A TIME for Physics First

Academy for Teachers - Inquiry and Modeling Experiences for Physics First

For 9th grade science teachers

NEWSLETTER: Vol 2, No. 2, August 2008

Three Years of Physics First

Sara Torres, Columbia Public Schools

WOW! The third year of A TIME for Physics First Math-Science Partnership is coming to a close. Throughout the past three years, we, as a team, have diligently completed the tasks that we were granted: to design and implement a professional development curriculum for teachers, and to teach Physics First in 9th grade classrooms, thus increasing the number of highly qualified physics/physical science teachers. It has been a true pleasure working with each member of the team and watching everyone's knowledge of physics and pedagogy increase over the past three years.

At this point, funding for the academic year has not been secured; however the Leadership Team is hopeful that it will be by October 1st. But, if it is not, the Leadership Team believes that the support systems that have been provided have laid the foundation for teachers to succeed in their continuous effort in implementing a freshman physics course. Although Coach-Mentors will not be visiting teachers monthly, participants can continue meeting as a PLT, plan and reflect on concepts through a lesson study, and continue to keep in contact with the other participants and teaching team for support.

Just a reminder, the commitment that was signed by participants and their districts stated that pre and post assessments would need to be completed for the 2008-09 academic year, regardless if funding was secured. Teachers' professionalism and follow-through of their commitments is greatly appreciated as we put all of the final pieces together for DESE and the Math-Science Partnership Reports.

The project would not be a success without the support from teachers and district administrators from across the state. Thank you for your commitment! I am looking forward to working with you in the future.

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Three-year and Protege participants, along with several instructors and Coach-Mentors, sport their Physics First T-shirts (June 26, 2008).

CORE Data Information

Please be sure that your school district records the correct data on CORE data. The course name is: **Physics First, #135950.** The description reads: All secondary science and mathematics certified teachers are allowed to teach the conceptual physics course. Local LEAs need to verify appropriate training to teach the course. DESE is using CORE data information to determine which End of Course Assessments are created in the future. It is vital that they have the correct number of students/teachers who are teaching a freshman physics course.

Reading as a Part of Science

Mandy Melton, Kirkwood High School

With the many challenges facing students and teachers in education today, most schools try to lighten the burden by focusing on one problem area that can be addressed by every teacher. This task becomes increasingly difficult at the secondary level because instructors are no longer teachers of kindergarten, third grade or sixth grade, but rather teachers of math, science and history. What then do schools choose to focus on that can be integrated throughout each content area? Reading.

Inevitably all secondary educators have heard the key terms, “reading and writing across the curriculum” and “content area literacy.” I would bet that most schools even have a committee devoted to literacy or reading strategies. As educators we can all recognize the importance of reading, right? Why, then, does such an important skill cause math and science teachers to internally groan?

I believe the resistance of secondary math and science teachers comes from many thoughts of which we are all guilty. “This is high school; by the time students get to us they should be able to read.” “I can’t get through my curriculum as it is, where am I going to find time to teach reading?” “We don’t even use a textbook!” And probably the most common, “I’m a science teacher, not a reading teacher!”

This last statement says it all. It communicates the fear within us that we are being given extra content we don’t have time to teach. We are also afraid the little professional development we have had hasn’t prepared us to teach reading. And lastly, the fear that we are somehow not doing our jobs correctly, especially knowing that between all the graphs, diagrams and mathematical models we have to grade that our requirement of complete sentence answers has fallen by the wayside. After all, those verbal descriptions can be graded easier and still be correct when written as a few simple phases, such as “increasing velocity, constant acceleration, positive of the origin.”

Well, through many revisions and with the cooperation of many former colleagues at McCluer High school, we developed a process for integrating reading into our science classes – the RAPS (Reading As Part of Science) sheet. This simple worksheet (ah, gasp) *accompanied* by class discussion is a great way to incorporate content literacy into science class. It encourages reading skills such as identifying main ideas and using context clues to define scientific vocabulary. But most importantly, it encourages students to engage in critical thinking and to communicate their ideas.

RAPS is easy to incorporate into the classroom routine. I often use it as bellwork or to transition between activities. RAPS is particularly useful in showing how physics content is being applied in the “real world.” Once you maintain the standard that “IDK” is an unacceptable answer, students really enjoy discovering new things and discussing their ideas. I tell my students that there are no holds barred; that they can even write “This article is stupid ...” so long as they justify their opinion. It is important for students to know that communicating ideas and findings for critical review is important in achieving valid progress in the scientific community. The discussions promoted through RAPS do the same on a small scale.

One of the best things about integrating RAPS into the classroom is that it can be tailored to the needs of each class. The probing question provided by the teacher can vary in difficulty. The material that is presented easily changes with different articles. The readability level of each article can vary depending on your source. We are not so lucky to always have our local newspapers cover content that we are currently working on in class, so a little work is required in finding appropriate articles. Though not exactly a journal, sciencedaily.com provides articles summarizing scientific research. It is easy to search for articles by topic and content area. Most teachers have seen “Science World” magazine published by Scholastic, but my favorite source for articles for my ninth graders is “Current Science," a magazine published by Weekly Reader. Each issue has a physical science article that is kid friendly with italicized and defined science vocabulary, current topics, and great pictures and diagrams. Over time, your catalog of articles will easily cover all the concepts you teach.

Though we might not think teaching reading is our job, promoting students' science content literacy and ability to communicate their ideas surely is. Incorporating reading into the science curriculum can be both useful and fun if you aren't afraid to throw down some RAPS.

Resources:

http://www.weeklyreader.com/teachers/current_science/

Mandy recommends a sample article entitled "Jump for Joy," which features pogo sticks. Current Science, Volume 91, Issue 16, page 5 (May 16, 2006).

RAPS Worksheet

Reading As Part of Science

NAME: ___________________________

HOUR: __________ DATE: _______

ARTICLE REFERENCE:

1. What is the main idea or theme of this reading? (If you are having trouble identifying the main idea, summarize the article.)

2. List any new words or phrases introduced to you by the article. Use the reading to attempt to write a definition for these words.

3. What feelings and/or ideas did this reading inspire in you? Explain.

4. Please write and answer the probing question on the board provided by Mr./Mrs./Ms. (teacher name).

Example: Draw energy bar graphs for the Flybar 1200 with the initial position as the beginning of the bounce (on the ground) and the final position as the peak of the bounce. Choose and identify your system.

Graphical Analysis

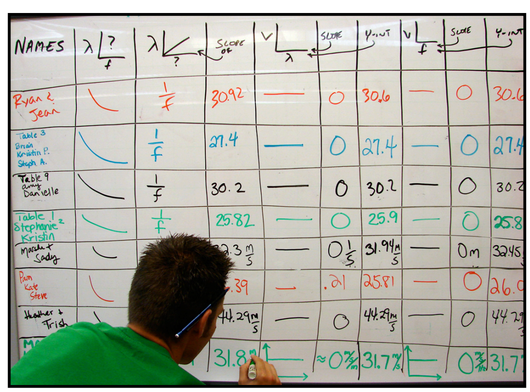
Amy Scroggins and Jaime Horton,
Carthage Jr. High School

As college students we cruised through our physics classes blindly memorizing the equations that professors handed us. We never knew the origin of such equations; even after being shown derivations of equations, it didn't make much sense.

As Physics First teachers, we are finally realizing an easier way to make sense of the origins of the many physics equations. It all goes back to graphical analysis; if you have a graph created using data from a lab showing the relationship between two factors, you have an equation from analyzing the line (or curve) of that graph. Every time our students finish collecting data we tell them, "Ok, this is the cool part." By the end of the year, some of our students were actually looking forward to seeing the "magic" of physics unfold right before their eyes.

As a new addition to the Physics First program this year, we hope to collaborate with our math teachers to bridge the gap that often occurs when students go from the math classroom to the science classroom. We hope to create bulletin boards for both classrooms showing a physics equation on one side and the math connection on the other. We and our math teachers are willing and ready to use the same terminology for graphical analysis. Our algebra II teacher uses quite a few of examples from physics (i.e. projectile motion when dealing with parabolic functions).

Looking back, we would have loved to have seen the connections between graphs and mathematical models in physics (or chemistry) in high school. It would have relieved a bundle of stress in remembering those pesky formulas at test time. We hope that our students will see our class in the same light!



Do not Fear, Physics is Here: A CWC Teacher's Experience

Heather Morris, Mehlville Senior High School

Upon hearing nearly three years ago that I would be teaching a physics class to high school freshman students, I have to admit my initial concern and skepticism. I thought about the student considered to be gifted and could imagine well a successful scenario accompanying her. I then thought about my classroom, which is very diverse in both its skills and academic success experienced in previous science courses. Many of my students entering the first year of Physics First were as concerned as I was with their ability to find a place within the program to achieve. I was fearful of the math required and the amount of problem solving that is placed directly with the student. Many of my students have individual education plans that include a disability within the mathematics field.

To my great surprise this program worked! At the risk of sounding completely cynical, I have been teaching science for ten years and have seen different programs come and go. Many did not demand as much from the individual student as Physics First does, yet this program allows them to feel such ownership over their own success.

A CWC classroom needs to allow for students to be active and not passive learners. The program achieves this in each unit by presenting a construct and allowing each child to formulate preconceived notions about it and to test those ideas within a laboratory framework. The students quickly discover with encouragement from their teacher and class members which initial ideas work with the construct and which need to be adapted. This also allows children to take risks and learn from their mistakes providing for some very powerful learning situations.

Students with disabilities must be free to learn at their own pace and have accommodations, with alternative assessment strategies in place to meet their specific needs. Physics First allows for each student to have time to process their thoughts. First, as mentioned, students must discuss their prior knowledge and then test this knowledge within the laboratories. As conclusions are drawn from each lab they might be whiteboarded, which is a way for each student to present their ideas to the rest of the class. Whiteboarding allows the student to solidify their ideas and also allows the CWC teacher to find areas where alternative strategies or accommodations need to be made.

Most importantly students need to feel success. Physics First helps each and every child feel success through specific goals that challenge them through each unit. My initial fears about this program were not solidified but the concrete information learned throughout this course was. Each student felt successful within some portion or most of the units. Many of my students said they enjoyed science for the first time in their lives. I think this is the greatest achievement of the Physics First program.

Academy Speakers

Sarah Hill, MU

During the 2008 Physics First academy, several guest speakers were invited to round out the content and demonstrate real-world applications.

Prof. Diandra Leslie-Pelecky, University of Texas, is author of "The Physics of NASCAR; the Science Behind the Speed." She became interested in NASCAR literally, she says, by accident. Surfing TV channels one Sunday afternoon, she saw a spectacular crash occur for no apparent reason. She was intrigued – and the result was a book about how physics, math and engineering play a daily role in NASCAR.

Prof. Carl Wenning, Coordinator, Physics Education Program at Illinois State University, Normal, conducted hour-long workshops on using inquiry to study pin-hole cameras in the three Physics First classrooms. He then gave a lunch-hour talk on using inquiry to study density.

Mizzou's own Prof. Angela Speck, Department of Physics and Astronomy, delivered a talk entitled "Planetary Nebulae – What a Beautiful Way to Die."

Rená Smith, PhD candidate, MU College of Education, explained classifications of Depth of Knowledge of a concept especially in relation to state GLEs. She

Physics in the CWC Classroom

Dave Cornett and Tarigene Doile, Winnetonka High School

Teaching Physics First to freshman at Winnetonka High School in the North Kansas City School District has had it challenges but with many positive results. One of the biggest challenges has been teaching a Class Within a Class (CWC). It provides the opportunity of teaching and collaborating with a Special Education teacher. The CWC classroom provides instruction for students with learning disabilities and/or behavioral problems in the same classroom as regular education students.

The program provides training and supplies for participating science and special education teachers. The science and special education teachers co-teach the class to provide differential instruction to meet all learning styles of students in the classroom.

In order to meet the different learning styles for special education students the Physics First program allows the students to be assessed mathematically, by written expression or verbally, using graphs, and motion diagrams (pictures).

Physics First provides an environment of inquiry. This is sometimes difficult for students in special education because many times students have not been successful in the classroom. It is hard for students to ask questions and realize that it is okay not to have the correct answer during inquiry and white boarding. Students have a difficult time creating their own conclusions and may need the teacher to guide or facilitate them through the process until they become comfortable and confident in asking questions and revealing their thinking.

The program also provides materials for students to explore by using activities to answer questions in each unit of study. In introducing constant velocity the student were able to understand the concept by using the bubble tube lab. The students were able to plot data to show constant speed by observing the bubbles traveling through the tube. Students were able to graph the information to show the slope of the graph to illustrated constant speed.

For example, we have a student with a learning disability in math calculations and math reasoning who was successful in the class. This student was able to make a motion diagram to show constant velocity, explain verbally what was taking place, and he could plot the data and explain on the graph what had taken place. Since this student was able to show his understanding with three of the four models it was determined the student understood the concept of constant velocity.

As the year progressed students were eager to share their thinking through white boarding. Students learned to work together, began to understand their own strengths and respect the differences and opinions of their peers. The students had gained confidence and a feeling of success in the Physics First Program.

described four levels; recall, skill/concept, strategic thinking and extended thinking. She noted how one must consider the level of work students are expected to perform, the complexity of the objective and not the difficulty, and the kind of thinking involved in a task, not the likelihood of completing a task correctly.

Columbia Water and Light partners Jay Hasheider, Tim Pohlman and Sara Francis conducted two 3-hour hands-on sessions. In the first session, participants built houses of different construction materials and tested how heat loss is affected by the material's insulating capacity. The second session examined flow rates of several shower heads and calculated the cost of heating water for one's daily shower.

Participants discuss the Insulating a House activity

How do we Know that the Earth Rotates?
(aka, A Geek's Paris Highlight)

Meera Chandrasekhar, Department of Physics, University of Missouri

It was a cool Paris spring day in April 2008. My three daughters and I were on a whirlwind tour of four European cities, of which Paris was the last stop. We'd taken in all the famous spots (ok, many, not all), and now it was time for Mom's "geek stop." I had been a bit whiny that day, asking when we would get to the Panthéon (sweet revenge for all those "are we there yet" car trips). After a long day of walking, there we were, in the early evening, watching the giant pendulum bob of the original Foucault pendulum announcing to the world that the earth does, in fact, rotate.

Historically, acceptance that the Earth and other planets orbit around the Sun and rotate on their axes was slow to come. Galileo's publication of his telescopic observations of the moons of Jupiter in 1610 and his experiments on gravity helped provide scientific proof. Astronomical observations confirmed that the earth rotates about its axis to cause day and night. However, there still was no terrestrial experiment, especially one that made it evident to the layperson.

And so it remained until 1851, when a French scientist named Jean Bernard Léon Foucault (1819 – 1868) came up with the brilliant idea of using a simple pendulum to prove that the earth rotates. Foucault was quite an accomplished scientist. He conducted an early measurement of the speed of light, discovered eddy currents, and, though he didn't invent it, is credited with naming the gyroscope. The Foucault crater on the Moon is named after him.

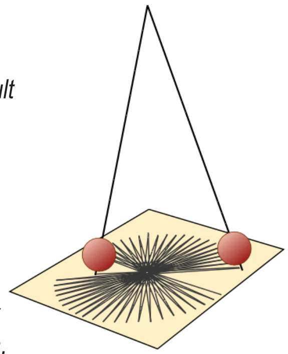
Foucault noticed that if a simple pendulum was set swinging, it seemed to change the direction of its swing with time. Puzzled, he set about trying different parameters that would help him sort out his observations. Like most pendula in our everyday labs, the oscillations die out rather rapidly. He realized that having a massive ball (to increase the inertia) and a long pendulum (to slow it down, so air resistance is decreased) would help sustain the oscillations for a longer time. His first pendulum, set up in his cellar in January 1851, was 2 meters long. Excited scientists helped Foucault set up an 11 meter-long pendulum at the Paris Observatory. By March 1851 the French authorities were convinced that he should be allowed to suspend a pendulum in the Panthéon.

The Panthéon is a vast building, with a massive dome and a huge central hall. Like the buildings of its time, it is full of arches and curved ceilings, with statues and paintings of favorite gods. The Panthéon in Paris was completed in 1789, a successor of the ancient Pantheon in Rome. Rome's Pantheon was built in 125 CE, and has an interesting hole in the middle of the dome; apparently, the Romans had not figured out how to complete a half-spherical dome without the center falling in (concrete and free body diagrams, right?). However, that pesky construction problem had been solved by the time the Paris Panthéon was built, so Foucault got his engineer friend, M. Frommet, and his crew to shimmy up to the top and securely attach his pendulum to the center of the dome.

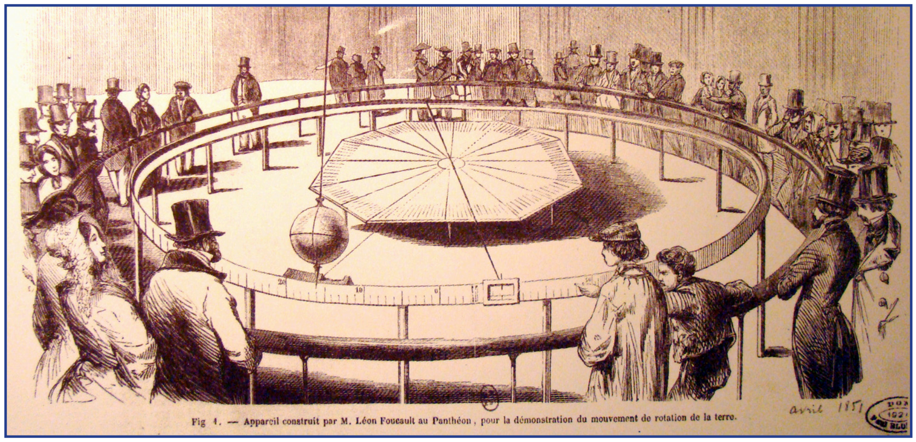
The pendulum was quite a sight. The bob consisted of a 28 kg (67-pound) sphere, and was suspended by a 67 m (223-foot) cable. A wooden floor marked in degrees and quarter-degrees, 6 m in diameter, was set up on the mosaic floor below. A mahogany balustrade surrounded it, allowing onlookers to patiently observe the swinging pendulum. The pendulum's swing measured 6 m from one end to the other. "After a double oscillation lasting sixteen seconds," wrote Foucault, "we saw it return approximately 2.5 mm to the left of its starting point." But just in case folks did not care to measure the motion, the pendulum had a needlepoint attached to the bottom of the bob, and damp sand had been sprinkled on the floor. The swinging of the pendulum was recorded by traces in the sand, obvious for all to see.

Over a period of 24 hours, the direction of the swing of the pendulum seemed to have rotated about 270 de-

Left: A schematic diagram of the trace left by a pin attached to the bob of the Foucault pendulum



Right: Picture of observers at the Panthéon from the newspaper L'Illustration, April 1851, on display at the Paris Panthéon.



grees in the clockwise direction. Needless to say, the experiment created a sensation in Paris. A newspaper report describing the stir it created remains posted in the Panthéon.

So what's the Earth got to do with a swinging pendulum? After a pendulum has been pulled to one side and set in motion, its *inertia* makes it continue swinging, *gravity* helps pulls it straight back (gravity pulls it *down*, the tension in the cable causes it to swing in an arc), and *air resistance* makes the bob swing in shorter arcs, but arcs that are just as "flat". If the string-and-bob are attached to a stand, it swings back and forth along its original path. However, the pendulum's stand is connected to the floor, which moves laterally with the *Earth*. If the pendulum is mounted by a universal joint, it will not twist: there is no force that can make the pendulum's swing change direction. Therefore, if such a pendulum's swing appears to rotate, it must be the *Earth* under it that is rotating!

Let's see how this works. When a pendulum swings back and forth over the North Pole, its swing direction remains the same while the Earth rotates under it. For an onlooker, who rotates with the earth, the plane of the swing *appears* to rotate ~360 degrees in a 24-hour period. But the onlooker is the one who is rotating! Since the plane of the pendulum's swing remains the same, and the onlooker takes 24 hours to go around the pendulum, the onlooker, who does not feel him/herself rotating with the earth, feels like the plane of the pendulum's swing rotated 360° in 24 hours. The apparent rotation of the plane of the pendulum's swing is called *precession*.

In contrast, at the equator, the plane of the swing travels with the earth. The pendulum does not appear to precess at all. Therefore, at latitudes between 90 and zero, the precession effect is between 360° and zero.

Foucault explained the precession of the swing using the following formula:

$\omega = \Omega \sin\phi$

where

ω is the pendulum's angular precession rate (in degrees/day or degrees/hour)

Ω is the earth's angular velocity = 15.04 degrees/hour

ϕ is the latitude (in degrees)

In Paris, where the latitude ϕ = 48.6°, sin(48.6) = 0.750 and the pendulum precesses 270° per day or

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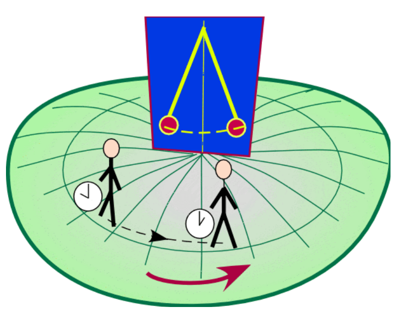
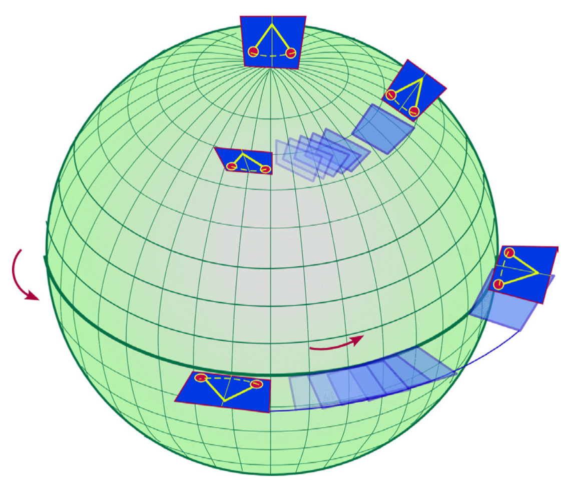
Left: At the North Pole, the pendulum swings in the same plane, but the observer (shown very close to the pole) rotates with the Earth.

Right: The plane of the swinging pendulum at the North Pole, in the northern hemisphere, and at the Equator.





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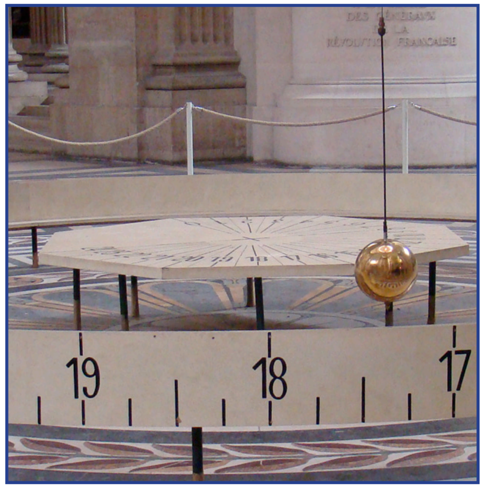
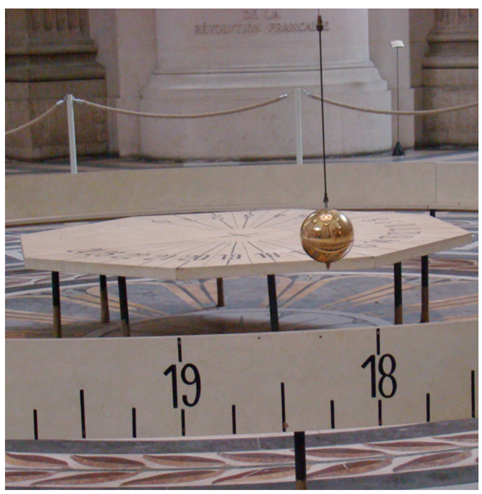
11.28°/hour. In Columbia, Missouri, the ϕ = 38.6°, sin (38.6) = 0.623, and the pendulum precesses about 225°/day or 9.4°/hour. At the North Pole, ϕ = 90 °, sin (90) = 1 and the precession rate is the same as the earth's angular velocity, 15.04 degrees/hour. At the equator, ϕ is 0 ° and the precession rate is zero.

Pretty simple math – but with deep implications. Embedded very obviously in the formula is the earth's angular velocity Ω. If the earth did not rotate, it has no angular velocity, and the pendulum will not precess. If the pendulum went to the moon, whose angular velocity is much less, it will precess much slower at all latitudes.





Photographs of the Foucault Pendulum at the Panthéon, taken one hour apart (April 2008)

A small detail: to be exact, over the North Pole (latitude 90 degrees), the pendulum precesses 360 degrees in a *sidereal* day. A sidereal day is the time for the earth to spin once by 360 degrees as seen from distant stars. However the time from noon to the next noon, which we call a solar day, is about 4 minutes longer than the sidereal day. This is due to the Earth's rotation around the Sun. Correcting for the solar day, the pendulum precesses 361 degrees in a *solar* day, i.e. 15.04 degrees/hour at the poles.

Notice that the period of the pendulum does not matter – just the latitude if its location! Does that mean that any old pendulum, even one made with a cup on a string, should precess? Yes, it should (unless you are at the Equator). However, most pendulums experience friction at their mounting point and due to air resistance, so their swinging stops within a few minutes, perhaps too soon to notice a precession. If you could make it swing long enough to notice the precession, *all* at Columbia's latitude pendula would precess at the rate of 9.4°/hour.

Why does the pendulum in the Panthéon in Paris precess in the clockwise direction? Since the earth rotates from west to east, if we look down on the rotating earth from the north pole, it appears to rotate counter-clockwise. To the observer on earth, who perceives him/herself stationary, the pendulum's swings, instead, will appear to press in the opposite sense - *clockwise*. If, instead, the observer looked down on the rotating earth from the south pole, the earth appears to rotate in the clockwise direction – and the Foucault pendulum will precess in the counter-clockwise sense in the southern hemisphere.

Mathematically, this effect can be described using the same expression,

$\omega = \Omega \sin\phi$.

The latitude ϕ is positive in the northern hemisphere, and negative in the southern hemisphere, changing the sign of the precession rate ω, and hence the sense of the prescession. The counter clockwise precession in the southern hemisphere (and even at the south pole) has been observed experimentally.

The Foucault pendulum enjoyed great popularity in 1851. Louis Napoleon Bonaparte's interest in science speeded up the installation of the pendulum at the Panthéon; but when he became Napoleon III through his December 1851 *coup d'etat*, he handed the Panthéon back to the church. All the scientific skepticism that came with the institution resurfaced. Criticisms of the pendulum included accusations that it was rehabilitating the memory of Galileo. The pendulum was removed. The bob later made its way to the museum of the CNAM, an institute of science and industry.

Memories of the strong impact the pendulum made in 1851 remained. In 1885 the Panthéon was dedicated to the nation and its great men, including Victor Hugo, who had died that year. A number of influential scientists and intellectuals persuaded the Third Republic to reinstall the pendulum. The passing of the influential writer Émile Zola and the 100th anniversary of Hugo's birth in 1902 made that year seem like the perfect time. The pendulum was reinstalled and set in motion again in the fall of 1902. Thousands of visitors stopped by to see the pendulum swinging from what was called "the eye of God." Scientists would come by every Thursday and Saturday afternoon, and explain the physics to all who were interested. However, by July 1903, the pendulum was removed again.

In 1995, France launched a "Science is Fun" campaign. What better occasion to reinstall the pendulum for the third time? And so it was hung again, with meticulous construction of the suspension equipment. The original bob is still at the CNAM museum, but another bob constructed by Foucault in 1855 now swings at the Panthéon. Unlike smaller versions such as the one at the Physics Department at MU, its oscillations do not have the benefit of the electromagnetic "pusher" mechanism that keeps the amplitude constant. The amplitude of the pendulum at the Panthéon dies down in a couple of hours. A designated technician pulls the pendulum outward, makes sure the swing will be "flat," and lets's go……and there goes the pendulum again, swinging and precessing, to mark out the rotation of the earth.

Following many ooohs and aaahs over Mom's geek moment, we visited other areas of the Panthéon, allowing the girls to experience their *own* geek moments at the tombs of Marie and Pierre Curie, Emile Zola, Louis Braille, Alexandre Dumas, Victor Hugo, and the statue of Voltaire. When we returned about hour later, the pendulum bob had moved over, just as Foucault predicted 157 years ago. The Panthéon was surely the icing on our Paris visit.

Answers to April 2008 Brain Benders

1. Cool and Not Humid?

Cooling the air in a room by air conditioning is accompanied by dehumidification. Why?

Answer: When warm air is cooled, some water vapor condenses into tiny water droplets. There will be more low speed collisions between water molecules at a lower temperature, so more merge into droplets. Cool humid air is not as comfortable as cool dry air, so dehumidification is necessary.

2. Shiny Metal Workers

Workers at open hearth furnaces often wear protective clothing coated on the outside with a thin metal layer. Since metals are excellent conductors of heat, wearing this clothing seems to make no sense. How does metal clothing protect the workers from heat?

Answer: Most of the thermal energy from a red hot slab of metal heats you via infrared radiation, electromagnetic energy with a frequency just below the red part of the visible spectrum. Metals are excellent reflectors of electromagnetic radiation, so a metal coating provides an effective shield against the infrared radiation emitted by the hot slab.

Mylar thermal blankets made of a thin metal film on a plastic sheet (often seen in emergency kits) utilize this principle. Shiny metal films have a high infrared reflectivity. When this blanket is wrapped around a person, the person's infrared emission is reflected back onto their body. This keeps the small layer of air between the body and the blanket pretty toasty warm even in freezing cold ambient temperatures.

3. Fireplace Logs

Does the amount of thermal energy radiating into a room from a fireplace depend upon how the burning logs are piled?

Answer: Yes, it does. Instead of having the fire burn between the logs, the logs should be supported so that one can see the hottest glowing region from the room. This configuration usually requires that the front log be removed to leave an opening, while the upper logs rest on supports. Then much more infrared radiation will be emitted into the room.

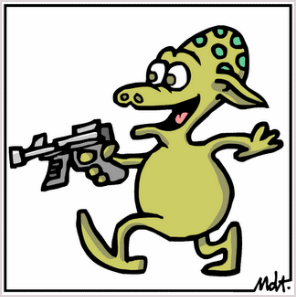
4. Not my Voice

When we hear our own recorded voices most of us will swear that this recorded voice sounds different from the voice we know. Are we victims of an illusion or is the difference real?

Answer: The difference is real. Your voice sounds thinner and less powerful to others than to you because you hear your own voice through skull bone conduction and air conduction. You can verify the difference: hum with closed lips, then stopper your ears with your fingers, and the hum will be louder! When sound is conducted in air, most of the vibrational energy goes into frequencies above 300 hertz, with very little going into the lower frequency sounds.

Brain Benders

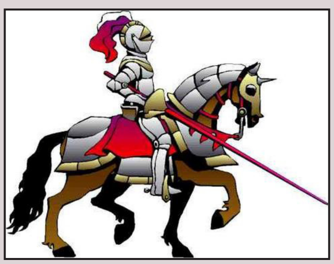
Dorina Kosztin, University of Missouri



1. Hollywood Physics

In a movie, the bad guy is stationary and fires his gun at point blank range (ie extremely close) to his stationary victim's chest. The bullet has a mass of 0.025 kg, leaves the barrel of the gun at a speed of 500 m/s and comes to rest inside the victim. The victim has a mass of 100 kg. Assume that all the momentum of the bullet is transferred to the victim. Determine the speed of the victim's body as a result of the impact of the bullet. In the light of your calculations, comment on the accuracy of movie scenes where the victim's body is actually thrown backwards by the bullet's force of impact.

2. The Punctual Knight



A knight wanted to visit a princess. He had to arrive at exactly 5:00 pm. If he were to travel at 15 km per hour, he would arrive one hour too early. If he were to travel at 10 km per hour, he would arrive one hour too late.

a) At what time did he leave to arrive at 5 pm?
b) What distance did he travel?
c) At what speed did he travel?

3. The High-Rise Kid

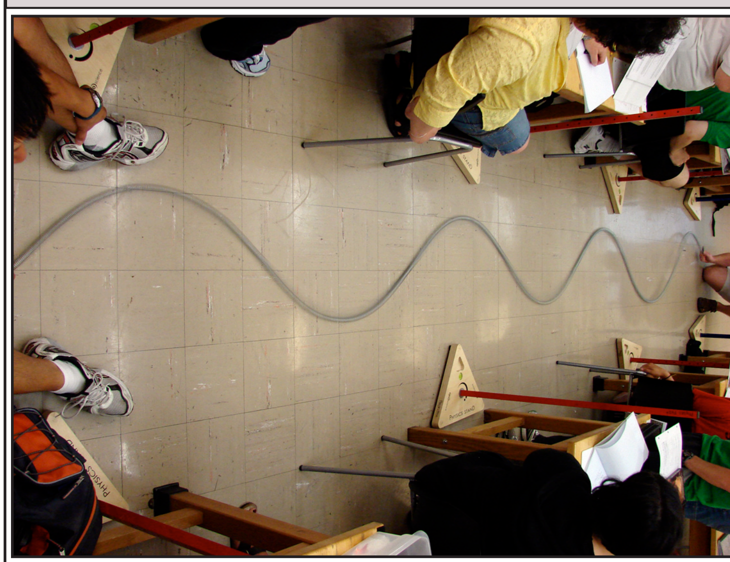
A young boy, one meter tall, lived with his parents on the tenth floor of an apartment building. When leaving for school in the morning, he would use the elevator to get to the ground floor. When returning from school, he would take the elevator to the fifth floor. Then, he would get out of the elevator and climb the stairs to the tenth floor. Why did he not use the elevator to get to the tenth floor?

4. Row-Row-Row Your Boat

John, his wife, and their daughter wish to cross a river. The row boat can only hold 100 kilos. John weighs 80 kilos, his wife and daughter weigh 40 kilos each. How is it possible for all three to cross the river?

5. Useful Holes

If you examine a modern parachute you will notice that it has a large hole at the top. Why is there a hole in the parachute?



Left: Participants observe waves using a long "snakey" spring
Right: Laura Zinszer conducts a "teach-a-class" peer-teaching session

What is A TIME for Physics First?

A TIME for Physics First is a partnership among school districts, institutions of higher education, state and regional educational centers, businesses and non-profit organizations. The project is formulated to design and implement a professional development curriculum for teachers so that they may teach a year-long Physics course in 9th grade classrooms. The project's long-term goals are to increase the number of highly qualified physics/physical science teachers, increase the proficiency of students as evidenced by standardized state tests, and to increase students' interest and success in science/engineering degrees. The program includes a summer academy in Columbia, Mo, and academic year support.

The project is funded by the Missouri Department of Elementary and Secondary Education Mathematics and Science Partnership High School Science Reform Grant (2005-2008).

Leadership Team:

Columbia Public Schools (CPS):

- Ms. Sara Torres, Lead District PI and Project Director, Science Department

University of Missouri, Columbia (MU):

- Prof. Meera Chandrasekhar, Lead Institution of Higher Education PI, Department of Physics and Astronomy
- Prof. Dorina Kosztin, Department of Physics and Astronomy
- Prof. Mark J. Volkmann, Department of Learning, Teaching and Curriculum
- Prof. James Tarr, Department of Learning, Teaching and Curriculum

Missouri State University, Springfield:

- Prof. Mani K. Manivannan, Department of Physics, Astronomy and Materials Science

Coach-Mentors:

- Mr. Charlie Bock, Kansas City
- Dr. Dennis Nickelson, Ms. Calene Cooper and Mr. Andrew West, Central Missouri
- Dr. Becky Baker, Southwest Missouri
- Ms. Nancy Iannotti, Ms. Linda Kralina and Mr. Glenn Owens, St. Louis and Southest Missouri

Peer Instructors:

- Mr. Gabriel de la Paz, Clayton High School
- Dr. Dennis Nickelson, William Woods University
- Mr. James Roble, John Burroughs High School

Project Administration:

- Ms. Sarah Hill, Program Coordinator, Department of Physics and Astronomy, MU
- Ms. Molly Delgado, Bookkeeper, CPS

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Partners:

Columbia Water and Light:

- Jay Hasheider, Tim Pohlman and Sarah Francis

Central Missouri Astronomical Association:

- Randall Durk, Ralph Dumas, Val Germann and Lanika Ruzhitskaya

Heart of Missouri RPDC

Physics First: Participating Districts

Original Partner Districts

Columbia (Lead) – 15*
Carthage R9 - 2
Hazelwood – 7
Frances Howell – 1
Ferguson Florissant – 3
Mehlville – 9
Morgan R2 – 1
Perry County – 3
St. Vincent – 1
Webb City – 1
Hickman Mills – 3
Archbishop O'Hara HS – 1

2008 Attendance:

70 Science Teacher Participants
(48 Year 3, 22 Protégés)
16 Math Teachers
14 Administrators

Other Districts

Salisbury R4 – 1
North Kansas City – 6
West Platte – 1
Poplar Bluff R1 – 2
Aurora R8 – 2
Ava R1 – 1
Willow Springs – 1
Kirkwood - 1
Camdenton – 1
Hannibal – 1
Adair Co. R2 – 1
Cole Co. R1 – 1
Dora R3 – 1
Elsberry R2 – 1
Keytesville R3 – 1
Ralls Co. R2 – 1
Windsor C1 – 1

*Numbers indicate total number of science teachers from district

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