High School A **Thursday, December 11th, 2003**
Teacher A **Observation Time: 5.5 Hours**

I observed with Teacher A's class from 8:00 AM until 1:30 PM. I observed two AP physics classes, one regent's class period, a Regents laboratory period (taught by another teacher), a 9th grade earth science class (taught by another teacher), and attended a departmental meeting. I was also present during one of Teacher A's planning periods and spent that time discussing AmhersSchool A's physics program with him. We also discussed education and a bit of teaching philosophy throughout the day.

In the AP classes Teacher A was discussing gravitational forces on celestial bodies. His class was conducted through the use of overheads and handouts. The handout had blanks for the students to complete and also provided space for extra notes. The lecture was a series of problems that Teacher A solved in class with the assistance of the students that ranged from bodies of different sizes and densities.

In the Regents class the students were introduced to Newton's Laws. Students had seen them in middle school but needed reminding. Teacher A introduced the laws by asking why things happen – explaining cause and effect. The lecture was short but all three laws were introduced, he said that it would take another lecture or two for the concepts to really hit home.

In the laboratory students dropped a metal sphere through a photo gate onto an impact pad from a variety of heights. The students recorded the times it took for the ball to fall and arrived at an experimental value for the force of gravity. The lab seemed a tad mundane and some of the groups had malfunctioning equipment. Another teacher, who is relatively new to the school, taught this section. One student in the class was particularly disruptive, he repeatedly curses loudly and complained about having to attend the laboratory session. The instructor either ignored or did not hear most of the cursing; she did however notice his displeasure. She had him volunteer to help her with the demo and this seemed to calm him down for a bit until the students performed the labs on their own.

The earth science class was an entirely different world. The students received a test they had taken the previous week and review the questions, the class as a whole was rambunctious. They had to be told several times to calm down. The period was their first class after lunch; the teacher confided to me that they're always wound up after they eat loads of sugar. The new material that was introduced was on geological formations. The presentation was on PowerPoint and each of the students received an outline version with room for note taking. The class as a whole seemed energetic but the material was not as much to my liking as the physics.

The departmental meeting was marked by quite a bit of complaining from the 9th grade teachers. Several have been saddled with small classes populated with entirely troubled kids, they face severe behavioral problems and it seemed to be difficult to get all in class let alone teach them anything or even pay attention. Several constructive comments were made considering the curriculum and letting students out of class for extracurriculars, the teachers maintained that not only do the students miss material; their leaving also disrupts class. It was a good meeting to attend to see what really goes on in the department behind closed doors.

Middle School B **Tuesday, February 17, 2004**
Teacher B **Observation Time: 5 Hours**

I observed with Teacher B's class from 9:00 AM until 2 PM. I observed two eighth grade classes, an earth science class, and participated in hall duty.

In Teacher B's eighth grade classes the students were introduced to Plate Tectonics by the use of a puzzle exercise. Students were sorted into groups and then given a packet of puzzle pieces the size of an 8 _ x 11 sheet of paper. The first set was just a blank sheet of paper; none of the groups completed the puzzle within the allotted time. The second puzzle was a double-sided sheet of printed material from a science supply magazine- all the groups completed the puzzle in the amount of time given.

Teacher B's earth science class was a review of a recent test that was returned to the students. Teacher B noted that three-quarters of the questions on the Regents test involve the use of the reference tables, so students need to become familiar with the material on the tables and their use.

The two topics that struck me most about Teacher B's class were disciple/motivation and technology. As far as discipline goes there were no major problems in the class, once or twice he had to say, "All eyes on Mr. B please," but that was the extent of the problem. Motivation was achieved through unabashed bribery, for answering a question correctly students received their choice of a sugar cube or mini-marshmallow. I have no problem giving out sweets or even rewards, but not to everyone every single time a question is answered- this seemed excessive.

The technology that Teacher B uses is impressive. He utilized a website called Brainpop.com to teach students about plate tectonics- students watched a streaming video using two characters which they'd seen in previous videos and then answered questions via an interactive data gathering device- handheld buzzers made by Classroom Performance Systems. These buzzers only work for multiple-choice systems, but got students interacting and added a lot to the class. The other system Teacher B has on hand is Quizdom, which is better in his opinion because it allows for students to input numbers and decimal places rather than just multiple-choice answers. The only problem is that he has a set of eight buzzers, and a class of 30 students. He is working on getting a full set for the 04-05 school year, but for now Quizdom is relegated to Jeopardy-type game status only. The data gathered by these systems appears on his central machine, the display of which is projected onto a screen by a digital projector. The students effectively took the Brainpop quiz themselves- Teacher B took the majority vote and answered the online quiz as they went.

This technology was virtually unclaimed by the rest of the school- all Teacher B had to do was ask for it and sign it out each week- but nobody ever wants it besides him. Sometimes he has trouble getting the projector but not often. Teacher B compared this to his first teaching assignment at another school, where he didn't have his own classroom and the elevator was often broken. What do you do with a cart of mass balances when the elevator is broken?

I went to observe with Teacher B to gain insight into the differences between teaching in a middle school versus an upper school environment. The middle school students seemed to be less moody than the upper school students in general, but also had a shorter attention span. My visit to Middle School B confirmed my goal of teaching in a high school environment, both for the extra challenge of the material and also for the maturity of the students, but I was glad to see another environment as well.

High School C **Winter-Spring 2004**
Teacher C (and Teacher D)

Observations of general structure are followed by specific notes from classes/labs/exercises.

General Observations and Reactions to Class Structure

Organization

Teacher C teaches in a rectangular shaped room with a horseshoe shaped arrangement of desks around a central lab bench. The desk has chairs that push entirely away (preferable in my eyes). Study halls are not permitted to be held in science classrooms to prevent tampering with equipment and also because the rooms tend to be in various states of disarray.

Teacher C is one of the most organized teachers I have ever met. His material for both AP and Regents courses is stored in 3-ring binders: black for regents and white for AP. A single binder holds information for a two-week long topic; the AP class has 10 different binders while Regents has 12. These binders hold a brief outline of the class, homework assignments, old quizzes, and demonstrations. In addition to the teachers' binders, 10 smaller black three-ring binders are always in the laboratory. These binders hold information relevant to the current topic such as lab activities, relevant technical articles, sample problems of each type presented in the 2-week topic period, extra work, and a bibliography of all the information used to generate the topic. Each binder holds identical information, which is changed out at the end of each two-week topic. The extras are strung together and stored randomly throughout the classroom, Teacher C said that he's been meaning to collect them but has been quite busy.

The course starts with mechanics, but before anything begins Teacher C conducts a two-week math review. He gives all of the students (both AP and Regents) a pretest to make sure that they're in an appropriate setting. The test is out of 18, a Regents student who scores higher than 14 is encouraged to advance to AP and an AP student who scores below a 16 is encouraged to take Regents instead. The lowest score Teacher C ever saw by a student who passed Regents was a 4/18, he mentioned that it was quite a lot of extra work on both his part and that of the student but she did in fact pass the course. Teacher C currently has a freshman in his Regents class; the student has an A and is doing fine. Teacher C believes that this student's performance is a good indicator and shows that a Physics First curriculum may be beneficial. He told me that if he were to be given a freshman class he wouldn't change a thing from his current Regents class.

The AP class that Teacher C teaches is AP Physics C. He warned me away from AP Physics B, they have taught it in the past. B is merely Regents plus thermo and another topic and the class has to be done a month ahead of the normal regents class- the pace is so hectic that the students don't learn nearly enough and always feel rushed. His AP class, on the other hand, is only mechanics and they only move on when all the students show mastery of the material.

Regent's students are not given a textbook, Teacher C told them to take one from the cabinet if they ever feel the need but he uses them mostly for doorstops or to support apparati around the classroom. The AP book is somewhat better; he has his students do 10 problems per 2-week topic from the book (any 10, their choice).

Homework

Teacher C is a proponent of choices. He states that if the students are treated like adults then they behave as adults and take responsibility for their actions. Homework assignments are

given out on the first day of each two-week topic and aren't due until the third-to-last day (the second-to-last day is review and the last day is dedicated to the test itself). The date when the students will have learned the necessary information to do the homework is indicated on the assignment. Homework is composed of several parts:

1. Multiple Choice Questions (10, work must be shown on an attached sheet)
2. Easy Questions (Short answer)
3. Hard Questions (Multi-step)
4. Review Work
5. Bookwork (AP only, any 10 Q's)
6. Topic Notes (with room on the side for extra info)
7. Chapter Outline

The homeworks have a large possibility of extra credit, for the Regents class they are worth 80 points but graded out of 50 (30 E.C.). The AP students are graded out of 60 for a higher standard. Homework is design to take 10 min. per night for each night of the week, but most students wait and do a marathon session at the end (this is somewhat avoided by the HW Check quiz type- see below). The extra credit is put toward test or homework grade deficiencies; the total grade for a unit is a combination of points from quizzes, tests, and the homework.

Quizzes

Both quizzes per topic are announced, but the type of quiz is not. The possibilities are:

1. Equipment Check (Composition book, calculator, pencil, reference table)
2. H.Q. – Hard Question (Multi-step)
3. E.Q. – Easy Question (Short answer)
4. Reading – a segment of a technical bulletin or part of an instruction manual is displayed for 5 minutes– students must then either: tell all they can remember, or answer specific questions about the piece
5. HW Check – A quick check of HW progress is done to see if they students are where they're supposed to be on the current assignment.

Quizzes are chosen by a student rolling a die, whatever lands face up is the type of quiz for that day. The 6^{th} side is roll again. On last year's regent's test, High School C's students averaged 62% on the multiple-choice questions and 87% on the answer your own questions. As Teacher C put it, "They can do the physics just fine, they just can't read." To that end the reading quiz type has been instituted to sharpen critical reading of technical passages. Answers to quizzes are incorrect if units are not provided in the answer AND carried through all of the calculations.

Tests

Test tests are graded out of 90 points: 45 points are multiple choice and the other 45 are answer on your own. The 5 answer your own are more than the 3 on the AP test, but the students are allowed to select the points they want to be graded on for each problem (20,10,10,5,5), effectively choosing the students to identify and rely on their personal strengths. AP students take a full-length 90-minute test every other day 3 (High School C is on a 6 day schedule, it

works out to about every two weeks). As with quizzes, test answers are incorrect if units are not used throughout the calculations and provided with the final answer. Test questions for the AP classes are pulled directly past AP tests to provide a realistic test. Tests are graded similar to the actual AP grading; a mean and standard deviation are determined and student scores are based off of these statistics. Within one standard deviation of the mean earns a 3, between one and two standard deviations gets either a 2 or a 4, and a score two standard deviations away from the mean garners a 5 or a 1. Most of the class scores a 3, but there are always outliers. The statistics are computed using the grade recording software provided by High School C.

Laboratory Experiments and In-Class Exercises/Demonstrations

Composition/lab books are bought by Teacher C and Teacher D over the summer. They outfit the books with a table of contents, sheets for recording grades, and other applicable materials. The students are then required to buy the books back for use during the year. Students keep track of their grades to better recognize their own performance; failing grades must be taken home and shown to parents.

Labs are another area where students have a wide array of choices. Labs are of several types, the two main distinctions being cooperative/in-class and partnered (the latter is a distinction I make purely for this discussion). Cooperative or in-class experiments are performed by the class as a whole or in conjunction with the other AP class. These labs take several days to perform and are written up in an outline form with emphasis on a particular student's role in the lab. The partnered labs last 5 weeks, at the end of which students present their results in front of the class. The lab types are:

1. Challenge - data is difficult to take
2. Competitive - Compete against lab partner for superior results, winner gets extra points
3. Confirmation - prove/substantiate info from class
4. Cooperative - a class effort, mentioned above
5. Discovery - topic is tangential to current class topic, may be new material
6. Gedanken - thought experiment, no equipment
7. Observation - black box – data is crucial
8. Procedure - Difficult experiment with complicated directions – follow instructions
9. Research - Outside info (books, articles) must be used
10. Technology - Learn to use new equipment or techniques (photo gates, etc.)

At the beginning of the year each team of lab partners chooses a theme sheet from which they will pick their labs. The theme sheets are all quite interesting; themes such as forensics, amusement park rides, computer modeling (including Nintendo and Playstation analysis), and military analysis all tempt the students. The more interesting the topic, the more difficult the lab. Students are given rough guidelines for a laboratory in most situations; analyze a gravitational situation in Super Mario Bros., determine how many cars speed in the school zone, analyze the terminal velocity of a parachute under a variety of circumstances. The exact experiment, however, is up to the student to design. In 6 years no laboratory group has ever done an experiment the same way, in itself this is a testament to the creativity that this curriculum instills in the students. At the beginning of the year students choose a lab partner - they are encouraged

to pick someone on their own level rather than someone who, though a friend, may not be as intelligent as the student themselves.

These formal laboratory experiments are presented at the completion of the labs, every 5 weeks. Students present their experiment and results in front of the class using 2'x2' square handheld whiteboards. The first presentation of the year sets the tone for the rest of the year: students are admonished for presenting data rather than figures and have a difficult time prying their gazes away from their toes. By repetition the students improve; by the time I observed the class students generally spoke to the class and most used charts with labeled axes and slopes. These presentations are called "Share Your Feelings!" Students are graded individually on a range of elements: results and data are important but chart relevance, clarity, enthusiasm, and eye contact (among others) are also considered. Scores for each section range from 0-3, with a final value of 0-3 representing each student's overall performance in the lab. It is worthwhile to note than while in a given section no two groups work on the same lab at the same time, but different sections of students may have two or more groups all working on the same experiment. Teacher C has a vision of creating 20-minute meetings between groups from different sections to see how other groups tackled the problem presented and what data was generated.

Composition Books

As stated previously, students are required to "buy-back" composition books from Teacher C and Teacher D at the beginning of the year. These books are outfitted with a table of contents and sheets to record grades for each two-week topic. Points are deducted from laboratory grades for failure to keep track of scores and also for failure to fill out the table of contents. These composition books are also used to record data from class exercises and cooperative experiments. In addition, they are also used for: demo write-ups, book problems, and review (all part of HW). Composition books are graded while students write their bi-weekly tests and returned at the completion of the test.

Material

Both the AP and Regent's courses run off the content that has been developed and stored in the binders, but as they are so proud to say Teacher C and Teacher D "never do the same thing twice." This is not so much for in-class exercises; the impetus for cheating or copying work is quite low in a class setting. This applies more to homework and tests. I witnessed Teacher C creating a review sheet for the test on 1/22/04. He sat down at a computer and pulled up a sheet of problems on a computer. First he deleted 4 out of the 5 problems and then wrote new ones off the top of his head. From start to finish the quiz took him about 5 minutes to prepare. I asked if he ever planned to have a "library" of questions to pull from; he replied, "maybe, but probably not. If I don't change things I get bored and if I'm bored it wouldn't be as much fun." (Please see observation note on this subject under January 22nd, 2004)

The AP course ends when the students take the AP test, which is a month before school lets out for the summer. During the last month Teacher D and Teacher C present a topic or lab usually not seen in class. In years past these have ranged from discussions of fractals and chaos theory to the construction of 2-L water bottles rockets. When I myself was a high school student we performed the latter activity, but during the first semester.

Grading and Attendance

High School C uses a computerized grading system, but the system is not networked school-wide. It appears to be easy to use, though it takes some getting used to. Attendance is problematic for Teacher C, he says it's because the attendance book is so hard to find. He estimated that attendance is taken about half the time, which is an improvement. He feels that teaching is his number one priority, and when the office calls to check attendance it takes away from the class and is a waste of time.

Results and Specific Techniques

All of the above techniques combine to produce astonishing results: Teacher C's students are motivated and well behaved- they even interact in class. And 90% of last year's regent's students passed the exam, compared to 30-40% statewide (BEFORE the rescaling of grades January 2004).

Teacher C depends on many different techniques and types of questions to achieve these results. One of these is Fermi questions, which I was unfamiliar with. The questions are open-ended, "How many blades of grass are there on a football field?" "How much does a pirate chest full of gold weigh?", "How far does a Goose fly?" The students need to make an assumption (or several), perform calculations, and convert units to arrive at a reasonable answer. Guesses are no good whatsoever!

Teaching Philosophy, Curriculum, and Discipline

The teaching philosophy in terms of discipline seeks to keep students busy so that they don't have time to goof off. Teacher C also explained to me that both he and Teacher D "lean on" the students during the first month of classes so that the deadbeat students drop the course, leaving the well-intentioned students to work with. The number of physics students with behavior problems is very low, only a handful of students out of 6 classes (2 AP Physics C, 4 Regents). Teacher C told me that a frown goes much further than yelling to affect a change in student performance – disappointment is a powerful tool.

According to Teacher C, the physics program at High School C "teaches to the top students, but we provide a safety net for the lower students." I was told that in educational philosophy courses I would be taught to tailor the curriculum to meet all of the students' needs, but Teacher C and Teacher D disagree with that philosophy. They teach material at its highest level but don't expect the lower students to achieve this perfection. They rather provide enough extra credit (through HW mostly) for the lower students to be able to score well given that they do some extra work. Only top students finish tests, they are made to be demanding and trains students to react well when pressed for time. Another difference is that only a top student COULD finish the test, the last question on the second section (where students provide answers rather than M.C.) is sufficiently difficult that lower students will not be able to complete it. The reason for this is that "lower students don't deserve to complete the harder question; it's too hard for them." They lose points because of this, but Teacher C and Teacher D feel that this is correct – lower students should lose points because they don't in fact deserve an A. The course is unquestionably geared toward the high end of the student spectrum, but it functions well at that level and keeps everyone interested, albeit on slightly different planes. An inverse structure exists for formal laboratory presentations; students are graded on their performance relative to their capabilities rather than some standard to which all must conform. This is admittedly subjective but keeps different levels of students trying their best to fulfill the expectations that their teachers have of their abilities, which seems to be very accurate.

Another aspect of discipline that needs to be addressed is language. In his discussions with me Teacher C repeatedly used curse words even with students in the vicinity; he routinely uses language of this sort both in the laboratory and the classroom. I am in no way offended by this, but I wonder if he receives many complaints from students' parents. I imagine that it gives him more street credit – credibility in other words – to speak to the students on their own level, but it can only go so far. When a student used the word "fuck" Teacher C threw an eraser at the cabinet above him and then made him stand in the corner for several minutes. It appears that there are strict limits to how far the language rule can be taken, but coming in late in the first semester of classes I am not sure how far it can be bent. More on this to follow, I hope…

One significant adjustment that has been made to the High School C Physics curriculum in the past years is the scheduling of momentum – it is currently being taught (December-January). The reason is that this is one of the most stressful times for students, seniors in particular. It is the end of _ year courses, and it is also the time of year for the science Olympiad. For both the students and teachers it is a stressful time of year, and momentum is taught now since it is a reasonably easy concept. On another note, it is important to note that High School C uses a ranking system that does not take senior year grades into effect, so long as their college acceptances are not rescinded because of poor grades the students have little reason to care besides their motivation to do well.

Science Olympiad

An extension of physics education at High School C, particularly at this time of year, is the Science Olympiad. This year two teams are entered, which means more than twice as much work to be done (see below in Student Reactions). The laboratory is currently the building site for all the elements of the Olympiad teams, and the disarray is in fine form, much as it ought to be in a well-used physics lab. The teams are designing many different devices: musical instruments, "Mission" devices to be activated with a card and end with the lighting of a candle, Rube Goldberg devices, the list goes on. The problem solving and design aspects of the Olympiad are not the only benefits; competitors are also challenged purely academically and by "thinking on your feet" problems that involve spontaneous problem solving and design.

Student Reactions

Teacher C's students seem happy for the most part and are motivated. I did hear a few complaints, particularly from the AP students who also compete in the Olympiad, that Teacher C isn't aware that they have other coursework to complete outside of class or other extracurricular commitments. He arrives at school at 7:00 AM and rarely leaves before 5, this time of year he's usually in his classroom until 6 or 7. On nights when he has to grade (all papers are returned the following day barring Acts of God) he rarely gets to be before 1 or 2. I think it is partly because he works as hard as he does that he expects so much from his students- they are loathe to let him down for the most part. This year is particularly bad; High School C has entered two teams for the Olympiad because of student interest, which equates to more than twice the work because the easiest way to perform a given task is taken by the first team and the second's job becomes that much harder.

Facilities and Materials

The physics facilities at High School C are composed of a classroom and a laboratory. Teacher C and Teacher D alternate teaching periods: one of them is almost always either

teaching or in the laboratory. The classroom is outfitted with a television, overhead, whiteboards, and several places to attach apparati from the ceiling. The laboratory has 7 workstations, each equipped with a power supply and other useful connections. The lab is outfitted with a variety of tools and materials, most of which have been provided by Teacher C and Teacher D. The reason for this is primarily due to the structure of the course: since only two students work on an experiment at a given time a bare minimum of one set of materials is required for the lab. By the same token, a single set of a wide variety of materials is needed, which does not lend itself well to traditional school supply methodology. In the end the teachers end up purchasing most of the equipment for the laboratory on their own (even computers and printers in some cases) and use the annual allotment from the school for miscellaneous expenses.

Faculty

Outside of Teacher D, Teacher C regularly speaks to 3 other faculty members. These include faculty in English, biology, and a librarian. He is on good terms with the principal but has butted heads with a certain vice principal on several occasions.

Graduate, Undergraduate, and Test Experience

Teacher C went to Buffalo State College for his undergraduate degree in physics and attended the University of Buffalo for his master's degree beginning in his third year of teaching. Teacher D also attended Buffalo State for his undergrad but completed his master's work at Canisius College. Both teachers commented that it was difficult to finish master's work while teaching full time, but were also glad to begin teaching as soon as they did.

Tuesday, January 20th, 2004 **Observation Time: 3.25 Hours**

I observed with Teacher C's class from 12:00 PM until 3:15 PM. I observed an AP physics class and spoke at length with Teacher C during two free periods.

The 8th period AP class I observed was working on a laboratory assignment in conjunction with his other AP class, which is 3rd period. Both classes are at the same point and are currently studying momentum, with an emphasis on angular momentum. On the first day period 3 built the balance and period 8 constructed a scale for the balance. On the second day period 3 calibrated the balance and period 8 made and tested predictions. I observed class 8 on the second day of the experiment- the predictions and the tests.

Teacher C assigned jobs to the students by passing around a "Jar O' Truth" filled with crumpled up pieces of paper with tasks written on them. Each student chose a task and performed that task during the course of the class. Most students were analyzing the data from period 3, making predictions, or testing the predictions. Several people were slated to be recorders and kept track of what everyone else was doing and the results that were obtained. Nobody tried to shirk his or her tasks or trade with someone else.

The torsion balance was constructed of a bar hung from the ceiling. The bar had 2 kg weights at its ends and a mirror attached to the line above its center. A laser shone on the mirror and was reflected onto the whiteboard, upon which a scale had been constructed. To calibrate the

scale forces had been generated by rolling marbles down a ramp and into the balance. The forces being tested were applied using a bellows set a given distance away from a given end of the balance. Using data generated by period 3 - day 2 using the bellows, period 8 fit the data with best-fit lines and made predictions. They predictions were fairly accurate; Teacher C postulated that the balance might have been more accurate had the students used the suggested monofilament line rather than the woven cord chosen. Special care had to be taken to keep doors closed to prevent air currents from affecting the balance.

Wednesday, January 21st, 2004
Observation Time: 7.25 Hours
I observed with Teacher C's class (or Teacher D's class, as noted) from 7:45 AM until 3:00 PM. I observed the following:

1st Period – Free Period w/ Teacher C
2nd Period – Regent's Physics Class w/ Teacher D
3rd Period – AP Physics w/ Teacher C
4th Period – Regent's Physics w/ Teacher C
5th Period – Regent's Lab w/ Teacher D
6th Period – Regent's Physics w/ Teacher D
7th Period – Free period w/ Teacher C
8th Period – AP Physics w/ Teacher C
9th Period – Free Period w/ Teacher C
10th Period – Free Period w/ Teacher C

Throughout the day I observed several different types of classes. In Regent's Physics I observed homework reviews covering impulse and momentum. In AP Physics Teacher C reviewed material for a test on 1/22/04. In Regents lab presentations students presented their labs from the previous 5-week period.

Some material that I thought worked particularly well from the day was "Looney Tunes Momentum." Teacher C and Teacher D use Looney Tunes throughout the year to demonstrate different physics principles, and they serve the purpose well. Students can identify with the characters and one or more characters is always falling off some object, hitching a ride on a rocket, or running into an inanimate object at high speed. Another idea I liked was a chart that could be placed on the whiteboard for use in problems. It had bays for v_i, v_f, v (as a vector), a, delta t, and delta s. It hung on the board and was a constant for students to refer to: many drew the same figure on their homework and tests when confronted with motion problems. The chart can be broken down into x and y components and seems to be a hit.

Another interesting piece of the day was a particular student who was late turning in his lab write-up. The teachers do not accept late material, so the student received a zero on the write-up. If he does submit the lab before the test he will be allowed to write the test, but if is not submitted he may not take the test. There is a makeup test at the end of each quarter but the tests cover all of the material from the marking period and are usually difficult.

January 22nd, 2004
Observation Time: 7.5 Hours

I observed with Teacher C's class (or Teacher D's class, as noted) from 7:45 AM until 3:15 PM. I observed the following:

1st Period – Free Period w/ Teacher C
2nd Period – Regent's Physics Class w/ Teacher D
3rd Period – AP Physics w/ Teacher C
4th Period – Regent's Physics w/ Teacher C
5th Period – Regent's Lab w/ Teacher D
6th Period – Regent's Physics w/ Teacher D
7th Period – Free period w/ Teacher C
8th Period – AP Physics w/ Teacher C
9th Period – Regent's Lab w/ Teacher C
10th Period – Free Period w/ Teacher C

During the Regent's classes students again gave laboratory presentations. In AP Physics Teacher C reviewed material for the test and introduced a new grading scheme for the 3rd quarter.

I had several interesting discussions with both Teacher C and Teacher D throughout the day. One of Teacher D's Regent's physics labs contains three-quarters of his Regent's student; the final quarter of the students are divided between two other labs. Teacher C mentioned that physics labs are supposed to follow directly after class so that students can take double-period length tests and complete extended experiments. Many of his students' schedules do not in fact do this, which is a mistake from guidance. He has absorbed the difficulty in stride but it seems to harm the students most: who wants to stop halfway through a test and come back to finish it two hours later?

The biggest issue during my observations today was the modifications to the grading scheme that Teacher C introduced to his AP classes (Regents classes stay the same). The impetus for the change is basically because the students have become "lazy" in Teacher C's words. The course is graded at the end of a 2-week topic, and the students are given the responsibility for completing the work at their own rate. However, Teacher C asks that the students work approximately 10 minutes every evening and checks this periodically through homework quizzes (see quiz section above for full description). The reason for check that students are on track is twofold: to ensure that they are following lectures and to facilitate classroom discussion and laboratory experiment. On a recent occasion Teacher C discovered that the majority of the students had not begun their homework several days after having started a new topic. He admonished the students and said that he wanted them to buckle down and do their work. A week later he checked a student's composition book at random and did not find any additional work since the previous week. This observation was reinforced when he collected the laboratory books during the test (on 1/23/04, this segment is written after the fact) and found that most students had done their book problems and homework AFTER the review for the test.

The new grading scheme will be nearly identical to that of a college course: students will be graded solely on test and laboratory marks. Students will not be required to do homework or take quizzes, but they will have a test every week instead of every two weeks. On the downside, however, they will not be given homework or given extra material to help with the topic at hand. Teacher C explained the situation to the class in the following way:

"This class used to be a democracy, but that ended when you stopped doing your work. Teachers are not adversaries; I didn't become a teacher so I can screw kids over… I want to help. I know that you all work hard, but I work even harder. I make stuff for you to practice, and if you're not doing it then I'm the only one working and I feel like you're flippin' me off . . . I don't hate you, I'm not mad, I am just disappointed. Don't take it personally – no – take it personally, but it's not the end of the world.'

Teacher C confided to me in private that there are several students who do all the work and score consistently well in every aspect of the course that do not need this change at all- in fact these students will likely resent the change more than anyone else. But the MAJORITY of the class isn't doing the work, and something has to change. He also said that this is the first time in his 6 years teaching (all with the same format) that students have stopped doing their work, and he isn't sure why. I suggested that maybe it was because of having two science Olympiad teams, but he refuted that saying, "The Olympiad kids are doing the best in the class; they do all their work all the time. It's not them."

Teacher C and I also discussed the topic of summer preparation. He told me that during his first year teaching he was only a day or two ahead of students at any given time, he worked tons and only had one set of materials. During the summer after his first year he worked 8 hours/day, 6 days a week for the entire summer developing new material and labs. He keeps developing new material as he goes, but now he has gotten good enough to do it on the fly between classes and in the evenings. He keeps making new material both to stay interested (and so he doesn't have to grade the same old questions over and over) and to stay interesting to the students – making new material keeps him sharp and students notice.

Several lab presentations in the Regent's class were quite interesting. My favorite was a beanbag toss, where students were given aluminum rods and some wood and told to construct a device to throw a beanbag as far as possible. A Gedanken lab involved calculating K for the sun. A amusement park ride lab used a map of Disney World and asked the students to compare time vs. displacement for walking to all of the entrances to rides in the park and then back to the gate. They were supposed to measure all of the vectors use vector addition to show a total of zero displacement, but this particular group missed that aspect. They did, however, stick to the paved paths within the park rather than drawing vectors as the crow flies. A forensics group analyzed given tires skidmarks (to scale, of course) to determine the speed of a car given wet/dry and asphalt/concrete conditions. This lab was research based, in order to determine a relationship between skid lengths and coefficient of friction students had to find a relevant website. Two students presented a lab relating both x and y displacement vs. time for a mock roller coaster: data was gathered using photocells. The last lab I observed tested various strengths of thread and determined the maximum acceleration that a given number of threads could exert on a given mass.

January 23rd, 2004
Observation Time: 8.75 Hours

I observed with Teacher C's class (or Teacher D's class, as noted) from 8:00 AM until 4:45 PM. I observed AP Physics and Regent's classes with Teacher C and Regent's lab presentations with Teacher D.

In AP physics the students used the double periods to take their tests. During the tests I observed Teacher C grade their lab books. A surprising number of students neglected to record

their grades or fill out the table of contents, which lost points from the very start. Conversely, others had the maximum amount of demo write-ups and homework problems and scored into the seventies and eighties on an assignment that was worth fifty points.

During Regent's physics Teacher C reviewed the test and then introduced new material: work and energy. On the AP level these comprise two different topics, but in Regent's the two short sections are combined into a single topic. He used several interesting points/examples.

A. High School C physics students is taught to express units in terms of fundamentals: seconds, kg, m, etc. Shorthand units such as Newtons and Joules are described and explained but the students are urged to stick to the fundamentals. The history of the Joule, by the way, is as follows: Mr. Joule was a beer brewer. During his quest to produce beer-brewing equipment, he discovered conservation of energy. He approached the elitist scientific community, but was turned away for his common background. He turned to a different sort of publication: the newspaper. And the rest is history, so they say.

B. Another point that was considered was, "Why isn't holding a pen up with your hand considered work?" The answer lies in the definition; something has to move for work to be done. But in a more basic sense it depends on how the system is defined. What is being considered is the system of the hand and the pen, but the ENTIRE system is actually the human body with all of its related processes. In this description of the system it can be seen that chemical work is done to convert sugars into energy to support the hand, but it terms of the physical dimension no work is done.

C. Teacher C used examples involving two characters, "Little Timmy," and his sister, "Little Suzy." Apparently these characters have been with us since the beginning of the course; in the past they were used to explain the concept of conservation of energy using Little Timmy's blocks. This idea really rings home with me; during my differential equations class as an undergraduate my professor used Little Timmy quite a bit. Timmy was always getting into trouble somehow; he either let the screen door swing shut (and we had to model it), accidentally poured dye into the lake, or broke the dam in the gorge. He served as a uniting element through the course and added some much needed humor; I was overjoyed to see his rebirth in Teacher C's classroom.

D. Teacher C confided to me that the only disagreement that he and Teacher D ever have is regarding the laboratory experiments. Teacher C tends to push the students hard both during the experiments and the presentations, whereas Teacher D grades more lightly during the presentations. Teacher C has two students that are in Teacher D's lab section; he grades their lab presentations himself.

January 30th, 2004
Observation Time: 3.75 Hours

I observed with Teacher C from 11:30 AM until 3:15 PM. From the time I arrived until the beginning of Teacher C's AP Physics class at 1:05 I worked with students on the "Mission" project for the Science Olympiad. They were attempting to build a device that combined the following operations:

To begin with, it held a metal marble-sized sphere in place using an electromagnet. When the current to the magnet was interrupted, the marble rolled down a ramp and somehow activated a circuit by compressing a spring.

I first helped the students test to see if the electromagnet was operable (it was not). We skipped that part for the time being and focused on the compression of the spring by the rolling ball. They discovered that it was impossible to hold use the electromagnet to hold a ball that was of sufficient size to compress the spring, so the students decided to hold a smaller ball that, when released, would collide with the larger ball and knock it onto the scale.

At this point I left to observe Teacher C's AP class. During the class he reviewed questions from the latest test, which covered the topics of force, acceleration, and gravitational bodies. The questions were mainly geared toward blocks sliding down ramps with pulleys and that sort of thing; one nice variation was a train made of three wheeled carts linked together. Another good question was an amusement park ride, the "swings," which begin in a vertical orientation and move toward the horizontal as the angular speed of the ride increases. The angle that the chains on the chairs made and lengths were given, students were asked to calculate the tension in each chain when the ride was at rest and while moving. They were also asked to calculate the forces exerted by three linear bodies on a point off in space, but there was no mass to the point so it gave some students problems.

The tests are scored just like a real AP test (see the Test section above). On Part I, the multiple choice section worth 40 points, the two periods of AP class combined for a mean score of 15 and a standard deviation of 10. There was one 5, three 4's, twelve 3's, etc… On Part 2, the problem section worth 50 points, the class scored two 4's, six 3's, and eleven 1's. The students scored as he expected them to, but for the next topic Teacher C confided to me that he expects to see a decrease in scores because of the change in classroom structure.

After class I returned to the laboratory and again assisted students with the "mission" project. The device was built using an adjustable plastic track for the spheres and a wooden platform to support the track and to guide the spheres from the track into the hole leading to the scale. This apparatus worked well, but the spring mechanism that had been constructed did not work well enough to complete a circuit as required.

Note: after I left this spring was replaced with a kitchen scale, which worked much better (the wiring for the circuit was attached to the needle showing mass which, which moved by the mass of the spheres, close the circuit. Also, the electromagnet was abandoned in favor of a traditional magnet attached to a motor, which released the ball when turned on.

February 6, 2004
Observation Time: 6.25 Hours

I observed with Teacher C from 11:30 AM until 5:45 PM. The majority of this time was spent with students working on various Science Olympiad projects, but I also observed Teacher C's 8th period AP physics class covering a calculus-based approach to impulse. The topic covered was that of an object with a variable force acting up on it. The students were given the function of the force acting on the object, its mass and initial speed, and the time interval during which the force was applied. Teacher C then asked the following, "What is the final velocity of the object? - **Do not** simply convert the force into an acceleration and integrate, you must use the force and impulse stuff that we've been doing in class." The students turned to their own papers and began calculating. After a few minutes students gave a wide range of answers, ranging from

the irrelevant to correct and covering the wide range in-between. The teacher finally got a consensus from several students and asked one in particular how he arrived at the answer. The student explained it and the Teacher C outlined the solution on the board. A good reason to attack the question this way is that if the initial speed changes all that has to be changed is a constant- the calculus is still the same. But if the question is solved using Newton's Laws it becomes an entirely new problem with different numbers.

Teacher C then expanded the discussion to that of a cannon on a pirate ship, which was quite useful because students can see how things happen and relate to the vocabulary easily. Students were intrigued by the question regarding recoil: "Would a cannon shoved up against a tree shoot further than one that was on wheels and free to recoil?" Teacher C eventually led them through the reasoning behind the idea that recoil leads to a father shot – momentum of the system must be conserved.

Casualties behind cannon injuries were discussed (with a ship mounted cannon, chances of wounding someone on another ship was 3/10, on your own ship, 6/10), and then the class moved on to modern day cannons. Recoilless rifles were mentioned, as were the large guns on battleships that recoil inside large sheaths and are slowed by the compression of air/gas rather than the ropes of old. A cool thing to mention is that the compressed gas is then used to eject the spent shell and load the new one.

Teacher C then presented the class with a trapezoidal-shaped graph of force as a function of time and asked the class to tell them their thoughts. He asked the class, "What's your first job when you see a graph in front of you?" The answer came back, "What do the area and slope represent?" At the bequest of Teacher C, the class discussed and answered questions about what was happening at different points on the graph. He also related the graph to a real world example of kicking a kickball, where during the first part of the graph only his toe makes contact; during the second his entire foot imparts a force, and during the last it is again only the toe that makes contact. A concept integral to this discussion was that of force vs. direction; just because a force is negative doesn't mean that it equates to a negative direction of travel.

The last type of problem that was covered was that of a moving object that gains mass at some point during its travel (such as a train that is for some odd reason loaded with grain while moving). Teacher C pointed out that this sort of problem has only occurred on an AP test 3 or so times during the past 20 years, but that it was worth knowing how to do. He guided the students into an approach to the problem, which eventually included the following steps:

1. Momentum must be conserved
2. The final momentum in the y-direction must be zero, the train cannot move downward.
3. Momentum in the x-direction must also be conserved.

Momentum Before = $M_t * V_t = P_t$

Momentum During = $[M_t + R_t] * V = P_t$

Momentum Before = $[M_t + M_g] = P_t$

These equations are what may be asked for on the test, R_t represents the rate that the grain flows into the train and V is a velocity that varies as the grain is added.

My time before and after class was spent assisting in the laboratory as students put the final touches on different parts of the Science Olympiad projects. Using a voltmeter (monkey meter) I helped a group analyze the routing of a circuit to find the reason why a strand of tungsten wire in a circuit was not heating up. We also discussed possible reasons for the problem before starting, and though one of the students had no formal education in electricity he eventually grasped the idea and helped find what we thought was a ground out. After disassembling the apparatus Teacher C stopped by and tried a brand new battery, which worked just fine. I felt bad but it taught me the lesson that sometimes the most obvious explanation is actually the problem and should always be looked at first. The rest of the afternoon was spent in a variety of ways; I went on a food run and to the shed (Radio Shack) for servos and wiring harnesses; I also visited the local drugstore for new batteries to be used on competition day. It was exciting to see the team gearing up for the competition; the packing of all the apparatus was an exercise in engineering all by itself.

February 7, 2004
Observation Time: 2.25 Hours

I visited High School E from 10:30 until 12:45 PM to observe the High School C Science Olympiad team at work. I watched several events including mission, the Wright Stuff (plane), Robot, and Castle (trebuchet). These events were easily visible and quite entertaining, I was glad to see that the students enjoyed themselves. Last year the team enjoyed themselves so much using a variety of bicycles, big wheels, and other transportation devices that this type of thing was prohibited this year. What I was not able to see were the written examinations, all that we had in terms of feedback were students' reactions to the events themselves. This feedback was usually accurate, and more often than not positive in nature. NOTE: the team won 26 medals and has been invited to the state competition to be held at West Point this March.

February 13, 2004
Observation Time: 3.5 Hours

I observed with Teacher C from 11:30 AM until 3 PM. The majority of this time was spent reviewing the status of different Science Olympiad Events and working with students, but I also observed Teacher C's 8th period AP physics class.

The events are coming along- several new events will be held at States that were not included in the regional event. New events include a paper airplane event (the plane must turn a corner and fly through a hoop) and a 1 L bottle rocket event powered by compressed air and water, score is based on flight time. I worked with a student setting up the hoop in the hall (it is hung a meter and a half above the ground).

During his 8th period AP physics class Teacher C announced the results of the most recent laboratory assignment, which was to send a single Pringle's potato chip to Teacher C in the mail in the smallest package possible. The mass of the package was multiplied by the volume, and the lowest # won. The score was determined relative to other students: two score of 10 were given, two nine's, etc. Any student whose chip broke was at the end of the list.

During class Teacher C presented several problem-solving exercises involving work. He used the example of a person pushing a block across a floor and asked students to solve for the work done. At the end of the example he reversed the question and asked for the work done by the floor- the students correctly surmised that this is the opposite of the work done by the man. Students were then polled as to where the energy went (sound, heat, break tiny pieces of

floor/box off). The problem was then switched so that the force was applied at an angle- introducing components of vectors into the mix. Throughout the exercises Teacher C made the class keep close track of their units- if an answer was given verbally without some form of units he would query, "So 6848 goat-heads?" This worked well- always referring to goat-heads as a unit both made students laugh and let them see how arbitrary units can appear if not specified.

The next topic introduced was that of power- the rate at which work is done. The class was asked for the difference between power and strength – power is how fast you can do something while strength is just a maximum force that can be generated. Teacher C discussed Olympic weightlifting as an example- short people have an advantage in power lifting (the clean and jerk) because they don't have to lift the bar so high. A good demonstration or exercise I thought of when viewing this would be a video of the World's Strongest Man Competition- ask students to determine the power involved in several events. Might make a good lab topic!

Teacher C also discussed the units of power, which is permanent topic on the AP exams. A mass of units will be given for each category of a Roman numeral format (I, II, II) and students will be asked to determine which are acceptable units for power. This was reviewed and discussed at length, for the majority of High School C students I do not think that this will be a problem.

Power was then demonstrated to be work over time, which is F * delta s/delta t, which is Force 8 average velocity- it was pointed out that this is a useful equation for elevator problems. A chart which is omnipresent in the High School C classroom appears as: V_i V_f V_{avg} (shown as V_{bar}) a t s students are trained to use this chart from day 1- they all draw it from memory and it is a very useful tool for students to keep things straight. Using the equation $v_f^2 = v_i^2 + 2 \cdot a \cdot \Delta s$ Teacher C walked the students through the following transformation (assuming v_i equals 0:

$$v^2 = 2 \cdot a \cdot \Delta s$$

$$\frac{v^2}{2} = a \cdot \Delta s \qquad F = m \cdot a$$

$$\frac{v^2}{2} = \frac{F}{m} \cdot \Delta s \qquad W = F \cdot \Delta s$$

$$\frac{mv^2}{2} = F \cdot \Delta s$$

$$W = \frac{m \cdot v^2}{2}$$

$$W = KE$$

I think that this was a good transition- it helped students see a natural transformation of the concepts they know and are familiar with (velocity, acceleration, work) and relate this to kinetic energy (which must always be positive). Some might argue that this was not a good transition because of its dependence on the manipulation of equations, but as long as the concepts are reinforced through class work and guided exercises I think that it works well.

The class then moved on to a discussion of the smart balls that know momentum very well, Newton's Cradle. Using the cradle on the lab bench Teacher C guided the class through an exercise with the number of balls pulled back and the number that will be knocked out. A very

good distinction was made that the balls conserve energy as well as momentum- this is the reason why two balls being pulled back results in 2 balls knocked out- it can't be just one ball knocked out twice as far. A real world connection was made to sending an opponent's ball in croquet.

The class then moved on to a discussion of potential energy, focusing on gravitational for this period. The definition given was that potential energy is: energy associated with being somewhere you don't want to be. A kid at the dentist's office has tons of potential energy, but in a toy store has none. The distinction was made that gravitational potential involved a change in height rather than an absolute height- a good phrase was that big kids call gravitational potential big U to introduce the symbol. A quick example was done using a ballistic momentum problem- fire a bullet from a gun into a pendulum, what height does the bob reach? (The bob is wood so the collision in inelastic).

February 13th marked the first day of a game that Teacher C invented to get his students back on his traditional grading scheme. The game goes like this: students do book problems every night. Each day they come in and their book problems are counted for a point each. The two periods must combine for a total of 80 points a day or the cumulative total reverts to zero. This averages out to 3-4 problems per night per student. When the cumulative total reaches 900 the grading structure reverts back to the original and the lecture/test based structure is abandoned.

After 8th period I worked with Olympiad Students on worldwide epidemics- each student was in turn given a disease until all had been given (to get them familiar with the diseases), then I would describe symptoms and see who could guess the disease first.

February 20, 2004
Observation Time: 3.3 Hours

I observed with Teacher C from 11:40 AM until 3 PM. Teacher D was out sick for the day (it was actually his son who was sick) so Teacher C had double the teaching duty covering his classes. The substitute was left to supervise the lab environment and study halls, and did not seem particularly adept in a science environment.

In the Regent's class students were led through a brief review of the characteristics and behaviors of waves that they had learned so far. Teacher C noted that of the 5 characteristics and 7 concepts related to waves, all 12 items will appear on the Regent's test. A good example that was presented was that of a construction worker running a jackhammer- the headphones they were actually emit "white noise" which is designed to cancel the noise of the jackhammer. Teacher C also had two wave-shaped pieces of metal (each about a foot long) that could be used to represent two waves and their interference. To reinforce these concepts a handout was given out and completed by the students in class. I assisted several students with the refraction question; they were confusing the angle between the ray and the mirror with the angle between the ray and the perpendicular.

Teacher C went through a review test with his AP students; the scores were not very good overall. Many students made mistakes with the material they did remember and had trouble finishing the test.

During 9th period Teacher C taught Teacher D's Regents class and I worked with his Regents students in the laboratory.

February 27, 2004

Observation Time: 3.25 Hours

I observed with Teacher C from 12:45 PM until 4 PM. Between the time I arrived and his 8th period AP class at 1:05 I discussed Science Olympiad progression and planning with Teacher C and several students.

In his AP class Teacher C gave a review for the test on Monday. The topics of work, momentum, transfer orbits, and several related trivia/formulae absent from the reference tables were covered. The list of 5 problems given to students was:
Transfer orbit
Elastic collision
Modified Atwood Machine – something with teeth (meaning difficult)
Dot-product work calculation
Force-potential integral (F/U graphing)

Teacher C then distributed a review sheet with sample problems of each type given above. Students generally had trouble with the review sheet, it took most of them too long to get through the first and second problems; most did not finish in class.

The students reached the goal of 900 points since my last visit on 2/20/04, and the old grading system is back. They have received homework packets as usual and will have the opportunity to turn them in, but the packets will be graded out of 20 points rather than the usual 50 because of the accelerated timeline.

March 5, 2004
Observation Time: 4.5 Hours

I observed with Teacher C from 11:45 AM until 4:15 PM. When I arrived I helped Teacher C grade the review tests from his Regents class, we were interrupted by an unscheduled fire drill in the middle of a rainstorm. After the drill I finished grading the multiple choice sections and read two articles in *Physics Today*. I also worked with several students on Science Olympiad Projects: the bottle rocket and instrument events.

During his AP class Teacher C asked students to do two book problems from each of 5 categories:
1-D motion
Center of mass
Asymmetric parabola
Elevator
Ballistic Pendulum

Students have not been doing well on review tests: he has given 4 tests in the past 6 weeks- more than any previous year by a factor of 2. He reviewed a take home quiz of 5 old part II problems- he has started assigning these to ensure that students remember past material.

Three new topics were then introduced; the first was springs with a variable spring constant (harder to stretch @ end, or harder @ beginning (like taffy). He gave them several equations for the force and then asked them to find potential (integrate as below), noting that force is the negative derivate of potential.

$F = -k \cdot x$ $F = -k \cdot x^2$

$U = \frac{1}{2} \cdot k \cdot x^2$ $U = \frac{k \cdot x^2}{3}$

Teacher C then said that these questions are rare on the AP test, but that if you see them on Part II just remember that force is the negative derivative of potential and work through it step by step.

The second new idea was a potential function that depends on more than one variable. He gave the students two examples and then asked for the **i** and j coefficients (see below).

$U = 3 \cdot x^2 \cdot y^3 + 2 \cdot x \cdot y^2$ $U = 4 \cdot x^2 y + 3 \cdot x^2 \cdot z^3 \cdot y + 3 \cdot x^4 \cdot z^2$

$F = -\nabla[(\blacksquare)i + (\blacksquare)j]$ $F = -\nabla[(\blacksquare)i + (\blacksquare)j + (\blacksquare) \cdot k]$

$F = -\nabla\left(6 \cdot x \cdot y^3 + 2 \cdot y^2\right) \cdot i + \left(9 \cdot x^2 \cdot y^2 + 4 \cdot x \cdot y\right) \cdot j$ $F = -\nabla\left(8 \cdot x \cdot y + 6 \cdot x \cdot z^3 \cdot y + 12 \cdot x^3 \cdot z^2\right) \cdot i + (\ldots) \cdot j + (\ldots) \cdot k$

Students seemed satisfied that they could fill in the blanks- Teacher C called on 6 different students with only a few slight errors.

The final type of problem was an Atwood-Looking problem using springs and was one of two types: a problem solved most easily with energy or one solved most easily with forces. The first problem was a block on an inclined plane that slid and hit a spring; friction was ignored. The distance along the plane between the starting position of the block and the point where it first touched the spring was the goal: the angle, mass, and spring constant were all given. Students were told to forget about the kinetic energy that is built up during the block's movement- it doesn't matter since energy is conserved.

The second type of problem was a block on a declined plane attached to a fixed spring (on the horizontal) by a string. The block is initially supported, the distance the block moves down the ramp when it is let go was the goal. After the first iteration friction was added.

March 10, 2004
Observation Time: 2.25 Hours

I observed with Teacher C from 2:45 PM until 5:00 PM. I arrived after the end of the school day and in the middle of the final Science Olympiad meeting. During the course of the afternoon I worked with two students on their bottle rockets for Science Olympiad. The goal was to achieve the longest flight time possible. The students were going down two paths: a longer rocket weighted at the rear, and a shorter rocket with one oversized fin. After a few trials I noticed that neither of the rockets ascended aerodynamically or fell haphazardly, which would have created a good flight time. I suggested that we try modifying the rockets to change their center of gravity in-flight, and we did this with some success using magnets and a dowel attached to the outside of the rocket. Though the flight time we achieved was not superior to that achieved by the original design, we felt that it had promise. When I left the decision of which rocket to take to the state competition on March 12 had not been made.

March 12, 2004
Observation Time: 0 Hours

I was at High School C from 11:30 AM until 3:15 PM. Both Teacher C and Teacher D were absent due to their trip to the state science Olympiad competition at West Point. I helped the students with their classwork during two sections of Regent's and one AP physics.

March 26, 2004
Observation Time: 5.25 Hours

I observed with Teacher C from 11:45 AM until 5:00 PM. I arrived in the middle of Teacher C's free period and talked with him about the state of things at High School C until his 1:05 8th period AP physics class. The first thing that the class did was review a quiz from the day before. The quiz involved a situation with a block sliding on a frictionless surface that began horizontal and curved into a loop (like on a roller coaster). A bullet was fired into the block (inelastic collision) and a series of questions was asked involving potential energy, kinetic energy, and the initial velocity of the bullet necessary for the block and bullet to make it around the loop.

The rest of class was spent working on two problems. The first was a barbell made of two spheres and a cylinder, rotating about the center of one of the spheres. Students had to find the moment of inertia of the body, angular acc. (alpha), the torque provided by a force of 100 N at acting on the far sphere (tau), angular speed at 10 s (omega), and v of the a bug at the outer edge of the far sphere at 10 s. The class did reasonably well with the problem but some students had to be cajoled into working, they couldn't stay focused.

A similar occurrence happened for the next problem, which was an Atwood machine with a real pulley. A small group of 3-4 students was very resistant to leaving the world of frictionless massless pulleys, even after going through an example of these with the blocks for the upcoming problem. It seemed difficult for Teacher C to get the class to stay focused, several students were on the ball but the louder group at the back of the room caused difficulties. They were not focused on the problem, which was easily evident when they cancelled masses which were in fact different. Teacher C seemed perturbed that it took the students so long to solve the problem, he said that it should take them less than six minutes and it certainly did not. He relayed this to the students and implored them to look at the material and work on their homework over the weekend.

Teacher C had a laboratory session during 9th period. I worked with two students to help them understand why momentum had apparently not been conserved in their laboratory experiment. I identified several probably sources of error but could not provide as good of an explanation as Teacher C, who asked the students to determine how much energy had been "lost." They came back with 0.0015 J, which was very small. He then challenged them to find the coefficient of friction between the wheels of the cart and the tracks, which they did. These were two of the top students in the lab, their apparatus had used carbon paper to track the exact landing point of the ball fired off the cart. In contrast, another group sat and played with the extra-large slinky for the first 15 minutes instead of focusing on their lab (Teacher C was working with other students). This was surprising to me, especially because this was the last day

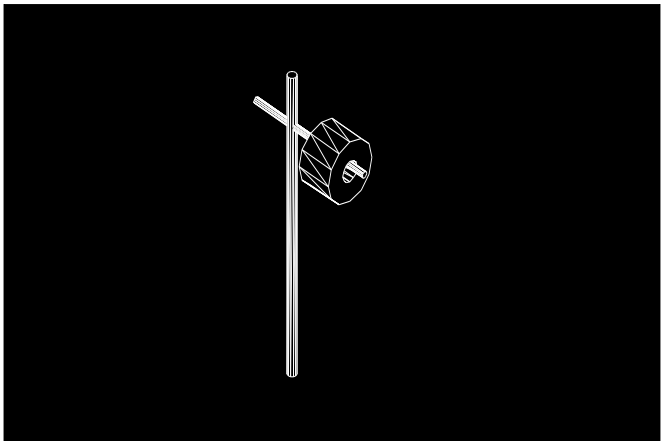
for them to work on this particular assignment. I removed the slinky from their lab table and they seemed to buckle down a little bit.

It is always an interesting day when one is confronted by a situation that is bleak enough to cause a near-complete loss of idealism and altruism, at least temporarily. It is also an interesting day when this situation occurs to one's mentor, which is what I walked into on March 26th. I will not go into detail here but it is sufficient to say that change is coming to High School C. The only thing that I will mention, simply because it is the most asinine thing that I have ever heard, is that the Regent's chemistry will now be taught over two years. That is enough for now.

March 30, 2004
Observation Time: 5.25 Hours

I observed with Teacher C from 9:15 AM until 3:30 PM. I arrived just before 3rd period and observed Teacher C's AP and Regents classes and laboratories. In the AP class Teacher C reviewed their most recent quiz and then presented a laboratory for the students to complete.

The lab was a procedure lab, and the task was for the students to correlate the moment of inertia of a roll of toilet paper to its radius. The TP was set on a horizontal bar and a mass was attached to the end of the roll (either using tape or by tying it in place using the TP itself). The mass was dropped from a given height and timed until it hit the ground. 6-7 trials were performed at a variety of outer diameters- students got to tear off about half a cm (in diameter) from the TP between trials. The laboratory was very rewarding to the students, in part because of the mess they made.



Students were asked to submit their lab on Friday (3 days) and were required to do the calculations to find I for a given radius and also to form a graph of I vs. R (outer radius).

In his AP lab Teacher C and I viewed the 5-week lab presentations. The topics were as follows:
1. Finding the k-value of a miniature trampoline (drop masses from a recorded height so that they just barely make a mark on the carbon paper below).
2. A power lab walking and running up stairs.
3. A lab to test the k of silly putty as a function of hoop diameter (using tauri) and temperature (putting in freezer for 5 minutes).

Teacher C introduced circuits to his Regents class. He prefaced electricity as a topic that isn't directly related to other parts of physics by saying that, "2000 years ago, all of knowledge was called physics. Different pieces broke off bit by bit, and what we're left with is lumped into the broad category of physics. Electricity should have splintered off sometime in the 40's, but it didn't, so we're going to study it." He used terminology from everyday life like that used in *There Are No Electrons: Electronics for Earthlings* by Ken Amdahl. I liked his presentation and could envision copying chapters of this book and handing them out to students as supplementary readings for this topic. He presented series and parallel circuits in the same class period and used a compare/contrast method.

I taught the 8th period AP class. I thought that it went well, and Teacher C agreed. The only thing that I would have done differently is that I would have kept my calculations aligned vertically on the board, but I suspect that I will develop this skill with practice. Teacher C said that the manner in which I teach causes this to happen- using a shoot-from-the-hip style of teaching to engage the students naturally leaves the teacher running for the board to get ideas and the ideas don't always make it to their most logical homes. I was glad for the experience and encouragement and felt that it made my visit especially worthwhile.

April 2, 2004
Observation Time: 5.25 Hours

I observed with Teacher C from 12:30 PM until 3:30 PM. I observed his 8th period AP class and the following Regents lab period. The students took a test during the class, and filled out a survey that Teacher C handed out regarding the state of the course (see the handout in observations). Student replies ranged from good to bad and covered most extremes, some wanted more book work and some less, some less homework and others more. Several requested more time for each topic, but due to the nature of the schedule this is impossible.

The lab students were beginning work on new 5-week labs. One of the more interesting experiments was a group that was constructing a xylophone out of a meter stick. I am not sure where they are headed with it but they had clamped a meter stick down to the table and attached a marker to one end. But giving the meter stick some initial amplitude and letting it go the system functioned as an underdamped harmonic oscillator, giving a nice sinusoidal pattern with decreasing amplitude on the paper. By counting the number of oscillations and measuring the time they let the system oscillate, the students were able to determine a frequency for the movement. The frequency they initially determined was too low to be heard by humans, but they planned to adjust the apparatus on their next lab day. It is worth noting that this was not one of the more proficient groups in the class but nonetheless they were making progress. Another group was sent to the library to do research on rail guns: their lab is to build a miniature one.

April 23, 2004
Observation Time: 3.5 Hours

I observed with Teacher C from 11:45 AM until 3:15 PM. I observed his 8th period AP class and led the 9th period AP lab in Part II problem solving questions. Teacher D was out sick and Teacher C was covering his classes as well. Students in the Regents classes took a test while the AP students reviewed a quiz and completed a classwork. The quiz was quite difficult, I asked Teacher C how much time the students had and he replied that he had given them 15 minutes. I believe that I could have completed the quiz in 15 minutes if given the chance, but it would not have been easy. When Teacher C passed out the classwork he told that students that he or I would be answering questions- it was nice to be directly involved rather than just an observer.

The big news at High School C is that two students dropped AP physics this week, 10 days before the AP test. The first dropped with an 86 average because he was concerned that the low grade would keep him out of the top 10 next year (he is currently a junior). His mother works for the school and wrote a letter directly to the superintendent rather than pursuing more conventional channels. The other student who dropped had recently been in a grade slump, his current average was 65. He was a member of the Science Olympiad team and had been a star student in Regents physics the year before. His mother also works for the school. Both Teacher C

and the AP coordinator are concerned that letting the students drop (they were both very opposed at this late stage in the year) sets a precedent and that others may join the bandwagon, so to speak. It was interesting to see the bureaucratic and political sides to the AP courses in addition to the actual content and teaching.