The Virginia Instructors of Physics
http://vip.vast.org

VIP's mission is to foster communication among teachers of physics and physical science as well as to provide unique learning experiences for teachers and their students.

Spring 2009 Edition

In this newsletter:

Spring Professional Development and meeting
Flexbook: A New Kind of Physics Textbook ..... by Jim Batterson
Team Problem Solving with Cooperative Learning ..... by Tony Wayne
Constant Speed ?? (Activity) ..... by Andy Jackson
Physics and the Men's Pole Vault Record ..... by Andy Jackson
Scales of Speed ..... by Andy Jackson

The VAST conference was great! VIP's contribution of presentations was enjoyed by all. Now is the time to look forward to the spring meeting. It is coming fast!

VIP/VAST Spring Meeting Information

Theme: waves light and sound
Who: Physical Science teachers and Physics teachers and professors
When: April 25th (time agenda below) 8:30 – 4:00
Where: the physics building, Jesse Beams Laboratory. There is a good web map at http://www.virginia.edu/webmap/GMcCormickRoadArea.html The physics building is #41. You may want to park behind #38 off of stadium road. Do not park at the physics building. This is 24/7 permit parking. You may be towed is you park next to the physics building.
Why: 'Cause it's a fun way to become better at what you do!
Cost: Free!!!
Sponsor: This meeting is hosted by the Physics Department of the University of Virginia and supported by funds in association with the Virginia Association of Science Teachers and Jefferson Lab.

RSVP IF ATTENDING – FIRST 24 GUARANTEED MAKE AND TAKE EQUIPMENT – greg.mathes@fcps.edu

Agenda
8:30 – 9:00 Hellos and Juice, Coffee, and Danish
9:00 -10:00 Share session: Bring something to share. A demo, 30 copies of a worksheet or lab.
10:00 – 11:00 Dr. Bloomfield (from the University of Virginia) will speak about new lighting technologies.
11:00 – 11:30 VIP business (Officer elections and VAST participation)
12:45 – 3:00 Make and Take the junior "theremin." (http://www.apogeekits.com/theremin.htm) The theremin combines areas of capacitance and electric fields with electronic sound production. For a demonstration of theremin being played, see http://www.ted.com/index.php/talks/pamelia_kurstin_plays_the_theremin.html. The junior theremin is not as flexible as the typical theremin, but it just as much fun to play and demonstrate.
Bring a lesson, idea, piece of equipment- bring a friend! We will head to local restaurants for lunch together. (But as far as lunch costs – you're on your own.)

FLEXBOOK: A NEW APPROACH TO PHYSICS TEXTBOOKS

Virginia's Physics Flexbook Project and Release v 1.0

Jim Batterson
Project Lead

In September of 2008, Virginia's Secretary of Technology, The Honorable Aneesh Chopra, issued a Request for Collaborators seeking parties who were interested in participating in a pilot technology project, in which they would contribute to an online, open-source physics book. Within the next three weeks, 15 people had volunteered to be a part of the project either through authoring content or reviewing content. The Secretary was looking for 6 – 10 authors to each develop a chapter on contemporary or emerging physics, or a physics laboratory incorporating state-of-the-practice technology.

The seed for this book came out of the reports from panels of practicing scientists and engineers who met in the summer of 2007 under the joint sponsorship of Virginia's Secretary of Education, The Honorable Tom Morris, and NASA Langley Research Center. The goal of these panels was to review Virginia's SOL in chemistry and physics with an eye toward content that would serve the average Virginian in participating in the political, economic, social, and technological world of the 21st century. These results were sought to help inform the scheduled 2010 State Board of Education science SOL review. Among the findings of these panels were:

- Both the chemistry and physics SOL are dated to the 1950's and 60's.
- Organic chemistry was not part of the chemistry SOL
- There was little if any contemporary or emerging (21st century) science in the SOL
- The physics SOL were way too broad for any in-depth understanding of its content

Among the recommendations were:

- In this age, which is dominated by molecular biology, organic chemistry MUST be included in high school chemistry SOL
- Contemporary and emerging science drawn from areas such as nanotechnology, astrophysics, biophysics, plasmas, microelectronics, quantum computing, and the like must be taught as a part of chemistry and physics.
- The current physics SOL must be pared down and contemporary/emerging physics added.
- Virginia should consider reordering its science courses as recommended by Nobel Laureate, Leon Lederman of FermiLab from biology, chemistry, physics TO physics, chemistry, biology to give students an appropriate physical science and chemistry background to understand 21st century molecular biology.
- Virginia should consider significant multidisciplinary approaches that reflect the way science and innovation are accomplished in this century.
- Virginia should support an open-source software platform such as a wiki so that teachers can contribute contemporary and emerging physics and chemistry content in a timely way.

After seeing these findings and recommendations, Secretary Chopra vigilantly looked for an opportunity to provide an appropriate open-source software platform technology to address the last recommendation above. The non-profit CK-12 enthusiastically agreed to provide a platform that they had developed along with technical support and Virginia's physics flexbook pilot project was born. While not a wiki, the CK-12 flexbook platform had a number of features that were attractive to this pilot project. Their platform, the flexbook (please see CK12.org), was designed to be an open-source

adaptive textbook. All material in CK-12 flexbooks is licensed as creartive commons (specifically CC-SA or CC-BY[1]) much like the wikipedia. Teachers and students can copy entire chapters, parts of chapters, or combine parts of chapters with information from other sources or their own work to make customized lessons for their classes or themselves. Thus the flexbook is an adaptive textbook available to all.

This *pilot flexbook* itself is aimed at several outcomes:

- Making valuable contemporary and emerging physics ideas available to all teachers in Virginia at a single URL
- Making laboratory activities that employ industry state-of-the-practice equipment available to all teachers
- Providing a starting point for continuous improvement from teachers themselves through comments and new ideas after using a chapter with their physics classes.

This pilot flexbook *project* seeks many outcomes:

- Can working teachers provide useful contemporary, emerging, and laboratory curriculum content in addition to their teaching duties?
- What, if any, intellectual property (IP) issues may be barriers or facilitators of providing open-source content?
- Is the CK-12 flexbook a good open-source platform for Virginia's purposes
- What, if any, additional features would make the CK-12 flexbook even more useful to Virginia?
- What quality assurance process is required for content that will be available to all teachers and students?
- Is a book of many chapters by many authors in many voices readable by students?
- Some valuable contemporary and emerging physics content that supplements current physics SOL.
- Content will be readily available to ALL of Virginia's physics teachers at a single web-based source.
- Feedback to CK-12 that will help them improve their flexbook software yet further for teachers' use.
- Feedback to CK-12 regarding any web 2.0 needs
- Provide Virginia's education policy-makers some concrete examples of the 2007 physics panel's recommendations to help inform their deliberations over the 2010 review of Virginia physics SOL.
- Some idea as to the qualitative value of an e-format in potentially replacing some of our textbook purchases.
- Whether to extend this type of project to the instruction side of the DOE and to other disciplines.

The volunteer authors who included eight high school teachers, a community college professor, three university professors, and two professional scientists collaborating to develop ten chapters. They spent approximately ten weeks writing their drafts. There were three levels of review to help assure integrity of the content:

- Technical review of all chapters by a research university physicist
- Peer review of each chapter by three other authors (much like professional journal reviews are done)

[1] CC-xx is the acronym for "creative commons" and replaces traditional copyright of intellectual property by making that property publically available to all

- Student review by three high school students and a college freshman

The first release of the flexbook is scheduled for February 27, but as with any first time activity such as this, it could be delayed a week or so. Additional releases are expected as new material is provided by both current and new authors. The first release will be announced out of the Secretary of Technology's Office and on the Virginia Physics Teachers yahoo interest group (http://groups.yahoo.com/group/va-inst-physics/). The flexbook will be available to anyone at the CK-12 website. All physics teachers are encouraged to access the site, use the flexbook in class, and critique both the idea and the content.

TEAM PROBLEM SOLVING WITH COOPERATIVE LEARNING

by Tony Wayne

At some point in almost physics unit, students will be working on solving word problems. I've come up an activity that encourages team problem solving. I use this process as part of a review for a test for many units. Here is how it is done in a kinematics unit. First I pick 4 or 5 problems for the students to work on. I choose problems that are not solved the same way but are solved using the unit's concepts and methods. The problems are not new but they are also not identical to any homework or classwork. Typically I use this type of activity to hone students skills and knowledge. (It also makes for a good review for some AP physics topics.) I put together packets of papers. Each packet consists of 3 sheets. Each sheet has the same questions but different numbers in the problems. One third of my class receives page one of the packet. One third receives page 2 and the final third receives page 3. I make a few page 4's to handout to fill in the gas in numbers. Students do this page for homework. I give a small grade a little larger than my typical homework grade if they completed the assignment by the next class.

During the next class I assign students to groups of three such that each person in the group has a different page. If a student is absent (and there almost always is) I have be creative with the groups. The ground rules for the second part of the activity are printed on the back of the summary sheet or as a PowerPoint slide. (It is too much text for a typical PowerPoint slide. It's just one more point of reference.)

Rules for this group problem solving activity

You may refer to your,
- textbooks,
- notes,
- old homework assignments, and
- the other students in your small group of 3.

You may not discuss the questions or answers with any other groups.

Transfer each person's answers to the summary sheet.
All of the answers in the summary sheet's boxes equals ___.

If the sum of the answers on your summary sheet does add up to the correct answer, then here is how you can help each other. **SWAP PAPERS.**

- Check their givens for correct,
  - variables, and
  - numbers with the correct variables.
- Check to see if they have selected the correct formula and/or have set it up correctly.
- Have them explain how they did the math.
- Pass the paper to another group member and start this list over
- If all else fails, do their problem from scratch without looking at their work until you are finished.

Turn in:

- Staple all the sheet together
- The summary sheet is on top.
- Each group member's sheet is underneath.

How the grade is determined:

- Doing this for homework in a timely manner
- Individual answers
- Having shown all your work correctly
- Have the group sum correct

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This activity is the easiest to create when using a spreadsheet application like Excel to set up the worksheet. Since all the problems solve the same, each column could represent an activity sheet. The rows represent the givens and answers. This makes playing around with the numbers from worksheet to worksheet a lot easier. This sounds like a lot of work for one individual, but if you work collaboratively in a PLC group, either within your building or district you could divide up the tasks by units or even the number of questions within an activity. Go to **http://vip.vast.org/teamproblemsolving** to see an example without the spreadsheet. (Since my students know how to search the web, I did not want them to find the answers ☺ .)

CONSTANT SPEED ??

The cart provided is advertised as a constant speed cart. Conduct an experiment to test this claim.

Materials – meter sticks, constant speed cart, 4 stop watches

Collect the data you need to test the manufacturer's claim of a constant speed. Display this data and your conclusions on both the white board and on paper to turn in.

Determine the average speed of the cart and describe just how constant its speed is. Display this on both the white board and on paper to turn in.

The lab above represents another step I've taken to allow the student to have more control of his/her own learning. A step towards more of an

inquiry style lab and a step away from cook book style labs. I conducted this lab on day three of my course. The only instruction the students have had at this point is a lab reviewing measurement and significant figures, and a lab regarding experiment design.

The students began playing with the equipment and discussing how they were going to conduct the experiment. There were five groups of four students in the room. After a little bit of time (maybe five minutes) I noticed that four of the five groups were using the same approach. They had marked off a measured distance and would put the cart at the start and time how long it took the cart to complete the distance. They would then record the time and repeat. The working assumption seemed to be that if the cart completed the given distance in the same amount of time over and over, then it was traveling at a constant speed. I interrupted their work to provide the following example: "If a runner completes the 100 m dash consistently in 12.0 s, does that mean he runs at a constant speed the whole time?" This seemed to instantly click with all the students and all groups immediately broke their distance down into intervals which they timed.

When the students reported their results to each other, some groups had calculated speeds by dividing the distance interval by the time interval while others just reported the amount of time needed to move through equal distance intervals. Most groups identified any variance as proof that the cart did NOT have a constant speed and were ready to sue for false advertising. This led to a useful conversation about measurement uncertainty that was NOT expressed by the significant figures. For example the stopwatches displayed times down to the hundredth of a second, but the students quickly agreed that their procedure did not allow for that degree of precision. The end product was that all groups were able to express the average speed of the cart and provide a bracketed range for that speed. A common form for communicating this was "23 cm/s ranging from 20 cm/s to 27 cm/s" where the groups often cited the extremes of speed they measured as being the limits of the range. At the conclusion of the presentations to each other there was still debate about if the carts truly had a constant speed or not. I do love a good physics argument.

Buggy image from
http://www.physicstoolboxinc.com/p-62-constant-speed-buggy.aspx
(Available for $6 each from the Physics Toolbox)

This year's VAST Professional Development Institute will be held at the Hilton in Washington Dulles, November 5 - 7, 2009. Mark your calendar now and go to www.vast.org to keep current with the conference. At the VAST website you may sign up and pay for the conference online. You can also see the session choices when they become available in the fall. While you are on the VAST website you can download current and past issues of "The Journal of Science Education." It is a peer reviewed science education journal from the Virginia Association of Science Teachers.

As an affiliate of VAST, VIP encourages you to visit all of us physics types at the conference. Sit down with your colleagues and torque a while.

VIP has an email group. Our email group is mostly made of physics and physical science teachers from Virginia who like sharing ideas about physics education. It's an easy, non-judgmental place to get your physics questions answered. It's free and it won't clog up your inbox with useless email. http://groups.yahoo.com/group/va-inst-phys.

PHYSICS AND THE MEN'S POLE VAULT RECORD

by Andy Jackson

A pole vaulter approaches the pit at a speed of 10.0 m/s. What is the maximum pole vault height he can clear?

Clearly state all assumptions you make. Now look up the men's pole vault record and compare your answer to it.

Explain the difference between the two values.

Find the data for the progression of the men's pole vault world record. Plot a graph of Height Vs Year to visualize the progression. Can you come up with any explanations for periods where the record stands for several years or for where there are times of rapid change in the record? Based on solving the problem and your research, what is your prediction for the future of the men's pole vault record?

I give my students the assignment above after they have been introduced to kinetic, potential, and conservation of energy. When my students solve the problem most do not consider the height of the vaulter at all and incorrectly assume that the given speed is too slow for a world record vault. When they analyze the graph, many students provide interesting comments about periods of stability in the record – like the occurrence of World War II . Many often correctly supply and comments about new techniques or equipment being responsible for rapid increases in the record. For example the fiberglass pole started being used somewhere around 1960, this replaced the aluminum pole, which had replaced the bamboo pole.

There is a very nice article that does a great job of explaining the math and physics involved and it includes with a pole vault height calculator at this link. Unfortunately, it is in mph and feet.
http://www.aip.org/png/html/polevault.html

If you or your students want to see how much physics really goes into a pole vault check out the article at this link – happy reading!

http://people.brunel.ac.uk/~spstnpl/Publications/PoleVault(Linthorne).pdf

SCALES OF SPEED

Let's be reasonable – teaching constant speed and establishing an understanding of scales of speed.

Early in the physics course it is important to establish problem solving routines. One of those routines should be to check your answer for reasonableness. Many students arrive in my physics class with an

understanding of metric units of length, and time of course and to a lesser degree of mass. However, I find that few of my students have a good visualization of speeds in m/s. To help with this I present a power point called what does 6.7 m/s look like? It is quite easy to put together and I use it right after we do a lab on constant speed where we measure the time for a person walking as they cover a 10 meter distance. We record the cumulative time at every meter interval and I use it to introduce graphing of distance vs time. At this point we have established that someone in our class is capable of walking a fairly constant speed and it is very close to 1.0 m/s.

The power point starts with a slide showing the value 1.0 m/s. After a click it displays 1.0 m/s and shows an image of a person walking. The next slide displays 10 m/s. After a click it displays an image of men's Olympic 100 m dash. I work my way up to 100 000 m/s by powers of ten. The table below indicates the details.

Speed (m/s)	Image	comments
1	Person walking	
10	Olympic men's 100 m dash	(22 mph) Some of us may run that fast for a small bit of time.
100	NASCAR	(220 mph) NASCAR cars at their fastest
1000	Fighter jets breaking speed of sound	Mach 3 – 3 times the speed of sound. You won't go this fast unless you are in a fighter jet or space shuttle
10 000	Earth orbiting the Sun	Now your close to the speed of the Earth orbiting the sun – which is about 30 000 m/s
100 000	Large Hadron Collider	This is ONLY 0.03% the speed of light. In the LHC particles will reach more than 99.99% the speed of light!

This newsletter is available for download as a pdf and WORD file at VIP's website, http://vip.vast.org

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Please put VIP mail in the subject line and tell me what to change. If you are receiving multiple copies, let us know what address to delete. If it comes to you with someone else's name on it – just drop me a line.

It doesn't matter how beautiful your theory is, it doesn't matter how smart you are. If it doesn't agree with experiment, it's wrong.

– Richard Feynman, talking to his students in PBS's NOVA show, The Greatest Mind Since Einstein