



The Mathematics and Physics Institute NEWSLETTER

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RECRUITMENT DAYS

January 27th & 28th, 2003

On Monday, January 27, and Tuesday, January 28th, we are inviting for a visit all interested juniors and their teachers from the high schools involved in the MPI program. (Last year we hosted about 106 students.) See the poster below.

JUNIORS!

- Will you be a Senior next year?
- Do Mathematics and Physics excite you?
- Do you want 8 to 13 hours of FREE UMKC credit in Calculus and Physics (a savings of \$1500 to \$2400)?
- Do you want to study two hours each morning for the entire academic year with 50-60 local gifted & talented seniors from 5-11 high schools?
- Do you want to hear mathematics science or engineering enrichment speakers every 2 weeks and take 1 field trip a year?
- Do you want a challenging introduction to college demands and study habits *away* from the high school environment?

If so, ... Enroll in the 20th Class of the Mathematics & Physics Institute 2003-2004

See your counselor, math, or science teacher for details, or contact the MPI directly at (816) 235-1272 or mpi@umkc.edu.

Be sure to attend one of our Recruitment Days in Jan. 2003.

[We're located just behind the Truman Library in Independence.]

We look forward to seeing you!

Recruitment Days Schedule:

- Arrive between 8:00 and 8:10am
- Tour the MPI rooms with MPI Student Guides
- See the Calculus Computer Lab
- See the Physics Experiments Lab

- See Lectures or Problem Solving classes in session
- Hear a short presentation on the MPI
- Ask questions of MPI students & faculty
- Receive an MPI brochure
- Receive the latest MPI Newsletter
- Receive Calculus Readiness Test Sample
- Receive Calculator information sheet
- Eat free Donuts!
- Leave no later than 9:30am

For more information contact the MPI at (816) 235-1272 or mpi@umkc.edu.

**To all MPI Alumni:
You're Invited to the Annual**

MPI REUNION & ALUMNI PANEL DISCUSSION

**Tuesday, January 7, 2003
7:00-8:45 a.m.**

Here at the MPI, Room 207.
Come & Visit Old Friends
& (Even Older) Teachers!

**Would You Like to
Be on the Panel?**

Call 816-235-1290
or Email: mpi@umkc.edu

**WE LOOK FORWARD
TO SEEING
YOU!!!**

OPEN HOUSE THANK YOU

We had an excellent turnout for the MPI Open House this year. There were 85 people in attendance at the November 10th event. A total of 20 MPI students and 7 staff greeted the 58 parents, family members, and school administrators, and presented demonstrations and lab activities from both physics and mathematics. I want to thank everyone who attended for taking time out of your busy schedules to attend the Open House. The students did a fantastic job of displaying what they've learned so far at MPI.

Also, I would particularly like to thank the parents for attending. It was very encouraging to see such a nice turnout. It indicates that you are involved in your son's or daughter's education which is essential for their success both here at MPI and in future years.

We realize that the demands and expectations at MPI may be a new experience for your son or daughter. Although we want everyone to have a solid foundation in physics and mathematics, the real goal of the MPI is to help the student develop good study habits, reasoning abilities, and problem solving skills, which are essential to continued success in mathematics and physics in the future.

If you have any questions about MPI or about your son or daughter, please feel free to call.



Dr. Elizabeth Stoddard
Director

TO ALL MPI ALUMNI:

HAVE YOU GRADUATED FROM COLLEGE?

IF SO:
PLEASE CONSIDER BEING AN
- ENRICHMENT SPEAKER -
CALL (816) 235-1272
Or contact us at mpi@umkc.edu

MPI Alumni who have spoken:

Doug Bullock	(84-85)
Brent Harding	(84-85)
Pam Deters/Stephen Koop	(84-85)
Seth McMenemy	(88-89)
Tony Thornton	(88-89)
Mitch Dobson	(89-90)
Rachel Allen	(92-93)

ODDS AND ENDS

On October 1, Richard Delaware visited with mathematics and science teacher Steve Schlutow of Ruskin High School in the Hickman Mills District introducing him to the MPI program.

On October 26, Sheri Adams attended a Metropolitan Community Colleges (MCC) Professional Development Day at their Business and Technology College and made a presentation to MCC teachers on the Mathematics portion of the MAP test.

On October 28-29, the MPI sweatshirts and T-shirts arrived and were distributed.

On November 8, Richard Delaware spoke in the UMKC Department of Mathematics and Statistics Expository Talks Series on "Bishop Berkeley's 1734 Complaint and Colin MacLaurin's 1742 Response: The Calculus Finds Its Footing."

On November 21, Libbi Sparks attended a workshop on Evaluating Professional Development with MSIP.

On November 25, we welcomed Thanksgiving visitors Leslie Tiensvold (MPI 01-02) and Dustin Sullivan (MPI 01-02). On November 26, our first Director Richard Waring dropped by.

On December 5, Libbi Sparks will travel to Jefferson City to review new State of Missouri 3rd - 8th grade Mathematics Objectives for the Independence School District.

MORE MPI ALUMNI FACTS

In the October issue, we mentioned that 820 MPI Alumni have completed the program over the last 18 years. Of the 740 whose college careers we've been able to follow, the latest figures are that 26% attended UMKC, 53% attended one of the four UM-System Universities, and 74% attended college somewhere in the State of Missouri.

Other MPI students have earned their way into many prestigious academic institutions across the country. Below is a sample of those institutions, with the number of MPI students (to our knowledge) who attended each:

Boston University	1
Brigham Young University	3
Columbia University	2
Cornell University	2
Dartmouth University	3
Drake University	3
Georgetown University	1
Harvard University	2

Mass. Institute of Technology	3
Northwestern University	1
Oberlin College	2
Rice University	1
Tuskegee University	1
US Air Force Academy	3
University of Chicago	2
University of Indiana - Purdue	1
Vanderbilt University	3
Yale University	1

ENRICHMENTS

FOLLOW UP

On Friday, **October 11**, Darrin Ingram, a Project Manager and Senior Associate at Gould Evans Goodman Associates Architects, and member of the American Institute of Architects, spoke on **ARCHITECTURE: DESIGNING THE ENVIRONMENT.**

Students responded:

■ Mr. Ingram started his lecture off by showing a finished project – the AMC 24 complex in Grand Mesa. He then went on to talk about how there were so many steps to the process: zoning research, building code research, design development, and construction documents, etc. Once the design is complete, a person has to go to the city and get a building permit. The draft design is then sent to bidders where a construction company gives the amount it will take to build. Once the bids are in, a contract is awarded, generally to the lowest bidder. Then the building process begins and a certificate of occupancy is issued. There are a lot of safety factors that an architect has to consider, such as soil load capacity, lateral loads of wind and seismic, dead loads of building materials, snow loads, and occupancy loads. Mr. Ingram used many pictures as visual aids and had a question/answer session. It was a good lecture!

■ Darrin says that the first step in making or designing a building is to zone the area and get permission to build there. Then, you have to draw up what it will look like. These days we can get 3-D pictures on the computer. This helps because the architect can do a walk through and see just how big the rooms will be.

■ An EXCELLENT speaker!

■ He was very interesting and did a very good job. I loved his pictures especially the 3-D computer models.

■ I think he could have showed us the programs he works with on the computer. I would have gotten a better idea of exactly how long it takes to draw one building on a computer. Good job though! I've played with Legos when I was younger, so stuff like this is interesting.

On Friday, **November 8**, Michael Kruger, Professor of Physics at UMKC, spoke on **OPPORTUNITIES IN PHYSICS AT UMKC.**

Students responded:

■ Dr. Kruger first talked about why people study physics: search for truth, general utility, and career prospects. He then talked about physics at UMKC. There are 11 faculty members in the department. The student to teacher ratio is low with about 8 to 12 students in upper level classes. Students have the opportunity to help with research. There is also an interesting club that students can join. He talked about the costs at UMKC and about scholarships that could be earned. We made a pinhole viewer out of a toilet paper roll, wax paper, aluminum foil and black paper.

■ Fun lab thingy! Everybody kept asking me how it worked.

■ Fantastic, the idea of having us make something was nice.

■ It was fun that there was actually an activity that involved not just a talk.

On Friday, **November 22**, Douglas Carroll from the Department of Basic Engineering at the University of Missouri – Rolla, spoke on **SOLAR RACING: WHAT'S IT ALL ABOUT?** He has been the advisor for UMR Solar Car Team since 1992, and has done research on composite materials.

Students responded:

■ He told us about solar powered cars and the races that they hold in the U.S. and Australia. He also explained the differences between the two different types of solar panels. He talked to us about Rolla's trip to Australia and how the car went faster than their box truck. He also showed us Rolla's solar powered car.

■ Dr. Carroll spoke about several facets of solar car racing. He spoke briefly about the technology of solar cars, and how the array interacts with the battery. He then spoke about the races for solar cars and the history of solar racing. He showed many slides from races that Rolla has participated in.

He spoke about the problems they run into when transporting the car and during the races.

I would like to have known more about how the solar cells work, and about the engineering and design of the car.

■ Doug Carroll told us that the idea behind a solar race is to design the most energy-efficient car. The most efficient solar car will win. The UMR solar racing team competes in competitions across the world (and they are pretty good). The first world solar challenge took place in 1987. The sport is growing. The headquarters for solar racing is located in Freeman, MO. Doug showed us pictures from the world race in Australia. Very interesting.

■ In person, the car is quite astounding.

■ I thought he did a very good job, and it was very interesting. Seeing the car was really cool!

■ I enjoyed this subject. We need to use more solar power.

■ Overall he was very informative. I've always seen those cars on the road but I never knew. The car was really neat.

■ I thought that the idea of solar cars is very good because we need to use alternative fuel sources. I liked the car.

■ Solar cars are definitely cool.

UPCOMING:

On **December 20**, Frank Booth, a Forensic Chemist from the Kansas City Regional Crime Laboratories, will return to speak on **SCIENCE IN THE CRIME LAB**.

Tuesday **January 7, 2003**, we'll hold our annual **PANEL DISCUSSION AND REUNION** with current and former MPI students from 7:00-8:45 a.m. in Room 207.

On **January 17**, we have not yet scheduled a speaker.

On **January 31**, Caroline Davies of Geosciences at UMKC will speak about reconstructing the paleoclimate in Jordan or Yemen.

WE HEAR FROM PAST STUDENTS

Jake Fulcher (01-02)
University of Missouri - Columbia
Mechanical Engineering Major

Email received 10/28/02:

"Hi Dr. Delaware. I just got back my second Calc III test and I got an 89/100. My professor said that in his classes only 4 people did better than 90 so that makes me very happy. I got a 79 on the first test. I don't know what happened. I don't think I was as prepared as I should have been. I knew how to do all the problems, but I ran out of time because I wasn't adept at doing them. For this test, however, I was very prepared and I flew right through it. When studying, I just did problem after problem for hours and it became almost like **muscle memory**. I got to the test about thirty minutes early, worked some problems before, like you always told us, and I was rolling when I got in. Things are going well at Mizzou. I am definitely keeping busy. What days are you at MPI during the week of Thanksgiving? [Ed: Monday and Tuesday.] I would like to drop by just to say "hi". I will be home all week.

Nina LanFranca (00-01)
University of South Florida - Tampa
Marketing Major

Email received 11/5/02:

"I know that I haven't written in awhile, but I thought that I would write to catch up. Things are going pretty good here in sunny Florida. My classes seem to be going quite well. I am not worried about finals or grades, thank the lord! It is homecoming week here right now, so life is pretty busy. Being in a sorority, there are a million things that I am obligated to go to. It is well worth the effort though. We are having such a good time with everything. My main responsibility was to write up the skit. Only four out of 15 were chosen...and my idea was chosen. We are going to be performing it tomorrow, so I am really excited about that. I can't even explain how excited I am about coming home again though. I will be back the Sunday before Thanksgiving, and I am staying until the Saturday after. Then I will come back to Tampa for a week of classes and a week of finals. Then it is back to good ole KC! I am very excited about it. I miss the family and all of my friends."

Email received 11/14/02:

"Well, the skit went quite well. We were definitely the best ones out there, no questions asked. Other than that, our Homecoming Week was a blast! There was a carnival with rides, fireworks and a bonfire one night. The next night there was a parade which all of the sororities and fraternities made floats for which I was on. We won our homecoming game as well. Our football team is doing awesome. We

have the 2nd longest home winning streak in the country right now. If Miami loses their last game then we will be #1. Enough about that though.

School is going pretty well now too. I just took an accounting test and I got a 96% on it. I was pretty proud of that one. Other than that, I have a really big paper that I am working on. There isn't too much else going on academically.

I am very excited about coming home in 11 days! Hopefully I will make it up to MPI on Monday or Tuesday. I don't think that it should be too hard for me to accomplish. (I will try to remember to bring some photos of Nicole's recent wedding. She was so stunning.) It is a small price to pay to see ya."

Sheryl Nance-Durst (84-85)
BS Mathematics, UMKC
MILS (Master of Information & Library Science)
University of Texas

Email received 11/24/02:

So...I've been asked to write a little about my life after MPI and how it may have helped me. Why not? I'll give it a shot. One thing you might want to know is that I'm a real MPI old-timer! I was in the very first year of the program when it was all still experimental. We made wonderful guinea pigs! (wink, wink).

My life after MPI. Hmmmm. Well, I went to college at UMKC where I majored in math. Big surprise, huh? One way in which MPI influenced me - I started to think of math classes as fun! The week I graduated, his employer transferred my father to Louisiana. Not having decided what I wanted to do in life, I went along for the ride. In Louisiana, I was lucky enough to get a job in a library. When I moved back to KC, I stayed in libraries, eventually deciding to get my Masters in Library and Information Science. I love my job helping people find information, and couldn't imagine doing anything else.

So, did MPI have any lasting influence on me? Being asked to write this item got me thinking about that very question. I decided that the answer is a very big YES, but not in ways that you might imagine. I think one of the biggest influences MPI had on me was to simply teach me to think logically. (Did I say simply? I'm not sure the teachers thought it was simple!) I was never the most organized person, so being forced to think logically, step-by-step, to solve those math & physics problems taught me a lot. And believe me, I need every bit of that logical thinking when someone comes to me in the library who doesn't even know what information they want, let alone how to articulate their request!

A second, and more subtle way, that MPI influenced my life was by introducing me to people that came to be dear friends. I have three very close friends to this day, almost 15 years after high school. These three women were the bridesmaids at my

wedding. They are almost as close as my own sisters. One I met in MPI when we attended it together. A second one I met because she attended MPI the year after me. The third was a childhood friend of the first MPI friend. In fact, the girl that attended MPI with me introduced my husband to me. (This girl even met her first husband in MPI.) Looking back, I can't imagine how empty my life would be without these people. And I wouldn't have any of them if I hadn't attended MPI. I know that introducing people is not the primary goal of the program. But I can't deny that that's where it had its most far-reaching influence in my life.

You never know where you'll go in life. Things have unusual repercussions. A program in math and physics helped me become a better librarian and (in a roundabout way) gave me some of the most important people in my life. Imagine that.

2002-2003 STUDENT FIRST IMPRESSIONS

"MPI has definitely not been easy, and at first I thought I was in over my head. The lectures are fast paced; the homework is assigned nonstop; and when they say two hours of studying a night that is almost what it takes. But I love it. It is definitely a challenge, but I have learned that it is very doable. And actually, it is fun (that is all except the labs).

They have definitely changed the way I think. I went from needing help on all of my assignments to learning to think things through on my own. Curves are another great thing about MPI. Although they say to be happy with low B's and C's, I think the A's feel so much better to get, and it is very possible if you apply yourself. This works in Physics anyway; Calculus I'm still working on."

Cathy Martens
Center Place Restoration School
Ft. Osage School District

"I was pretty nervous about coming to MPI but all my friends who came last year told me I could handle it. Turns out that they were right. The classes are hard but if I study I do fine. Actually, the hardest part is getting to class on time."

Rachel Van Tuyl
Ft. Osage High School
Ft. Osage School District

"Going to MPI is somewhat a life-changing experience. For most of us here, succeeding in class was never a problem, in fact, some of us here are at the top of our class. But be aware, that will change. The MPI has tested skills like never before, challenging every single brain cell in our heads, pushing them to the brink. And, of course, we have

failed. Some worse than others, but we have failed. And with that failure, there will come success. What the MPI has done is that it has shown us what failure is so that we don't take success for granted. When I leave here, I will leave knowing that, yes, there is a chance of failure in life, but an even better chance of succeeding, which is why we are here."

Edgar Vargas
Hickman Mills High School
Hickman Mills School District

"We're finally settling down to a routine at the MPI, and the anxiety before a test now causes only mild dyspepsia. I feel like I am learning a lot, and I will have an advantage in college because of the study skills I am picking up."

Matt Orlovick
Truman High School
Independence School District

"Never in my academic life have I ever been so challenged. I have had to change my study habits and school work ethic to adjust for the change."

Ryan Larson
William Chrisman High School
Independence School District

A SOLUTION TO MATHEMATICS CHALLENGE #75

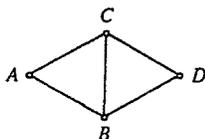
Recall the problem statement:

If each point of the plane is colored red, white, or blue, prove that some unit segment will have both its endpoints the same color.

[From: Mathematical Chestnuts From Around the World, by Ross Honsberger, MAA, 2001, problem #26, p. 71.]

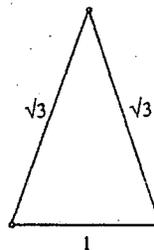
SOLUTION:

We'll call a unit line segment "monochromatic" if both its endpoints are the same color. Suppose no unit line segment is monochromatic. Then consider two abutting triangles ABC and BCD of unit sides as shown below.



Since no unit line segment is monochromatic, the three vertices of each of these triangles must each receive a different color, red, white, or blue. But that forces the

same color on vertices A and D. Now, observe that (by the Pythagorean theorem) each triangle has altitude equal to $\sqrt{3}/2$, hence length $AD = \sqrt{3}$. So, if no unit line segment is monochromatic, it follows that every line segment of length $\sqrt{3}$ must be monochromatic. Now construct an isosceles triangle whose equal sides are of length $\sqrt{3}$ and whose base is of unit length. The previous result then forces all three vertices to have the same color. So the unit base is monochromatic.



This contradicts our assumption that no unit line segment is monochromatic. Hence, there exists at least one monochromatic unit line segment in the plane.

A SOLUTION TO PHYSICS CHALLENGE #66

Recall the problem statement:

In 1905, Einstein produced the Special Theory of Relativity that says that the speed of light as measured by any observer will be the same, $c = 3 \times 10^8$ m/s. Consider the following paradox:

You are in a very fast (nearly the speed of light!) ship flying above the surface of the earth. If you turn on the lightbulb located precisely at the center of your compartment, you expect the light waves will simultaneously strike the front and back wall of your compartment. Meanwhile, I am watching this happen from earth, and I see that the light moves forward at 3×10^8 m/s from the bulb toward the front wall and backward at 3×10^8 m/s toward the back wall. But, since the ship is moving forward, the back wall is moving forward to meet the light wave sooner. Also, the front wall is moving forward and away from the light wave, so the light hits the front wall later.

So, did the light waves hit the wall simultaneously as you observed or did they hit the back wall first as I observed? Which was it?

SOLUTION:

The events of light hitting the front wall and back wall are simultaneous as measured by you in your frame of reference. But, the events are not simultaneous as measured by me in my frame of

reference since the speed of light must be the same as measured in any frame of reference. (Einstein's 2nd postulate of relativity.) This illustrates that absolute simultaneity is a naïve concept when relativistic effects are important. When this is the case, two events that are simultaneous in one frame of reference need not be simultaneous in another frame, which is waving relative to the first as a consequence of Einstein's second postulate of relativity.

MATHEMATICS CHALLENGE #76

Prove the surprising fact that for any fixed positive integer $n \geq 2$, the function

$$f(x) = \cos(x\sqrt{1}) + \cos(x\sqrt{2}) + \dots + \cos(x\sqrt{n})$$

is not periodic for real values of x .

Recall: A function $f(x)$ is periodic if for some positive real number p we have $f(x + p) = f(x)$ for all real values of x .

[From: Mathematical Chestnuts From Around the World, by Ross Honsberger, MAA, 2001, problem #3, p. 25, from the East German Olympiads.]

PHYSICS CHALLENGE #67

Another Special Relativity question: Say an astronomer found an earth-like planet 200 light years away from earth. Given that nothing can travel faster than the speed of light and that people cannot live for much more than 100 years, do you think that it would be physically possible to send a single person to visit that planet and return alive? Let's assume that technical problems such as propulsive energy and protection from cosmic radiation could be overcome.

Editor/Writer:

Richard Delaware

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