Mπ

The Mathematics and Physics Institute NEWSLETTER

RECRUITMENT DAYS– January 28ᵗʰ & 29ᵗʰ

On Monday, January 28, <u>and</u> Tuesday, January 29, we are inviting for a visit all interested juniors and their teachers from the high schools involved in the MPI program. See the poster below. (Last year we hosted about 117 students.) They will arrive between 8:00 and 8:10 am and, with MPI student tour guides, take a short tour of MPI classrooms. There will be MPI students at work on Calculus, a Physics lab set-up for viewing and problem-solving sessions in action. Following the tour, everyone will be led to Rm. 207 to receive an MPI brochure, this issue of the Newsletter, a sheet containing information about the Calculus Readiness Test and MPI Mathematics Technology, donuts, and at 8:30 am, be seated for our slide show which includes computer, calculator, and physics demonstrations. Afterward, we'll all take questions from the audience, finishing up at about 9:30 am.

JUNIORS !

- Will you be a Senior next year?
- Are you interested in Mathematics and Science?
- Do you want 8 to 12 hours of FREE UMKC credit in Calculus and Physics (a savings of $1200 to $1800)?
- Do you want to study two hours each morning for the entire academic year with 50-60 of some of the best local gifted & talented seniors?
- Do you want to hear mathematics, science or engineering enrichment speakers every 2 weeks?
- Do you want a challenging introduction to college demands and study habits, away from the high school environment?

If so, ... Enroll in the 19ᵗʰ Class of the

Mathematics & Physics Institute, 2002-2003

See your counselor, math, or science teacher for details, or call the MPI directly at 235-1272.
[We're located just behind the Truman Library in Independence.]
Be sure to attend our Recruitment Day in Jan. 2002.

We look forward to seeing you !

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

MPI REUNION
&
ALUMNI PANEL
DISCUSSION

Tuesday, January 8, 2002
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 64 people who attended the November 4ᵗʰ event. A total of 18 MPI students and 7 staff greeted the 39 parents, family members, 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.

Eli Stoddard

Dr. Elizabeth Roth 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

Libby Stoddard and Richard Delaware visited three school districts encouraging them to participate in the MPI program: **September 20,** Hickman Mills District; **September 25,** Liberty District; and **October 2,** North Kansas City District.

On **October 23,** Libby Stoddard and Richard Delaware made a joint presentation on the MPI at the Independence, MO, Board of Education meeting.

On **November 8-11,** Libby Stoddard attended an American Association of Physics Teachers New Faculty Conference in Washington, D.C.

On **November 20,** we ordered MPI T-shirts and sweatshirts.

On **December 11,** Libbi Sparks will attend in Lenexa, KS, a workshop on Brain-Based Learning for Education.

ENRICHMENTS

FOLLOW UP

On Friday, **October 12,** 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:

■ Darrin told us the basic things needed to become a successful architect. He spoke about building design projects. He told us the steps, how to start, the construction process, the math/science principles in architecture, design loads and the structural calculations. For someone coming in not knowing anything about architecture, I was really educated. He even gave me thoughts of becoming an architect. I never realized it but I love to build, and I know that there are more steps than just building. You have to decide on projects, plan, establish project teams, and schedule. He showed me my dream.

■ I learned a lot about the world of architecture. He showed the steps and ways you present a project to an owner interested in building. He told how they show pictures to the owner and bounce ideas off each other. He showed an example of building an AMC movie theater, which was awesome. He explained all the workers needed for the project and what they do. He showed soil bearing capacity, wind, seismic calculations and formulas.

■ Very good speaker who kept me awake. It got me interested in architecture. Definitely bring him back for next year's class. Interesting how the theaters are built. The best speaker yet.

■ He's the best speaker so far. He shows an occupation that really needs math (and other subjects) to perform and do it right. However, he doesn't get real technical with equations or descriptions, he makes it sound fun and exciting. I like how he didn't have any pauses; one idea flowed into the next. He showed lots of pictures and slides to show his meaning.

■ Excellent presentation with interesting pictures. Very informative and a real attention keeper.

On Friday, **November 9**, paleontologist and "dinosaur hunter" Craig Sundell of KU spoke on **THE REAL JURASSIC PARK: A WINDOW INTO PALEOECOLOGY.**

Students responded:

■ The earth is 4.6 billion years old and always changing. The crust, climate, plants and animals are always changing. There are four ages for living organisms: 1) Paleozoic – plants and fishes; 2) Mesozoic – reptiles, dinosaurs, etc.; 3) Cenozoic – birds, mammals, etc.; 4) Ice Age – modern day. There are 10 to 40 million species alive on earth today. 99.9% of the world's organisms that have ever lived on earth are now extinct.

■ He showed us a sabre-tooth tiger skull, a tooth of a T-Rex, and ancient insects in crystallized amber. He also showed slides on his excavation sites and what fossils look like in the ground.

■ This was awesome and was enlightening at the same time. The only way to make it better would be to take the group to a dig site.

■ Very very interesting. Good subject matter, maybe a little more time to look at specimens.

■ I really don't have any suggestions, except maybe a longer time allotment. I had no idea we were still in the Ice Age, Wow!

■ Excellent hands-on exhibits, very informative.

■ The enrichment speaker's performance and subject were excellent. He showed enthusiasm, and it seemed as though he really loved his work. I could see in the way he talked about finding fossils and bones that there was nothing else he would rather be doing. I enjoyed listening to him and he kept me awake.
■ He held our attention and handled all of our questions. Very well done, very well done indeed.

UPCOMING:

On **December 7**, Frank Booth, a Forensic Chemist from the Kansas City Regional Crime Laboratories, will return to speak on **SCIENCE IN THE CRIME LAB.**

Tuesday **January 8, 2002,** 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 18, 2002,** we hope to have once again Douglas Crawford, a UMKC molecular biologist from the School of Biological Sciences, who spoke last year on: **STUDY THE COMPLETE GENOME: THE FUTURE FOR BIOLOGICAL SCIENCES.**

WE HEAR FROM PAST STUDENTS

Nathan Johnson (99-00)
Kansas State University

E-mail received 10/16/01:

"This is Nathan Johnson, I went to MPI 2 years ago, and I was wondering if you could let me know where I might be able to get Derive or a program similar to it. I am in Calc 3 at K-State and I'm remembering how useful that program was. If you could just e-mail me whenever you get a chance that would be greatly appreciated.
Thank you"

E-mail received 10/17/01:

"K-State has been a fun experience so far. I have been taking mostly gen ed classes like Calculus, Physics, Chemistry and the such. I have 1 more semester then I can apply for admission into the professional Architectural Engineering program. I can say without a doubt that MPI helped me out tremendously. Everything you guys suggested we do really does help; doing the suggested homework, reading the book.
Thanks a lot."

Pat Liang (86-87)
BS Biochemistry, M.D.
University of Indiana

E-mail received 10/29/01:

"Hello Richard!! It has been a long time since we've talked or emailed.
I need to ask a favor. I am applying to a graduate program in cardiovascular perfusion where, combined with my MD, I will be doing some

research in cardiovascular perfusion and its function in cardiac or chest trauma. I need a reference and you were one of the first names that came to my mind. May I use you as a reference and send you a reference form to complete and return? The program is through the undergraduate program here at Upstate Medical University, but I am the only student doing the independent work at a graduate level. Please let me know so that I may then send the form to you.
Thanks in advance."

Reply from Richard Delaware 10/29/01:

"Of course you may use me for a reference. Also, are you free Tuesday, January 8, to come at 7am for our Panel Discussion and Reunion? (I never pass up an opportunity to ask! Also, if you know any other older MPI students pass the word to them or me.)
Thanks. I look forward to hearing from you."

Alan Canfield, P.E. (86-87)
BS Mechanical Engineering
University of Missouri - Columbia
Test Engineer

E-mail received 11/5/01:

"Greetings from Panama City, Florida. My MPI newsletter arrived but the address needs to be expanded for appropriate delivery here at the Naval Station.
Please pass on my heartfelt welcome to Dr. Roth Stoddard for joining MPI as the new Director. As always, best wishes to Prof. Delaware."

2001-2002 STUDENT FIRST IMPRESSIONS

"When I first started high school, I thought it would be hard, and I would have to study for hours a night to pass. I was wrong. I found classes which interested me, but nothing kept my full attention for long. Simply put, I was bored. The first day at MPI I learned two things: college is not as easy as high school, and I truly do not know everything. The MPI has given me a challenge that continues to educate and intrigue me as well as my fellow MPI students. Without the MPI I probably would have been in for a rude awakening in college. For all of these reasons I have become addicted to the MPI."

Chris Nevans
Truman High School
Independence School District

"MPI has been a great learning experience in more ways than one. Of course there's the calculus and physics that is the basic learning objective. But there is more, like what it is like to be graded on a curve. What a marvelous invention. Waking up earlier is not all that great, but a person can get used to it. If this is how college is, sign me up twice."

Tim Colyer
Ft. Osage High School
Ft. Osage School District

"I truthfully did not want to attend MPI, but I was convinced to try it. I am glad I did, although it is very difficult, I find it fun. A little advice, get the easy points like homework and labs, and study for your tests before the night before. The friends you make at MPI are what enable you to succeed. Learning from one another and teaching one another is a great strategy and one that is easily taken advantage of."

Joshua Tanner
William Chrisman High School
Independence School District

"I had the idea of dropping out of the program since I missed the first three weeks. But, Dr. Delaware asked me to come and they would help me catch up with all the materials I missed. As I understand more about physics and calculus, I realize it is not just simple math and science, but an art of thinking. In usual math and science classes we have to follow different laws and equations, and they are very straightforward. On the otherhand, in calculus or physics we use equations and laws also, but all we use is the idea of it and apply it into different situations. A good example would be the Newton's Second Law: we usually use it to find the force an object is exerting, its mass, or the rate of acceleration. The equation is F = ma (Force=mass x acceleration), using this same equation I can use it for an object traveling in a circular motion too.

$$F = M \frac{V^2}{r}$$ (Force Centripetal = mass x $\left(\frac{Velocity^2}{radius\ of\ circle} \right)$) with this equation I can solve for the centripetal force of the object, its mass, its velocity, and the radius traveling.

This is a great program. It is not just a common college calculus and physics class, but also an introduction to high school students of all the intense work we will be facing in college next year. Unfortunately, I am the only student from my school attending this program. At the end of the school year, I will definitely introduce this program to all the underclassmen."

Raoul Chung
Paseo High School
Kansas City, Missouri School District

A SOLUTION TO
MATHEMATICS CHALLENGE #70

Recall the problem statement:

Suppose finite real numbers x, y, z, and t satisfy the following (simultaneous) system of equations:

$$x(yz + zt + ty) = 0$$
$$y(xz + xt - zt) = 0$$
$$z(xt + xy - ty) = 0$$
$$t(xy + xz - yz) = 0$$

PROVE that at least one of x, y, z, or t must equal 0. In fact, show that at least two of them must be 0.

[From: The Pi Mu Epsilon Journal as quoted in Mathematical Chestnuts from Around the World, by Ross Honsberger, MAA, 2001, Section 6, problem #11, p.50.]

SOLUTION:

First, assume none of the variables x, y, z, or t equals 0. Then, the given system of equations can only be satisfied if each of the four factors in parentheses is 0, that is,

$$yz + zt + ty = 0$$
$$xz + xt - zt = 0$$
$$xt + xy - ty = 0$$
$$xy + xz - yz = 0.$$

Observe that each equation above involves only three of the four variables. To simplify, divide each equation by the product (which we have assumed is nonzero) of the three variables involved in that equation, yielding:

$$\frac{1}{t} + \frac{1}{y} + \frac{1}{z} = 0$$

$$\frac{1}{t} + \frac{1}{z} - \frac{1}{x} = 0$$

$$\frac{1}{y} + \frac{1}{t} - \frac{1}{x} = 0$$

$$\frac{1}{z} + \frac{1}{y} - \frac{1}{x} = 0$$

Adding the last three of these simplified equations, and using the first simplified equation, gives:

$$2\left(\frac{1}{t} + \frac{1}{y} + \frac{1}{z}\right) - \frac{3}{x} = 0$$

$$-\frac{3}{x} = 0$$

But this last equation has no solution. So the original assumption cannot hold, meaning one of the variables x, y, z, or t must equal 0.

Next, consider the original given system of equations again. We have proven that at least one of the variables x, y, z, or t must equal 0. Suppose x = 0. Then the second given equation becomes:

$$y(xz + xt - zt) = 0$$
$$- yzt = 0.$$

So one of the variables y, z, or t must also equal 0. Similar conclusions can be reached if any of the other variables is initially taken to be 0. So, it is always true that at least two of the variables x, y, z, or t must equal 0, as desired.

NOTE: The conclusion above is the best possible. For instance, if x = y = 0, then all four equations in the given system immediately become 0 = 0. So, t and z can be any real numbers. The same conclusion follows given any pair of variables equal to 0.

A SOLUTION TO
PHYSICS CHALLENGE #61

Recall the problem statement:

In all collisions, linear momentum is conserved. Explain how linear momentum is conserved when you give a ball upward momentum, i.e. you throw it upward.

Then explain how linear momentum is conserved when a ball bounces from the floor.

SOLUTION:

Before you throw the ball, the momentum of ball+earth system is zero. So, when you throw a ball upward, the world recoils with an equal amount of momentum in the opposite direction. However, since momentum is mass x velocity, the total momentum of the system is still zero.

$$M_{earth} \times V_{earth} = M_{ball} \times V_{ball}$$

$$V_{earth} = \frac{M_{ball}}{M_{earth}} \times V_{ball}$$

The earth's change in velocity is imperceptible because the mass of the earth is so huge. If the mass of earth and mass of your ball were equal (that's a big ball!) the earth and ball would move apart at equal speeds.
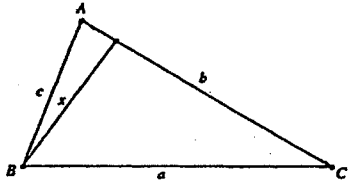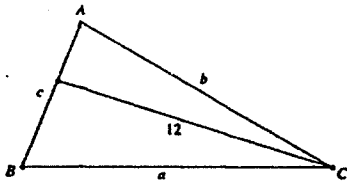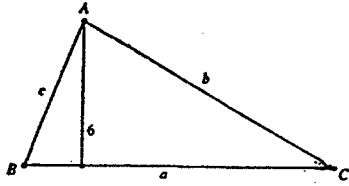
For the case where the ball is bouncing off the floor, the same logic should be applied. So, it

may actually be more appropriate to say that the earth and ball are bouncing off each other!

MATHEMATICS CHALLENGE #71

If two of the altitudes of a triangle ABC have lengths 6 and 12, prove that the third altitude, x, must exceed 4, meaning, x > 4.

[From: The 1990 Manitoba Mathematical Contest as quoted in Mathematical Chestnuts from Around the World, by Ross Honsberger, MAA, 2001, section 16, problem #18, p.179.]

PHYSICS CHALLENGE #62

Let's move from the topic of momentum to optics...

Peacocks have no pigment in their feathers, unlike cardinals, bluejays, etc. Instead, they have microscopic ridges in their outer feathers. Can you think of the physical reason for the peacock's colorful appearance?