the formation of ions. This concept was reinforced with a practice worksheet. Lewis dot structures were then taught through modeling with the students practicing on white boards and on a worksheet. The unit culminated with a flame test lab. Review activities included completing and reviewing study guides and a review Jeopardy game. Finally, the posttest was given. A complete unit plan can be found in Appendix C. A copy of the unit 3 assessment can be found in Appendix A.

The analysis of results includes looking at raw gains and normalized gains for several assessments. Raw gains are a measure of how much a student's test score increased from the pretest to the posttest. The raw gains are measured by simply subtracting the pretest from the posttest using the following equation:

$$\boxed{\text{Raw Gains} = \text{posttest-pretest}}$$

Normalized gains are used to measure how much a student learned of what they didn't know on the pretest. This measure allows an instructor to see if student's progressed no matter what their pretest score was. Normalized gains are calculated by taking the raw gains and dividing them by the highest possible score subtracted by the pretest score. Because my data uses percentages, my high score on all assessments is 100%. The equation I used to calculate normalized gains is below:

$$\boxed{\text{Normalized Gains}= \frac{(\text{posttest-pretest})}{(100\text{-pretest})}}$$

Results

This experiment was conducted over the course of two separate school years at two different schools. The data collected in the Spring of the 2010-2011 school year at East Feliciana High School on the acids and bases unit yielded the following results:

Table 1: Percent Scores on Unit 7 Acids and bases 2010-2011 Assessments

Pretest Control	Posttest Control
21 +/- 2	66 +/- 4
Pretest Experimental	Posttest Experimental
20 +/- 1	81 +/- 3

The results are shown graphically below.

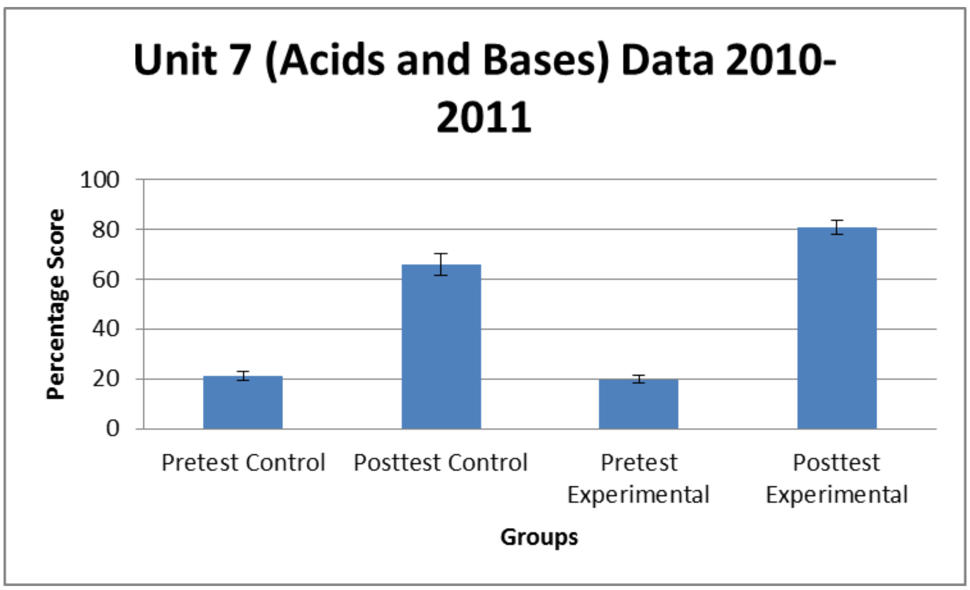

Figure 1: Percent Scores on Unit 7 2010-2011 Assessments

Groups were compared using a T-test which decides within a 95% confidence interval if the groups are statistically similar or not. A p-value (determined from a T- test) of less than 0.05 indicates that groups are statistically different, and a p-value of more than 0.05 indicates groups that are not

statistically different. All T-tests used in this study assumed the scatter in the data is different unless otherwise specified. The T-test run on the pretest for this particular unit gave a p-value of 0.531 which showed that the experimental and control groups were most likely not different going into the unit. The posttest T-Test showed a p-value of 0.00633 which shows that the posttests were most likely significantly different. This test confirms that there is a good chance of a significant difference in the experimental and control groups. The results show that offering students a reward of pizza most likely caused them to achieve higher posttest scores than students not offered a reward.

The data collected from the fall of 2011-2012 school year was done on two separate units at Madison Preparatory Academy. The first unit was unit 3 which focused on atomic structure and theory. The results are as follows:

Table 2: Percent Scores on Unit 3 2011-2012 Assessments

Pretest Control	Posttest Control
19 +/- 1	84 +/- 3
Pretest Experimental	Posttest Experimental
20 +/- 1	86 +/- 3

The results are shown graphically in Figure 2. The results for this unit did not show a statistical difference in the 2 groups. The T-Test run for the pretests showed a p-value of 0.617 which confirmed that the groups were most likely at the same level of knowledge going into the unit. The posttest T-Test yielded a value of 0.496 which confirms what the graph shows. The mean of the posttest for the control and experimental groups over lap with the uncertainty in the mean. This indicates that there is most likely not a difference in the results from the experimental and control groups.

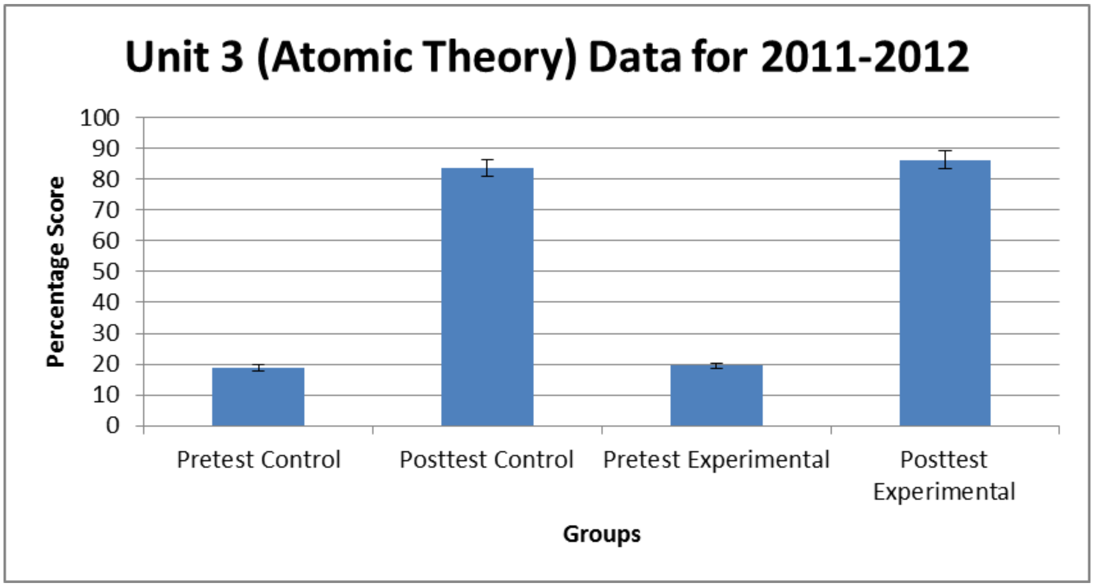

Figure 2: Percent Scores on Unit 3 2011-2012 Assessments

The second unit tested at Madison Prep was the same unit as the previous year, unit 7 on acids and bases. These units were taught using identical materials both years. The experimental and control groups were flipped for this unit. The results were as follows:

Table 3: Percent Scores on Unit 7 2011-2012 Assessments

Pretest Control	Posttest Control
8.5+/-1	80+/-3
Pretest Experimental	Posttest Experimental
9+/-1	75+/-4

The information is shown graphically below:

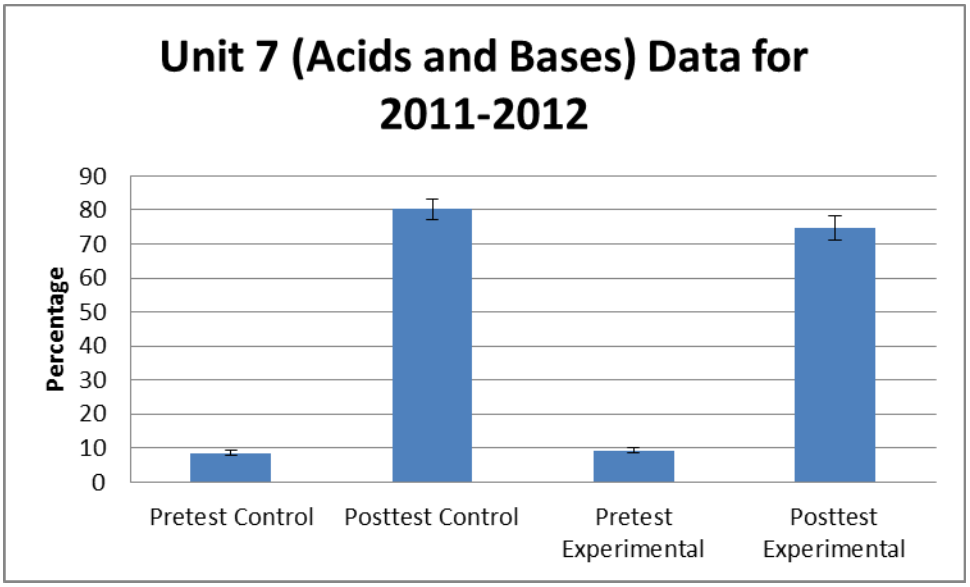

Figure 3: Percent Scores on Unit 7 2011-2012 Assessments

The T-test for the pretest gave a value of 0.508 which implies that the groups most likely had the same knowledge going into the unit. Unfortunately the posttest data yielded a T-test value of 0.262 which shows that there is probably not a significant difference in the posttest data for the experimental and control groups. Neither unit taught with the offer of pizza as a reward for a score of 80% or higher on the posttest during the 2011-2012 school year at Madison Prep Academy showed an improvement in student knowledge on the unit test when compared to the control group.

Given the different nature of the results from the two different schools I worked at, I decided to compare the populations from the schools to each other. I compared the pretest and posttest results as a whole from East Feliciana and Madison Prep Academy for unit 7 on acids and bases. The results are as follows:

Table 4: Unit 7 Comparison of Pretests and Posttests- East Feliciana vs Madison Prep

Unit 7- School Comparisons	
East Feliciana Pretest	East Feliciana Posttest
21+/-1	72+/-3
Madison Prep Pretest	Madison Prep Posttest
9+/-.5	77+/-2.5

They are shown graphically below:

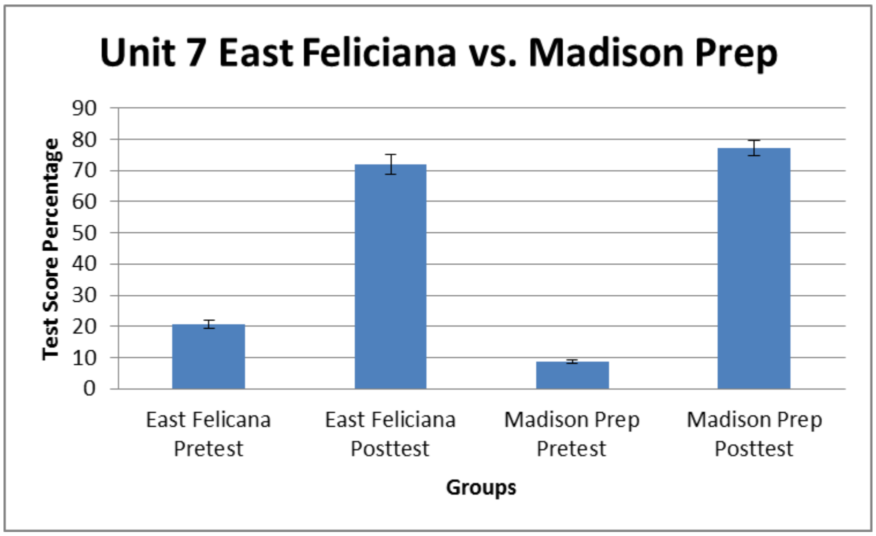

Figure 4: Unit 7 Comparison of Pretests and Posttests- East Feliciana vs Madison Prep

The T-test for the comparison of the pretests for the two schools yielded a p-value of $1.45\text{x}10^{-14}$. This indicates a very strong likelihood that the students taking this test were not at the same level going into the unit. The students from East Feliciana High School appeared to be much more knowledgable about acids and bases before the unit began. The difference in pretest results is most likely a product of the fact that I taught most of my students at East Feliciana physical science in their freshman year. Physical science is a course that introduces chemistry and physics. Students at Madison Prep Academy had a physical science teacher that quit in October of their freshman year and the rest of the course was taught by substitute teachers. I believe the pretest results reflect the fact that East Feliciana students

genuinely had more knowledge of acids and bases going into the unit. The posttest T-test comparison of the two schools showed a p-value of 0.089. This indicates that there is probably not a difference in the two populations in the posttest results. The posttest scores alone were compared one another to see if the difference in experimental and control groups could influence the averages.

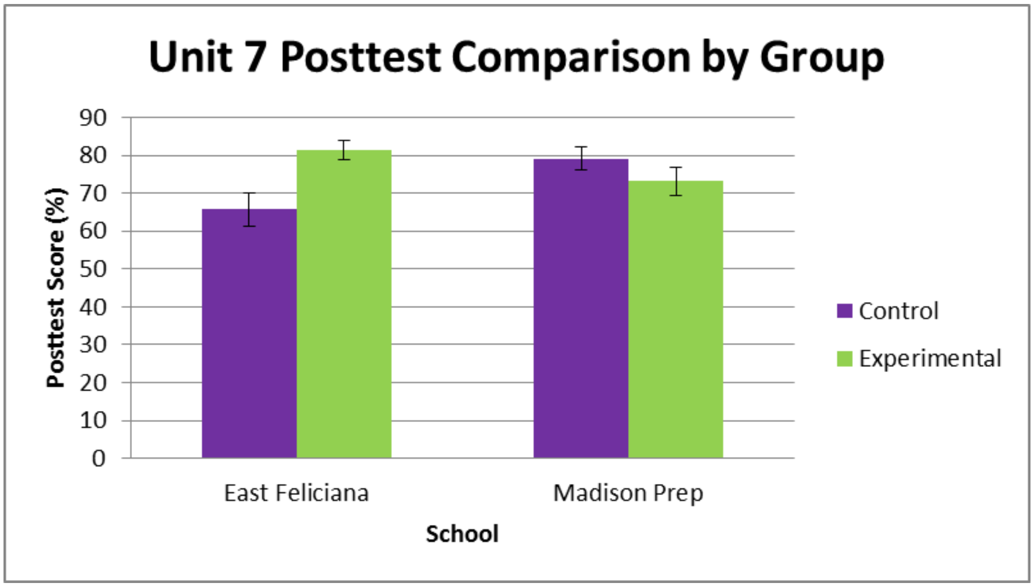

Figure 5: Unit 7 Posttest Comparison by Group

This graph shows that the average of the East Feliciana scores matched the Madison Prep scores as being statistically similar because the experimental group was so different from the control group. If East Feliciana did not have an experimental group, they would most likely have a much lower average score than Madison Prep. The groups from Madison Prep appear to have performed the same, implying that the reward did not influence the average. The students at Madison Prep would have gotten approximately the same score no matter if a reward was offered. The students at East Feliciana only performed at the same level when offered a reward. An ANOVA test was run to see if there was any difference in the four posttest groups. This test yielded a p-value of 0.017 which shows that there is a statistical difference in these groups, confirming what the graph shows. The normalized gains confirm

what the posttest scores showed on each unit. Normalized gains results for each unit can be found in appendix K.

According the study done by Angrist *et al*., females should have higher scores when offered a reward. In order to see this effect in my study, I compared males and females in the experimental group to the same gender in the control group. The pretests for the different genders are as follows:

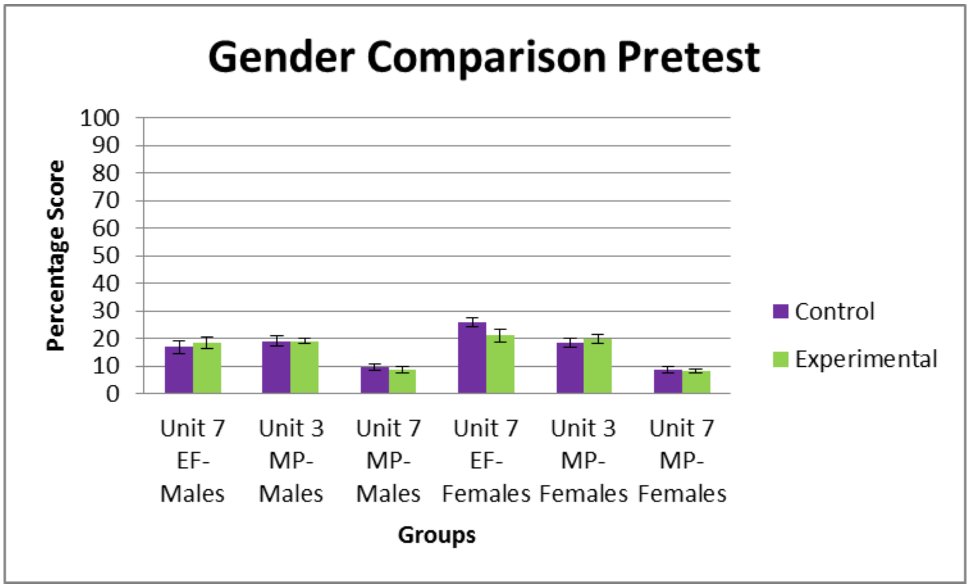

Figure 6: Pretest Results by Gender

All of the pretest scores show that males and females scored similarly on almost every unit. This indicates that the control and experimental groups were most likely not different going into most units. The one exception is the unit 7 group for East Feliciana females. In this group, it appears that the control group had more knowledge than the experimental group going into the unit. This difference in apparent knowledge could be misleading because of the low percentages of the scores and the small sample number. That particular unit of females had 15 subjects in the control group, and only 11 subjects in the experimental group. These small sample sizes mean that one student's test score could

greatly impact the average. If even one student had been absent from the pretest, the results could have changed dramatically. Therefore, the small sample size makes the average of this group unreliable.

Knowing that most groups were statically similar going into the units, the results after the unit test was given were analyzed. Graphs for the posttest scores, raw gains, and normalized gains are shown below:

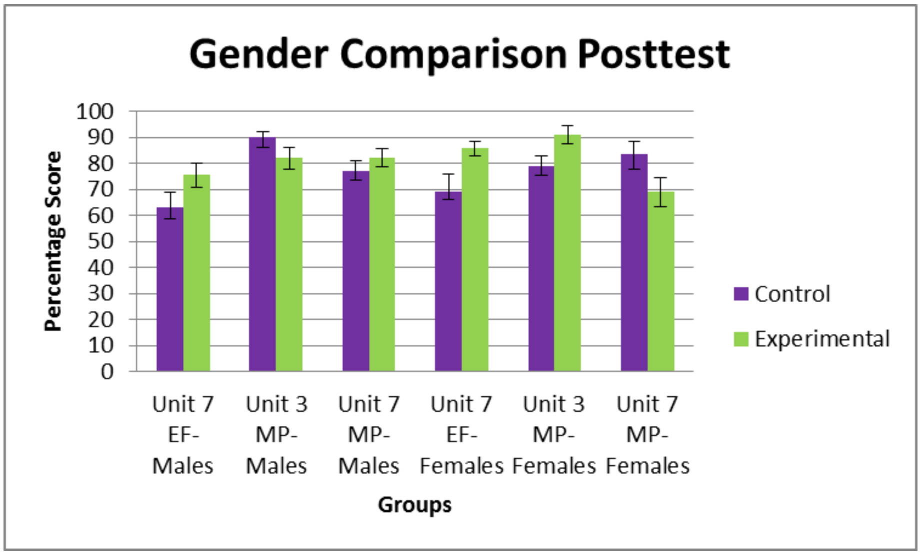

Figure 7: Posttest Results by Gender

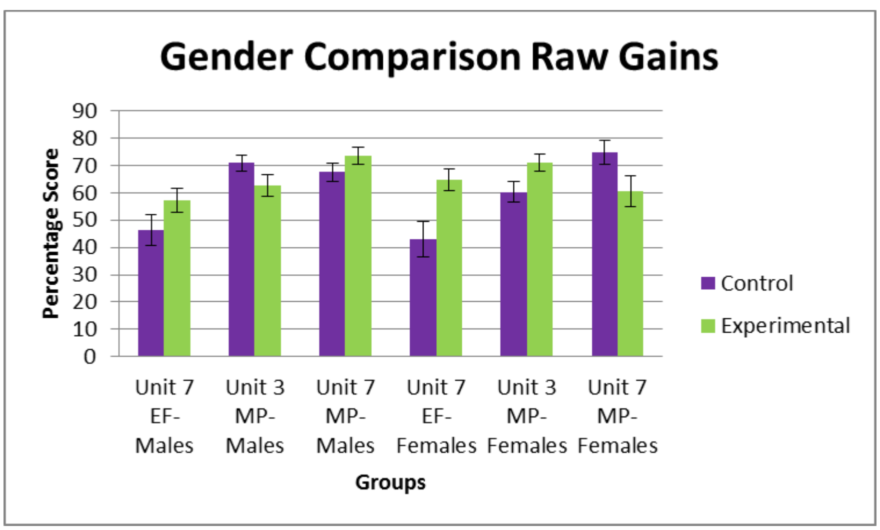

Figure 8: Raw Gains Results by Gender

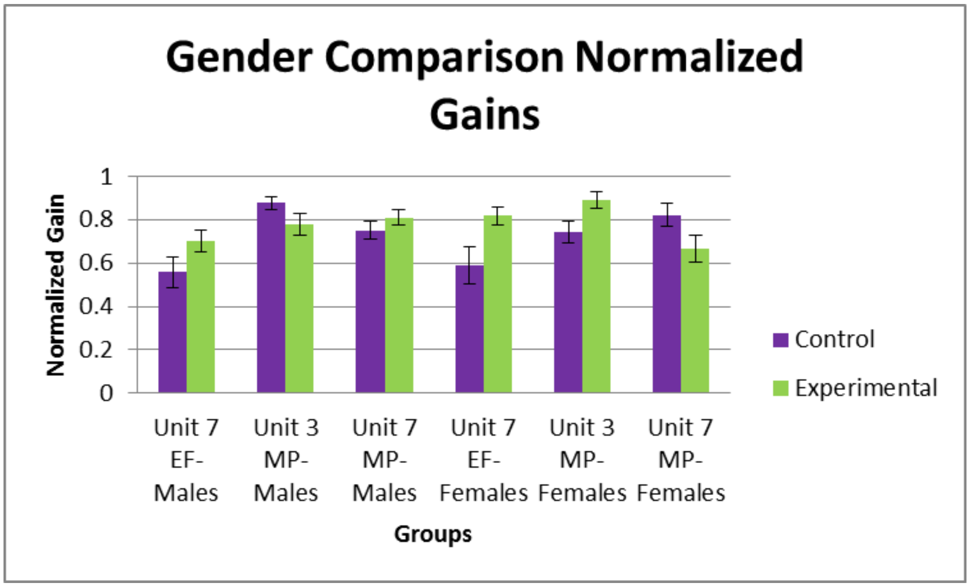

Figure 9: Normalized Gains by Gender

The graphs for the posttest results, raw gains, and normalized gains all show similar results. In every case, there is no difference shown between the control males and experimental males for any unit. The females, however, did show some differences. For every measure (posttest scores, raw gains, and normalized gains), females show a higher achievement in unit 7 at East Feliciana and unit 3 at Madison Prep in the experimental groups. For unit 7 at Madison Prep, there is also a significant difference in the results, but this time the control group outperformed the experimental group. It is important to note that the control and experimental groups were switched between unit 3 and unit 7 at Madison Prep. This means that the same group of girls outperformed another group of girls on both units. It is not clear if the reward was a factor in the results, or if this particular group of females will always perform higher. These results indicate that there was an effect on females at East Feliciana but the results are inconclusive for Madison Prep.

The pretest scores, posttest scores, raw gains, and normalized gains were also run through a T-test comparing the control males or females to the experimental males or females. A one tailed T-test was used to deteremine if the higher result was really statistically higher. The results are as follows:

Table 5: Control vs Experimental P-values by Gender

T-Tests Control vs Experimental by Gender				
	Pretest	Posttest	Raw Gains	Normalized Gains
Unit 7- East Feliciana Males	0.316	0.055	0.072	0.054
Unit 7- East Feliciana Females	0.043	0.016	0.004	0.011
Unit 3- Madison Prep Males	0.500	0.054	0.058	0.054
Unit 3- Madison Prep Females	0.266	0.016	0.018	0.015
Unit 7- Madison Prep Males	0.306	0.164	0.097	0.147
Unit 7- Madison Prep Females	0.380	0.032	0.030	0.032

*** Highlighted boxes indicate a p-value of less than 0.05

The highlighted p-values indicate a statistically significant difference in results. The T-test results confirm what was shown graphically above. There appears to be a difference in the pretest results for East Felicaina unit 7 females. Again, that result may not be reliable due to such a small percentage score on the test as well a a small sample size. The male populations in all 3 units did not show any difference between the control and experimental groups. The high pretest p-values for males show that the populations were homogeneous going into the units. The T-test also shows that the populations were the same in posttest, raw gain, and normalized gain values for all 3 units. This data seems to indicate that males did not perform better when when offered a reward than that group that was not offered a reward. The significant results in posttest scores, raw gains, and normalized gains for all female units indicate there may be a difference in the groups. The effect seen in East Feliciana on unit 7 appears to be significant. The control group in Madison Prep's unit 7 and the experimental group for Madison Prep's unit 3 were the same students. Therefore, the fact that both of these groups performed higher than their counterparts make it impossible to tell if the reward had an effect on results.

Due to the inconclusive nature of the females' results, tests were run to see if females outperformed males on any unit when offered a reward. The same pretest results are shown below, but they compare males and females to each other rather than to the same gender.

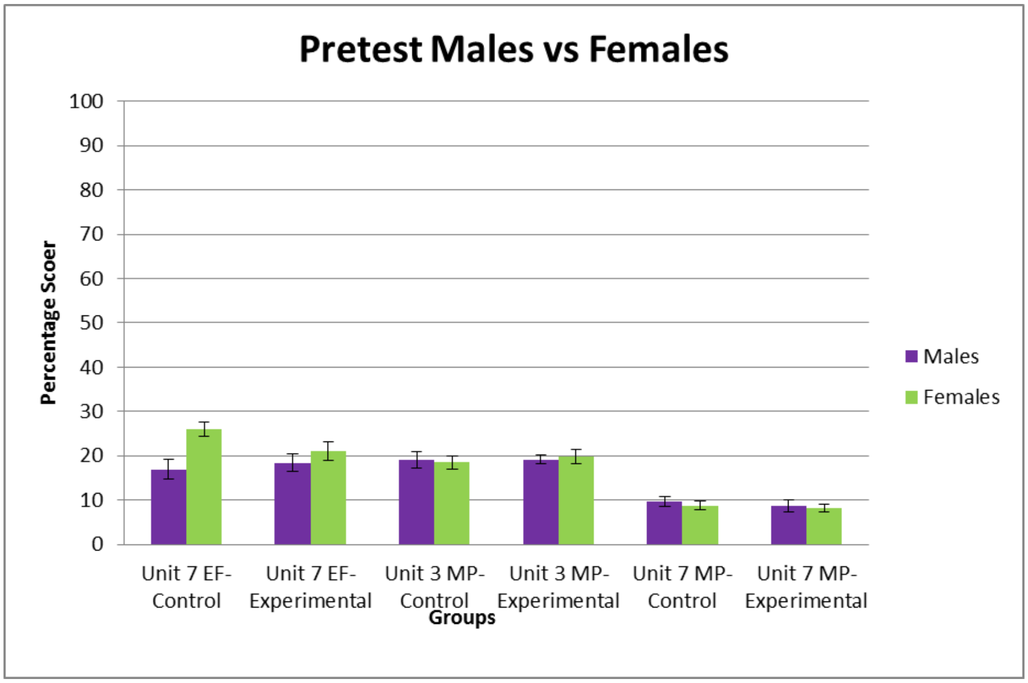

Figure 10: Pretest Results- Males vs Females

The pretest values when comparing males to females show that every population is homogeneous going into the unit except for one. The unit 7 control group for East Feliciana appears to be statistically different. The anomaly in these results is in the same group as the previous pretest comparisons. Again, due to small percentages and low sample sizes, these test scores may have been greatly affected by just one or two students' scores. Therefore, this difference is probably not a reliable indication of the sample group, and the groups are most likely at the same level of knowledge going in.

The male and female groups were compared to each other in posttest scores, raw gains, and normalized gains. The results are as follows:

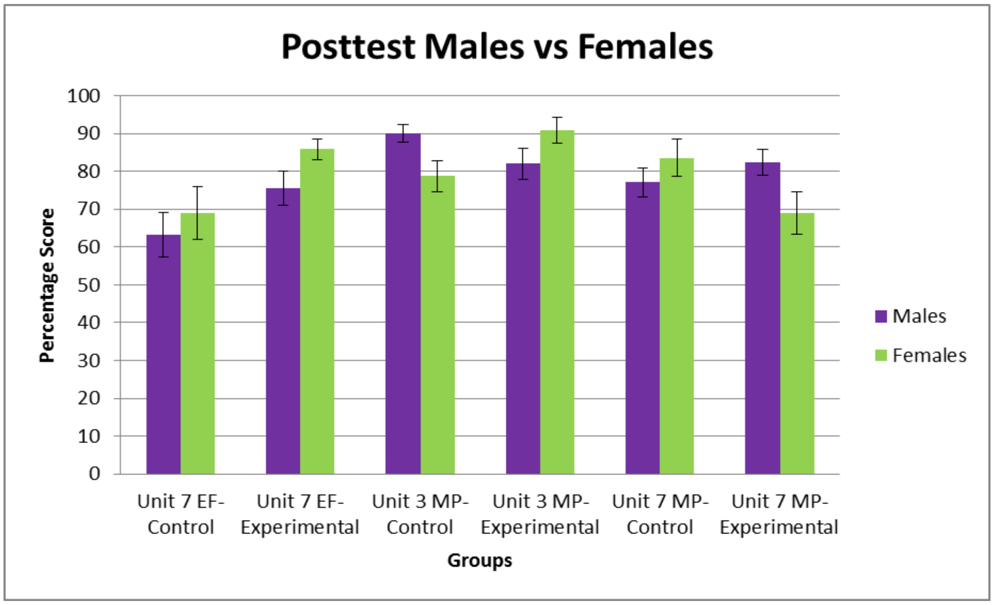

Figure 11: Posttest Results- Males vs Females

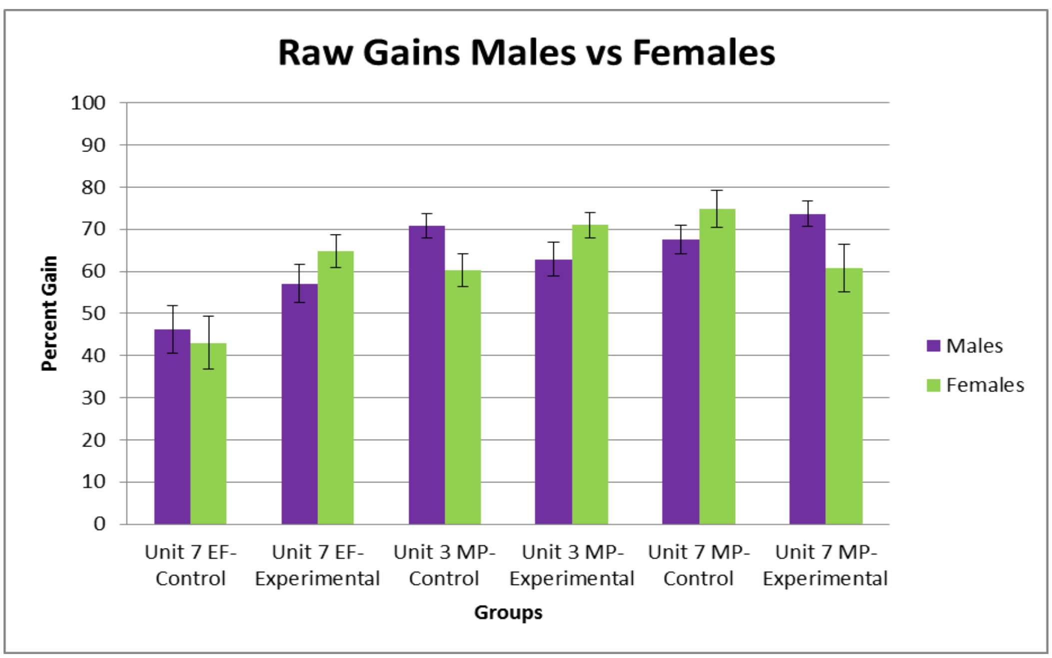

Figure 12: Raw Gains- Males vs Females

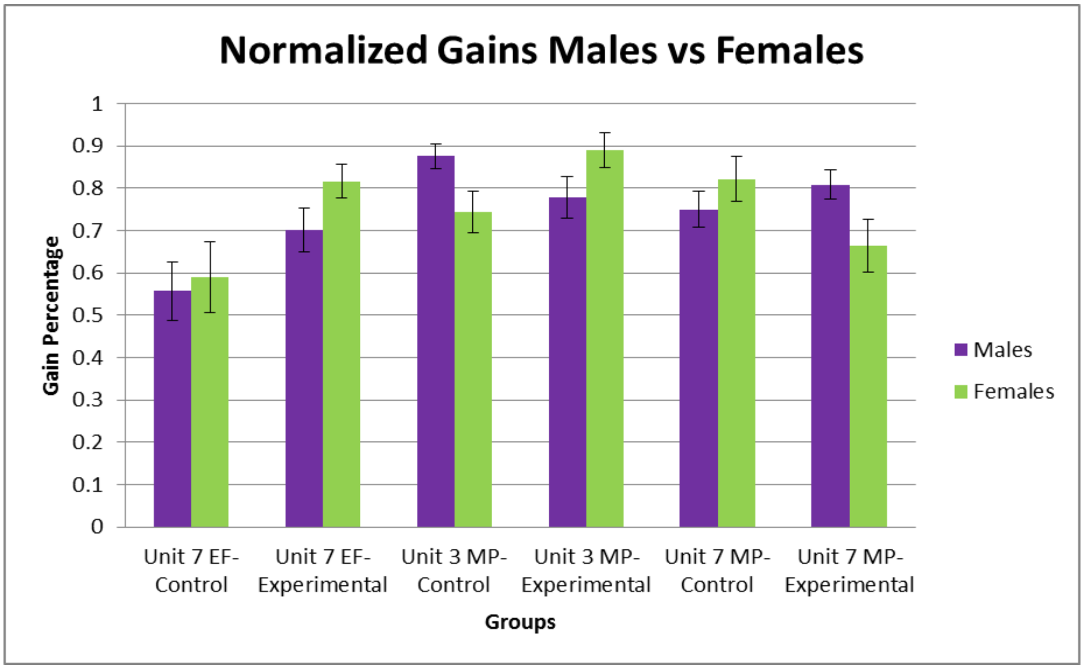

Figure 13: Normalized Gains- Males vs Females

The results when comparing males to females are similar when looking at posttest scores, raw gains, or normalized gains. There is not a difference based on gender in the unit 7 East Feliciana control group. It appears that females outperformed males in the experimental group on unit 7 at East Feliciana High School. The males appear to have outperformed the females in the Madison Prep unit 3 control group. The female population did better than males in the experimental group for unit 3 at Madison Prep Academy. The unit 7 control group at Madison Prep shows no statistical difference between males and females. The experimental group for Madison Prep's unit 7 shows that males outperformed females on every measure.

T-tests were also run on these groups to confirm the statistical significance of the differences seen. A two tailed T-test was run to determine if there was any difference in the results of the two groups. The results are as follows:

Table 6: Males vs Female T-Test Results

Male vs Female T-Test				
Group	**Pretest**	**Posttest**	**Raw Gains**	**Normalized Gains**
East Feliciana Unit 7- control	<0.001	0.264	0.700	0.383
Madison Prep Unit 3-Control	0.391	0.014	0.035	0.016
Madison Prep Unit 7- control	0.279	0.158	0.210	0.148
East Feliciana Unit 7-Experimental	0.183	0.036	0.213	0.049
Madison Prep Unit 3-Experimental	0.348	0.054	0.116	0.049
Madison Prep Unit 7- Experimental	0.392	0.029	0.054	0.027

*** Highlighted boxes indicate a p-value of less than 0.05

The T-tests confirm what was seen in the graphs. The only differences in the groups on the pretest results are in unit 7 from East Feliciana. In the posttest scores, there is a difference by gender in Madison Prep unit 3 control group, the East Feliciana unit 7 experimental group, and the Madison Prep unit 7 experimental group. The normalized gains show significant differences between genders in the Madison Prep unit 3 control group, and all experimental groups. The raw gains only show a significant difference in the Madison Prep unit 3 control group. The results from the normalized gains the raw gains are expected to match in significance, but these results do not in several categories. The lack of matching results most likely has to do with the fact that the sample sizes are very small and one student's score has the ability to dramatically affect results.

Overall, the data collected does not show one gender clearly outperforming the other. The females outperformed the males in the unit 7 experimental group at East Feliciana and the unit 3 experimental group at Madison Prep. The males outperformed the females in the unit 3 Madison Prep control group and the unit 7 Madison Prep experimental group. Based on the background literature, I expected to see females outperform males in all the experimental groups. This clearly did not happen. It is important to note, however, that the unit 3 control males and the unit 7 experimental males are the same group of students because they were switched between units. It is possible that this group of

males is just exceptionally high performing and therefore showed high results that were not an effect of the reward offered. There is clearly a difference in genders in these groups, but the differences do not follow a consistent pattern and cannot be attributed to the reward only.

Conclusion:

Upon viewing the overall results of my experiment, it is clear that I have some conflicting data. The 2010-2011 data showed a very definitive and statistically significant positive result in both the test averages and the normalized gains comparisons. From that data, it appears that offering students an extrisinic reward will improve their academic performance on a unit test. Yet the two trials run in the 2011-2012 school year showed exactly the opposite. Offering pizza to a group of hungry teenagers in no way improved their academic performance.

The study done by Fryer suggested that offering a reward for testing was not a significant way to increase academic gains because students do not feel like they can control these results. Although I knew this going into the experiment, I felt that the situation in my class was different. The tests looked at in the Fryer study were standardized state tests. I know from first hand experience that state tests generally use unfamiliar language and are taken out of the context of a class. My teaching experience has shown me that students often feel that they can't control the results on the state test no matter the preparation. In my class however, students had already taken several tests written by me. The tests align directly with the material in class and questions are usually ones that they saw on previous work in the unit. In the units taught before the study began, students were allowed to make test corrections by providing correct answers for missed questions and citing exactly where they found the answer from their notes, classwork, etc. The students also had to reflect on why they missed the question and what they would do to help prepare for a test next time. My students had the tools and prior knowledge to feel that they could control the grade they earned on one of my unit tests, fitting into the groups with significant gains in Fryer's study. With this in mind, I made the decision to use unit tests as a basis for the reward offered. Despite my optimism, no gains were seen during the 2011-2012 school year on either unit tested.

The data comparing students across schools shows the populations going into unit 7 were not the same. One would expect students in the same grade with the same prerequisite classes to have the same prior knowledge. Students at East Feliciana, however, had more knowledge going into unit 7 than Madison Prep students. Although this seems contradictory, I have a good idea as to why this happened. My first year at East Feliciana, I taught physical science (a class that covers basic chemistry and physics concepts) to many of the students that I taught in chemistry during the testing year. The students at Madison Prep had a physical science teacher that quit half way through the semester and the rest of the class was taught by long term substitutes. Because of these mitigating circumstances, I believe that the East Feliciana students genuinely had more knowledge of acids and bases going into the unit.

Despite their disparity in knowledge going into the unit, both populations of students ended with the same basic performance on the unit 7 posttest. When the posttest scores are compared by the experimental and control groups, it is clear that the East Feliciana control group perfromed worse than the experimental group at East Feliciana and both the control and experimental groups from Madison Prep's unit 7. Because the experimental group performed well, however, the average score of the two schools are statistically similar. The offer of pizza at East Feliciana high school caused the test scores on the unit 7 exam covering acids and bases to be much higher. The offer of pizza at Madison Prep did not appear to influence test scores at all.

So what is going on here? Are the results from my first year a fluke, or did I somehow subconsiously flaw my procedure in the second year? I think several factors contributed to these contradictory results. To begin with, one must look at the qualitative qualities of both the school and students in the two different enviornments in which this study was conducted. East Feliciana High school was dealing with the merging of two community schools into one parish high school. We had a brand new administration and very little law and order on campus. The atmosphere could be described

as constantly chaotic and, often times, dangerous. Skipping class, disrespect to teachers, fights, and drugs were very commonplace on campus. The students behaved however they wanted with very few consequences and there was little emphasis on academic achievement. The culture at Madison Prep Academy paints a much different picture. It is a small charter school with more emphasis on respect and far fewer distractions in the way of behavior, fights, and drugs on campus. While the academic atmosphere at the school is not great, the lack of behavior problems allow for more focus on learning and less on the basic safety and respect of students.

I believe that the differences in the cultures of these two schools could be a partial explanation for why my results were so different based on location. At East Feliciana High School, the idea of academic achievement was a relatively novel concept. The students were rarely met with praise for anything related to academics, much less an actual physical reward. The students were, however, acclimated to the idea of being rewarded for good behavior. One of the few attempts to encourage good behavior implemented at East Feliciana High School was a rewards party once a month for any student who had not received a behavior referral for that month. Usually these parties involved the student's missing the last half hour of their 7th hour class on a Friday. They were allowed to socialize during that time and were given a snack such as nachos or cake. Although these behavior parties were relatively low cost and easy to implement, the students really got excited if their names were on the list for the social. My study mimicked this reward procedure, with an emphasis on academics rather than behavior.

At Madison, students are used to the focus in the classroom being "work" rather than behavior. Although the rigor of the work of many of the classes is not up to par, there is less time spent fighting with students to pick up a pencil and try on a given assignment at Madison Prep. Students constantly ask for updates on their grades and love seeing a high score on a returned assignment. I believe that the

newness of the concept that grades are the MOST important thing with my East Feliciana students and their familiarity with a similar rewards system helped contribute to their motivation to achieve that 80% score. The students at Madison Prep were already used to the idea of being encouraged to achieve so they were, perhaps, less impacted by the offer of the extrinsic reward.

It is also important to note that in the rural parish of East Feliciana there are very few establishments that sell pizza, and even fewer who will deliver to the outskirts of the parish where many of my students lived. Fresh, hot pizza was a rare treat for my East Feliciana students. My students who attend Madison Prep live in the city of Baton Rouge. Baton Rouge has many pizza places and it is relatively easy and common to access pizza for a meal. The prize was probably more significant to the students who lived in East Feliciana than the students who live in Baton Rouge. Because the reward may have seemed more desirable to students at East Feliciana High School, this could have motivated them to more than Madison Prep students to strive for 80% on the unit test.

I also believe much of the success of the first year of the study could have been influenced by the way that I, as the teacher, sold the concept of a reward to my students. I was frustrated with the aforementioned culture of the school at East Feliciana High School. I could not get my students to turn in assignments, take lessons seriously, or try on graded work and tests. This thesis concept was born from the frustration and desperation felt as a educator in this situation. When the time came to implement my research, I was so encouraged about the possibility that I might actually get my kids to do some work that I sold the idea with gusto to my classes. I constantly reminded and reinforced the reward throughout the unit. In my second year of the study, I was not facing the same kind of academic discouragement. While I did to my best to try and remember to push the idea on my students, I know it fell to the wayside in the context of normal academic life. The fact that the kids were not reminded as

frequently of their potiential reward could be a factor in why the results were not significant during the 2011-2012 school year.

Based on the study done by Angrist *et al*. (2006), I expected the females in the study to have higher gains on the basis of a reward than the males. Overall, the males did not show a significant difference in performance when offered a reward no matter the unit or the school they were attending. When females in the experimental group were compared to the females in the control group, there were significant differences in two units from my study. In the third unit, the control group of females had higher test scores than the experimental group. The females at East Feliciana indicate that offering a reward did increase the test scores of girls when compared to a control group. The Madison Prep females that performed better in both the unit 3 experimental group and the unit 7 control were the same group of students. It is impossible to say (based on this group) if a reward increased test scores or if the results were being influenced by one particualarly strong group of females. Because of this, the results from Madison Prep Academy can only be called inconclusive. The variations in the prize in my study and Angrist study are pretty stark. Perhaps the fact that I offered only pizza, rather than a significant monetary incentive like $5,000 (the equivalent of one year of tuition) caused the vague effects seen. Repeating the study on the same population with a more substantial reward could show clearer evidence of a gender difference.

Comparing males and females to each other to determine if one gender is more influenced than another showed some interesting results. Normalized gains results indicate that females outperformed males in two experimental group, and males outperformed females in one control group and one experimental group. The raw gains did not mimick these results, which indicates that the low sample size could be affecting results. Because the experimental and control groups were switched at Madison Prep, the group of outperforming males for unit 3 control and unit 7 experimental were the same

students. Because these students were high performing no matter the reward situation, it is impossible to conclude that the reward had an effect on males. There appears to be an effect on students based on gender, but this effect does not appear to be consistent between groups of students. Again, I suspect that the value of the reward probably had a big impact on the motivation of the students. Had I offered my students a reward equivalent to $5,000, it is very possible that I would have seen a difference in motivation overall, and females in particular. Offering this caliber of reward, however is not feasible on a small scale, such as an individual classroom, and would not sustainable with the typical budget available to a teacher.

Given the inconclusive nature of many of my results, expansion of this study could provide significant educational insights. Once such expansion could involve including a qualitative assessment of student's attitudes and motivations toward school. As an educator, I can usually tell within two weeks of the start of an academic year which students will perform well and which will perform poorly based on attitude. The road block of a student who is just not willing work, despite intelligence, is one of the biggest frustrations that modern teachers face. One of the motivating factors of this study was to try and find a way to break down that unwillingness to work by providing an incentive. A way to attempt to relate attitude and the impact of an extrinisic reward could be providing opinion surverys to students on their academic attitudes and motivations. This could offer a correlation between mindset and the affect of extrinsic rewards. It would also be beneficial to take a look at students' home lives to assess the motivation coming from home and whether or not that has an effect on a student's ability to be influenced by physical rewards. For example, students that attend Madison Prep Academy have parents who chose to remove them from their home schools (the school they would have been sent to based on geographic location and district lines) and enroll them in a charter school. With parents involved enough

to make conscious academic choices for their child, are students at Madison Prep more motivated to learn than students at a traditional public school like East Feliciana?

Another study modification that could show increased student achievement would be to not base the reward on an assessment at all. Fryer's study (2010) suggested that rewards based on assessments were not the best way to motivate students. Since one of my biggest obstacles as a teacher is getting students to try the work given, perhaps a rewards structure based on turning in graded assignments such as labs and homework would have more of an effect on test grades. Attendance is another struggle which causes students' content knowledge to be affected. Offering rewards for showing up to school could also be a helpful expansion of the study.

Overall, it is pretty clear that more research needs to done to assess the effect of extrinsic motivators in the high school classroom. This research needs to be conducted using significantly more subjects from diverse socioeconomic and racial demographics as well as geographic locations. The study would also benefit from outside funding to put less of a limit on what an individual teacher could offer as a reward. An emphasis needs to be put on the effect that a single teacher's attitude and encouragement can have on a class' view of a rewards system as well as how the overall school environment affects academic performance and mindsets. I believe that further research on this subject has the ability to significantly change the way that educators view motivation in the high school classroom.

<u>References:</u>

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Clark, Carl A.; Walberg, Herbert J; Chicago State College; "The Influence of Massive Rewards on Reading Achievement in Potential Urban School Dropouts"; *American Educational Research Journal*; 1968

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McInerney, Dennis M.; Roche, Lawrence A.; McInerney, Valentina; Marsh, Herbert W.; University of Western Sydney, Macarthur; "Cultural Perspective on School Motivation: The Relevance and Application of Goal Theory*"; American Educational Research Journal*; Spring 1997, Vol.34, No. 1, pp. 207-236

Appendix A- Pretest/Posttest Unit 3- Atomic Theory

Chemistry Exam 3

Multiple Choice
Identify the letter of the choice that best completes the statement or answers the question.(3pts each)

____ 1. There are _____ groups on the periodic table (PS 15)
a. 18 c. 9
b. 7 d. 15

____ 2. What group is extremely reactive with water? (PS 15)
a. Group 1 c. Group 14
b. Group 2 d. Group 18

____ 3. Which of the following groups contains members with similar chemical reactivity? (PS 15)
a. Li, Be, C c. Sc, Y, Zr
b. Be, Mg, Sr d. C, N, O

____ 4. An unidentified element has many of the same physical and chemical properties as magnesium and strontium but has a lower atomic mass than either of these elements. What is the most likely identity of this element? (PS 15)
a. Sodium c. Beryllium
b. Calcium d. Rubidium

____ 5. The elements from which of the following groups are most likely to react with potassium (K)? (PS 15)
a. Group 2 c. Group 13
b. Group 7 d. Group 17

____ 6. A sample of an element is malleable and can conduct electricity. This element could be (PS 15)
a. H c. He
b. S d. Sn

____ 7. Elements that are poor conductors of electricity and usually found in the gaseous state are (PS 15)
a. Metals c. metalloids
b. non-metals d. transitional

____ 8. Atomic radius increases in what directions on the periodic table? (PS 15)
a. Up and to the right c. Up and to the left
b. Down and to the right d. Down and to the left

____ 9. Ionization energy and electronegativity increase in what directions on the periodic table? (PS 15)
a. Up and to the right c. Up and to the left
b. Down and to the right d. Down and to the left

____ 10. Which of the following atoms will have the LARGEST atomic radius? (PS 15)
a. Flourine (F) c. Francium (Fr)
b. Sodium (Na) d. Zinc (Zn)

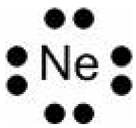
____ 11. Which of the following has the highest electronegativity and ionization energy? (PS 15)
a. Phosphorus (P) c. Cobalt (Co)

b. Strontium (Sr) d. Gallium (Ga)

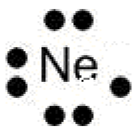
____ 12. How many protons, neutrons, and electrons are in Cl? (PS 15)
- a. p: 17, n: 17, e: 17
- b. p: 17, n: 18, e: 17
- c. p: 18, n: 17, e: 18
- d. p: 17, n: 18, e: 7

____ 13. How many protons, neutrons, and electrons are in Al^{3+}? (PS 15)
- a. p: 13, n: 14, e: 13
- b. p: 13, n: 13, e: 13
- c. p: 16, n: 14, e: 13
- d. p: 13, n: 14, e: 10

____ 14. Which of the following diagrams correctly represents the electron dot diagram for Neon? (PS 9)

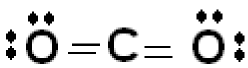
a. 

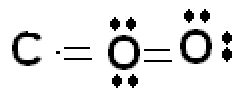
c. 

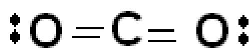
b. 

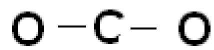
d. 

____ 15. What is the correct Lewis structure for CO_2? (PS 9)

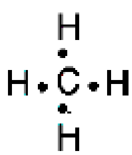
a. 

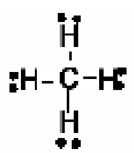
c. 

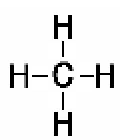
b. 

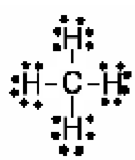
d. 

____ 16. Which of the following is the correct Lewis dot structure for CH_4.? (PS 9)

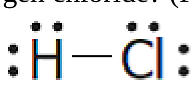
a. 

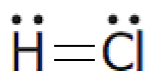
c. 

b. 

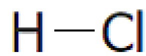
d. 

____ 17. Hyrdogen chloride is a covalent compound. Which of the following is the correct Lewis Dot Structure for hydrogen chloride? (PS 9)

a. 

c. 

b. 

d. 

____ 18. According to the periodic table, which of these elements will form an ion with a –2 charge? (PS 16)

a. S c. F
b. Mg d. Rb

____ 19. Which of these elements is most likely to donate (give up) one electron? (PS 16)

a. Be c. Rn
b. Cs d. He

____ 20. What will a Potassium (K) ion have to do to achieve stability (have a full outer shell)? (PS 16)

a. give away 1 electron c. give away 3 electrons
b. gain 1 electron d. gain 3 electrons

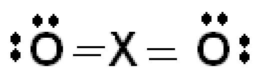
____ 21. Chlorine (Cl) combines with Sodium (Na) to achieve stability. How does Chlorine gain a full outer shell? (PS 16)

a. gives away 1 electron to Na c. gives away 3 electrons to Na
b. gain 1 electron from Na d. gain 3 electrons from Na

____ 22. Calcium (Ca) bonds with Oxygen (O) to form a stable ion. How does Calcium form an ion? (PS 16)

a. Gain 1 electron from O c. Give away 2 electrons to O
b. Give away 1 electron to O d. Gain 2 electrons from O

____ 23.



The model above shows how an unidentified element, X, forms covalent bonds with oxygen. In which group on the periodic table does Element X most likely belong? (PS 13)

a. Group 6 c. Group 14
b. Group 12 d. Group 18

____ 24. How many bonds can the element Phosphorus form? (PS 13)

a. 1 c. 5
b. 3 d. 8

____ 25. How many bonds can the element Lithium form? (PS 13)

a. 1 c. 3
b. 7 d. 6

____ 26. Identify the element in Period 4 of the Periodic Table that reacts with oxygen to form an ionic compound represented by the formula $\boldsymbol{X_2O}$.(PS 13)

a. Al c. S
b. Ca d. K

____ 27. Carbon has 4 valence electrons. How many more valence electrons does it need to become stable? (PS 13)

a. 3 c. 2
b. 5 d. 4

____ 28. Nitrogen has 5 valence electrons. How many bonds is nitrogen likely to form? (PS 13)

a. 2 c. 3
b. 4 d. 5

____ 29. How many bonds is oxygen most likely to form based on its number of valence electrons? (PS 13)

a. 2
b. 3
c. 4
d. 5

Matching (PS 15- 3pts each)

a. One electron short of a full octet, most reactive of the non-metals
b. Harder, denser, but less reactive than the Alkali Metals, form 2+ ions
c. Full electron shell, very non reactive
d. Soft enough to cut with a knife, very reactive, form 1+ ions

____ 30. Alkali Metals
____ 31. Alkaline Earth Metals
____ 32. Halogens
____ 33. Nobel Gases

Short Answer

34. Use the following compound to answer the questions (PS 9- 7 pts):

BP

a) How many valence electrons does each element have?

B___ P___

b) Draw the Lewis dot structure for the compound

.

35. Use the following compound to answer the questions (PS 9- 7pts):

K_2O

a) How many valence electrons does each element have?

K___ O___

b) Draw the Lewis dot structure for the compound

.

36. Use the following compound to answer the questions (PS 9- 7pts):

CaPo

a) How many valence electrons does each element have?

Ca___ Po___

b) Draw the Lewis dot structure for the compound

.

37. Use the following compound to answer the questions (PS 9- 7pts):

H_2CS

a) How many valence electrons does each element have?

H_____ C____ S_____

b) Draw the Lewis dot structure for the compound

.

38. For the following elements, circle whether each is a Metal, Non-Metal or Metalloid; tell what group and period it is in; and list at least one characteristic (conductivity, malleability, ductility, etc) it is likely to have. (PS 15- 4pts each)

a) Potassium (#19) – (metal/non-metal/metalloid) Group:_____ Period:_____
Characteristic:

b) Nitrogen (#7) – (metal/non-metal/metalloid) Group:_____ Period:_____
Characteristics:

c) Silicon (#14) – (metal/non-metal/metalloid) Group:_____ Period:_____
Characteristics:

.

39. Draw the Bohr Model for the following element (PS 15- 5pts):

S

.

40. Draw the Bohr model for the following element (PS 15-5pts):

Mg

Appendix B- Pretest/Posttest Unit 7- Acids and Bases

Exam 7- Acids and Bases

Multiple Choice

Identify the letter of the choice that best completes the statement or answers the question. (4pts each)

____ 1. An aqueous solution with pH 5 has a hydroxide ion (OH^-) concentration of (PS 33)

a. 1×10^{-11} molar
b. 1×10^{-9} molar
c. 1×10^{-7} molar
d. 1×10^{-5} molar

____ 2. Which of the following will have a pH of 2? (PS 33)

a. A 0.01-molar solution of HNO_3
b. A 0.01-molar solution of $NaNO_3$
c. A 0.01-molar solution of $Cu(OH)_2$
d. A 0.01-molar solution of NaOH

____ 3. A solution of H_2SO_4 is found to have a hydrogen ion concentration of 1×10^{-3} M. What is the hydroxide ion [OH^-] concentration in the solution? (PS 33)

a. 1×10^{-13} molar
b. 1×10^{-11} molar
c. 1×10^{-7} molar
d. 1×10^{-3} molar

____ 4. Two clear solutions are placed in separate beakers. The first solution has a pH of 4, and the pH of the second solution is unknown. If the two solutions are mixed and the resulting pH is 5, the second solution must have (PS 33)

a. fewer suspended solids
b. a lower temperature
c. more dissolved salt (NaCl) particles
d. a higher concentration of OH– ions

____ 5. What is the pH of a 1.0×10^{-4} M solution of H_2SO_4? (PS 33)

a. 12
b. 4
c. 10
d. 6

____ 6. What is the pH of a 1.0×10^{-2} M solution of KOH? (PS 33)

a. 2
b. 10
c. 16
d. 12

____ 7. An unknown solution is tested using blue litmus paper. The blue litmus paper remains blue. What can be determined about the pH of the solution? (PS 33)

a. The pH is greater than 7
b. The pH is less than 7
c. The pH is 7 or greater
d. The pH is 7 or less

____ 8. Which of the following substances has a pH GREATER than pure water? (PS 33)

a. baking Soda
b. acid rain
c. lemon juice
d. coca-cola

____ 9. An unknown substance is dissolved in water. The solution is corrosive, conducts electricity, and has a higher concentration of H^+ ions than OH^- ions. What kind of solution does this unknown substance form? (PS 33)

a. an acidic solution
b. a basic solution
c. a neutral solution
d. a non-electrolyte solution

____ 10. An acid and a base are combined in a neutralization reaction. What substance or substances will result from this reaction? (PS 33)

a. only water
b. another acid
c. another base
d. water and a salt

____ 11. The formula for molarity is: (PS 20)

a. moles/liter
b. moles/kg
c. liter/mole
d. kg/mole

____ 12. The formula for molality is: (PS 20)

a. moles/liter
b. moles/kg
c. liter/mole
d. kg/mole

____ 13. Ms. Vargo gives 20 moles of HCl. You dissolve the HCl in 5 liters of water. What is the molarity of the resulting solution? (PS 20)

a. 100M
b. 5M
c. 4M
d. 0.25M

____ 14. A student dissolves 10 moles of solute in 50kg of solvent. What is the molality of the solution? (PS 20)

a. 500m
b. 5m
c. 0.2m
d. 100m

____ 15. What is an acid? (PS 35)

a. A substance that donates protons
b. A substance that accepts protons
c. A substance that donates electrons
d. A substance that accepts electrons

____ 16. What is a base? (PS 35)

a. A substance that donates protons
b. A substance that accepts protons
c. A substance that donates electrons
d. A substance that accepts electrons

____ 17. What is the mass of 71.30moles of NaCl? (PS 41)

a. 1.229g
b. 4135g
c. 0.8135g
d. 2485g

____ 18. How many moles is 6.42×10^{25} atoms of flourine (PS 41)

a. 0.00938mol
b. 3.38×10^{24} mol
c. 107mol
d. 3.86×10^{49}mol

____ 19. How many moles is 742.00g of Ca_3P_2? (PS 41)

a. 4.0769mol
b. 135040mol
c. 4.4668×10^{26}mol
d. 0.24528mol

____ 20. How many molecules of NaOH are in 15.01 moles of NaOH? (PS 41)

a. 2.493×10^{-23} molecules
b. 0.3752 molecules
c. 600.4 molecules
d. 9.036×10^{24} molecules

____ 21. Acids are known to taste (PS 33)

a. Sour
b. Bitter
c. Sweet
d. Salty

____ 22. Bases are known to taste (PS 33)

a. Sour
b. Bitter
c. Sweet
d. Salty

Short Answer

23. In the following reaction, identify the acid, base, conjugate acid, and conjugate base (PS 35-9pts)

$HCl + NH_3 \text{ --> } NH^{4+} + Cl^{-}$

Acid: Conjugate acid:
Base: Conjugate base:

24. In the following reaction, identify the acid, base, conjugate acid, and conjugate base (PS 35-9pts)

$HCO_3^- + HF \dashrightarrow H_2CO_3 + F^-$

Acid: Conjugate acid:
Base: Conjugate base:

25. In the following reaction, identify the acid, base, conjugate acid, and conjugate base (PS 35-9pts)

$HPO_4^{2-} + H_2O$ --> $OH^- + H_2PO_4^-$

Acid: Conjugate acid:
Base: Conjugate base:

26. Using your knowledge of acids and bases, write the conjugate acid and conjugate base (don't forget to adjust the charges and remember that only one H moves!): (PS 35- 9pts)

Acid	Base	Conjugate acid	Conjugate base
H_2SO_4	F^-		

27. You begin with 88 mol of solute. if your solution has a molarity of 4.0M, how many liters of solvent did you add? (PS 20-6pts)

.

28. What is the molality of 64.5mols of solute being mixed with 200.0kg of solvent? (PS 20-6pts)

.

29. As student is conducting and experiment in which 5.40M solution of K_2O is needed. If the solution is being mixed with 3.00 liters of water, how many moles of solute were added? (PS 20-6pts)

.

30. Ms. Vargo is mixing chemicals for her students to use in lab. She mixes 456g of HCl with 22.0 liters of water. What is the molarity of the solution she mixes? (PS 20-8pts)

Appendix C- Unit 3 Unit Plan

UNIT 3 ATOMIC THEORY				
March 2012				
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
	28 Pretest Metals/nonmetals lecture and guided notes Practice Worksheet	29 Subatomic particle review Element Scavenger Hunt	1 Bohr Model lecture and guided notes Bohr Model practice worksheet	2 Periodic Trends lecture and guided notes Periodic Trends activity
5 Valence electron and ion lecture and guided notes Ion practice worksheet	6 Lewis Dot Structure intro Whiteboard practice	7 Whiteboard practice Lewis Dot Structure worksheet	8 Flame test Lab	9 Flame test lab completion/ review
12 Study guide work day	13 Review Jeopardy	14 Test Day	15	16
19	20	21	22	23

Appendix D- Unit 7 Unit Plan 2010-2011

UNIT 7 ACIDS AND BASES				
May 2011				
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
2 No School Pretest given on Friday April 29th	3 Discovery Lab	4 Mole lecture and guided notes	5 Mole practice worksheet	6 Molar mass conversion lecture and guided notes
9 No School	10 Molar mass conversion practice Molar mass conversion worksheet	11 Molarity/molality lecture and guided notes	12 Molarity/molality worksheet	13 Conjugate acid/base pairs guided reading
16 No school	17 Conjugate acid/base pairs worksheet	18 pH scale lecture and guided notes	19 pH practice worksheet	20 Acids/bases lab
23 No School	24 Review stations	25 Study Guides	26 Review trashketball	27 Test Day

Appendix E- Unit 7 Unit Plan 2011-2012

UNIT 7 ACIDS AND BASES				
December 2011				
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
28	29 Pretest Discovery Lab	30 Mole lecture and guided notes Mole practice worksheet	1 Molar mass conversion lecture and guided notes	2 Molar mass conversion practice Molar mass conversion worksheet
5 Molarity/molality lecture and guided notes Molarity/molality worksheet	6 Conjugate acid/base pairs guided reading	7 Conjugate acid/base pairs worksheet	8 pH scale lecture and guided notes pH practice worksheet	9 Acids/bases lab
12 Review stations Study Guides	13 Review trashketball	14 Test Day	15	16
19	20	21	22	23

Appendix F- Sample Powerpoint Lecture

Acids and Bases

Ms. Vargo
12.14.11

Warm Up:

Name the acid, base, conjugate acid, and conjugate base in the following reactions:

1) $NH_4^+(aq) + OH^-(aq) \leftrightarrow NH_3(aq) + H_2O(l)$
2) $CO_3^{2-}(aq) + H_2O(l) \leftrightarrow HCO_3^-(aq) + OH^-(aq)$

3) Write the balanced chemical reaction that would happen between Aluminum and sulfuric acid.

ACIDS/BASES

Acids & Bases

Characteristics of Acids:
Taste Sour
Affect indicators (red=acid)
Neutralize Bases
pH between 0 and <7

Acids & Bases

Characteristics of Bases:
Taste Bitter
Feel Slippery
Neutralize Acids (Antacids)
Affect indicators (base=blue)
pH between >7 and 14

Acids & Bases

Examples of Acids:
HCl
H_2SO_4
HNO_3
Vinegar
Fruit Juices

Acids & Bases

Examples of Bases:

$NaOH$

$Ca(OH)_2$

KOH

NH_3

Soap, Ammonia, Lye, Baking Soda

- Acids are proton donors. This means that they will ionize in water to make H^+ ions.

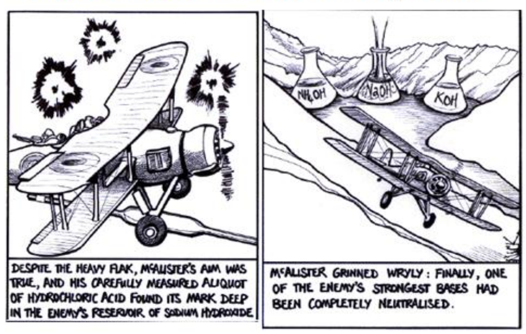
- Bases are proton acceptors. When they usually ionize in water they create OH^- ions

- Acids and bases react with each other to create a salt and water.
- These are called NEUTRALIZATION reactions.

- Example:

$HCl + NaOH \rightarrow NaCl + H_2O$

Neutralization of Bases using Acids



Acids & Bases

Which of the following would be acids and which would be bases?

Acids & Bases

Acid or Base?
KOH
HCl
HNO_3
NaOH

Acids & Bases

Acid or Base?
KOH

KOH → K + OH

Acids & Bases

Acid or Base?

KOH	Base
HCl	Acid
HNO_3	Acid
NaOH	Base

To find the strength of an acid or base, we use a pH scale.

- pH is a measure of the concentration of H^+ ions in a solution
- The concentration of H+ ions is measured in molarity

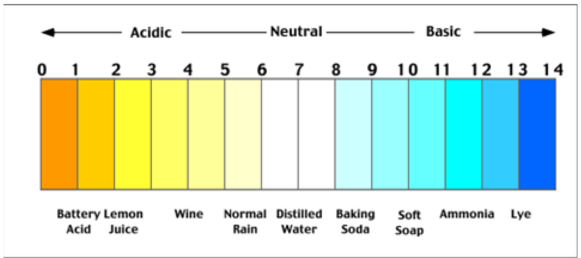
- pOH is a measure of the concentration of OH^- ions in a solution
- The concentration of OH^- ions is measured in molarity

Acids & Bases

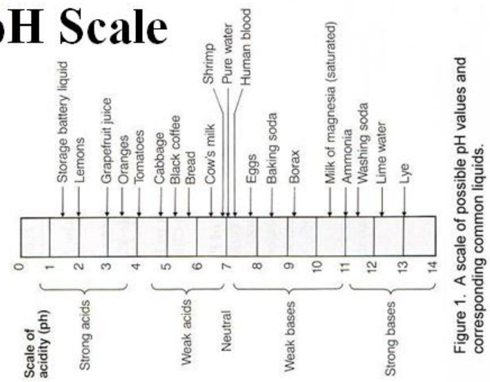
pH is measured on a scale of 0 – 14

Acids are low, bases are high.

pH Scale



pH Scale



Acids & Bases

Figuring out pH…

Acids & Bases

Figuring out pH…

When looking at a concentration of molarity, it's easy!

Acids & Bases

Figuring out pH…

Example:

1.0×10^{-3} M concentration of HCl

Acids & Bases

Figuring out pH…

Step 1: Figure out if it's the $[H^+]$ or $[OH^-]$.

Acids & Bases

Figuring out pH…

Example:

HCl gives the concentration of $[H^+]$

Acids & Bases

Figuring out pH…

Step 2: Take the absolute value of your exponent

Example:

$1.0 \times 10^{-3} \rightarrow$ use 3!

Acids & Bases

Figuring out pH…

Step 3: $[H^+]$ – Use the pH scale

$[OH^-]$ – Use the pOH scale

Acids & Bases

Figuring out pH…

1.0×10^{-3} M concentration of HCl

It's pH is 3!

Acids & Bases

Figuring out pH…

The concentration of H ions ($[H^+]$) is1.0×10^{-pH} M

Or 10^{-pH} M

Acids & Bases

Figuring out pH…

1.0×10^{-4} M concentration of NaOH

Acids & Bases

Figuring out pH…

1.0×10^{-4} M concentration of NaOH

Acid or base?

Acids & Bases

Figuring out pH…

NaOH is a base (because when it breaks up it will release OH^-)

Acids & Bases

Figuring out pH…

The concentration of OH ions ($[OH^-]$) is 1.0×10^{-pOH} M

Or 10^{-pOH} M

Acids & Bases

Figuring out pH…

2) Take the absolute value of your exponent (1.0×10^{-4} → use 4!)

Acids & Bases

Figuring out pH…

1.0×10^{-4} M concentration of NaOH

It's pOH is 4!

Acids & Bases

Figuring out pH…

Wait a sec, we can only figure out if it is an acid or base if we know the pH… so….

Acids & Bases

Figuring out pH…

pH + pOH = 14

Acids & Bases

Figuring out pH…

1.0×10^{-4} M concentration of NaOH

It's pOH is 4!

14-4 = 10

pH= 10!

Why does this work?

pH + pOH = 14

Why is this? Acids and bases are in solutions with water! They have some H^+ ions and some OH^- ions

Acids & Bases

Figuring out pH…

1.0×10^{-5} M concentration of HNO_3

Acids & Bases

Figuring out pH…

1.0×10^{-5} M concentration of HNO_3

pH of 5!

Acids & Bases

Figuring out pH…

1.0×10^{-2} M concentration of KOH

Acids & Bases

Figuring out pH…

1.0×10^{-2} M concentration of KOH

pH of 12!

Acids & Bases

Figuring out pH…

1.0×10^{-8} M concentration of LiOH

Acids & Bases

Figuring out pH…

1.0×10^{-8} M concentration of LiOH

pH of 6!

What is the pOH of a 1.0×10^{-4} solution of HCl?

What is the pOH of a 1.0×10^{-4} solution of HCl?

pOH= 10

What is the pOH and pH of a solution with $[OH^-]$ of 10^{-5}?

What is the pOH and pH of a solution with $[OH^-]$ of 10^{-5}?

pOH=5 pH = 9

Acid or base?

What is the pOH and pH of a solution with $[OH^-]$ of 10^{-5}?

pOH=5 pH = 9

Acid or base?

Base

What is the pOH and pH of a solution with $[H^+]$ of 10^{-5}?

What is the pOH and pH of a solution with $[OH^-]$ of 10^{-5}?

pH=5 pOH = 9

Acid or base?

What is the pOH and pH of a solution with $[OH^-]$ of 10^{-5}?

pH=5 pOH = 9

Acid or base?

Acid

Concentration WS.

Try these:

1) What is the pOH and pH of a solution with $[OH^-]$ of 10^{-9}
Acid or base?

2) What is the pOH and pH of a solution with $[H^+]$ of 10^{-13}
Acid or base?

Exit Ticket

- Acid or Base?

1) HF 2) NaOH 3) HNO_3

Find the pH of:

4) 1.0 x 10^{-4} M LiOH 5) 1.0 x 10^{-2} M $HClO_3$

Appendix G- Sample Guided Notes

Acids and Bases Notes

- Characteristics of Acids:
  - Taste ___________________
  - Affect indicators (____________________)
  - ______________________________ Bases
  - pH between ___________________

- Characteristics of Bases:
  - Taste _____________
  - Feel ___________________
  - __________________ Acids (Antacids)
  - Affect indicators (____________________________)
  - pH between ___________________________________

Examples of Acids: Examples of Bases:

- Acids and bases react with each other to create a ________ and _______________.
- These are called _____________________________ reactions.
- Example:

- pH is a measure of the ______________________ ions in a solution
  - The concentration of H+ ions is measured in ____________________
- pOH is a measure of the __________________________________ions in a solution
- The concentration of OH^- ions is measured in ________________________

- pH is measured on a scale from ___________________

- Acids are ____________, bases are _____________

To figure out pH:

1.0×10^{-3} M concentration of HCl

- Step 1: Figure out if it's the _________or ___________.
    - Example:
- Step 2: Take the absolute value of your ___________
    - Example:
- Step 3: $[H^+]$ – __________________________________
  $[OH^-]$ – __________________________________
    - Example:
- 1.0×10^{-3} M concentration of HCl has a pH of _________
- The concentration of H ions(___________) is1.0 x 10___ M

Example 2:

1.0×10^{-4} M concentration of NaOH

- The concentration of OH ions (___________) is 1.0 x 10_____ M
- pH + pOH = _____

Other Examples:

What is the pH of:

1) 1.0×10^{-5} M concentration of HNO_3

2) 1.0×10^{-2} M concentration of KOH

3) 1.0×10^{-8} M concentration of LiOH

4) What is the pOH of a $1.0x10^{-4}$ solution of HCl?

5) What is the pOH and pH of a solution with $[OH^-]$ of 10^{-5}?

a. Is it an acid or a base?

6) What is the pOH and pH of a solution with $[H^+]$ of 10^{-5}?

Is it an acid or a base?

7) What is the pOH and pH of a solution with $[OH^-]$ of 10^{-9}
Acid or base?

8) What is the pOH and pH of a solution with $[H^+]$ of 10^{-13}
Acid or base?

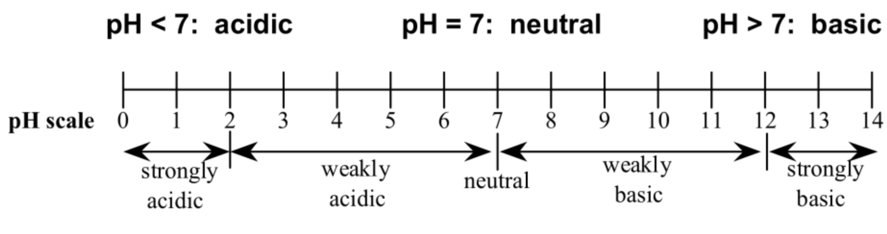
Appendix H- Sample Practice Worksheet

Acids and Bases

The pH scale shows us the _______________ of different _________________ and _______________
Acids have a pH between:

Bases have a pH between:

A neutral substance has a pH of



The pH Concept

pH Scale: measures concentration of hydrogen ions, [H+]

Acid or Base?

1) _____________________ **HF**
2) _____________________ **MgOH**
3) _____________________ **Diet Coke Soda (pH = 4)**
4) _____________________ **Baking Soda:**
5) _____________________ **Sour Candy (pH = 4)**
6) _____________________ **HBr**
7) _____________________ **NaOH**
8) _____________________ **Tylenol (pH = 9)**

pH and pOH (Integer Values Only)

Getting pH given [H+]: Recognize that [H+] = 10^{-pH}

To get pH if [H+] = 0.1M for a given solution, change [H+] given to 10^{-pH} form.
so [H+] = 0.1 M = 10^{-1} M → pH = 1
and [H+]=0.0001M=10^{-4} M → pH = 4

Example: Determine pH for the solutions below:

a. [H+]=0.001 M → pH = ____________ b. [H+]=0.0000000001 M → pH = ___________

c. [H+]=0.00001 M → pH = ___________ d. [H+]=0.000000000001 M→ pH = _____________

e. [H+]=0.000001 M → pH = ___________ f. [H+]=0.0001 M → pH = ___________

pH and pOH!
pH calculates the concentration of _____________ while pOH show the concentration of __________.

Converting between pH and POH: pH + pOH = 14

pOH= 4 → pH=________ acidic basic neutral pOH=7.61 → pH=________ acidic basic neutral

Remember you can only figure out if a compound is an acid or a base using the ____________

Example: Calculate the pH of a solution given that the following pOH values, then indicate if the solution is acidic, basic, or neutral:

pOH=2.65 → pH=________ acidic basic neutral pOH=7.61 → pH=________ acidic basic neutral

pH = 10.53 → pOH=________ acidic basic neutral pH = 6.91 → pOH=________ acidic basic neutral

pOH = 3 → pH=________ acidic basic neutral pOH = 12.91 → pH=________ acidic basic neutral

pH = 5.3 → pOH=________ acidic basic neutral pH = 9.01 → pOH=________ acidic basic neutral

Calculating pH from concentrations:

a. [H+]=$1x10^{-4}$ pH = ___________ pOH = ___________ b. [H+]=$1x10^{-8}$ pH = ___________ pOH = ___________

c. [H+]=$1x10^{-10}$ pH = ___________ pOH = ___________ d. [H+]=$1x10^{-2}$ pH = ___________ pOH = ___________

e. [OH-]=$1x10^{-8}$ pOH = __________ pH=____________ f. [OH-]=$1x10^{-14}$ pOH = __________ pH=____________

g. [OH-]=$1x10^{-3}$ pOH = __________ pH=____________ h. [OH-]=$1x10^{-3}$ pOH = __________ pH=____________

i. $[OH^-]=1x10^{-3}$ pOH = __________ pH=____________ j. $[OH^-]=1x10^{-3}$ pOH = __________ pH=____________

k. $[OH^-]=1x10^{-3}$ pOH = __________ pH=____________ l. $[OH^-]=1x10^{-3}$ pOH = __________ pH=____________

m. What is the pH of a solution of KOH with a hydroxide concentration of $[OH^-]=1x10^{-7}$?

n. What is the pOH of a solution of HCl with a Hydronium ion concentration of $[H^+]=1x10^{-2}$?

o. What is the pOH of a solution of HF with a Hydronium ion concentration of $[H^+]=1x10^{-4}$?

p. What is the pH of a solution of NaOH with a hydroxide concentration of $[OH^-]=1x10^{-3}$?

Lets reverse it: From the pH and pOH give the concentrations of the ions in the solution
Example pH 7 = 1.0×10^{-7}M $[H^+]$

Try it

pH 1 = pOH 13 = pH 3=

pOH 4= pH 9= pOH 7=

Appendix I- Sample Lab

Name___________ Date____________

Acids and Bases Lab

Grade: _____/50

Acid: Turns blue litmus paper red and red litmus paper stays red

Base: Turns red litmus paper blue and blue litmus paper says blue

Procedure- Part 1:

1) Record the substance you are working with
2) Predict if the substance will be an acid or a base based on what you know about it.
3) Test with the litmus paper
4) Flip the card over and record either the pH or the concentration.
5) Calculate either the pH or the concentration based on the given information.

Substance	Prediction (acid or base?)	Test results (acid or base?)	Concentration	pH	pOH

Part 2: pH Paper

1) Obtain a piece of pH paper from Ms. Vargo

2) Dip the pH paper into the substance at your last station

3) Record the reading of the pH paper below

Substance______________________________ pH__________

Post Lab Questions: Answer the following in complete sentences. (5 points each)

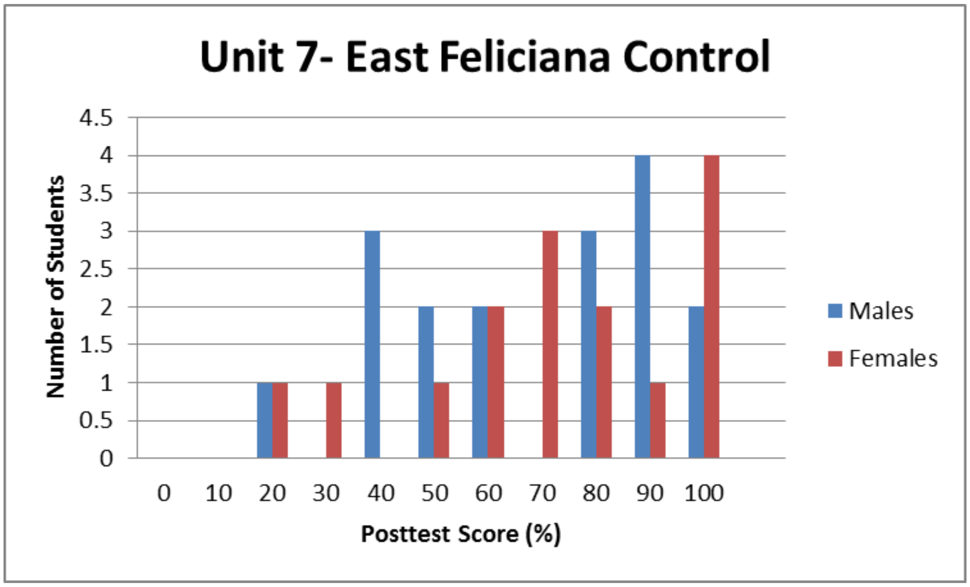
1) What ion does red litmus paper detect?

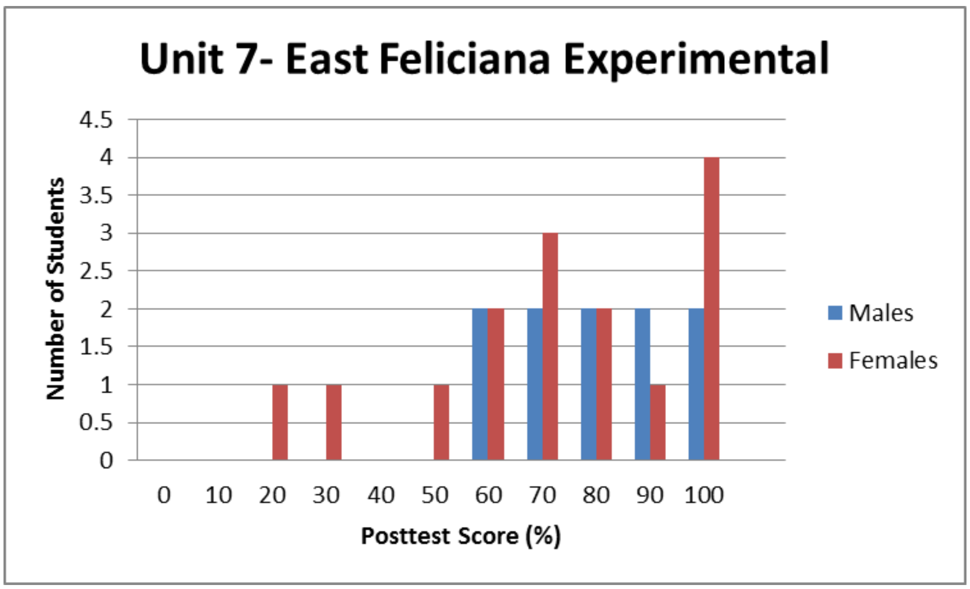
2) What ion does blue litmus paper detect?

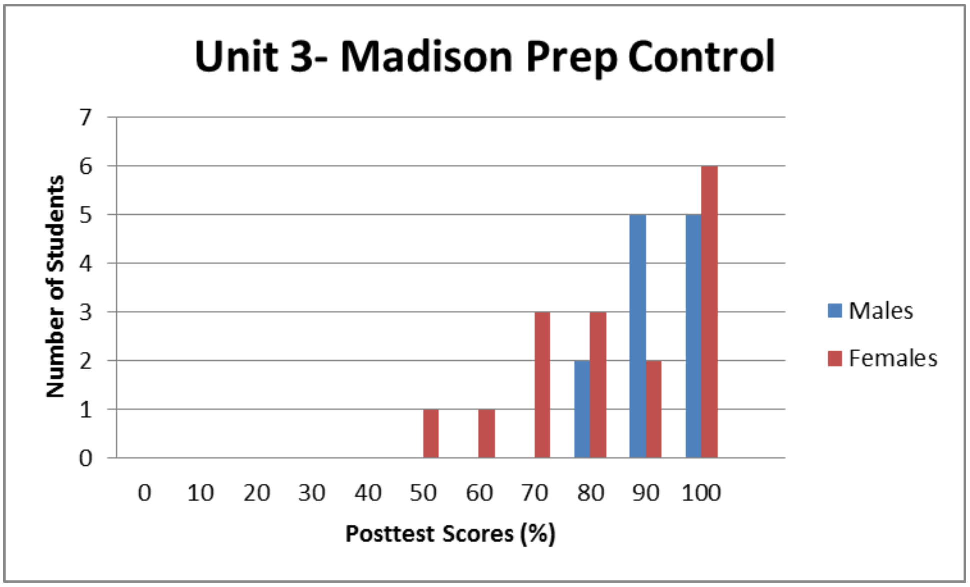
3) How could you use red litmus paper to determine a strong base from a weak base? How reliable do you think this method is?

4) Knowing what you know about red and blue litmus paper, how do you think pH paper works?

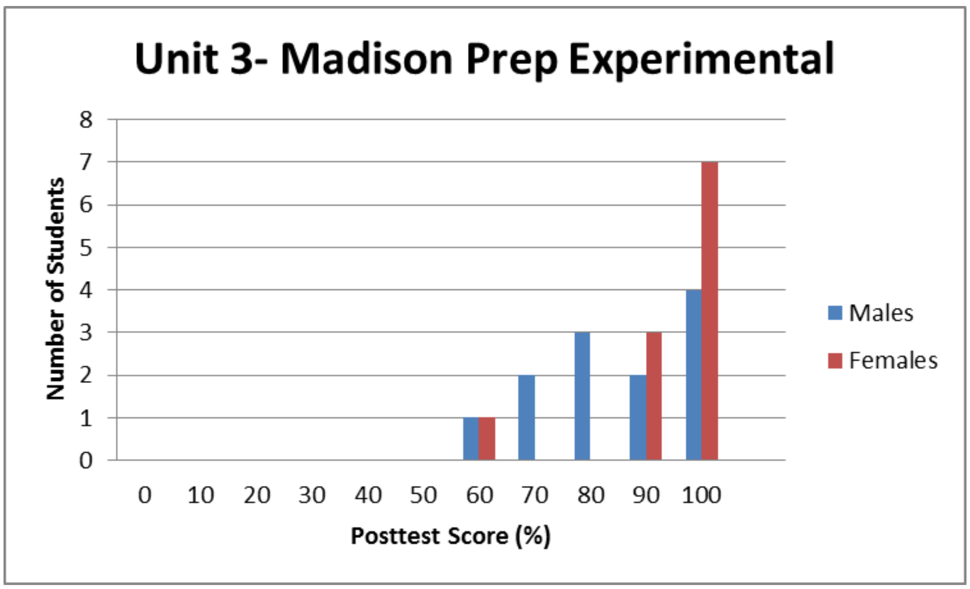
Appendix J: Raw Data Histograms



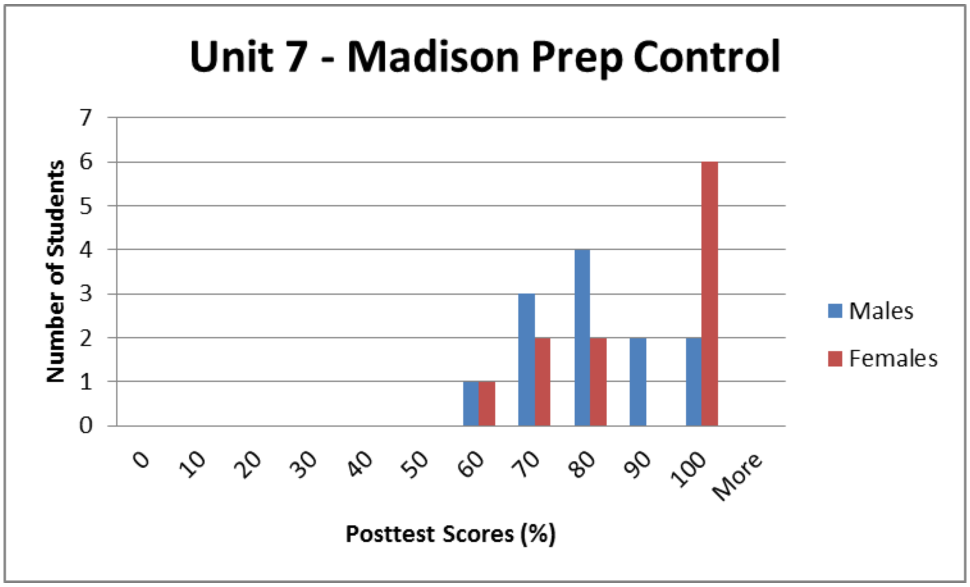




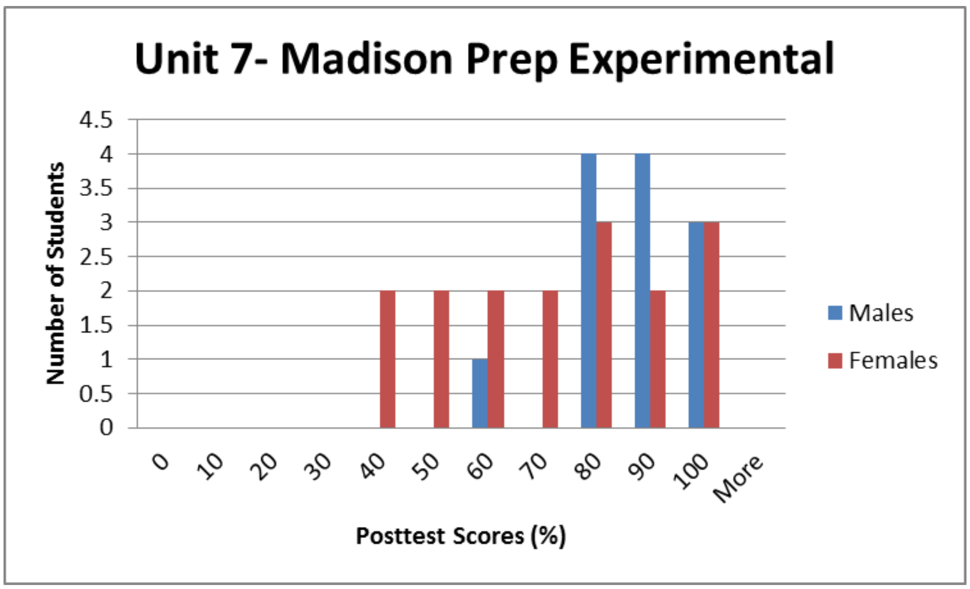
Unit 3- Madison Prep Control
7
6
5
4
3
2
1
0
Number of Students
0 10 20 30 40 50 60 70 80 90 100
Posttest Scores (%)
Males
Females



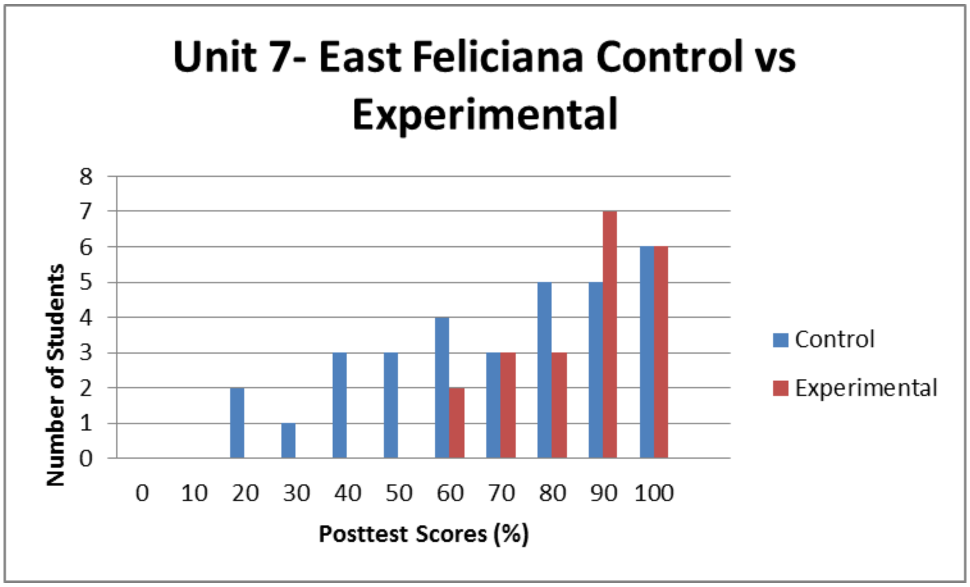
Unit 3- Madison Prep Experimental
8
7
6
5
4
3
2
1
0
Number of Students
0 10 20 30 40 50 60 70 80 90 100
Posttest Score (%)
Males
Females

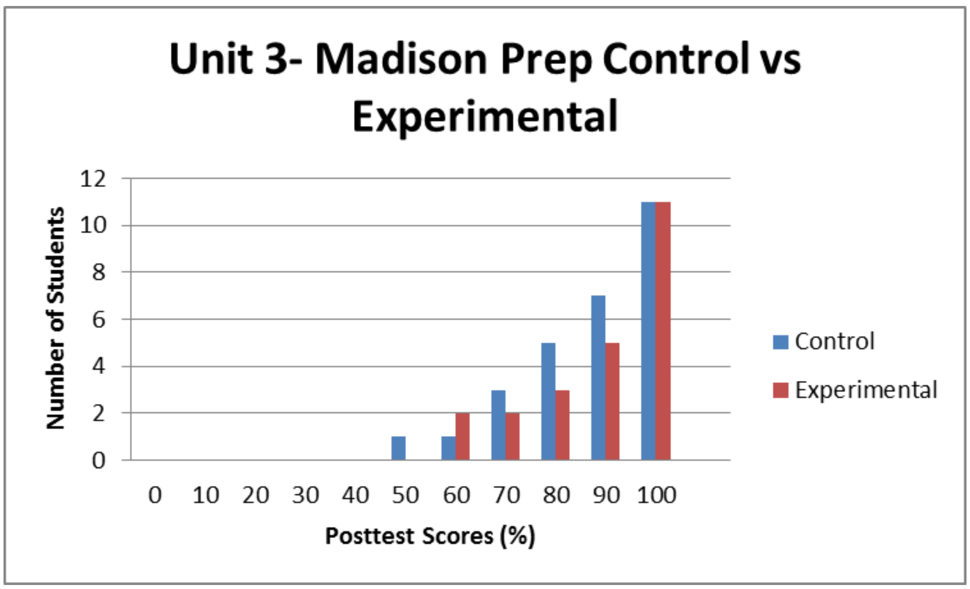


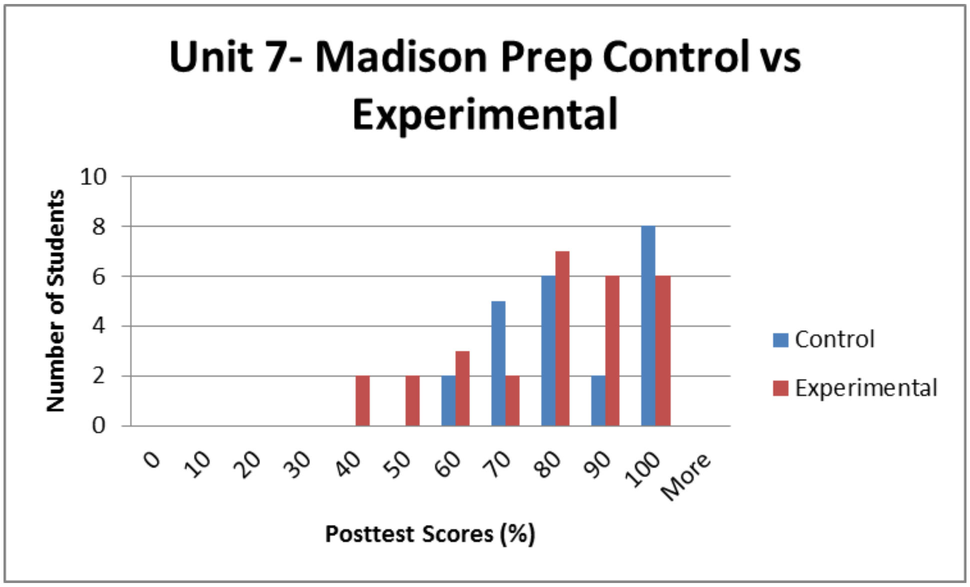
Unit 7 - Madison Prep Control
Number of Students
7
6
5
4
3
2
1
0
0
10
20
30
40
50
60
70
80
90
100
More
Posttest Scores (%)
Males
Females



Unit 7- Madison Prep Experimental
Number of Students
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
10
20
30
40
50
60
70
80
90
100
More
Posttest Scores (%)
Males
Females


Unit 7- East Feliciana Control vs Experimental
Number of Students
8
7
6
5
4
3
2
1
0
0
10
20
30
40
50
60
70
80
90
100
Posttest Scores (%)
Control
Experimental

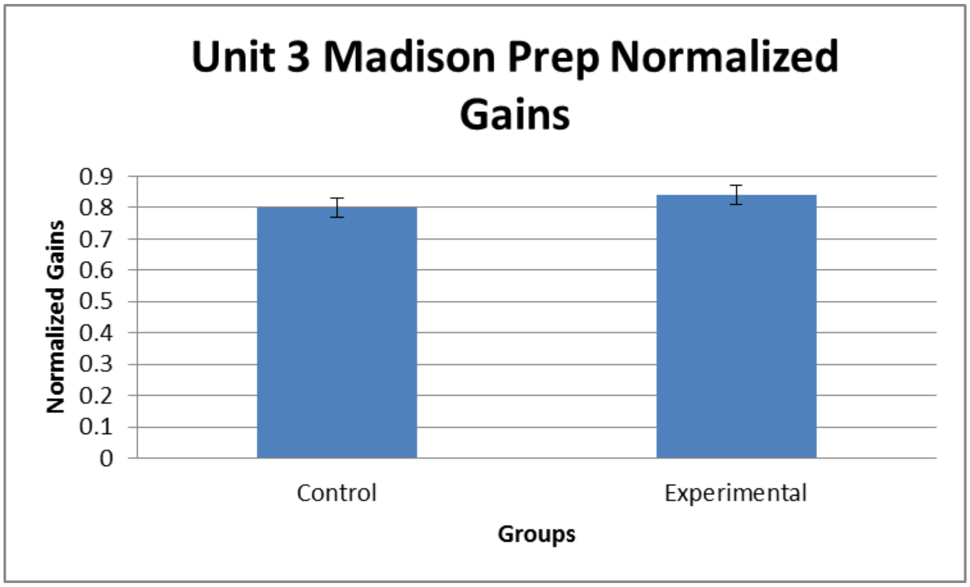

Unit 3- Madison Prep Control vs Experimental
Number of Students
12
10
8
6
4
2
0
0
10
20
30
40
50
60
70
80
90
100
Posttest Scores (%)
Control
Experimental


Unit 7- Madison Prep Control vs Experimental
Number of Students
10
8
6
4
2
0
0
10
20
30
40
50
60
70
80
90
100
More
Posttest Scores (%)
Control
Experimental

Appendix K- Normalized Gains Results per Unit

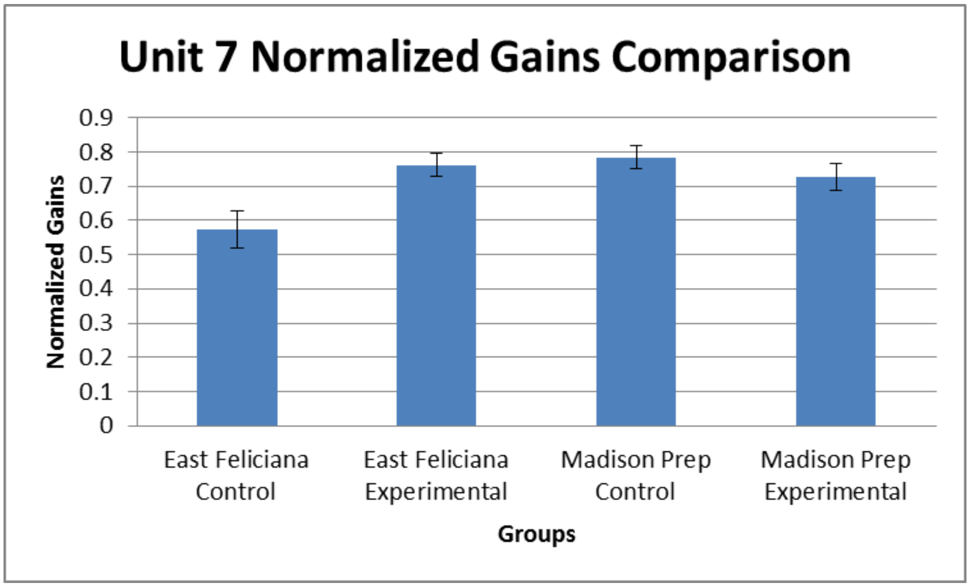
Normalized Gains Comparison in Madison Prep students for Unit 3

Unit 3 Madison Prep	
Control	Experimental
0.80 +/- 0.03	0.84 +/- 0.03



Normalized Gains Unit 7 Comparison- East Feliciana vs Madison Prep

Normalized Gains Comparison	
East Feliciana Control	East Feliciana Experimental
0.57 +/- 0.05	0.76 +/- 0.03
Madison Prep Control	Madison Prep Experimental
0.78 +/- 0.03	0.73 +/- 0.04



T-Test comparison of Normalized gains- East Feliciana vs Madison Prep

	T-Tests- Normalized Gains
East Feliciana Control vs Experimental	0.004
Madison Prep Control vs Experimental	0.270
EF vs MPA- Control	0.001
EF vs MPA- Experimental	0.498

*** Highlighted boxes indicate a p-value of less than 0.05

Appendix L- Study Consent Form

Study Consent Form

Project Title: The Effect of Extrinsic Rewards on Chemistry Test Scores in High School Students

Performance Site: Madison Prep High School

Investigators: The following investigator is available for questions, M-F, 8:00 a.m.-4:30 p.m.

Amanda Vargo Madison Prep Teacher, LSU graduate student (513) 513-404-7290

Purpose of the Study: To see if the offer of pizza for scoring an 80% or higher on a chemistry unit test will increase test scores.

Inclusion Criteria: Students who are enrolled in Ms. Vargo's regular chemistry class for the 2011-2012 school year.

Exclusion Criteria: Students not enrolled in chemistry class

Description of the Study:

Over 2 units, class will be categorized as experimental or control groups. Both classes will be taught the same exact material by the same instructor. One class will be offered the reward of a pizza party if they score above an 80% on the posttest (If a student cannot eat pizza, another food will be substituted in accordance with their dietary restrictions). The other class will just get the normal intrinsic reinforcement of learning to get into college and excel in the future. The students will be given the exact same posttest. The following unit the control and experimental groups will be swapped and the test will be repeated. The experiment should take 2-3 months.

Benefits:

Subjects may improve their test scores with the extra incentive beyond academic performance and teacher's can use the information to increase student learning in the future.

Risks: There are no known risks.

Right to Refuse:

Participation is voluntary, and a child will become part of the study only if both child and parent agree to the child's participation. At any time, either the subject may withdraw from the study or the subject's

parent may withdraw the subject from the study without penalty or loss of any benefit to which they might otherwise be entitled.

Privacy:

The school records of participants in this study may be reviewed by investigators. Results of the study may be published, but no names or identifying information will be included for publication. Subject identity will remain confidential unless disclosure is required by law.

Financial Information:

There is no cost for participation in the study, nor is there any compensation to the subjects for participation.

Signatures:

The study has been discussed with me and all my questions have been answered. I may direct additional questions regarding study specifics to the investigator. If I have questions about subjects' rights or other concerns, I can contact Robert C. Mathews, Chairman, Institutional Review Board, (225) 578-8692. I will allow my child to participate in the study described above and acknowledge the investigator's obligation to provide me with a signed copy of this consent form.

Parent's Signature Date

The parent/guardian has indicated to me that he/she is unable to read. I certify that I have read this consent from to the parent/guardian and explained that by completing the signature line above he/she has given permission for the child to participate in the study.

Signature of Reader Date

Appendix M- IRB Approval Form

Application for Exemption from Institutional Oversight

LSU
Institutional Review Board
Dr. Robert Mathews, Chair
131 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
F: 225.578.6792
irb@lsu.edu
lsu.edu/irb

Unless qualified as meeting the specific criteria for exemption from Institutional Review Board (IRB) oversight, ALL LSU research/projects using living humans as subjects, or samples, or data obtained from humans, directly or indirectly, with or without their consent, must be approved or exempted in advance by the LSU IRB. This Form helps the PI determine if a project may be exempted, and is used to request an exemption.

-- Applicant,Please fill out the application in its entirety and include the completed application as well as parts A-E, listed below, when submitting to the IRB. Once the application is completed, please submit two copies of the completed application to the IRB Office or to a member of the Human Subjects Screening Committee. Members of this committee can be found at http://www.lsu.edu/screeningmembers.shtml

-- A Complete Application Includes All of the Following:
(A) Two copies of this completed form and two copies of part B thru E.
(B) A brief project description (adequate to evaluate risks to subjects and to explain your responses to Parts 1&2)
(C) Copies of all instruments to be used.
*If this proposal is part of a grant proposal, include a copy of the proposal and all recruitment material.
(D) The consent form that you will use in the study (see part 3 for more information.)
(E) Certificate of Completion of Human Subjects Protection Training for all personnel involved in the project, including students who are involved with testing or handling data, unless already on file with the IRB. Training link: (http://phrp.nihtaining.com/users/login.php.)
(F) IRB Security of Data Agreement: (http://www.lsu.edu/irb/IRB%20Security%20of%20Data.pdf)

1) Principal Investigator: Dana Browne **Rank:** Professor

Dept: Physics **Ph:** 8-6843 **E-mail:** phowne@lsu.edu

2) Co Investigator(s): please include department, rank, phone and e-mail for each

Amanda Vargo- LaMSTI Program, Graduate Student, 513-404-7290, avargo27@gmail.com

IRB# E5564 LSU Proposal # ____
Complete Application
Human Subjects Training

3) Project Title: The Effect of Extrinsic Rewards on Chemistry Test Scores in High School Students

Study Exempted By:
Dr. Robert C. Mathews, Chairman
Institutional Review Board
Louisiana State University
203 B-1 David Boyd Hall
225-578-8692 | www.lsu.edu/irb
Exemption Expires: 7-17-2014

4) Proposal? (yes or no) No **If Yes, LSU Proposal Number** ____

Also, if YES, either ○ **This application completely matches the scope of work in the grant**
OR ○ **More IRB Applications will be filed later**

5) Subject pool (e.g. Psychology students) Madison Prep High School Students

*Circle any **"vulnerable populations" to be used:** (children <18; the mentally impaired, pregnant women, the ages, other). Projects with incarcerated persons cannot be exempted.

6) PI Signature [signature] **Date** 29 JUNE 2011 (no per signatures)

**** I certify my responses are accurate and complete.** If the project scope or design is later changes, I will resubmit for review. I will obtain written approval from the Authorized Representative of all non-LSU institutions in which the study is conducted. I also understand that it is my responsibility to maintain copies of all consent forms at LSU for three years after completion of the study. If I leave LSU before that time the consent forms should be preserved in the Departmental Office.

Screening Committee Action: Exempted √ Not Exempted ____ Category/Paragraph 1

Reviewer Mathews **Signature** [signature] **Date** 7/18/11

Study Consent Form

Project Title: The Effect of Extrinsic Rewards on Chemistry Test Scores in High School Students

Performance Site: Madison Prep High School

Investigators: The following investigator is available for questions, M-F, 8:00 a.m.-4:30 p.m.

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Benefits:

Subjects may improve their test scores with the extra incentive beyond academic performance and teacher's can use the information to increase student learning in the future.

Risks: There are no known risks.

Right to Refuse:

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Signatures:

The study has been discussed with me and all my questions have been answered. I may direct additional questions regarding study specifics to the investigator. If I have questions about subjects' rights or other concerns, I can contact Robert C. Mathews, Chairman, Institutional Review Board, (225) 578-8692. I will allow my child to participate in the study described above and acknowledge the investigator's obligation to provide me with a signed copy of this consent form.

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Signature of Reader Date

Study Exempted By:
Dr. Robert C. Mathews, Chairman
Institutional Review Board
Louisiana State University
203 B-1 David Boyd Hall
225-578-8692 | www.lsu.edu/irb
Exemption Expires: 7-17-2014

Child Assent Form

I,________________________________, agree to be in a study to find ways to be academically motivated. I will not have to do any extra work for the teacher. I can decide to stop being in the study at any time without getting in trouble.

Child's Signature:____________________________ Age:______

Date:__________________

Witness* __________________________________ Date:__________________ * (N.B. Witness must be present for the assent process, not just the signature by the minor.)

Institutional Review Board Dr. Robert Mathews, Chair 203 B-1 David Boyd Hall Baton Rouge, LA 70803 P: 225.578.8692
F: 225.578.6792 irb@lsu.edu | lsu.edu/irb

Study Exempted By:
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Exemption Expires: 7-17-2014

Vita

Amanda E. Vargo was born in St. Louis, Missouri, in March 1987. She attended elementary, middle, and high school in Loveland, OH. She graduated from Loveland High School in June 2005. The following August she entered Marquette University and in May 2009 earned her degree in Clinical Lab Science. She entered teaching through the Teach for America Program and earned her chemistry certification through The New Teacher Project alternative certification program. She entered the Graduate School at Louisiana State University Agricultural and Mechanical College in June 2010 and is a candidate for a Master of Natural Sciences. She has taught high school in East Feliciana Parish and currently teaches chemistry at Madison Prep Academy in Baton Rouge, Louisiana.