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. 1, April 2012

Making the Most of Technology in Physics First

Mike Hall, Jefferson City School District

If you're like me, technology is something of a double-edged sword. I mean, I love technology (Napoleon Dynamite reference) when it works and when it makes my life easier, but who has the time? Here are some ideas to try in your classroom that might just make life more enjoyable for you and your lessons more exciting for your students:

1. Use your SMARTboard smarter. I use the cut and paste function of my SMART Notebook software to cut graphs and motion diagrams from worksheets so I can use them later. A quick look in the Help Center and you can learn how to add content to the Gallery that you can easily access later when you need a quick example. You can also use the SMART Recorder feature to create videos that you can make available to your students.

2. Take digital photos. Kids love to see their pictures on the screen and so do their parents. Digital cameras have lots of uses. We recently had a registration night for our incoming freshmen and each department was asked to have a display table. I threw some equipment on a table and started a slideshow of all of the digital pictures I'd been taking this year – it was easy, instant advertising for our classes. Digital cameras are also great for documenting lab results or preserving student whiteboards as well. Once I whiteboarded an answer with some intentional mistakes, took a picture of it, and put it on the SMARTboard for the students to critique – it was a great change-up activity.

3. Use a document camera. Another good alternative to whiteboarding is having students put their work on an overhead document camera. I have found this to be especially useful when going over word problems. It's much quicker to have a pair of students bring up their worksheets than to have them recreate the entire problem on their whiteboard. I just ordered a new document camera for under $200 that connects with one USB cable and can capture video as well. I plan to record myself working out some math problems so I can post them on our Physics First website.

4. Try something new. The Internet has new applications for teachers on a daily basis. If you haven't created your first "Prezi" yet, do it today at www.prezi.com. It's way more fun than making a PowerPoint and educators can use it for free. If you can't afford clickers, but have access to a computer lab, try Socrative (www.socrative.com) - it lets you create questions ahead of time or on the fly and then emails the student responses to you. Give Wordle (www.wordle.net) or Tagxedo (www.tagxedo.com) a try for making "word clouds." They are great ways to display information in your classroom or make cool handouts for your kids. These are all free and "cloud-based" so you don't need to pay or download any software to your computer.

It's tempting to keep the status quo during the spring "home stretch" but testing the technology waters might be a good way to jazz up your lesson plans just enough to get you through the rest of the year. Good luck!

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The "Skinny" on Rearranging Math Formulas

Michael House, Springfield School District

Rearranging simple formulas can be an exhaustive and non-productive exercise in futility for any teacher. Do you relate to that statement? I have in the past, but I have developed and honed a procedure that yields amazing results. The procedure even works with special education students. This may sound silly at first, but all I have done is create a concrete, step-by-step set of directions that students are allowed to use until they have memorized the procedure.

Here are the instructions that I share with my students:

1. Make everything a fraction. (Either over or under 1.)

2. Circle the unknown.

3. Make sure the unknown is on top.

- If unknown is already on top, go to rule 4.
- If unknown is on bottom, flip ENTIRE problem. (I tell lower math students it's like a mirror image.)

4. Get unknown by itself by multiplying reciprocals to cancel. Hint: this is why you made the fractions. Repeat multiplying fractions until the unknown amount is by itself. This works best if you to remember to say "What you do to one side you do to the other, then cancel."

5. Multiply everything on top and WRITE it on top.

6. Multiply everything on bottom and WRITE it on bottom.

Papers and Presentations

August 2011- March 2012

Publications

- Hanuscin, D., Rebello, C., & Sinha, S. (in press). Supporting the Development of Science Teacher Leaders – Where Do We Begin? Science Educator.
- Rebello, C.M., Hanuscin, D., & Sinha, S. (2011) Leadership in freshman physics. The Physics Teacher. 49, 564-566.
- Chandrasekhar, M., Hanuscin, D., Rebello, C., Kosztin, D., & Sinha, S. (2011) Teacher professional development must come first for 'Physics First' to succeed. Journal Educational Chronicle, 1(2), 1-9.

Conference Presentations

National Association for Research on Science Teaching. Indianapolis, IN, March 2012

- The use of blogging as a practice to support teachers' identity development as leaders. Paper presented at the annual meeting of the National Association for Research on Science Teaching. Deborah Hanuscin, Ya-Wen Cheng, Carina Rebello, Somnath Sinha, and Nilay Muslu, MU
- Exploring ninth-grade science teachers' path of leadership for implementing educational reform efforts: A case study. Carina Rebello, Somnath, Sinha, Ya-Wen Cheng, and Deborah Hanuscin, MU

Interface Conference, Osage Beach, MO, February 26-28, 2012

- Using Technology to Model Motion Diagrams, Cathy Dweik, Laura Zinszer, Columbia Public Schools
- Electricity for Everyone! Lisa Grotewiel, Keytesville R-3, Rachel Kenning, Springfield Public Schools
- Whiteboarding – Maximizing Formative Assessment in Your Classroom, Michael Hall and Matthew Stacey, Jefferson City Public Schools
- The October Sky's the Limit, Tandi Steffens and Denise Corio, Grandview R-2

Science Teachers of Missouri Conference, Columbia, MO, September 2011

- Modeling Motion Diagrams, Laura Zinser and Cathy Dweik, Columbia Public Schools
- Modeling Acceleration Using a Spark Timer by John Clapp and Joe Pistone, Hickman Mills C-1
- "Accelerate" Student Success with Fun Formatives for Physics First by Marsha Tyson, Jaimie Foulk, and Ann Neubauer
- Stop at this Station (and Think), Meera Chandrasekhar and Dorina Kosztin, MU
- Beyond Probes, John Dedrick, North Kansas City
- Electricity for Everyone, Lisa Grotewiel, Keytesville
- Standards Based Science, Katherine Schottmueller, Ferguson-Florissant
- Supporting Success of ALL Students in Science, Deborah Hanuscin, MU

Google Applications

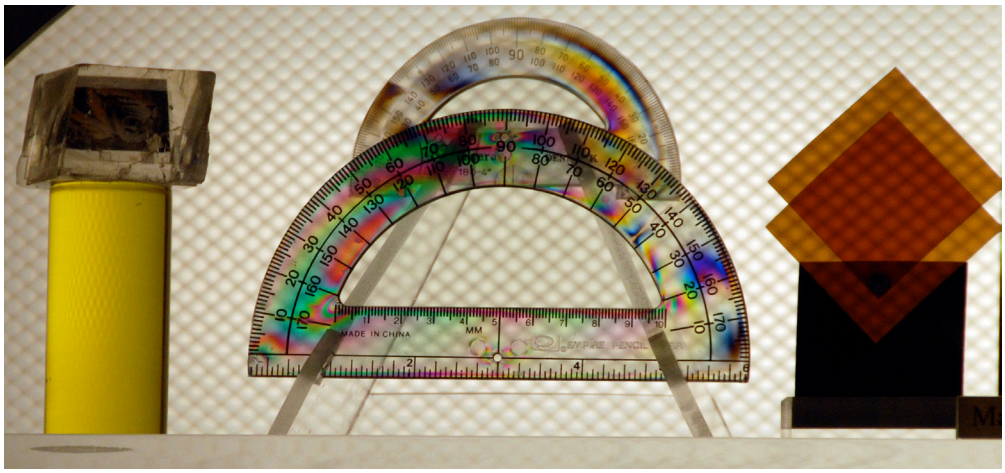
Jennifer Stutzer, New Franklin R-1

In the New Franklin School District, both teachers and students are very familiar with technology. We use different tools, software and applications in order to complete daily tasks, collaborate and create student-centered lesson plans. While school districts are focused on using these tools, money and teacher training are often lacking. In our district, we have become experts at using the many free Google Applications. While I encourage everyone to play with all of the free tools offered by Google, I have found Google Documents, Google Calendars and Google Bookmarks to be the most useful in my classroom. Google Applications is useful for building collaboration and planning.

Google Documents is a great way to create Word documents, PowerPoint presentations and Excel spreadsheets without using Microsoft software. You can upload, share and collaborate on many types of files. Our district technology department has set up a Google account for each student in our district. Each student has a school e-mail contact that links to all of the Google Applications. During the electricity unit I "passed out" a copy of the light bulb diagram in Google Docs to the class. They were able to complete the diagram from their seats…simultaneously! While one person was describing the filament another was adding information about the battery. When all was complete, we had a document full of information on a simple circuit. I uploaded and printed the document so that each student had a copy for their notebook. This was such a simple way for all students to be involved and collaborate.

While Google Calendar and Google Bookmarks are somewhat new to me they have already become a great tool. Google Calendar has allowed multiple teachers to set the PF pacing in our district. We share a calendar in order to see where each teacher is in the curriculum. We try to keep all of our students on the same schedule even if they have different teachers. Google Bookmarks is also a great tool for keeping track of and sharing interesting websites. I hate when I find a website, save it to my favorites then can't remember what I called it or which folder it is in. Tag the site, describe it and browse sites from any computer with Google Bookmarks! Hopefully, these tools can be taken back to your district and used with ease!

Google Applications is a great collaboration tool for teachers and administrators, especially between buildings. In New Franklin, we rarely have face-to-face meetings if it can be completed through Google Docs. Google forms are a great way to put out an idea and get feedback. For example, the Mass Media class wanted to start a school newspaper and needed input on a title. The students created a poll and had teachers, staff and other students vote. When visitors come to the district for eMINTS training, the curriculum coordinator sends out a form asking for volunteers to host trainees in the classroom. It has been a great tool to save time and work around everyone's busy schedule.



Calcite, a plastic protractor and circular polarizers. Part of the Polarization Display, Physics Building Lobby, University of Missouri, Columbia

"The Beautiful Invisible"

Book Reviews

Adapted from a review in Popular Science, http://www.popular-science.co.uk/reviews/rev628.htm

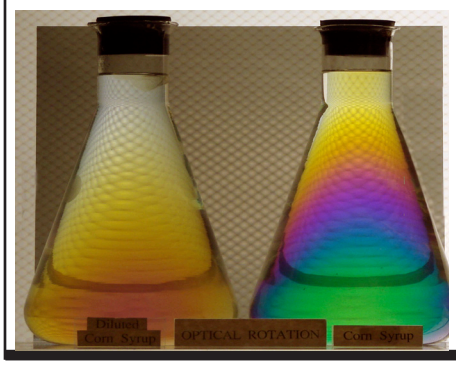
Whereas you might think of science as the temple of rationality where scientist with razor-sharp minds debate, without emotion, matters of fact or mathematical formulas, there is just as much expression, imagination and passion in our physical theories as there is in any poem or painting, physicist Giovanni Vignale argues in his recently published book (The Beautiful Invisible - Oxford University Press, 2011).

Fundamental limits to our understanding compel us to be imaginative, the book conveys. Reality is, at a deep level, inaccessible and unknowable, so we can only hope to describe it indirectly. We are forced to think creatively, to come up with stories and analogies, and to understand through metaphor and abstraction. Scientific theories, the author says, "lie at the interface between the fictional and the real world." And there are truths that only theory can uncover.

This may seem most obvious in the quantum mechanical world, where observations and experimental results don't make intuitive sense, so we have to think outside the box to make sense of them. But it is the same across all of physics, the book explains - fields, particles and all the rest are the result of the imaginative and creative thinking of physicists and do not exist in a literal sense.

Most of the examples the book chooses really get across the extent to which our descriptions of reality rely just as much on imagination as on hard, matter-of-fact data. And, fittingly, much of the book is written in quite a beautiful and poetic language. The book has a particularly interesting section on the similarities between theories in physics and updated versions of classic pieces of literature. Think, for instance, of the modern takes on Shakespeare's plays sometimes on television. Whilst these modern versions are superficially different from the original plays - the characters' names may be different, or we might be in 21st century America rather than 16th century Italy - the underlying themes that are dealt with are the same, and there is a core storyline that remains constant whichever version you are watching. In this analogy, the core themes and core storyline are the abstract theory, with the factual observations being just one version or 'representation' of it.

The Beautiful Invisible can be hard going at points. It combines a sophisticated philosophical outlook and numerous references to literature with uncompromisingly accurate, if non-mathematical descriptions of theoretical ideas. It is the kind of challenge that is enjoyable, however. If you approach it in the right spirit it will amuse you with unorthodox and disparate notions. From the second law of thermodynamics to the fact that God is a woman and makes noodles; from quantum teleportation to the psychology of quantum mechanics; from relativity all the way to the Nazis and Macbeth, the book wins points for uniqueness. It is common for authors to point out that science is beautiful. But Vignale's book explores the idea in much more depth. It does not just tell you that physics is beautiful: it really shows you that it is. All in all, the book makes such a gripping introduction to modern physics, that it might cause a young person (high school, college student) to fall desperately in love with the subject. It will also be great reading for physics teachers. But watch out: this is not a book for future presidents. In fact, there is high risk that it will seduce your future president into becoming a (theoretical) physicist instead.



Left: Corn syrup under crossed polarizers

Right: A strained and an annealed glass ball under crossed polarizers

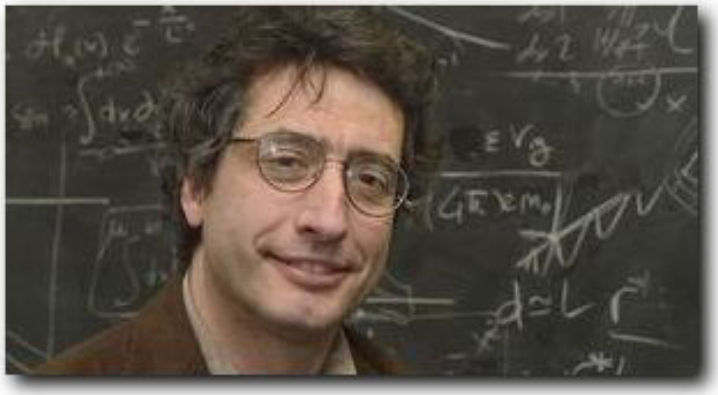
Both part of the Polarization Display in the Physics Building, University of Missouri, Columbia

Reprinted from http://www.physics.missouri.edu/research/faculty_profiles/GiovanniVignale.html by Laura Lindsey, MU College of Arts and Sciences

It isn't typical for a book to compare theoretical physics to literature, but that is exactly what Giovanni Vignale, Curators' Professor of Physics, has done in his latest book, **The Beautiful Invisible**. The title comes from a story called The Little Prince. The moral of that story stems from a frustrated child artist whose artwork is misinterpreted. The reader eventually learns that "whether it's a house, or the stars, or the desert, what makes beautiful is invisible." Vignale says this quote struck him as a good title for his book about the abstract science of theoretical physics.

A good scientific theory is like a symbolic tale, an allegory of reality," says Vignale. In the book, he emphasizes the artificiality of the concepts of theoretical physics. Those concepts may be illusions insofar as they are products of imagination: but they enable us to make a deeper contact with reality. As a rule, theorists seek to develop mathematical models that both agree with existing experiments and successfully predict future results while the experimentalists test the theories. Vignale wants people to know that physics isn't just pure rationality and number crunching, but hides in its heart a free and rebellious spirit. Theorists, he says, "look at reality through the lens of a creative imagination." His book demonstrates this point with examples ranging from Newtonian mechanics to relativity and quantum mechanics -- all written in a language accessible to high-school students."

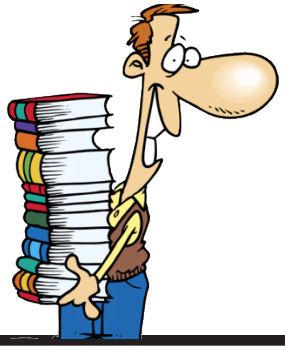
"Unlike practical science, theoretical physics provides us with a description of reality on a very abstract, mathematical level," says Vignale. Theorists have the ability to never deal with reality, but with idealizations, and they are able to discard a lot of information that is judged "not relevant". "It is similar to a novelist writing about his or her characters," says Vignale. "The author does not write about every single minute of every single day in the life of the characters, but rather, he or she only tells the reader about significant events meant to convey a message."



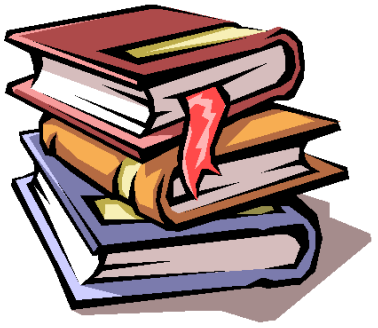
About the author: Prof. Vignale obtained his Ph.D. From Northwestern University. He joined the MU Department of Physics and Astronomy in 1988. He was elected Fellow of the American Physical Society in 1997. Vignale's main areas of research are many-body theory and density functional theory of electronic systems — two areas in which he has published almost 200 research papers.

Vignale came up with the idea for **The Beautiful Invisible** after he completed a five-year project -- writing a technical book full of complicated equations -- and experienced what he describes as "post-partum blues". He loves writing books and decided he wanted to try something different from what he had done in the past — something that would appeal to a broader audience, so he decided to put together his thoughts on physics. Although he has written many poems and short stories, he has never published a work of fiction but hints that is a possibility in the future.

He joined the physics department at MU in 1988 and was elected Fellow of the American Physical Society in 1997. Vignale's main areas of research are many-body theory and density functional theory of electronic systems — two areas in which he has published almost 200 research papers.



Have you read an interesting physics, science or mathematics-related book lately? Send us your reviews.



Group Dynamics

Christy Dablemont, Hermitage R-4

In spite of my belief in the benefits of group work, I nevertheless have found myself pulling my hair out over the decisions related to organizing these groups and the group dynamics involved. There are a variety of lessons and activities designed to help students focus on listening, constructive criticism, conflict resolution and reaching a consensus. In this session I will introduce one such activity that serves to show students the benefits of group consensus- making in solving a scientific problem. In collaborating together as educators to help students develop the skills they need to succeed in groups and structure our groups in effective ways, we can make the most of the cooperative learning opportunities that the Physics First curriculum provides for students.

Cousin's Animal (see box below)

Actions	A :My Score	B: Difference in A and C	C: Official Score	D: Difference in E and C	E: Group Score
Take its temperature.					
Put it in water to see if it can swim.					
Look it up and read about its natural habitat.					
Check for signs of infection in its mouth.					
Ask your friends what medicine to give it.					
Make a list of its physical characteristics					
Look up information about its food and water needs.					
Collect some waste droppings to examine.					
Force feed it dog food.					
Adjust temperature to be similar to that found in its natural habitat.					
Compare a list of characteristics with those of other animals.					
Observe the animal.					
Collect a blood sample to examine.					
Offer it a drink of water.					
Total		_____ of B		_____ of D	

The activity's main objective is to encourage students to learn techniques used in problem solving while learning to arrive at conclusions through group consensus. Students are given the following scenario: Their cousin brought home an unusual animal that he obtained from a recent trip around the world and now the animal is sick with an unidentified illness. They have only three days to work with it and they may anesthetize it. Expert advice is not available, but the animal is common in some parts of the world. They are then given a list of 14 actions they could take and asked to individually rank the actions in order of importance. They are then placed in groups of four or

Official score: These results were obtained from 100 science teachers and scientists who did this activity at a science convention.

Actions	Rank and Rationale
Take its temperature.	8 This will indicate whether the temp. is abnormal relating to possible illness.
Put it in water to see if it can swim.	14 Does not provide useful information related to illness.
Look it up and read about its natural habitat.	5 Provides information so that the animal can be put into a compatible environment
Check for signs of infection in its mouth.	9 Easily performed action which may provide information related to illness.
Ask your friends what medicine to give it.	13 Assuming that your friends do not have expert knowledge, this is probably useless.
Make a list of its physical characteristics	3 Provides information needed to identify the animal
Look up information about its food and water needs.	6 Provides information needed to meet animal's food and water needs.
Collect some waste droppings to examine.	10 May provide information related to illness.
Force feed it dog food.	12 Probably not useful, but may satisfy food requirements
Adjust temperature to be similar to that found in its natural habitat.	7 Acting on information found in step 5.
Compare a list of characteristics with those of other animals.	4 Provides information for identifying the animal so that its normal characteristics can be known.
Observe the animal.	1 This will make it possible to identify it and detect any abnormalities in its characteristics and behaviors.
Collect a blood sample to examine.	11 A more difficult and time consuming action than 8, 9, and 10, but it may provide information relating to illness.
Offer it a drink of water.	2 Adequate water is basic to survival and it can be easily offered.

five students and given instructions on how to reach a decision by consensus. For example, they should not use techniques like majority vote, averaging, or changing their mind just to avoid conflict.

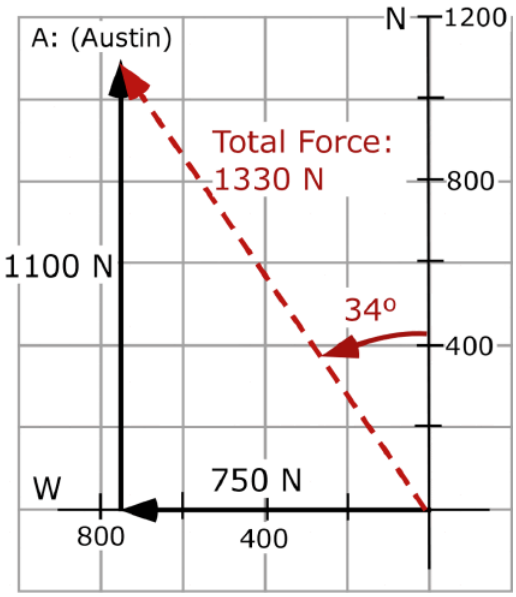
They should view differences of opinion as helpful, and approach the task on the basis of logic. The groups are then asked to rank the actions again in a separate column by reaching a group consensus. Finally the students are given the official ranking and they are asked to calculate the difference between their individual score, their group consensus score and the official score. Most often the consensus score will indicate that solving the problem by group consensus is more effective than attempting to solve it as an individual.

What's Wrong with These Vectors?

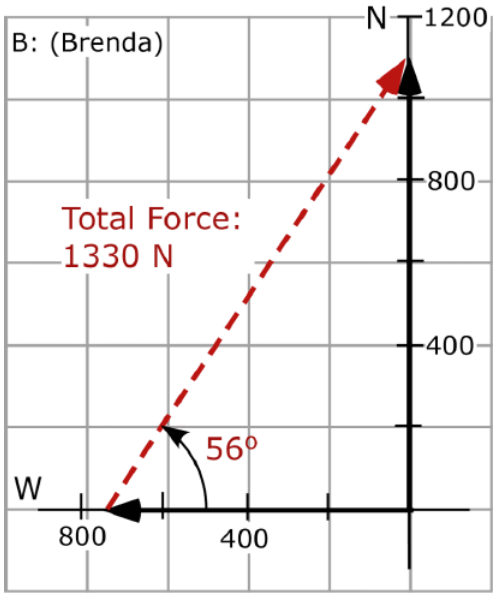
Meera Chandrasekhar, MU

Mrs. Spalding gives her class this problem: A mule pulls a wagon with a force of 750 N toward the west. A donkey pulls on it with a force of 1100 N toward the north. Four students, Austin, Brenda, Cathy and David draw the following diagrams the following diagrams. Which one, (if any) is correct? Explain what is wrong with the incorrect diagrams. Which one, (if any) is correct?

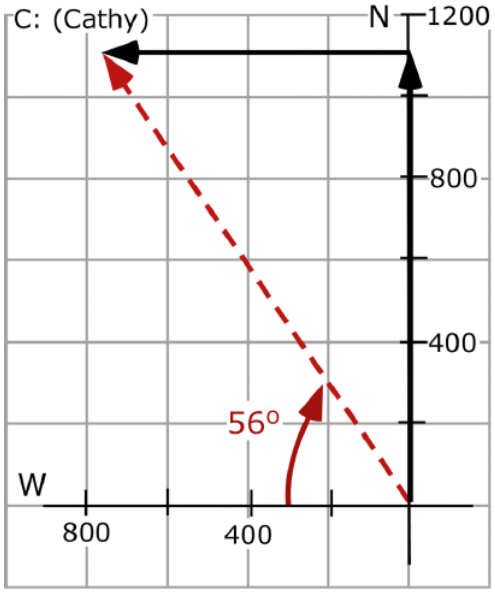
As you are figuring out the errors, also think about why students may have made those errors.



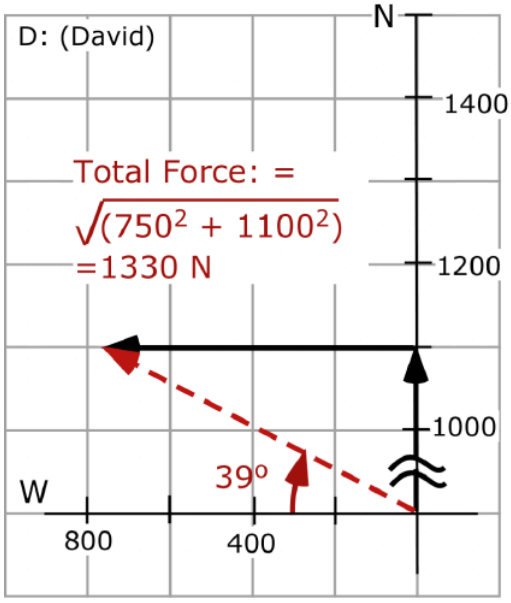
Austin's answer: The total force is 1330 N at 34° north of the west line.



Brenda's answer: The total force is 1330 N at 56° north of east.



Cathy's answer: The total force is 1330 N at 56° west of the north line.



David's answer: The total force is 1330 N at 39° north of west.

Answers to Dec 2011 Brain Benders

Row, Row, Row...

During a girl scouts' training session, three fathers and their daughters are out in the forest. They must cross a river to get back to the camp. But there are two problems: the boat can carry only two people at a time and none of the girls want to remain on either side with a man who is not their father. All girls and their fathers can row the boat. How do they finally make it across the river?

Answer:

We start with all fathers and daughters on the left side of the river. Two girls cross the river. One girl rows back and picks up the third girl and crosses back to the right side. Now all girls are on the right side and the fathers are on the left side of the river. The boat is with the girls. One of the girls returns to the left side and remains there with her father. The other two fathers row across to the right side. One of the fathers returns with his daughter to the left side. The two fathers cross to the right side while the two daughters are left on the left side. The girls on the right side rows back and picks up one of the girls. On the right side, the father without a daughter rows back and picks up the only girls left there. Now they are all on the right side of the river

The Biker

A cyclist has gone through 2/3 of his route when one of his tires gets punctured. He finishes his route walking, in twice the amount of time he spent cycling. How many times faster does he ride than walk?

Answer:

He walks half the distance he bikes, and spends twice the time. Therefore he bikes 4 times faster than he walks

Three Bulbs

A room has no windows and one door. Inside the room there is a lightbulb. Outside the room there are three switches. Only one of the switches turns on the light. You are allowed to open the door once, but you are not allowed to flip any switches while the door is open.

How do you find out which switch turns on which light?

Answer:

Start with you outside the room and the door closed. Turn on one of the switches and wait a few minutes. Turn off the first switch and turn on the second. Open the door right away. If the bulb is on, it's switch number two. If the bulb is off, check to see if it is warm. If it is, it is bulb number one. If it is neither on nor warm, it must be switch number three.

...Pants on Fire

You are traveling on foot to city A. On your trip you arrive at a crosswalk guarded by two men. One of them always tells the truth and the other always lies. They each know which road leads to city A. You do not know which one tells the truth and which one lies. You are allowed to ask only one of them one question. What question do you ask to guarantee you will take the road to city A?

Answer:

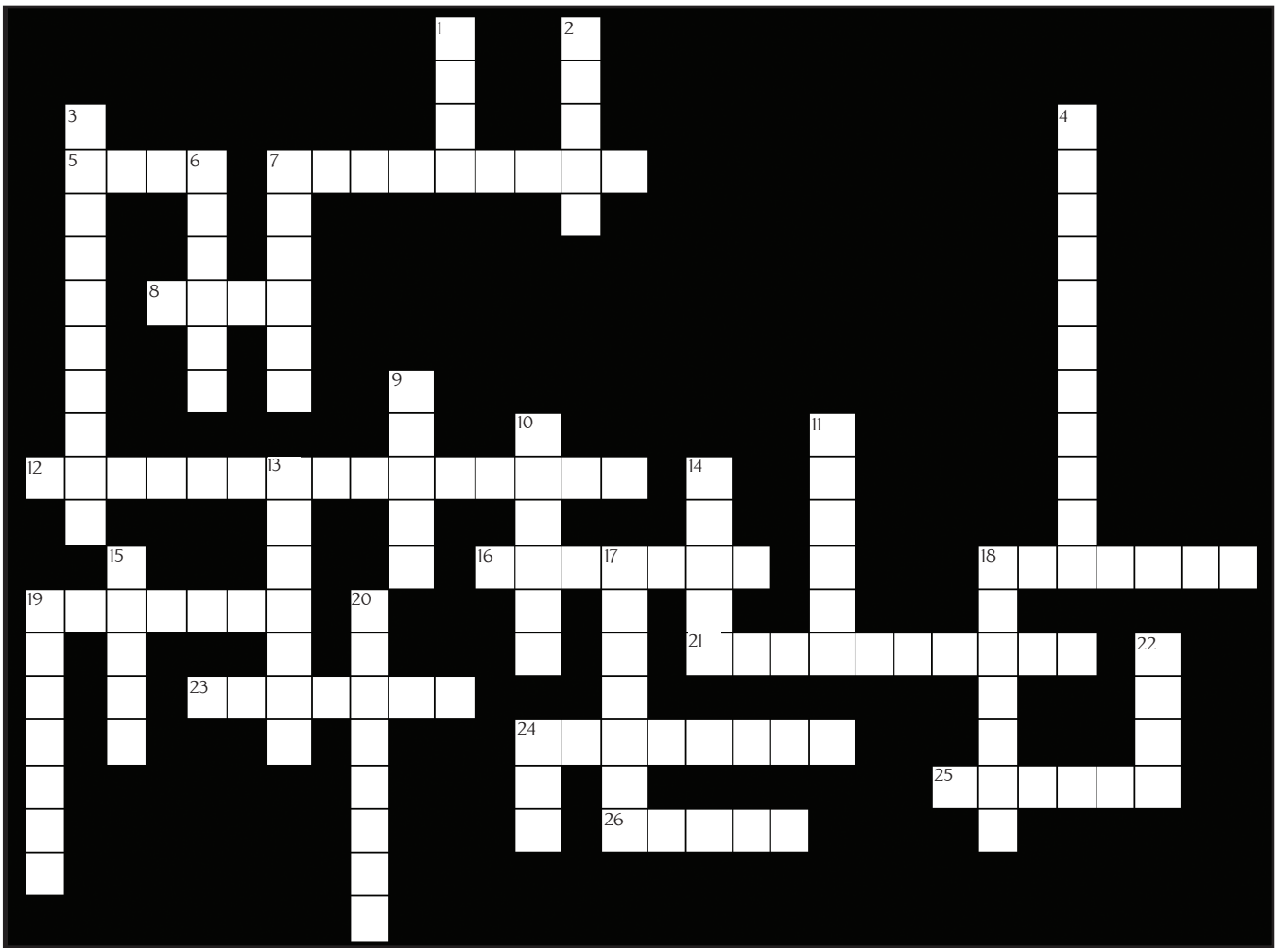
Ask either man which path the other man would recommend to get to city A. Then take the opposite road..

Sleeper

A passenger falls asleep on a train halfway to his destination. He sleeps until he had half as far left to travel as he traveled while asleep. For what fraction of the whole trip was he asleep?

Answer:

He is awake during the first half. In the second half, he sleeps twice as long as he is awake – so he slept 2/3 of second half of the trip = (2/3) x (1/2), which means he slept 1/3 of the whole trip.



Across

5. The drink most associated with the space program
7. The first human to walk on the surface of the moon
8. First American woman in space
12. The closest star to our solar system
16. First artificial satellite to orbit the Earth
18. Largest interplanetary spacecraft ever built
19. NASA sent a spacecraft to study Jupiter, launched in 1989, and named it after this astronomer, famous for discovering Jupiter's four largest moons
21. The first Space Shuttle orbiter, named after the famous television starship
23. The only person to hit a golf ball on the moon
24. This spacecraft was launched on February 7, 1999 to collect comet dust
25. These have been sent to Mars to collect samples and information. Popular ones: Spirit and Opportunity (pl)
26. This type of planet orbits a star and is large enough to be spherical but has not cleared its neighboring planetesimals and is not a satellite (Pluto is now one)

Down

1. The successor to the Hubble Telescope, named after the second Administer of NASA (Abbreviation)
2. Comes from the Greek word ozein, meaning 'smell'
3. The envelope of gas surrounding the earth or a planet
4. Largest volcano in the solar system
6. The manned space program that came before the Apollo program
7. The name of the first monkey the United States launched into space
9. In December 1962 the first successful planetary flyby was of this planet
10. This 'belt' of our solar system beyond Neptune's orbit was named after this astronomer that suggested it
11. The space telescope carried into orbit around 1990, still in operation, named after this astronomer
13. The lowest density solid material produced, frequently used by NASA
14. Made the first US spacewalk on 3 June 1965
15. First American to circle the Earth
17. First American Astronaut to ride aboard a Russian Soyuz rocket
18. The only US President to be present at a Shuttle Launch
19. First person in space
20. NASA's first orbiting space station for human habitation
22. The most massive 26 across planet in the Solar System
24. Prefix for [the official name of] all the Space Shuttle Missions

Brain Benders: NASA Crossword Puzzle

Summer 2012 Academy Information

Here are the dates of the upcoming Physics First summer academies:
Cohort 1 Academy: June 4-15, 2012
Cohort 2 Academy: June 4- 29, 2012
Math Teacher Academy: June 4 – 8, 2012
Administrators' Academy: June 7-8, 2012

Physics First participants will either be living on campus or commuting daily. Those with overnight lodging will be housed in the College Avenue dorms – MU's newest living quarters.

Class time will be scheduled Monday-Friday, 8:30 AM – 4:30 PM, with some evening coursework in order to view the starry, starry nights from MU Laws Observatory, located atop the Physics building.

We are planning lots of educational and fun activities and hope you are looking forward to your time back in Columbia.

Polarization Display, Physics Building Lobby, University of Missouri, Columbia

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:
Cohort 1: June 4-June 15 2012
Cohort 2: June 4 - June 29, 2012
Math Teacher academy: June 4-8
Adminstrators academy: June 7-8, 2012
Contact:

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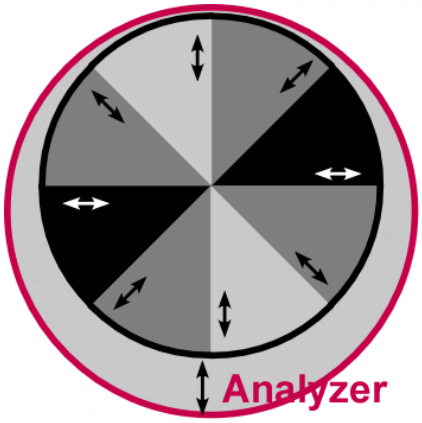

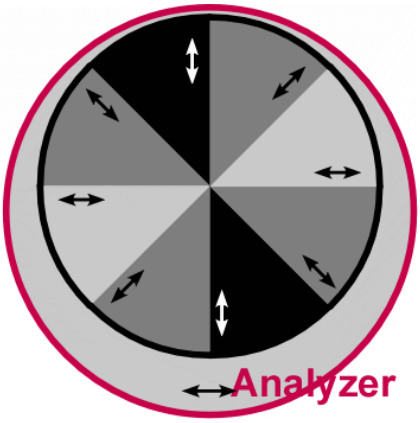

What is this anyway?

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