A TIME for Physics First

Academy for Teachers
Inquiry and Modeling Experiences for Physics First

Leadership in Freshman Physics, 2009-14

NEWSLETTER: Vol 5, No. 2, August 2011

Administrator Academy 2011

Ann Wallenmeyer, Springfield Public Schools

Adding anything to an already hectic schedule is difficult, but the 17 administrators attending the *2011 Physics First Administrators' Academy* found the two days time well spent and the collaboration priceless. Some of their big take-aways included: modeling strategies such as whiteboarding and multiple representation, overlap between math and science concepts, support for their teachers through mentors/coaches, administrator support strategies to guide teachers and empower them in leadership roles.

Administrators worked in groups collaborating, solving and communicating their reasoning. "How do you know…?" and "Why did you do…?" were questions asked as administrators shared their solutions. The strategy was whiteboarding, and the problem was tough. Using dry erase markers and plain old whiteboards, they showed multiple representations of their thinking. The change in the tone of the room as it shifted from individual problem solving to group problem solving was exciting. One administrator said, "Whiteboarding practice was an awesome experience to help us appreciate the thought processes we are trying to encourage through Physics First." Another administrator shared, "This is a great program. I really want to have these types of instruction techniques for all our classes."

Many of the administrators were not aware of the coaching/mentoring support that is embedded within the program, until this meeting. One of the biggest differences between Cohort 1 and Cohort 2 Fellows is the use of coaches and mentors. Cohort 1 Fellows have coaches that visit once a month to observe, reflect and support. Cohort 2 Fellows have mentors that will never physically visit the Fellow but will collaborate, reflect and advise through online methods. Either way, this provides a great support system for the Fellows expected to implement not only the new curriculum, but also the new strategies involved with Physics First.

On the first day of the academy administrators were instructed to brainstorm a list of things they could do to support their Physics First Fellows. Unbeknownst to administrators, the Fellows had already submitted their ideas of what they needed for support from their administrators. During the second day of the academy, administrators processed the Fellows' suggestions and created a bulleted list of ideas. It was interesting to see that the administrator list and the Fellows' list were similar. Some of the ideas found on both lists were resources, time, collaboration, parents and discipline. One administrator summed it up by saying, "Provide collaboration time. Let Physics First teachers inform other staff members of what they are doing. Find equipment for teachers to help them perform their jobs. Give your teachers freedom to teach. Inform parents of the program."

One of the goals for the *A TIME for Physics First* project is to create a cadre of teacher-leaders who will become advocates for excellence in physics content and research-based pedagogy. This goal is addressed through a leadership class, PLC groups, and individual action plans. One administrator shared, "The leadership component with the teachers is an important part. Let them know that administrators are counting on them to set an example. We want to be supportive

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Here's What Physics First Participants are Saying...

Summer Academy 2011

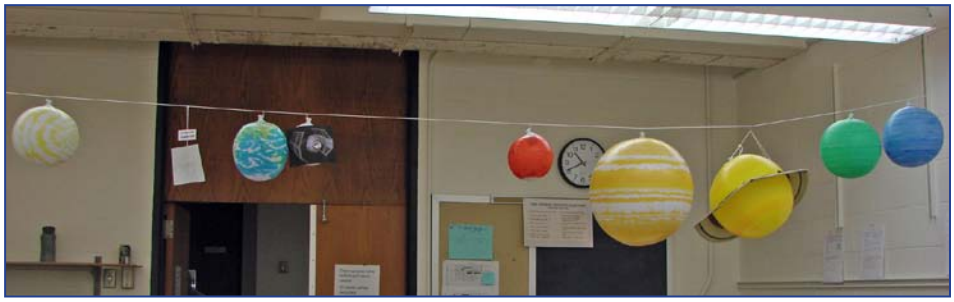
BRAD BUTLER, Versailles High School; Physics First was a blast. To learn a half years' curriculum in 16 days is amazing. I have taught for 22 years so I thought I would get 100% on all of our activities. Not so. That made it a challenge. The instructors were awesome. Meera's quotes of "If you do that you will really be in a soup" and "John – John, you know better. Put the cell phone up" were very funny. Marsha made you want to go back to the classroom and teach the material exactly like she did. MU was great. Food was good but the walks to the restaurants were better. All in all I am looking forward to teaching the curriculum to my incoming freshman next year.

JOHN GILBERT, Salisbury High School: As a first year teacher who has gone through two programs that push for inquiry, it tells me that inquiry is the way to go. I have seen how non-inquiry teaching works and how inquiry works and I will use inquiry as much as possible. I am from Columbia but if there was one thing I missed it was naps. I really was grateful for the support that I received from both the staff and Fellows in my cohort (who are for sure my friends now) during my mother's troubles with her health. It just shows me how great the people that are associated with this program really are.

Joan Twillman, C2 Mentor:

Each morning I read the New York Times. Then the St. Louis Post- Dispatch: A cup of tea; no noise. The word, "read" in the previous sentence is pronounced, "red" because I cancelled my subscription to the Times before the summer Physics First workshops began - after all, I was not going to be home. When I got to Columbia, Physics First days were full from 6:30 to 11 p.m. - working hard and playing hard. (What a worthwhile month! But there was no time for following the news.) Weekends turned out to be totally full- no time for me to watch the political scene. Somehow, it's now seven weeks later and I have still am not studying the news. Oh, I hear comments about the crisis in Washington, and the occasional political speech or program on the radio or TV, but no print, and no on-line coverage.

I have found that when I listen to the President speak or see a snippet of TV news, I pick up the storyline - just where they left off 7 weeks ago, reminiscent of when my college friends were able to follow the plot of their soaps by watching only during Christmas vacations. The time I used to spend on keeping up with the news of the world- 3 or 4 hours per day is now free. Better yet, I do not worry and fret about what is and is not being done in the world; Washington; Jefferson City; St. Charles. Oh, I know that back to school will mean returning to being an Informed Citizen but it has been awfully comfortable to let someone else watch the politicians this summer.



Shawn Hayden, our artistic teaching assistant, hung up a model of the solar system just in time for the Planetary Motion unit. Who says that college teachers don't decorate their classrooms?

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of all programs. I wish this type of staff development was available to all subject areas." Another administrator shared that the administrators' academy helped administrators gain an understanding of their role in helping/supporting teachers and having teachers lead others through the learning process.

Overall, there were many insights, much collaboration, and a "bucket full" of networking taking place at the 2011 Physics First Administrators' Academy. For more information about any of the topics covered, check out the *A TIME for Physics First* website. The PowerPoint, handouts and processing notes can be found under the administrator's section. There will be one more opportunity to attend the Physics First Administrator Academy during the summer of 2012. This academy will give you a basic understanding of Physics First and the associated pedagogy. As one of our attending administrators put it, "Be prepared to explain why PF doesn't look like other high school classes!"

Elizabeth Dyer, Kingston High School:

To read my emails sent home during the summer, you'd think my main purpose of coming to Physics First academy is to eat at as many new restaurants as possible. Every summer, my month in Columbia gives me the opportunity to taste things that I have only seen on the Travel Channel and Food Network channels.

But on the non-culinary side, I really appreciated the Wednesday afternoon talks from different professors. Even if I could only follow the outside edges of their research, they showed that scientists can have a passion for solving problems. That is something I hope to share with my students using Twitter feeds. So hopefully social networking will be a way for my students to see real science in progress.

Jack Wiegers, C1 Coach:

Musings on the 2011 Academy and the question: How do we know the Earth rotates?

The mother of I. I. Rabi, one of the father figures of American physics in the twentieth century, asked little Rabi when he came home from school each day: Did you ask any good questions today? Mrs. Rabi understood the heart of inquiry learning and teaching. I found the inquiry instructional model used this summer and the questions raised by everyone participating in the Academy this summer very helpful in improving my understanding of inquiry learning and teaching. The focus of this summer's academy was asking questions and gathering evidence to answer questions.

Certainly one of the most important questions in critical thinking is: How do we know? What is the evidence? Here is an example from one of the class sessions of the importance of these questions. (MU Professor) Angela Speck asked the question: How do we know the Earth rotates?

The evidence to answer this question does not flow from directly experiencing the Earth's rotation or revolution. Rather we experience the Earth as not moving. It took a very long time to assemble the evidence that the Earth rotates.

Angela Speck's question generated a rich discussion. From this discussion, places to look for evidence that support the statement the earth rotates emerged. The observed behavior of a Foucault pendulum provides important evidence. The Coriolis Effect as seen in the paths of long range artillery shells and in major wind patterns provides evidence. The observed Doppler Shift also adds to the evidence.

It was a great discussion and added to my knowledge of the evidence that answers the question: How do we know the Earth rotates? Perhaps even more importantly, it reinforced my belief that students need to be encouraged to keep asking the question: How do we know?

Crystal Turner, Greenfield High School;

If I had realized that living on a college campus would have turned in to a five star resort experience, I definitely would have become a professional student. The weather was warm and the living was easy.

What a great experience to have, you start your day with a nice stroll to class, you get to listen, learn, and experience Physics among a brilliant group of professors and teacher students. In the evening you have a wide range of entertainment and dining choices at very reasonable distances and prices. Hello, 50-meter pool, the Grotto, Trops, Shakespeare's.

I thought I had been teaching science in an inquiry based manner, until I had my first inquiry based science lesson ever on June 7th. The modeling of the modeling method helped me to understand that I have been a bit of an information giver in the past. Thank you so much *A TIME for Physics First*, for allowing my colleagues and I to expand our horizons, make great connections, and most of all help our students to look at the world with a more thoughtful and curious mind.

GEORGE ALLAN, North Kansas City High School:

Let me start by saying that I had no idea of what to expect from this venture for the summer.

I must say this experience ranked as one of the most thorough and enlightening professional development events that I have ever witnessed as a professional person. The University of Missouri staff was a well-coordinated and delightful team to work with this summer. The ice cream at Buck's Ice Cream was truly a delight and the servings were twice the amount expected for the money!

I feel a great deal more confident to teach physics as a direct result of this splendid Physics First Summer Academy.

George Allan, Eldonna Rose and Chris Goll, North Kansas City School District, work on plotting data

Reflections on the 2011 Summer Academy

Glenn Owens, Coach and Mentor

Now that I'm semi-retired, I have a lot more time to read things other than textbooks. One of my reading sources now includes the opinion and editorial sections of newspapers and magazines. Ya know, it's amazing how many people claim to know how to "fix the educational system" in the US. Another amazing thing is that most folks agree that having better teachers is a key element to the fix. However, this is where the fix gets complicated. How do you improve the quality of teachers?

The article I read this morning in the WSJ was based upon the philanthropic work of Bill Gates and his work to improve the educational system. Gates cited two main points: First, the amount of money spent on education is not a reflection of the quality or quantity of education produced in schools. The second point seems to march right along with the Physics First Program which focuses on research and development to make the proper changes in education.

The Gates Foundation is now focusing on reliable methods of measuring teachers' effectiveness. The methods used by effective teachers are observed, video-taped and studied. The Foundation has a five-year, $335 million project to determine whether effective teaching strategies (including classroom management, clearly expressed objectives, identifying and addressing common student misconceptions) can be videotaped and used as training tools for other teachers.

Admittedly, the PF program has less funding than the Gates Foundation project, but the basic method of improving the education is the same with an enhancement. The PF teachers are tasked to become the leaders in their schools. Not only to improve the teaching of others, but to encourage other teachers, even those in different disciplines, to observe the PF classrooms in an effort to gain feedback that could be used to improve their own lessons.

It seems that the biggest challenge for teachers is finding the time to do what needs to be done.

When I was teaching, I dreaded grading lab reports. It was tedious, time consuming and, for the most part, not the best investment of time input vs. learning gained. I asked an English teacher how he could grade students' writing and assign an "objective" grade to it. That's when I learned about the "scoring guide." What a concept. It saved me hours of grading time and the students produced better products.

Sometimes innovative ideas come from unexpected sources. Teachers need to share with their colleagues. When teachers collaborate, ideas are exchanged and education improves. That's the goal of the Gates Foundation and they're backing it with an investment of over a third of a billion dollars. The PF program is doing the same thing with its summer academy and extending it throughout the school year via the Action Plan. The best thing to do as a Fellow in the PF program is to choose an action plan that is reasonable and practical. Document all that you do and feel good that you are doing the same thing that the big foundations do….only you're doing it spending less money.

What do Coaches and Mentors Do?

Sara Torres, Coach-Mentor Coordinator, Arizona Science Teachers Association

A TIME for Physics First in Missouri provides support throughout the year to sustain the professional development teachers experienced during the summer academy. Professional Learning Communities, follow-up sessions, online discussion abilities, and coaches/mentors are components of the support system built into the program to assist teachers and schools as they implement 9th grade physics. During the 2011 summer academy, coaches and mentors worked diligently to learn more about their Fellows' (teachers) needs, learn the curriculum and pedagogy, and worked together to build common understanding about the tools they will use during the academic year.

Coaches visit each of their Fellows monthly during the school year and complete classroom observations. In 2010-11 the coaches used a modified Missouri School Improvement Plan Observation Sheet that was adjusted during the year to meet the needs of the coaches and Fellows. Although this document is simple to use, the coaches had varying degrees of common definitions of each of the observation descriptors. Therefore, during the academy, the coaches observed the teaching team of Cohort 1, completed the observation form and posted observation conversation as a group and then discussed the tool and how they completed the form. Through these activities, the coaches' internal reliability on the completion of the observation tool was increased and changes were made to assist the coaches, Fellows and the management team.

Just as the coaches were tweaking their observation form, the mentors did the same. Unlike the coaches, the mentors will not be visiting the Fellows in their classrooms. Instead, the Fellows will be responsible for completing a Self-Reflection Tool on a lesson each month, sending that to their mentor electronically, and have a virtual post-lesson conversation. To help the Fellows and the mentors understand how this will work during the academic year, the teaching team of Cohort 2 and the mentors modeled this process multiple times throughout the academy. The teaching team of Cohort 2 completed a Self-Reflection Tool following a lesson with the Fellows observing and even assisting the completion of the form. The Self-Reflection was given to a mentor to review and then in front of the class, the mentor guided the teaching team through a post-lesson conversation based upon the Self-Reflection. Through these experiences, the mentors and the teaching team modeled the expectation for the academic year, the teaching team had time to digest how the learning was occurring in their class and made adjustments to the curriculum and future lessons due to the feedback during the post-lesson conversation, and the mentors revised the Self-Reflection to meet the needs of all. These experiences also assisted the mentors in their ability to ask reflective questions which will help them as they work with Fellows during the academic year to think about the lessons taught and the learning that occurred.

Just as the teachers practiced their learning of physics throughout the academy, coaches and mentors practiced with the support tools they will use throughout the academic year. The coaches and mentors are not evaluators and tools they use are not for evaluation purposes. Physics First coaches and mentors support the 9th grade physics teacher in successful implementation of 9th grade physics, which in turn will enhance student success.

Left: One of the Cohort 1 classes.
Right: Cohort 2 works on Leadership

This is Physics?

Ann Neubauer, South Shelby County Schools

Note from the Editors: Ann Neubauer provided information for this article for her local newspaper. We reproduce it as an example for Fellows interested in writing for local newspapers or district newsletters.

South Shelby is one of the partner schools participating in Physics First. As part of the program and NSF grant, the science department got one group set and additional equipment worth $2300 to help us implement Physics First. Thanks to the generous grant to South Shelby from the Coca-Cola Foundation for which the Mayes family applied, we were able to purchase the additional equipment, technology and computers to fully implement Physics First.

So what is the difference between Physics First and Physical Science, the course freshmen have been taking? Physical Science included a little over a semester of physics, then Earth Science and Space and Universe Science. Physics First will be a full year of freshmen level physics that includes some Space and Universe science. The key difference is in how the students learn. Physics First leads students through labs, experiments and activities to discover the key ideas of physics and how everyday things work.

In this summer's academy we science teachers did the lessons our students will do. Here are examples of the lessons about electricity.

The first lab below shows one of the ways we learned about static electricity. Did you know that if you rub a balloon on your head you can then get it to stick to the wall?

Next, we measured how the resistance of a pencil lead changed as the length and the diameter of the pencil lead changed.

We were given a battery, a wire and a light bulb and had to figure out how to get the light bulb to light. This introduced us to the electrical circuit. With each activity each lab group summarized what we learned on a whiteboard and shared what we learned with the rest of the class.

Then we learned more about electrical circuits by making different circuits and seeing how brightly light bulbs light up, by measuring resistances and by determining the current in the circuit. Through these activities and labs the students will develop an understanding of what a circuit is and how resistance, voltage and current relate to each other.

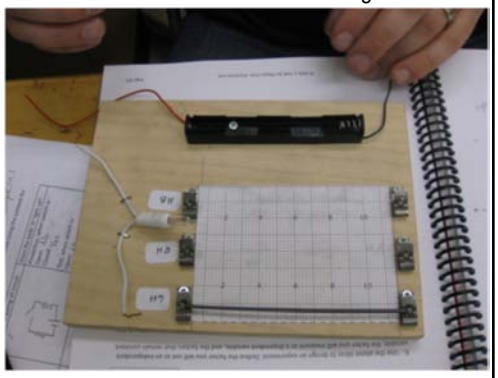
The MU Physics First program is part of a national movement to implement year-long physics courses in 9th grade and to better prepare high school students for science and engineering courses in college. "Our knowledge of science has changed dramatically during the past century," said Meera Chandrasekhar, program director and Curators' Teaching Professor of Physics and Astronomy in the College of Arts and Science. "Because biology courses now include elements of physics and chemistry, it's more practical to teach physics first so students are better prepared to handle the material."

So why do we need Physics First?

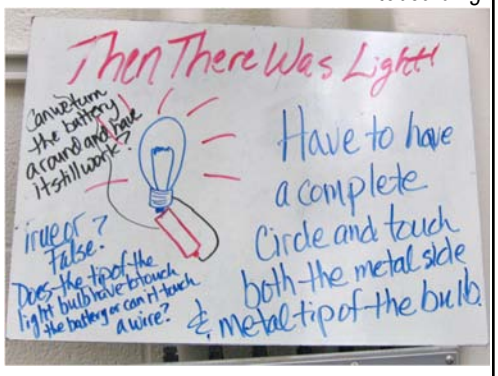
In 2000, The National Commission on Mathematics and Science

Static Electricity

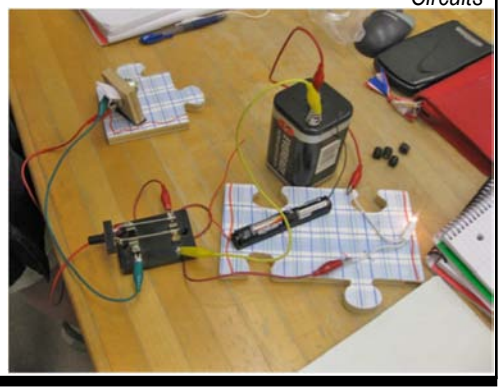
Measuring resistance



Whiteboarding



Circuits



Teaching for the 21st Century issued a report "Before It's Too Late." The Executive Summary makes these key points:

- The primary message of this report holds that America's students must improve their performance in mathematics and science if they are to succeed in today's world and if the United States is to stay competitive in an integrated global economy. The report's second message points in the direction of a solution: the most direct route to improving mathematics and science achievement for all students is better mathematics and science teaching.
- In an age now driven by the relentless necessity of scientific and technological advance, the current preparation that students in the United States receive in mathematics and science is, in a word, unacceptable.
- Reports of the performance of our country's students from both the Third International Mathematics and Science Study (TIMSS) and the National Assessment of Educational Progress (NAEP) echo a dismal message of lackluster performance, now three decades old; it's time the nation heeded it - before it's too late.
- Four important and enduring reasons underscore the need for our children to achieve competency in mathematics and science: (1) the rapid pace of change in both the increasingly interdependent

A TIME for Physics First (Academy for Teachers using Inquiry and Modeling Experiences) at MU

As part of the program Ms. Neubauer attended a four week summer academy (8:30 am to 4:30 p.m. Monday – Friday) this summer at MU. She will also attend a four-week academy next summer to learn the second half of the curriculum and a two week academy the following year. The goal of the academy is to build teacher physics content knowledge integrated with inquiry, modeling, technology and intellectual leadership.

The Summer Academy curriculum is based on inquiry and modeling pedagogies (hands on discovery activities) and leadership training. Physics topics are aligned with Missouri Course Level Expectations (CLEs) and National Science Education Standards (NSES). The academies are team-taught by university faculty and experienced peer teachers. The physics content courses will be organized as follows:

- First Summer Academy (4 weeks): Electricity, Uniform and Accelerated Motion, Forces, Newton's Laws
- Second Summer Academy (4 weeks): Applications of Newton's Laws, Energy, Astronomy, Heat, Waves
- Third Summer Academy (2 weeks): Track 1: for Praxis exam applicants: History of Science, Modern Physics, Magnetism and Electromagnetism, and additional topics
- Track 2: Flexible scheduling includes practice in content leadership skills, learn to conduct PD, work on curriculum revision, produce electronic resources, revisit concepts, work on National Board Certification materials.

A one-week academy is scheduled for math teacher colleagues from Fellows' districts along with a two-day administrator academy, both offered concurrently during the Fellows' academy in years 1 and 2. South Shelby Principal, Deacon Windsor, attended the administrator academy this summer.

Academic year activities are designed to support Fellows as they implement the Physics First curriculum in their 9th grade classrooms. Fellows will:

- Attend three face-to-face Saturday follow-up sessions that focus on content, pedagogy and leadership.
- Fully participate in Professional Learning Communities (PLC) and online discussions.
- Receive support from trained coaches/mentors.
- Access a web-based learning community.
- Utilize a kit-lending program for classroom sets of materials.
- Receive direct access to knowledgeable project staff.
- Attend Leadership in Science Education, a one-hour online seminar/course through MU.

Upon completion of the Physics First program, Ms. Neubauer will have completed 13 hours of tuition-free graduate credit (10 in physics, 3 in science education) and will receive a MU graduate certificate.

Yes! Physics is fun. This fall Physics First comes to South Shelby! Ann Neubauer is one of 72 teachers in Missouri chosen as a Physics First Fellow to attend the Physics First Academy, a graduate program through the Physics Department at MU and supported by a $5 million grant from the National Science Foundation (NSF).

Ms. Neubauer attended the Academy the month of June and learned the first semester of a new hands-on curriculum to teach Physics to high school freshmen. Now don't panic, this is discovering how everyday things work by doing labs and activities. No higher math, no just doing worksheets and memorizing formulas in this.

Physics First is playing broom ball to learn about how things move and using photogates, sparktimers, video, computers and cars to learn about speed and acceleration!

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global economy and in the American workplace demands widespread mathematics- and science-related knowledge and abilities; (2) our citizens need both mathematics and science for their everyday decision-making; (3) mathematics and science are inextricably linked to the nation's security interests; and (4) the deeper, intrinsic value of mathematical and scientific knowledge shape and define our common life, history, and culture. Mathematics and science are primary sources of lifelong learning and the progress of our civilization.

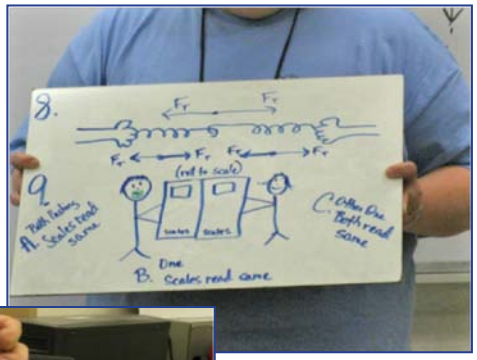
The results of the NAEP science test were updated in 2005 (http://nces.ed.gov/nationsreportcard/pdf/main2005/2006466_2.pdf). The study found overall performance in science declined since 1996 and performance of the nation's twelfth-graders in 2005 was unchanged from 2000; however, it was lower than that in 1996. This was true for both overall scores and scores for Earth, physical, and life sciences.

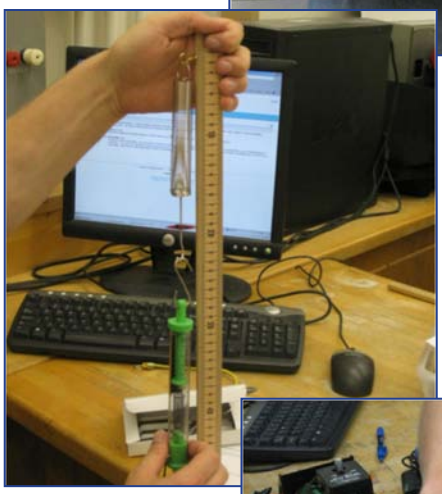
The study* did find that students in Midwest lead the nation! "Twelfth-graders in the Midwest scored higher than their peers in the Northeast, and both groups scored higher than twelfth-graders in either the South or the West. The study concluded a rigorous high school curriculum provides students with more options for postsecondary education, training, and employment. For that reason, many states have increased the number of courses required for high school graduation, especially in mathematics and science, as a part of their educational reform efforts.

The 2005 science results show that twelfth-graders who took biology, chemistry, and physics scored higher than students who took biology and chemistry, and both groups scored higher than those who took just biology or other science courses."

Physics First addresses several concerns by changing the way science courses are presented. Concepts and ideas are taught using activities, labs and experiments with students then summarizing what they learn. Through these steps students develop an understanding of the physics concepts. Ms. Neubauer said "I am so excited about starting Physics First at South Shelby! If the students have even half the fun and excitement I had this summer they will really enjoy Physics First and learn a lot."

*http://nces.ed.gov/nationsreportcard/science/interpretresults.asp





Newton's Third Law
Top: Whiteboarding a problem
Center: Observing the effect of the Law with springs
Bottom: Testing the Law with a track, car and force probes.

Excerpt from "Physics First in Science Education Reform"

By Vikram Pattanayak, http://www.jyi.org/volumes/volume6/issue7/features/pattanayak.html

This call for reform is supported by more than just the results of the TIMSS and NAEP studies. A leading science education reformer, Marge Bardeen, manager of the Fermi National Accelerator Laboratory Education Office, notes that what we learn in science courses could relate more to everyday life.

"Generally, I think people do not understand that science is a way of approaching problems, rather than a body of knowledge. As a result, they are often unable to assess claims and counter claims as they make choices on critical issues that face them as citizens," Bardeen says. "This is what we need to be concerned about - as we call it, scientific literacy for citizenship." Targeting high school science curricula is a way to increase science literacy, since all students, not just future scientists, must take high school science classes."

Physics First Math Academy Feedback

The letters below have been written by high school mathematics teachers attending the summer academy. They are addressed to mathematics teachers who were unable to attend the academy with the goal of providing insight into the needed collaborative effort between the mathematics and physics teachers.

David Tidwell, Hancock Place:

In collaborating with the Physics First teachers and other mathematics teachers over the past school year and last two summer sessions, I have learned many ways to help assist and collaborate with Physics First teachers. I have compiled a list of suggestions and vocabulary to share with other mathematics teachers to hopefully effectively assist and provide discussion topics with Physics First teachers.

- Ask the Physics First teachers to compile a list of formulas used throughout the school year. These formulas can be incorporated throughout the year in many algebra lessons. For example, when teaching students to solve formulas for a specific variable, using real-life formulas that they will see in Physics First would be ideal problems to use.
- Determine a rough draft of the timing and scope and sequence on concepts taught in Physics First and concepts taught in Algebra. These concepts do not necessarily need to be taught at the same time, but it would be important to be aware of when each class teaches each concept.
- Discuss the idea of graphing functions with independent variables and dependent variables. In Physics First, "x" is sometimes used to represent the position variable, and is plotted along the vertical axis. The letter "t" is sometimes used to represent time, and is plotted along the horizontal axis. A discussion on how to help students understand the underlying concept (and not get stressed out about the letters used) would be beneficial in this case.
- Physics First uses many variables with subscripts. Mathematics teachers could use these variables with subscripts to help students understand what they stand for. For example, one could say the formula for the area of a rectangle is $A = l \cdot w$ or in a slightly changed formula, $A_R = l \cdot w$ where the subscript represents the area of the rectangle. Another mathematics teacher suggested an example of having three students named Tiffany in the same class. Each student could be described as T_1, T_2, T_3 or classified by using the subscript letter of the first letter of their last name.
- Use real data collected from student experiments from the Physics First class to use in the mathematics class. This real-life data is relevant to the students and can be used to increase understanding of graphing and the mathematics teacher can use this to teach students how to write equations of best fit and how those equations can be applied in the real world.
- Physics First stresses to students to label mathematical calculations with units and will "cancel" units to come up with final answers. This could be introduced and used as needed in the classroom per discussion with the Physics First teacher and other mathematics teachers in the school/district.
- Discuss how to find the area under a graph and the real life application of what this "number" represents in physics.
- Discuss the use of whiteboarding and how it could potentially be used in the classroom
- Slope is used often and sometimes the formula is seen many differ-

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During the week of June 13-17, 2011, mathematics teachers from participating high schools in Missouri attended the second Physics First Summer Academy on the University of Missouri Columbia campus. This gave them the opportunity to work collectively as a group as well as to attend Physics First classes with their science teacher colleagues. In the process, mathematics teachers have familiarized themselves with key components of the Physics First curriculum and pedagogy, engaged in discussing implications for the mathematics curriculum of the Physics First course, explored in group discussions their role in implementing the Physics First curriculum in their respective schools, established the basic working parameters for an on-going collaboration with their science colleagues (as it relates to the Physics First course), deepened their mathematics content knowledge and their problem solving skills, and had the chance to meet with administrators to bring forward their suggestions regarding ways in which administrators may help facilitate the collaboration that needs to take place between the mathematics and science teachers at schools implementing the Physics First curriculum.

-- Dorina Mitrea, Professor of Mathematics, MU

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ent ways. A discussion with colleagues about the most frequently used ways to calculate the slope in both mathematics and physics classes would help make everyone aware of how it is used in both classes. This doesn't necessarily mean that both Physics First and mathematics teachers need to use the exact notations. This is just to make both parties aware of each other's practices.

- There are many slight changes in formulas that may be encountered. For example, in a mathematics class, a student might use the formula $D = rt$, and in the Physics First class, a student might use the formula $D = st$ or $\Delta x = v\Delta t$. It would be beneficial share with students that although the variables are different in each scenario, the idea is still the same.
- It is good to get an understanding of certain vocabulary words and symbols that show up often in Physics First. A few words that could be discussed as a collaborative team could include definitions of displacement, work, slope, velocity, vector, and force.
- A discussion about the use of decimals, fractions, scientific notation, etc. in each class might also be beneficial.

There were many more ideas and concepts learned throughout the time spent during the academy. One of the best resources and discussions is the collaboration with other mathematics teachers. Sharing ideas and thoughts is a great way to increase student learning in the classroom. I would highly suggest sharing email addresses with other mathematics teachers in the hopes that discussions, ideas and suggestions can continue throughout the year.

A long version of this article that includes all letters written by math teachers is published in a Supplement that accompanies this newsletter.

Sandy Davidson, Moberly:

I am sorry you could not attend 'Physics First' where we learned several fun applications between math and physics. Don't worry, with open lines of communication between your school's Physics First teacher and yourself, you will be able to catch up on what we learned. Here are some key points to help get you started.

Physics has a lot of labs that produce data that in turn can be extended in your math class. Instead of creating random data to teach or extend a topic in your classroom, you can use the data from physics labs. Furthermore, you can use physics formulas as examples to have students solve for variables to increase their familiarity. When creating real-life examples of slope and quadratics, simply use situations from physics.

A big misconception for students that you as a math teacher can help prevent deals with slope. In physics, the variable x may be plotted on the vertical (y-axis) as position. Students may incorrectly calculate the slope with the x-values on the numerator instead of in the denominator if they use the formula for slope literally! In addition, emphasize using different variables along the vertical and horizontal axes so students have to remember that the slope is the change in the vertical-axis (Δy) over the change in the horizontal-axis (Δx).

You can help students by having them explain graphs compared to its labeling. What does it really mean at the point (x,y)? For example, at time 5 seconds, the rock is 3 feet above ground level. Of course, there will be many pay offs within your math class as well.

If you can collaborate with your physics teacher and get similar terminology then students can spend more time on solving problems.

When students see a cyclical teaching of slope, graphs, units, and problem solving between physics and math they will be better for it. I hope you have a wonderful year with great collaboration between you and your physics teacher.

Sarah Doss, Willow Springs, MO

I have to admit my hesitation about freshmen taking Physics First, feeling that the combination of algebra and physics was too much for their level of development and math skills. However, upon completion of the academy, this order is beneficial. The skills they learn in physics can and do complement high order thinking, which is the base for the other science courses.

So how can algebra complement physics and vice versa? There are multiple ways the two use similar terminology and concepts, thus strengthening the students' skills in the long run.

How does this transition begin? As math teachers we can start using units. This is an easy way to merge. Then go over curriculum and what the two classes can do to support each other … in slopes, graphs, etc. It would be helpful to no longer say that, "That is wrong," but instead challenge ourselves to explore the possibilities.

Isn't that what math is about, exploring the possibilities? Math and science departments working together…imagine the possibilities? Most importantly, imagine how much more the students would learn from this marriage? It's exciting to think about.

BRAIN BENDERS

Dorina Kosztin, University of Missouri

The Turning Earth

You know that the Earth rotates around its axis, making a complete rotation in 24 hours. Why is it then that when you jump vertically upward, you land in your own footsteps rather than at a distance equal to the distance traveled by the Earth in the time it took you to jump?

Which physics law helps you explain this?

Down...down...down...

A coin and a feather fall at the same rate (equal speeds at any given instant) in an evacuated tube. Would it be correct to say that in a vacuum equal forces of gravity act on both the coin and the feather?

Tug-the-Strongman

Strongman has his hands tied to ropes connected to two horses that are pulling in opposite directions. He can withstand the tension force exerted by the two horses.

How would the tension force compare if only one horse pulled and the other rope was tied to a tree?

The Black Belt

When you deliver a karate chop to a stack of bricks, how will the impulse differ if your hand bounces back upon striking the bricks vs. if your hand remains in contact with the bricks?

How does the force exerted on the bricks compare to the force exerted on your hand?

Windmills

Rows of wind-powered generators are used in various windy locations to generate electric power. Does the power generated affect the speed of the wind?

Would locations behind the "wind mills" be windier if they weren't there?

Falling Freely

Pretend you are in an elevator at the top of a tall building. Mounted in the elevator is a video camera that takes pictures of you holding a ball in front of your face, then dropping the ball.

If you drop the ball at the same time the elevator cable snaps, so the elevator falls freely, how will the video footage of you dropping the ball be similar to or different from footage of you dropping the same ball in the orbiting space shuttle?

Fast Facts:

Grant period: September 1, 2009 - August 31, 2014
Funding Agency: National Science Foundation
Target Participants: Ninth grade science teachers in Missouri school districts

2012 summer academy starts June 4, 2012
Follow-up meetings: Oct 8, 2011 (Columbia); two 2012 dates TBA

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Above: Academy participants enjoy their end-of-academy lunch
Left: A Cohort 2 class tests Newton's second law with the help of John Gilbert's low-friction "cart."

From:
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