COMPILATION: AP-C modeling

Date: Wed, 20 Jan 1999
From: (a first year modeler)
Subject: Struggle of a 1st year modeling...2nd year AP Physics teacher
Hello everyone,

Throughout the year it has been great reading about everyone's great experience with the Modeling Method. I do also have my great experiences but I find myself at least two weeks behind where I was last year in preparation for the AP C (only Mechanics) exam. I have to admit that I think that my kids are better thinkers despite all the complaints that I get from them. Part of the problem was that I was not very good at the Socratic method of dialogue in the beginning of the year. I have improved since then but my poor performance in the beginning really undermined my authority with my kids in the beginning.

I have just finished the forces units (IV and V) and have since started on the Work and energy units. Due to time constraints I have started teaching traditional methods while allowing for some discovery when I know the labs are absolutely foolproof...such as Hooke's law lab. My kids at the same time have responded better to my old teaching style because I tell them answers as opposed to letting them struggle and discover it. (I really did not know how to get the kids to make the connection between Work and Delta energy of the system)

My question is one of balance. I am not fully convinced that 100% student discovery is a viable way for teaching AP Physics. I am curious how each of you do it out there....is there a balance between discovery and telling or do you just let them struggle and discover it by skillfully asking questions from their questions. It is my first year teaching with the modeling method and maybe I will be better next year. I just want what's best for my kids learning physics. At the same time, I would like to maintain a teaching style that gives my kids a relatively high level of morale because confidence is crucial when taking a test. If you have any suggestions, I would really appreciate it.

Date: Thu, 21 Jan 1999
From: Paul Gregg Swackhamer <pswackhamer@GLENBROOK.K12.IL.US>
Subject: AP Physics C
Hi folks!

I have not taught AP Physics C since I got involved in the Modeling workshops until this year....a hiatus of 5 years. I did not know that I would be teaching it until a few days before the beginning of the school year. It has been interesting to try to rethink this course on the fly.

For us, AP Physics is a second course. Every student comes from a Modeling class. So there is an advantage that I can build on. They already have a good understanding of kinematics and Newton's Laws. So we did not follow all the details of our reasonably good text, Serway. I presumed that they already knew a lot. So we spent much less time in model development ...practically nil until we got to extended body models. We just deployed the particle models. Inquiry is not so important for such a class, but neither am I a lecturer. Student presentations are still preferred by the students as the engine of learning.

Here is the real advantage that really MUST be emphasized in modeling: MODELS provide the conceptual organization for the course. We have already done all the particle models in electricity and magnetism, too. Charged particles in electric and magnetic fields are just like particles in mechanics; it IS still mechanics, really. So we did constant force particle models and central force particle models (mass spectrometer type things) in E&M at the same time we did them in mechanics. We also did a lot of energy things, since we deal extensively with the potential concept in their first course.

When doing extended body models with torques we also did electric dipoles in uniform E fields. The only difference between Serway's mechanics and his E&M particle models is the particular force laws: F=qE and F=qvBsin(theta) are just as good as any other force law. Students did very well with the E&M stuff; it was really the same as the mechanics stuff from their perspective.

The students have done very well on an AP scale. It is not Utopia, but there are real advantages compared to pre-modeling years. But *the advantage comes from having AP as a second course*

and from MODELS, which are the underlying similarities that physicists use in looking at nature, rather than TOPICS, which are the superficial similarities that textbooks use to look at nature. Inquiry is not as much the key any more, though the class is still student-centered.

Gregg Swackhamer
Glenbrook North High School
Northbrook, IL 60062-6700
Voice: 847.509.2612

Date: Thu, 21 Jan 1999
From: Brenda Royce <BrendaR@csufresno.edu>

I am in a similar boat, teaching AP-C Mechanics only. I know I've gotten off to too slow a start and we're just finishing 2-D motion (UCM included) before going to energy and work. Since I don't have much track record to work with, since this is my second year to teach AP physics (and that 2 years ago), I feel pressed about time. If I weren't pretty confident in the modeling approach, I would have returned to traditional style already. Our school is a rapidly growing suburban/rural school, with no history of any student passing AP Physics in at least a decade (it's been taught only sporadically). Yet because of two changes in teaching strategies (modeling and team teaching with calculus) we are hopeful of a decent pass rate, including an increase in the calculus pass rate, after looking at the results of our AP-styled semester finals in both physics and calculus. I do find that I take a slightly more traditional approach with my AP course than my regular physics, in part for time. However, I see an improvement in comprehension this year over the last time I taught AP physics. I would also be interested in hearing from others who have a longer track record with AP who are using modeling.

Date: Thu, 21 Jan 1999
From: Bob Baker <bob.baker@WORLDNET.ATT.NET>

This is a response from a first year modeler...

In my AP physics class as of January 21, 1999 we are finishing the energy unit of modeling. *I have taught exclusively using modeling this year and found it very effective.* This includes the 10 weeks I was on jury duty and had a substitute covering half the AP period each day as I rushed down to court after the first half hour of class. Instruction this year seemed to move very slowly most of the first semester compared to last year's traditional instruction, but the class pace is now rapidly picking up and I am confident that we will cover as much or more curriculum than we did last year.

All students in my AP class are solving extra problems I assign from the Giancoli book with much more effectiveness than last year's AP class that had a 75% pass rate on the AP physics B test. Last year we would practice a problem, such as solving pendulum velocities, several times so that the slower students could memorize how to solve this type of problem. This year, half way through the energy unit, I gave a pendulum velocity problem and over half the students solved the problem correctly using energy when they had never seen a similar problem before.

For the first time, I feel that all my students actually understand the physics and have not just memorized methods to solve different types of problems. Soon we will finish the mechanics modeling curriculum and focus on the rest of the material needed to pass the AP physics B test. I have suggested to my students that we focus on the physics AP C test in mechanics but my students seem to want to take the B test.

As a final note, I felt a need to change the energy unit slightly from the modeling handouts, perhaps because of my previous experience with energy. Energy was introduced this year with a stretched spring. I then asked what is different about the spring when it is stretched? I then fired an eraser across the room with the spring. The students suggested that the stretched spring has the ability to move objects. I asked what should we call this ability? The students after some discussion brought up energy. We agreed that the stretched spring has energy because it has the ability to move objects. I then asked what it takes to move an object. This question was answered with force interactions. Next we defined work as what the spring does when it moves an object, force and displacement. Next the flying eraser was used to knock over a plastic bottle. The

students determined that the eraser had energy since it could apply a force to make an object move. After discussing other examples of energy including gravitation energy, we did the modeling work sheets to more clearly understand energy transfers.

Date: Sun, 24 Jan 1999
From: Wayne Finkbeiner < wjfinkbeiner@aol.com>
Modeling and AP Scores

I teach AP Physics as a first year course in Block Scheduling. The course meets 27 weeks for 1.5 hours per day. A lot of class time is lost due to numerous reasons which is very frustrating to me, so what might be perceived as a lot of time is not. In fact when we switched to Block we lost time in our AP Science courses.

But as far as pedagogy, *I use Modeling whenever possible*. I begin some frustrations as I go into Angular Motion in February because I do not have a good modeling approach in this unit, but then I will go to Castle.

I know Modeling gives them a fundamental approach to understanding and "feeling" physics. As you can see, I spend about 21 weeks on the Mechanics C and about 6 weeks on a crash course of E and M using Castle.

What I do about the AP Exam. My students are out of class for about five weeks before they take the Exam and I run review sessions at night where we go thru old AP Exams. Modeling gave them the fundamental understanding, now they have to bring together (unify) many concepts which Modeling was doing all along. So we will Plug and Chug thru these AP Exams and I will be the answer machine they might have wanted if I can do the problems, and the results have been very good. I am back up into the 90-100 percent success rate (Mechanics-3 or better) according to my principal, but this always depends on the students of that particular year.

But the real beauty of this is that *I have found that bright students when put through the Modeling Approach and thought processes can carry these skills over into independent study because they are now behaving as scientists and succeed on the E and M Exam even if we only spent 6 to 7 weeks on the content.*

In terms of SAT II's my data is limited, but covering only Mechanics and 6-7 weeks of Electrostatics with some additional independent study. The three juniors who took the exam last year (June) all scored above 780.

I suggest that you track your scores and pass them on to the administrators to show them that Modeling works.

Date: Sun, 24 Jan 1999
From: Larry Dukerich <dukerich@ASU.EDU>
Subject: Modeling is not equal to inquiry
Hi Folks,

As I browse the thread that has been running through the last few days' posts on the listserve, I notice a possible misperception that has crept into the discussion. The discussion has described the conflict some teachers have about using Modeling techniques rather than Traditional techniques, implying that the former is accomplished exclusively by inquiry while the latter relies solely on lecture.

>I am curious how each of you do it out there....is there a
> balance between discovery and telling or do you just let
> them struggle and discover it by skillfully asking questions from their questions.

It is certainly true that we workshop leaders have introduced paradigm labs as a useful way to guide the students to the development of the applicable model and we emphasized student articulation over teacher presentation. Yet, *what makes our approach really stand out from the variety of inquiry approaches that currently exist is the emphasis on the USE OF MODELS to guide the way we view a situation/design a lab/tackle a problem.*

The difficulty we have, especially in a competitive examination situation like an AP course, is that there's an artificial emphasis on problem-solving. David Hestenes says that the problem with problem-solving is that students comes to see problems and their answers as the essential units of knowledge. So you get into the trap of trying to get students to see patterns of problems and hope that when you prepare kids for the AP exam that you have correctly anticipated the kinds of questions that appear on that year's test.

I just completed the momentum unit in my honors class, and I still have kids ask me questions like, "I'm not sure which of the formulas in the book to use to solve the problem." My head hurts when I have equations like m1v1 + m2v2 = (m1 + m2)v' barreling through my brain. I re-direct the student to describe the situation - "Are there outside agents acting on the system? If no, then the total momentum must remain constant. Now, how can we calculate the momentum both before and after the interaction?" They can tell you that intuitively and before you know it, they get "the right answer", but more importantly, they didn't have to invoke a situation-specific equation.

OK, so in an AP course, you are forced to deal with the time constraint brought about by the breadth of the material one needs to "cover" to prepare the kids to be successful on the test. This means that you don't have the luxury of taking a more leisurely approach to helping the students learn the features of the models inductively. There are a number of ways in which you can develop the models and show how their use leads to a deeper understanding. Clearly, student articulation is important, because if YOU do all the work at the board, then you are the only real beneficiary. But I have found that *my AP-type students can whiteboard a set of problems rapidly because they CAN see the underlying structure more readily than my regular students.*

So, I guess what I'm trying to say is that if you are forced to move along quickly, then you have to be judicious about the kinds of labs that you would use. You can't afford to let them loose in the lab and let students discover the important concepts. Lecture is not a mortal sin - it's just risky since "students systematically misunderstand most of what we tell them" (Hestenes). You MUST listen to the students articulate their understanding of the models when they describe lab results or present their solutions to the problems. You should GUIDE them to figure out what is wrong with their thinking rather than telling them the answer, but these kids are usually pretty sharp and will get there quickly enough. I never let them start a presentation with an equation; instead, they must describe the situation first and tell me why they chose to attack a problem a given way. *It's not so much a matter of inquiry vs telling the students. It's more of matter of where we place the emphasis when we DO tell them stuff and taking the critical time to listen to the students articulate THEIR understanding (as opposed to parroting yours).*

Larry Dukerich
Dobson HS
1501 W Guadalupe Rd
Mesa, AZ 85202
dukerich@asu.edu

Modeling Workshop Project
Box 871504
Dept of Physics & Astronomy
Tempe, AZ 85287