

Director: Jennifer Snyder  
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### FIRST SEMESTER – TOP TEN

By taking the mean of their college calculus and physics grades for the first semester, we have determined our current Top Ten MPI students. We congratulate them all. Listed alphabetically by schools, they are:

Aaron Ballantyne.....Center Place Restoration  
Allison Scott.....Center Place Restoration  
Mike Bowerman.....Ft. Osage  
Chris Gordon.....St. Mary's  
Jared Allen.....Truman  
Josh Bergsten.....Truman  
Jamie Chapman.....Truman  
Wyeth Killip.....Truman  
Luke Whorton.....Truman  
Emal Latifzai.....Wm. Chrisman

### RECRUITMENT DAYS– FEBRUARY 5<sup>TH</sup> & 6<sup>TH</sup>

On Monday, February 5<sup>th</sup>, and Tuesday, February 6<sup>th</sup>, 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 117 students.) They will arrive between 8:00 and 8:10am and, with MPI student tour guides, take a short tour of the 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 8:30am, 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 9:30am.

### 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 our NEW E-MAIL:  
[mpi@umkc.edu](mailto: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 January 19, the grey and blue MPI T-shirts and sweatshirts arrived.

On February 13, Richard Delaware will give an expository talk at Johnson County Community College entitled, "The Area of an Enigmatic Ellipse: Holditch's Theorem."

March 30-31, Richard Delaware will attend a Real Analysis conference in Louisville, KY, and present a paper.

## ENRICHMENTS

### FOLLOW UP

On Friday, December 8<sup>th</sup>, Frank Booth, a forensic chemist from the Kansas City Regional Crime Laboratories spoke on **SCIENCE IN THE CRIME LAB**.

Students responded:

■ There are only about 200 crime labs in the U.S. Mr. Booth is from the Kansas City Crime Lab at 66<sup>th</sup> and Troost. He is involved with investigating sexual assaults and murders. In investigating crimes, they use physics to find things such as where could a person be when they fired a gun. They examine the striations to find which gun was used in a crime. They use footprints in dust on floors to solve crimes and have convicted many people merely by using footprints that are invisible to the naked eye. They have caught a bomber by using fingerprints on the back of the tape used on a pipe bomb. They can tell what kind of an animal something is by one hair. This enrichment was my favorite one so far. It was extremely interesting and I really enjoyed the presentation. He did a really good job. Definitely have him come back next year. The presentation was well worth my time.

■ Iel fur perfecto! (He was perfect!)

■ I enjoyed this Enrichment. I think that this topic is something that some people aren't very knowledgeable about, and it makes it intriguing to listen to someone talk about it.

■ I really like this enrichment. It amazed me how we, as humans, can create such chemicals to invent certain things; to solve mysteries that everyone thinks are impossible to solve.

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Our 16<sup>th</sup> annual **PANEL DISCUSSION AND REUNION** was held on **January 3<sup>rd</sup>** in Room 207, and moderated by Richard Delaware. As usual, each of the panelists discussed their college experience, their major, and/or work experience.

The alumni panelists this year were:

**Katie Allen** (98-99)  
University of Kansas

**Laura VanFleet** (98-99)  
Political Science, Truman State University

**Amanda Thatch** (99-00)  
Studio Art, Washington University

**Sarah Smith** (99-00)  
Physics, Truman State University

**Jeremy Knoll** (99-00)  
Architecture, Washington University

**John Hershberger** (99-00)  
Chemistry, University of Missouri-Rolla

**Lyndsey Main** (99-00)  
Computer Science, Univ. of CA-San Diego

Some specific current MPI student comments were:

■ The seven alumni were very helpful with their advice and by sharing their knowledge and experiences. It's always nice to hear people talk about things you are about to go through. Although I don't think their advice will prepare me fully for my college experience, I do think it will be appreciated to remember that these people went through it also.

■ Each of the panelists told us their experiences with college. It was interesting to hear about the application of MPI. They also discussed living arrangements and studying tactics. It seemed strange to think that, truthfully, we could be here next year talking about college.

■ I think it was very helpful to hear from new college students. This has encouraged me to go to a challenging school.

■ They helped me think twice about studying!

■ I liked hearing firsthand college stories, especially those about classes and living situations.

■ I really liked the way this enrichment was set up. There was more than one opinion on some of the subject matters. Plus, these people are very close to our age and they understand better.

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On Friday, **January 12<sup>th</sup>**, Steve Snyder, Adjunct Professor, Physics Department, UMKC, spoke on **THE PHYSICS OF TOYS**.

Students responded:

■ Toys! Resonant coupling (spring ball), ferromagnetic fluids (Gak!), tops and gyroscopes, some really neat optical illusions.

■ Springs bouncing up and down with a mass connected to it will change directions and move back and forth. A special kind of gak is attracted to a magnet. After staring at a spinning top with lines on

it, we looked at Dr. Snyder and it caused an illusion that he was moving in and out. Dr. Snyder said this was because the muscles in our eyes relaxed once we quit looking at the top and our vision was altered by this. He also showed a top that would move up and down the edges of metal strips that were placed in its path of motion.

■ I wish we had more time to see the rest of his demonstrations. I think it would be cool to see some of the calculations for the velocity and centripetal force of the gyroscope and tops.

■ Steve was awesome! He made the presentation fun and enjoyable.

■ He did a good job and everybody loves toys. He was a lot of fun.

■ MORE! As a scientist he is one to be admired.

■ Coolest guy yet.

■ I thought this was very good enrichment. The idea of perception was also very interesting, to see how we look at things.

■ We should change Calculus-based Physics to Toy-based Physics.

■ It was fun to see how much math and physics there are in some pretty simple little toys.

On Friday, **January 26<sup>th</sup>**, Douglas Crawford, a molecular biologist who studies the molecular evolution of gene expression with UMKC's School of Biological Sciences spoke on **STUDY THE COMPLETE GENOME: THE FUTURE FOR BIOLOGICAL SCIENCE.**

Students responded:

■ He did a really good job.

■ He was really awesome! I would really like to have him as a teacher. SO COOL!

■ Dr. Crawford began by talking about the cell structure, DNA and RNA. He talked about the role RNA plays in developing the protein in a cell, which controls cell growth. He then talked about micro arrays, which are gene spots on a slide. The concentration of RNA in each gene spot can then be determined. Then he talked about his job working with fish. He also talked about how micro arrays will be used in the future to determine health or future health.

■ He amazed me when he talked about DNA.

■ Very interesting speaker...very into the subject he was talking about.

■ Dr. Crawford was fun and seemed to know his stuff. He interacted well with the students.

■ This was an excellent presentation. It applied to what I would like to do in the future. I would love to work at the Stower's Institute as a medical researcher.

■ Cool. He can walk on his hands!!!

■ He worked a lot on basic, rudimentary information that most of us already knew. However, he was extremely engaging and brought up some very good points. He presented his topic very well and was informative and energetic. I liked him.

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#### UPCOMING:

We have not yet scheduled speakers for **February 9, February 23, or March 9.**

On **March 23**, we'll take a two-part field trip to UMKC, separated by lunch, to visit both the **Physics Dept. laboratories** in the new Flarshheim building, and the **Rare Book Room of Linda Hall Library of Science, Engineering & Technology.** In Physics, last year we toured labs in Atomic Force Microscopy, Scanning-Tunneling Microscopy, High Pressure Physics, Chaos/NonLinear Dynamics, Photoelectron Spectroscopy, and Photo-Luminescence. At Linda Hall Library, we viewed rare and historically significant mathematics books including the first calculus textbook (1696), books by Newton and Leibniz, co-inventors of the calculus, several versions of Euclid's Elements, and about 20 more books. MPI students will also be required to write a short response paper for calculus class.

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#### WE HEAR FROM PAST STUDENTS

**Matt Barrows (93-94)**  
University of Missouri-Rolla  
Civil Engineering Major

"Keep it up! If it was the same program as a few (6) years back, it does an excellent job of preparing students for college!"

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**Derek Olson (94-95)**  
Project Manager, J.E. Dunn Construction Co.

"MPI was a great experience. The classes and instruction adequately prepared me for college. I highly recommend this program to high school students."

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**Jennifer Woolsey (94-95)**  
Staff Accountant, Henderson Warren & Ecklinger,  
PC, PA

"Keep up the good work!"

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**Jessica Ostrom (96-97)**  
University of Kansas  
Secondary Mathematics Education Major

"The instruction I received at MPI was better in quality than most of the math and physics courses I have taken since. It gave me a head start and a first taste of the level of difficulty to expect from college."

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**Shelly Record Butler (96-97)**  
William Jewell College  
Mathematics Major

"The MPI courses were not quite as difficult as later courses at Rolla because the instruction was so much better. The availability and quality of the instructors was very helpful. The college credit I received helped me to choose my major and to graduate from college in three years while taking a regular schedule. The courses prepared me for the level of commitment that college courses would take. For students who are ready to make a commitment to their education, these courses are a wonderful opportunity. Students with strong interest and aptitude for math and science will find these courses a great base for entering into an associated field. In my discussions with other students, I have never heard of any district with a better opportunity than MPI offers."

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**Courtney Jones (97-98)**  
Texas Christian University  
Elementary Education Major

"Personal instruction at MPI was great, definitely superior to what I've experienced in

college. MPI gave me confidence in my ability to tackle hard courses. That's why this semester, after taking only elementary ed. math classes since high school, I'm adding a math specialization to my teaching certificate. I know the classes will be hard, but I know with dedication and work I'll succeed."

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**Amy Williams (97-98)**  
University of Missouri – Columbia  
Speech Pathology Major

"The instructor to student ratio is much better at MPI, and I felt like the instructors at MPI care if the students do well. It prepared me for harder classes and a higher expectations at college. It taught me how to study."

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**Jason O'Malley (99-00)**  
Blue River Community College  
Business Major

"I learned a lot in Physics and enjoyed it immensely. I have the knowledge to learn physics at any level. While attending the MPI I learned how to study for hours, not just minutes. Being able to prioritize, set and meet goals, is very important. I realized that I didn't know everything, and that you must study longer and harder to achieve the grades you expect. The best thing about the MPI is the test. It puts a person to the test of open-mindedness and the ability to listen. Since the subjects at MPI are so tough, a person must recognize their weaknesses and strive to improve themselves. Look at the MPI as a learning experience and accept the fact that you will probably struggle, so work harder and don't give up."

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**MPI E-MAIL ADDRESS:**

[mpi@umkc.edu](mailto:mpi@umkc.edu)

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**MORE 2000-2001 STUDENT IMPRESSIONS**

"Stick it out all year long. The farther you go, the easier it gets. Do your homework. If you do your homework, the tests are less stressful and you will enjoy yourself more. Have fun. Laugh at your teachers and life will be so much better."

**Leslie Palmer**  
Truman High School  
Independence School District

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“Before I started MPI, I thought 7:00am was too early. After about a month, I realized how wrong I was; it is way way way too early. But since I do wake up to get here, I would say it helps a lot. I learned Calculus and Physics, and got a lot of freetime at my school.”

**Chris Gordon**  
St. Mary’s High School  
Blue Springs School District

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“Compared to all of my previous high school courses, this has to be the most challenging of all. (Calculus, that is....Physics is a breeze.)”

**Matt Gann**  
Ft. Osage High School  
Ft Osage School District

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“One of the things that I have learned from MPI is that when you think you have studied enough for a Calculus test, go back and do it again because you aren’t ready for it.”

**Stephanie Kelley**  
William Chrisman High School  
Independence School District

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“I believe the Mathematics and Physics Institute will help me a lot to prepare for college. The classes have been much more challenging than I originally thought. I find myself working harder for my grade than I have ever before. The teachers are very knowledgeable about what they teach and expect a lot from each of us. Although, I think that living in Blue Springs and being the only one from my school hasn’t helped me at all. It would be a lot easier if I could get together with people closer to me to study instead of driving to Independence.”

**Kevin Tisdale**  
Blue Springs South High School  
Blue Springs School District

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“In February of my junior year, I was given an opportunity to visit MPI for the first time. The MPI students at that time performed some demonstrations which got me very interested. Two months or so later, I was given an entrance exam. I passed and enrolled in the classes. Since then, I have been taking the Calculus and Physics Classes.

I would strongly suggest offering these classes to anyone in the Blue Springs District who is able. The past twelve weeks has been a period which has opened my eyes. I’m glad that I won’t find out how different high school is from college when I have to pay for it.”

**Nathan Wagner**  
Blue Springs High School  
Blue Springs School District

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### A SOLUTION TO MATHEMATICS CHALLENGE #66

Recall the problem statement:

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On Day 1, Laura solved all the problems in a mail-in mathematical contest. Before sending her solutions by mail, she gave them to two student friends to copy by hand. On Day 2, these two students copied her solutions by hand. However, each of them made several (and different) errors in their copies. Then, in turn, these two students gave their copies to four other students to copy by hand (each of them to two other friends). On Day 3, these four students repeated the procedure, and this process continued.

Each new copy retained all the previous errors, and may have added new errors. It is also known that on some Day, each new copy will contain at least 10 errors.

Prove that there is a Day N, on which a total of at least 11 new errors are made in the copies.

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[From: Quantum magazine, Vol. 10, No. 5, May/June 2000, p. 23, problem M291.]

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#### SOLUTION:

We construct a “proof by contradiction.”

Assume, on the contrary, that no more than 10 new errors were made whenever a copy was created. On Day 1, the total number of errors would be no greater than 10. On day 2, the total will be no greater than  $2 \cdot 10 + 10$ . On Day 3, no greater than  $2(2 \cdot 10 + 10) + 10 = 2^2 \cdot 10 + 2 \cdot 10 + 10$ , and so on.

However, we know that there was a day when each paper contained at least 10 errors. If this was on the Nth day, then the total number of errors on that day will be *no less than*  $2^N \cdot 10$ , since the

number of students making copies that day was  $2^N$ . Thus, letting  $T_N$  be the total number of errors on Day  $N$ , we have the contradiction:

$$2^N \cdot 10 \leq T_N \leq (2^N - 1) \cdot 10.$$

### A SOLUTION TO PHYSICS CHALLENGE #57

Recall the problem statement:

McDonald's sells about 250 million packages of French fries per year. If these fries were placed end to end, estimate how far they would reach.

#### SOLUTION:

What we will do in this problem is find out how many fries are in one package and then multiply that by the number of packages sold. This gives us the total number of fries sold by McDonald's. We can then use this number to figure out how far they would reach.

There are many ways to estimate the number of fries in one package. I estimated the volume of a box of fries to be about one-half pint and then converted this number to cubic centimeters in the following manner:

$$0.5 \text{ pint} \times \frac{1 \text{ quart}}{2 \text{ pints}} \times \frac{1000 \text{ cm}^3}{1.056 \text{ quart}} \approx 250 \text{ cm}^3$$

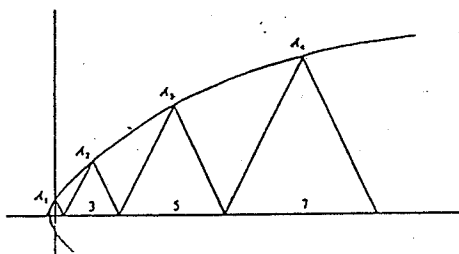
I then estimated the volume of one fry to be about  $10 \text{ cm} \times 0.5 \text{ cm} \times 0.5 \text{ cm}$  or  $2.5 \text{ cm}^3$  and the box to be about  $2/3$  full of fries. This means that there are approximately 60 fries in a box. The total number of fries sold by McDonald's in a year is then:

$$250 \times 10^6 \text{ boxes} \times \frac{60 \text{ fries}}{\text{box}} \approx 10^{10} \text{ fries}$$

If each fry is about  $10 \text{ cm}$  or  $10^{-1} \text{ m}$  long, then the fries would reach about  $10^9 \text{ m}$  or 1 million kilometers.

### MATHEMATICS CHALLENGE #67

Equilateral triangles of side lengths  $1, 3, 5, \dots, 2n-1, \dots$ , are placed end-to-end along the x-axis, as shown below.



Show that the vertices,  $A_1, A_2, \dots$ , which do not lie on the x-axis, all lie on a parabola.

[From: Mathematical Morsels, by Ross Honsberger, 1978, Problem #64, p. 167.]

### PHYSICS CHALLENGE #58

This month's problem relates to something that the students are working on in physics class right now. A rubber bullet and an aluminum bullet both have the same size, speed, and mass. They are both fired at a block of wood. Which is most likely to knock the block over?

- The rubber bullet
- The aluminum bullet
- Both the same

[From: Thinking Physics by Lewis Carroll Epstein.]

**Do you have a physics problem that you'd like to challenge the MPI students and alumni with? Send your question (with solution!) to the MPI address or e-mail to:**  
**[jdiscenna@umkc.edu](mailto:jdiscenna@umkc.edu)**

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