Mπ The Mathematics and Physics Institute NEWSLETTER

Director: Jennifer Discenna
Associate Director: Richard Delaware

February 1, 1999 Vol. 13, No. 4

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. alphabetically by schools, they are:

Laura Van Fleet	(Fort Osage)
Josh Albin	(Truman)
Katie Allen	(Truman)
Brad Martin	(Truman)
Josh Titus	(Truman)
Eric Watts	(Truman)
Mike Watts	(Truman)
Ryan Wilson	(Truman)
Jim Henry-Rhoads	(Wm Chrisman)
Brian McMillan	(Wm Chrisman)

RECRUITMENT DAY -- FEB 10

On **Wednesday Feb. 10**, we are inviting for a visit interested juniors and their teachers from the high schools involved in the MPI program. (Last year we hosted about 113 students.) They will arrive between 8 and 8:10 am and, with MPI student tour guides, take a short tour of the MPI classrooms. There will be MPI students at work on Calculus in our computer lab, a Physics lab set-up for viewing, and lectures or 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, a donut (!), 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.

TO ALL MPI ALUMNI:

HAVE YOU GRADUATED FROM COLLEGE?

IF SO:
PLEASE CONSIDER BEING AN
- ENRICHMENT SPEAKER -

CALL (816) 235-1272
or E-MAIL
rdelaware@cctr.umkc.edu

MPI Alumni who have spoken:

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

DORIS RETIRES

It was back in the dark ages when I started working at the MPI! It was, literally, the dark ages. I had to learn how to use a Display-Writer. Any typing that had to be done had to be sandwiched between the work of the engineering secretaries; there was one Display-Writer for all of us to use. (It used an 8" floppy disk!)

Then technology really took off, we installed the calculus PC lab, started using the graphing calculators, and using the PC's in the physics labs. Now, it is time to update again.

It has been a really exciting time in my working life, to see the

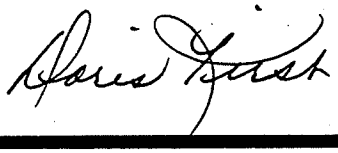
"cream of the crop" of young students in their struggles to adjust to the college atmosphere, and then to watch them gain confidence from their accomplishments. We have had some really wonderful people pass through the MPI.

The teachers have been a godsend, bending over backward to help me learn how academia does things. Their support and friendships have meant the world to me. I couldn't have had better, or nicer, people to be associated with, and we have become a close-knit family over the years.

My personal life has seen a few changes too! My husband, Willie, and I have 9 grandchildren – they are the light of my life! I hope that someday you will all experience this unconditional love and joy!

Willie and I plan to do some traveling, maybe follow the Royals to other stadiums, plant and raise a garden, and I have several flower beds to tend. I also enjoy crafting, and of course, the kids will be here, so I'm sure my hours will be filled.

The time has come for me to move on to new adventures. My hope is that the MPI prospers and grows! Bless you all, and good luck in the future!



ODDS AND ENDS

On **Dec. 17** the MPI T-shirts ordered by students arrived, and were distributed.

On **Dec. 18**, for the first time in about seven years, MPI students put together a Christmas party, including a wide selection of food, and music.

After the Christmas break, on **Jan. 6**, twelve 486 computers recently replaced in the UMKC Arts & Sciences computer lab, were delivered to the MPI, allowing us to upgrade from our current 386 machines for no cost.

Also on **Jan. 8**, Sheri Adams spoke on "Modern Day Mathematics" at a meeting of the GFWC Nu-Era Study Club in Independence, MO.

As mentioned in the December newsletter, from **Jan. 9-14**, Larry Harding attended the annual AAPT (American Association of Physics Teachers) convention in Anaheim, CA.

Finally, much to our regret, Doris Kirst, MPI secretary and more for nearly 11 years, will retire as of **Feb. 12.** [See the article elsewhere in this issue.]

AL MORSE HAS E-MAIL!

Al Morse, formerly of Wm. Chrisman high school, and MPI Calculus instructor who retired from the MPI in May 1998, now has an e-mail address:

almorse@richhill.net

If you're a former student of his, feel free to send him a note!

ENRICHMENTS

FOLLOW UP

On **Dec. 4**, Doug Bullock (MPI 84-85) now a mathematics professor at Boise State University, discussed: **HOW CAN YOU DISTINGUISH KNOTS?**

Some of the Speaker's Notes:

"Around 1880 the Scots physicist and mathematician Peter Gutherie Tait posed the following question: Are these two knots different?

Not surprisingly, he felt the answer was yes, but for a mathematician the real question is "Can you prove it?" In 1910, Max Dehn gave the first successful proof. Subsequent advances in knot theory will allow us to recreate his argument in this lecture..."

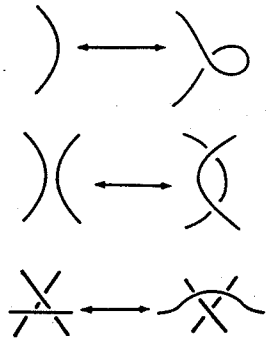
Students responded:

- Mr. Bullock spoke about knots and how you can tell if two knots are the same even though they look different. He also showed us how you can use a tri-color method to see if two knots are the same.

■ Mr. Bullock is a teacher but in his free time distinguishes knots – which I find a pretty interesting project. To distinguish two knots you can figure out if they can be plotted with three colors. At each intersection you can either have all three colors or all one color. If the knots match up they could be the same knot. Pretty cool stuff! Liked him a lot!

■ I was enlightened by the investigation of knots... Never would I have realized that people really researched something as "simple" as a knot.

■ If one manipulation of a knot is tricolorable, then all manipulations of that knot are. This can be checked by checking the color scheme after the 3 types of moves are done. The 3 moves were discovered by **Reidemeister.** Even if 2 knots are similar in appearance does not mean they are the same.



■ A knot is a closed loop in space. Two knots are the same if you can change one into the other. Some knots are classified by the overlaps, or crossings. Theorems have even been devised to work with knots. Even though the knot business doesn't have any practical applications except in the field of knots, it is still an interesting subject.

■ First Doug passed around knots and asked us to try to straighten them. Of course we couldn't. Then he showed us on the projector how the same knot can have a different knot diagram. He drew the projection on the board, showing the old and new way of drawing knot diagrams. He explained the process of tricoloring very thoroughly. There are no applications to the science of knots, but it was interesting to meet one of the first students of MPI. He showed me that anyone could probably make a theorem from anything, even if no one really cares about it. Who knows, if someone could make theorems of anything, one of those could probably have some applications.

■ I really liked this presentation and was encouraged by the fact that people pay him money for information that doesn't seem to have much relevancy to the majority of the population. I knew little or nothing of the studies of knots before this presentation, though having always been fascinated by symmetry and patterns, and felt as if afterward I had a fairly decent understanding of this field.

■ Doug was explaining to us how to see if knots are the same. He told us that a knot is a closed loop in space. He also said that two knots are the same if one can be changed into the other using <u>any</u> manipulations that do not involve breaking the loop.

■ He was a good speaker with a different topic. I liked his presentation, it's good to see somebody excited about something they do.

■ I liked the way he did audience participation.

■ The speaker did exactly what he was supposed to: introduced himself, told how he got into knots, told about the applications and jobs involving knots and made the subject interesting.

■ This was an interesting enrichment subject matter, but one I had a little difficulty relating to the real world. I was impressed by how much time and effort the speaker and his colleagues had dedicated to the study of knots, but I failed to understand the goal which they were trying to attain. In other words, if the study of knots has no applicable use in the real world, why study them at all. I mean, sailors could tell you much detailed information much faster than any mathematicians studying knots in a laboratory. But I know that one day I will be regretting these remarks because technology will catch up to mathematics.

■ Excellent presentation, interesting subject. This field has many interesting possibilities to explore. It is somewhat of a disappointment that there is currently no known application for knot theory; however, the logical thought process required for such work is invaluable in other applications.

■ I think Doug did a great job. I like hearing from people who have been through MPI. They know what we are doing, and can kind of relate back.

Our 14th annual **PANEL DISCUSSION AND REUNION** on **Jan. 5** was again held in Rm. 207, and moderated by Sheri Adams and Richard Delaware. As usual, each of the panelists discussed their college experience, their major, and/or work experience.

The alumni panelists this year were:

Tamara Calvert **(96-97)**
Central MO State University
Nursing Major

Samantha Webb **(96-97)**
Univ. of MO-Columbia
Biology Major

José Alcocer **(97-98)**
Rensselaer Polytech. Inst.
Engineering Major

Gretchen Nguyen **(97-98)**
Univ. of MO-Kansas City
Medical School

Courtney Jones **(97-98)**
Texas Christian Univ.
French Major

Their presentations were clear and perceptive.

The following is a list of the other alumni that visited. In all, 9 former MPI students attended.

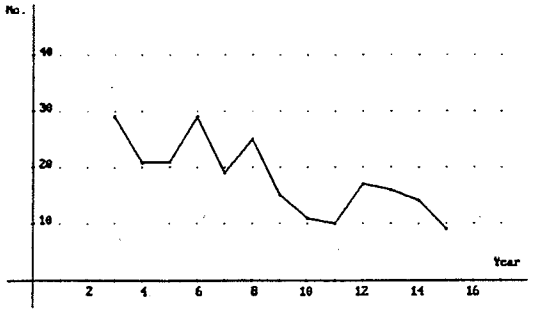
Jenny Coonts (96-97)
Central MO State Univ.
Chemistry Major

Brian Johnson (96-97)
Univ. of MO-Rolla
Computer Science Major

Alicia Siy (97-98)
Univ. of MO-Columbia
Int'l. Business/Computer Sci. Major

Jeff Weston (97-98)
Univ. of MO-Rolla
Computer Engineering Major

MPI Alumni Attendance Years 3-15



[NOTE: Of course no reunion was held in Year 1, and the number in Year 2 was not recorded.]

Some specific <u>current</u> MPI students comments were:

■ I thought it was interesting that all of the students (us), asked how the MPI experience affected them in college. We all were thinking: is all this work beneficial, I mean it is taking up quite a bit of my senior year.

■ The information and answers they gave were quite helpful. Loved the doughnuts!

■ It was very interesting to get a real perspective from college students who have gone through the MPI program when they spoke to us on January 5. They gave us many helpful tips, like where to sit in class and how to ask dumb questions. They also proved to us that you can live through MPI!

■ Just have good study habits and get to know your professors. I really liked getting to hear about their experiences at MPI and college. It was nice to see some of them from a few years ago and hear how they are.

■ Each of the students told us about their school and the classes that are required for their majors. Most of the students said that MPI set them in the right direction. It was said to sit up front and know the professor. "Tutoring helps!" said one girl. Ask around and get connections.

■ Several MPI grads came back to tell us how MPI helped them in college. Most of them said that it really

helped them because they wouldn't have to take any more math courses. They answered questions that were on many of our minds about college. They gave some great advice about college.

■ Former MPI students talked about the benefits of the MPI and their experiences of college. They talked about their class sizes, dorm life, frats and sororities, campus sizes, friendliness of students and professors, and accessibility of the professors.

■ Everybody that was here said that no matter how much that MPI has or has not helped, it really truly did prepare them in how to study. It is also nice to see what angle everybody has taken in choosing schools.

■ At the enrichment we got to hear from former MPI students and see how they are currently doing in college. Some are having an easy time and others are not. This helped give us a good idea what to look for in college next year. Surprisingly many of the former MPI students are not going into a math or science field.

■ A few hints that I picked up on was: (1) sit in the front of all classes (it acts as a confidence booster for you, and tells the professor you want to learn), (2) establish a relationship with the professor, and (3) you can always improve your study habits.

■ Former MPI students told of their lives at college. There were engineers and medical students. They told about how difficult it is. To succeed in college, they said that it is the student's job to seek and get help. Working on an engineering degree can be difficult and there are times set up where they just work on problems. Getting involved in programs and things like that around the community helps you learn also. These students found themselves working a lot less at jobs, and the jobs they have are on the campus.

■ I felt a sudden relief when they said (majority) that MPI was very beneficial to them, and prepared them well for college. Most seemed to have the same answers for all questions about study habits, and first semester frights. I was glad to see a handful of students that actually survived MPI.

■ They talked about every aspect of college life. Then we talked to the guys from Rolla for about an hour, we talked about frat houses, college life, and MPI credits.

■ Generally, they were glad to have taken MPI, because in most cases it reduced or eliminated the need to take further math and science credits. Also, they felt working at MPI had helped them prepare for college-style learning.

■ It was interesting that one girl said her senior year was more stressful than her freshman year at college.

Our **Jan. 29** speaker was Sam Gill who is an instructor at Johnson County Community College where he teaches Critical Thinking, and has written for The Skeptical Inquirer magazine. He spoke about **UNSOLVED MYSTERIES.**

Students commented:

■ This was an excellent enrichment day. Most of the things that Mr. Gill spoke about were already known to me, but it felt better to have a scientific backing to what I already believed. I think that the moral of the story here is to not just take people's word for unexplained phenomena, because there could always be a simpler explanation, but you should always have an open mind about things.

■ Science is a method of finding things out. The difference between science and religion is faith. Extraordinary claims require extraordinary proof.

■ He focused on how to distinguish evidence from wishful thinking.

■ Closed minded people don't have any curiosity and there are two kinds of close minded which are: gullible who believes anything, and cynical who don't believe.

■ Post hoc, ergo, propter hoc → after this, therefore, because of this — that's not always right. Just because I brush my teeth every night, and the sun comes up every morning, does not mean the sun comes up because I brush my teeth. Ad verecundiam — when an authority figure says something, we take it as

the absolute truth, even though sometimes it is not correct. This is dangerous in our country – people being tricked from logical thinking and rational judgement by these stupid things. He did pretty good. I'm pretty realistic, so I related to this well.

■ He talked about the scientific process and how to think out problems. Mr. Gill taught us ways to judge the quality of evidence. An extraordinary claim requires an extraordinary proof. I realized just how many extraordinary claims there are out there like seeing strange animals and being visited by extraterrestrial aliens. It was an interesting enrichment.

■ Mr. Gill talked about different unsolved mysteries (like bigfoot and aliens) and why we believe some and not others. Mr. Gill did an excellent job. His presentation was interesting and enlightening.

■ He was interesting and made us think. I enjoyed it immeasurably.

■ Mr. Gill came and talked to us about thinking about things before making an actual conclusion. He talked about different phenomena and how we make ourselves believe it rather than evaluating all the facts. However, he does advise you to avoid rushing to a conclusion. He encourages you to rationalize more than anything and make your thoughts make sense.

UPCOMING

For our **Feb. 12** enrichment, the speaker has not been confirmed.

Feb. 26 our speaker will be Kathleen Kilway, UMKC Organic and Organometallic Chemist.

As of this printing we do not have confirmed speakers for our **March 12** and **March 26** enrichments.

NEW (OR CHANGED) MPI ALUMNI E-MAIL ADDRESSES

[A complete list of known MPI Alumni e-mail addresses is available on request.]

** NEW **

(88-89) Anthony Aguilera
qaa000@email.mot.com
MOTOROLA, Ft. Worth, TX

(92-93) Steve Lee
shlee@dstsystems.com
DST SYSTEMS, Kansas City, MO

(93-94) Mike White, Jr.
mwhitejr@cctr.umkc.edu
UNIV OF MO-KANSAS CITY

(94-95) Greg Long
glong1948@aol.com
TUSKEGEE UNIV

(96-97) Thomas Gregory
tgregory@cctr.umkc.edu
UNIV OF MO-KANSAS CITY

(97-98) Matt Ashbaugh
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ROSE-HULMAN INST of TECH

(97-98) Joseph Chapman
jd02.cs12@usafa.af.mil
U S AIR FORCE ACADEMY

(97-98) Tim Gengler
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UNIV OF MO-KANSAS CITY

(97-98) Courtney Jones
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TEXAS CHRISTIAN UNIV

(97-98) Daphne King
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UNIV OF MO-KANSAS CITY

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CENTRAL MO ST UNIV

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dcm012s@mailsmsu.edu
SOUTHWEST MO ST UNIV

(97-98) Gretchen Nguyen
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UNIV Of MO-KC MEDICAL

(97-98) Alicia Siy
c742480@showme.missouri.edu
UNIV OF MO-COLUMBIA

(97-98) Amy Williams
amywilliams_98@hotmail.com
UNIV OF MO-COLUMBIA

** CHANGES **

(93-94) Derek Fisher
dfisher@cerner.com
CERNER CORP

(94-95) Jennifer Brown
jlynnbrown@aol.com
UNIV OF MO-KANSAS CITY

(95-96) Beth Hontz
ahontz@aol.com
UNIV OF MO-KANSAS CITY

(95-96) Heidi Miller
s211752@mail.nwmissouri.edu
or teddyladyh@aol.com
NORTHWEST MO ST UNIV

(96-97) Teresa Schlueter
taschlueter@hotmail.com
NORTHWEST MO ST UNIV

(96-97) Samantha Webb
c718948@showme.missouri.edu
or dnafixer@aol.com
UNIV OF MO-COLUMBIA

WE HEAR FROM PAST STUDENTS

Matt Ashbaugh (97-98)
(Mechanical Engineering Major)

E-mail received 11-25-98:

"Well, I am glad to finally get a break from classes to send a message to the MPI people.

I was reading through this newsletter and started remembering what it was like to taste college level math in high school. All I have to say about it is that the classes that I'm taking now make MPI look like a walk-in-the-park. I just got through taking Calculus I, Physics I, Chemistry I, Computer Programming I, Japanese I, and a class on time management. This college is not on a semester schedule it is in quarters lasting about 10 weeks each.

Which college you ask? Rose-Hulman Institute of Technology. Never heard of it? Not surprised. It's a small college in the small town of Terre Haute, IN. The enrollment here (freshman through senior plus the graduate students) is around 1,500. It is hard to get into and hard to stay in, but that is why it was named the best undergraduate engineering and science college in the nation.

It'll be tough but worth it. I am majoring in Mechanical Engineering. I will be getting a minor in Japanese language and culture. And I hope to become a robotic engineer in some graduate level work.

Well, if anybody wants to e-mail me the address is: Matthew.T.Ashbaugh@rose-hulman.edu or if you want to see what the heck my school is about:www.rose-hulman.edu. Well later, and remember to study those formulas or you'll get so lost you may never be found.

Matt"

Kristi Brown (92-93)
(A T & T)

"I just had a son on August 15, 1998, I'm currently engaged to be married in 1999. I will return to UMKC in the spring to complete my BA in Communication/Education. MPI was a great learning experience that instills discipline for studying on a daily basis. You will quickly learn this; if not you will easily fall behind. It also allowed the opportunity to grow past the confines of your particular high school."

Janice Wallace (93-94)
(BSBA Accounting)

"First, I would like to thank MPI for giving me the opportunity my senior year to experience what college life is like. Thank you!! I did complete my degree w/in four years and I had a great experience @ school adapting to many other people from many different places. I am the youngest of six children and the first to graduate from college w/in 4 years. MPI really helped me because of the projects, involvement, and the business-like manner in which it was presented to me. MPI also helped me advance my way through college. What I mean is I didn't have to take all my classes @ MWSC [Missouri Western State College] (I didn't start from scratch)."

Jennifer Brown (94-95)
(French Major)

"The (MPI) instruction was often of better quality from teachers who actually cared for the students as compared with my college experiences."

Teresa Schlueter (96-97)
(Unified Science Major)

"Very similar if not more rigorous expectations from MPI than my college courses. MPI prepared me for finals, professors, and constant studying.

(Because of the MPI) I was more comfortable in the college classroom. Many things were reviewed and touched on in my college coursework. I felt more confident and anxious to learn in my college courses.

I don't suppose (the MPI hours) could be any earlier (just kidding). This is a wonderful and well-structured program. I admire the concept as well as the execution of MPI, which cannot be said for many other programs."

Heidi Miller (95-96)
(Secondary Business Education Major)

"The only math classes that I have taken since MPI are finite (math) and statistics and those classes don't even compare to calculus. The quality of the teachers was very high at MPI. They really cared and took an interest in their students.

It taught me that college isn't as easy as high school. It is 10 times harder. The MPI teachers showed me this, even though I didn't realize it till later. The teachers taught me the value of studying, note-taking, and staying awake during class.

I think that MPI is a very good opportunity for high school seniors. It really opened up my eyes to what college classes are like. GOOD JOB MPI!!"

Stephanie Farnan (96-97)
(Secondary Education-Biology Major)

"MPI really helped me learn to study and learn how to study for very difficult courses. Also helped me realize how to work together."

Benetta Fairley (95-96)
(Psychology Major)

"It opened my eyes to the fact that it gets harder after high school. Nothing comes easy.

MPI was a great program in making me aware of the hard work needed to succeed in advanced education."

Anthony Aguilera (88-89)
(BS Electrical Engineering)

E-mail received 12-29-98:

"Hello, I just wanted to write an update on how I am doing. I was in Kansas City visiting my parents over Christmas, and I saw I had a pile of MPI newsletters sent to my parents' address. Here's my current address:

Anthony Aguilera
3025 Crystal Springs, #627
Bedord, TX 76021

Well, it's been a long time, about 10 years, since I attended MPI and I still look back and think of what a worthwhile program it was and still is. It's good to see MPI is still going strong and I wish you luck in the future.

You haven't heard from me in a while, so let me give you a quick update on the happenings in my life.

After MPI, I attended the University of Missouri-Rolla, and earned a Bachelors of Science in Electrical Engineering in 1993. I have to say that my experience at MPI, with real college instructors in a university setting, really helped me make a smooth transition during my freshman year at Rolla. Also, the credits I earned in Physics and Calc I & II gave me a headstart in my engineering curriculum and allowed me to earn my B.S. in 4 years.

Since my graduation, I've seen a couple of jobs come and go, but my current position is very fulfilling. I currently work with Motorola in Fort Worth, Texas as a Software Systems Test Engineer. I work with Motorola's Digital CDMA Cellular Infrastructure, we have a lab in which we test the software in a fully integrated cellular environment. We also support software installations and upgrades to our customers' CDMA infrastructure. This has allowed me to travel around the U.S., as well as

internationally to places such as South Korea, Taiwan, and the Philippines during my 2½ years with the company.

On a personal note, I will be getting married in a couple of months in the Philippines, to my fiancee Liza. After our wedding in Manila, we plan on settling down in Texas.

Good luck MPI and take care!

Anthony Aguilera
Class of 1989

P.S. Could you forward me the list of MPI Alumni email addresses? my email: qaa000@semail.mot.com."

Tim Gengler (97-98)
(UMKC Medical School)

"MPI helped me to realize that if something seems hard I shouldn't just quit, I just have to put in some extra effort. This has been very valuable to me because I am in a 6 year Med. program which is not even close to easy, but that extra effort is just what I need to get by.

At my school the teachers didn't seem to have a grasp on how to teach physics and calculus so we could understand. MPI was a great opportunity to learn and actually understand what I learned.

It is a great first step towards college. It gives you a chance to do college work with teachers that understand high school students."

Courtney Jones (97-98)
(French Major)

"MPI taught me that you have to work and do assignments even if they're not assigned and handed – in; College requires a lot of self-motivation.

MPI taught me that I can succeed at anything if I work hard enough. Also that I can learn to study any subject. (I had to learn to study calculus & math last year' this year I had to learn to study economics because the way of thinking is different for each subject.)

Free college credit! Because I got 4 hrs. of math from MPI, I don't have to take any math at TCU. Even if you never take college math or physics again (like me), you'll be used to working hard like you have to in college."

Jeff Weston (97-98)
(Computer Engineering Major)

"Calc-based physics (at UM Rolla) was boring – I already knew it."

Amy Williams (97-98)
(Pre-Medicine Major)

"I think my calculus class at MPI was better than some of the equivalent courses at MU.

I haven't taken physics but it helped me in my chemistry course.

Having discussion class periods where the teacher doesn't lecture, but is there to help students helped me learn how to use it & learn on my own – studying. I never had to study for a class before MPI.

MPI challenged me and I had never been academically challenged before. It challenged me and allowed me to study with students who are also academically gifted.

It prepares students for college better than any other high school class."

Greg Long (94-95)
(Electrical Engineering Major)

"My skills that I have learned from these instructors gave me a head start on my coursework, and led me to help others with problems in math and physics.

I have been in the lead of other students in math and physics and still remain a success because of my skills learned from MPI."

James McIntosh (94-95)
(Mathematics Major)

"Personal attention was much

better at MPI. Overall quality was great.

Led to interest in math major. Great foundation for major. I was very prepared for my later education.

Keep up the excellence. We need more programs like MPI."

Jessica Ostrom (96-97)
(Math Education Major)

"The instructors at MPI were as effective or more effective than the professors I've had since then, and the small sizes of the classes at MPI was an added benefit.

I was much better prepared for my later math and physics classes because of what I learned at MPI. Also, the difficulty of the MPI courses gve me a good idea of what college would be like.

You're doing a good job!"

MPI E-MAIL ADDRESS:

rdelaware@cctr.umkc.edu

A list of known MPI Alumni e-mail addresses is available on request.

MORE 1998-99 STUDENT IMPRESSIONS

"Well, let's see... you have to get up really early, but I'm over that. Umm... the work and tests are fairly difficult, but boy do I love that curve. Oh yeah, some people in your section like to bug you... no names mentioned, but they're just as clueless. So, I suppose if you look at the big picture, MPI is fun and you might learn a few things along the way too!"

Angelina (The Great!) Walls
Ft. Osage High School
Ft. Osage School District

"MPI has been a great experience for me. I have learned to study well and prepare better for college. Besides these courses gives me a head start on college. Truthfully, I am very glad that I decided to come to MPI. This will be an experience I will never forget. Thank you."

Tracy Weber
Northeast High School
Kansas City MO School District

"I wake up every day at 5:00 am to get ready for another morning of Mπ. There's the lectures in Physics and problem solving for Calculus, one after another. This first semester of MPI has been challenging and hard, unlike high school classes. I've experienced how to manage my time, and study for tests. I enjoy working with others on PC labs and in the Physics labs."

LaKeeia Hawkins
Van Horn High School
Kansas City, MO School District

"I found MPI more difficult than my regular high school classes. It is also much more difficult to prepare for the exams."

Ryan Wilson
Truman High School
Independence School District

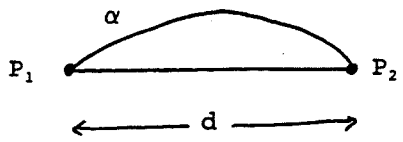
"Section C is the most tempting thing to drop out of, but I suppose that makes it more of a triumph to stay in it."

Samantha Bradley
Wm Chrisman High School
Independence School District

A SOLUTION TO MATHEMATICS CHALLENGE #56

Recall the problem statement:

It is well-known that through any three points in Euclidean Geometry a unique circle can be drawn. But can the same be said if the information is given in another form? For instance, suppose below we know both the length α of the circular arc and the distance d between the points P_1 and P_2 as shown.

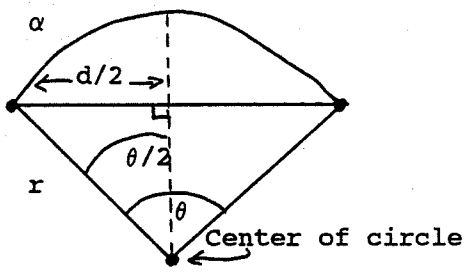


In terms of α and d, what is the radius r of the circle determined by these points, and is it unique, as we suspect?

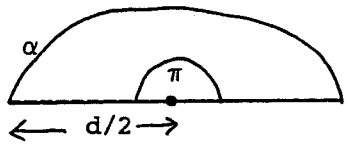
SOLUTION:

a. Historical Note: This problem was inspired by Prop. 25 in Book III of Euclid's Elements where for the situation indicated here, he provides a construction of the center of the circle, hence of the radius. However, the lengths of the arc (α), chord (d), and radius (r) are not discussed.

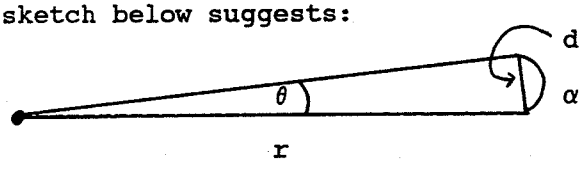
b. First, we extend and re-label the above sketch as shown:



c. Observe that $\alpha > d$, and when α is maximal the arc is in fact a semicircle, whose length is half the circircumference of the circle,



so $\theta = \pi$, $r = d/2$, and $\alpha = \pi(d/2) = \pi r$. This is the minimum value r can take on, since when the angle θ shrinks, r approaches ∞ , as the sketch below suggests:



d. Now, from the extended sketch in part "b", using the definitions of sine and of arc length, we can immediately write the two equations:

$$\sin(\theta/2) = (d/2)/r = d/(2r) \text{ , and}$$

$$\alpha = \theta \cdot r$$

Substituting $\theta = \alpha/r$ from the second equation into the first equation we get:

$$\sin(\alpha/(2r)) = d/(2r)$$

This is an implicit equation for r in terms of α and d, even though r is not isolated as we would prefer, and however unsatisfying, this answers the first question of the challenge. Now, for clarity as we proceed, in this last equation let $x = \alpha/(2r)$ yielding simply:

$$(*) \quad \sin(x) = (d/\alpha) \cdot x \ .$$

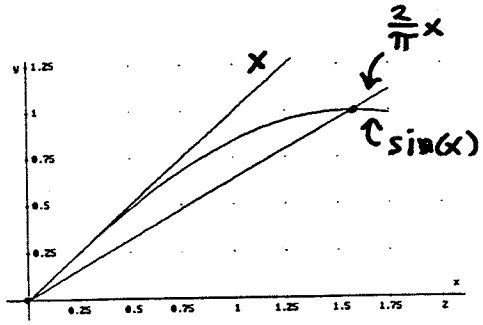
Note that $d/\alpha < 1$, and $r = \alpha/(2x)$.

e. As a side note, we can confirm the observation in part "c" that as r approaches ∞ , then α approaches d (the arc and chord tend toward the same length). Rewriting (*) as

$$\sin(x)/x = d/\alpha$$

and letting r approach ∞ , meaning x approaches 0 from above, affecting only the left side which (by a "famous" calculus limit theorem) yields 1, gives $1 = d/\alpha$. So, in the limit, $\alpha = d$.

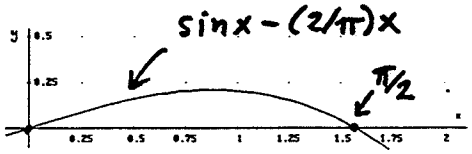
f. To confirm that (*) gives a unique value for x, and hence the radius r, we graph either side of (*) and count intersection points. To do this we need to find bounds on the size of the right side factor d/α. Since the maximum difference between α and d occurs for a semicircle, where $\alpha = \pi(d/2)$ as noted in part "c", in this case we have $d/\alpha = 2/\pi$. At the other extreme, as also noted in part "c", we know $d/\alpha < 1$. Therefore, d/α is always in $[2/\pi, 1)$. It is now clear from the graphs below that (*) has a unique solution under the conditions of this problem, which answers the second question of the challenge about uniqueness.



g. Finally, in practice, since α and d are known, we can approximate r from (*) by graphing the function $f(x) = \sin(x) - (d/\alpha)\cdot x$ on $(0,\pi/2]$ and approximating its zeros where its graph crosses the x-axis.

Example (maximal α):

Let $d = 1$ and $\alpha = \pi(1/2) = \pi/2$. We graph $f(x) = \sin(x) - (2/\pi)\cdot x$ to get:

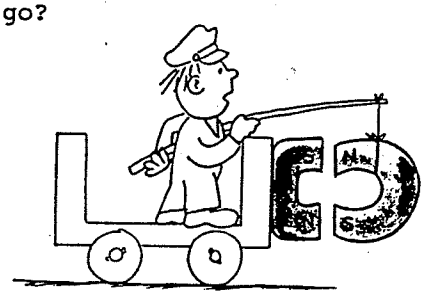


So $f(x) = 0$ when $x = \pi/2$, and hence when $r = \alpha/(2x) = 1/2$, which is the unique zero (radius value), as desired.

A SOLUTION TO PHYSICS CHALLENGE #47

Recall the problem statement:

Will hanging a magnet in front of an iron car, as shown, make the car go?



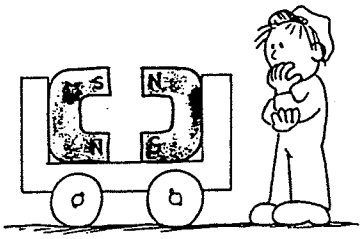
a) Yes, it will go
b) It will move if there is no friction
c) It will not go

[From: Thinking Physics, Practical Lessons in Critical Thinking by Lewis Carroll Epstein, p. 46]

SOLUTION:

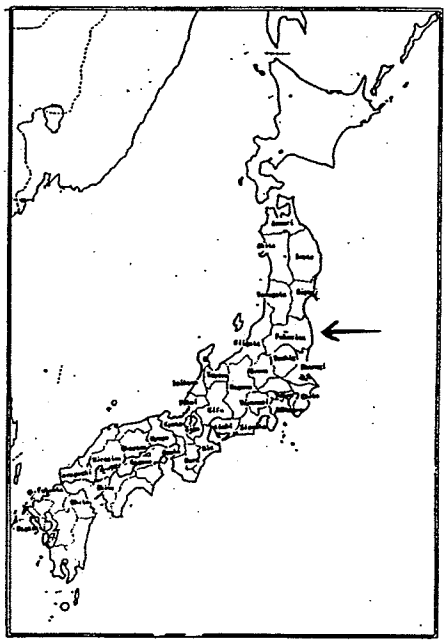
The answer is: **c.** You could just dismiss the thing by saying that no work output will result from zero work input — or perpetual motion is impossible. Or you could invoke Newton's Third Law: the force on the car is equal and opposite to the force on the magnet — so they cancel out. But these formal explanations don't illustrate why it will not work.

To see intuitively why it will not work, improve the design by putting the magnets in the car. Then comes the question: Which way will it go?

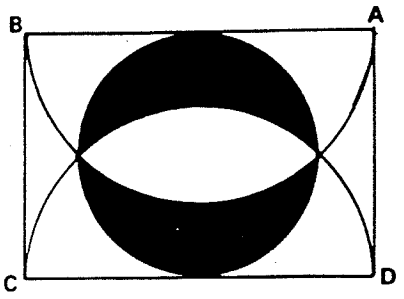


MATHEMATICS CHALLENGE #57

This problem, written in 1883 and from the Fukusima prefecture of Japan, is one of many that first appeared as a beautifully colored drawing on a wooden tablet hung under the roof of a Japanese shrine or temple as a common act of devotion.



In the following sketch, ABCD is a rectangle, $AB = \sqrt{2}\cdot(BC)$, the two large semicircles have AB and CD as their diameters, and the center circle touches sides AB and CD, and passes through the two intersections of the semicircles as shown:



Find, in terms of AB, the total (shaded) area of the two lunes.

[From: Japanese Temple Geometry Problems, by Fukagawa & Pedoe, 1989; Ex. 3.4.3, p.43]

PHYSICS CHALLENGE #48

You have a nice new thick blanket which is a good heat insulator, and a thin old blanket which is a poor heat insulator. It is a cold night and you need both blankets. You will be warmest if you

a) put the good blanket on top to keep the cold out of the bed, and put the poor one next to you.

b) put the good blanket next to you to keep the heat in, and put the poor one on top.

c) do it either way; it doesn't matter which blanket goes where.

[From: Thinking Physics, Practical Lessons in Critical Thinking by Lewis Carroll Epstein, p.407]

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The Mπ Newsletter is typed in WordPerfect 5.1 with MoreFonts and published five times a year on the first of the month during the months of August, October, December, February, and April at the Mathematics and Physics Institute (MPI), 600 W. Mechanic, Room 224, Independence, MO 64050, phone (816) 235-1272, e-mail: rdelaware@cctr.umkc.edu. Please address all correspondence concerning this newsletter to 'Mπ Newsletter'.