Mπ The Mathematics and Physics Institute NEWSLETTER

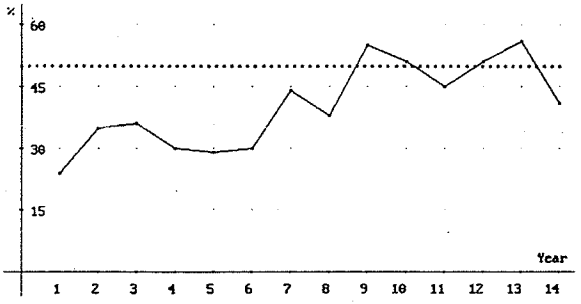
Director: Richard Waring
Mathematics Coordinator: Richard Delaware

April 1, 1998 Vol. 12, No. 5

YEAR 14 COMES TO AN END

Our 15th year will see many changes: A new MPI Director (see the article below), a new Physics Coordinator, an additional Calculus instructor (see another article below), and finally the introduction of the very late-in-coming SHARP EL-9600 graphing calculators. Other plans are also in the works. But to all of you who have supported this program over the past 14 years, please know that none of these changes will diminish the MPI, but only strengthen it. Our commitment to a solid grounding in Calculus and Physics for talented and gifted students will remain uppermost.

We also arrive at the end of this year with 41% of our remaining 39 students being female, as seen in the graph below. Over the last 6 years we have maintained gender equity.



RICHARD WARING
★ RETIREMENT OPEN HOUSE ★
Sunday May 3, 1998
Truman Campus, Rm 207, 2 - 4 pm

Richard Waring is retiring after 38 years of teaching. Come visit and reminisce about the "good old days" with him. Past and present staff will also be on hand to talk with you. Refreshments will be served. We hope you will attend!

The Open House will be held at the Truman Campus, Rm 207, from 2 – 4 pm. If there are any questions, please call:

235-1272 MPI Office
or 235-1290 Richard Delaware

MPI e-mail: rdelaware@cctr.umkc.edu

CALCULUS READINESS EXAMS

During the **last week of April and the first week of May**, the Mathematics Coordinator will travel to most of the high schools participating in the MPI to administer the MAA Calculus Readiness Test, a 25 question diagnostic test designed to determine roughly how prepared a student is to take calculus. It covers analytic geometry, algebra, and some trigonometry. A score of 12 or above is required to attend the MPI, although occasionally lower scores are accepted, provided a transcript and two recommendations are received, and a personal letter is written to the MPI Director, all by **FRIDAY, MAY 15** this year.

Of course, this little test is by no means definitive, and in fact, a student's commitment more often determines his or her success at the MPI than a score on one introductory test. However, this test has proved to be effective as long as it is complemented by CAREFUL SCREENING done at individual high schools by counselors and teachers who know the students in question. Let us be clear on this: students who have all the prerequisite classes and score 12 or more on the test, but who possess no maturity or commitment to hard work will not succeed at the MPI.

We hope that many of the approximately 104 students who visited us on our Recruitment Day Feb. 10 will decide to take the test.

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:

Brent Harding	(84-85)
Pam Deters/Stephen Koop	(84-85)
Seth McMenemy	(88-89)
Mitch Dobson	(89-90)

MORSE NO MORE, BUT WE'LL SEE SPARKS!

At the end of this academic year, Year 14 of the MPI, **AL MORSE**, one of our respected Calculus Instructors, will regrettably retire from the MPI. He has been teaching calculus at the MPI since we began in 1984, and for the past four years has continued to work here part time, even though he retired from Wm Chrisman High School in May 1994 after 31 years of teaching. We are pleased that he stayed on with us so long, and will sorely miss his experience, personable nature, and ebullient teaching style. Fourteen years of MPI students will attest to his positive effect on them, and if you are one of them, we welcome your comments!

Al will retire to Rich Hill, MO where he grew up, to his 1.5 acres of fruit trees, grape vines, berry bushes, and a huge (100 ft by 50 ft) garden. He and his wife Dorothy plan to do church work (Al even preaches every so often), and visit nursing homes in the area to sing (Al) and play the piano (Dorothy) for the residents. He says he will also occasionally teach mathematics as a substitute at Rich Hill High School, but doesn't plan to make a career of it. Finally, Al and Dorothy just bought a new computer, and we hope they will connect to the internet, and have an e-mail address some time later this year, so we can keep in touch.

The entire MPI staff wishes him many long, and happy years in Rich Hill. He's certainly earned his time off.

In the wake of Al Morse' retirement, and fresh from her first two years at Wm Chrisman High School, next year **LIBBY SPARKS** will join the MPI mathematics faculty.

She was raised in southeast Iowa, and attended Northeast Missouri State University (now, Truman State University), attaining a degree in mathematics education, and later her Masters Degree at UMKC. She is in her 12th year of teaching, and will be a welcome addition to the MPI team.

ODDS AND ENDS

Monday **Jan. 12** and Monday **March 9** were our only two cancellation "snow" days for this winter, a welcome change from 5 such days last year.

On **Feb. 10**, our Recruitment Day, we hosted 104 high school juniors, with about 9 other teachers and counselors, from 10 different high schools: Center Place Restoration, East, Fort Osage, Northeast, Paseo, Southeast, Truman, Van Horn, Westport, and Wm. Chrisman.

March 19-21, Jim Graczyk attended the Missouri Junior Science, Engineering, and Humanities Symposium held at the University of Missouri - St. Louis, in St. Louis, MO.

From **March 27-28**, the Mathematics Coordinator joined the AMS (American Mathematical Society) meeting at Kansas State University in Manhattan, KS attending a special section on mathematics education and the internet.

Sheri Adams will spend **April 1-4** in Washington, DC, at the annual

NCTM (National Council of Teachers of Mathematics) conference.

On **April 4**, the Mathematics Coordinator will be the guest speaker for the Kappa Mu Epsilon Regional Convention being held at Wm Jewell College in Liberty, MO, and, on **April 29**, he will be the Annual Mathematics Contest Awards Banquet speaker for KCATM (Kansas City Area Teachers of Mathematics) in Overland Park, KS.

THE AUGUST 1998 ISSUE

The August 1 Mπ Newsletter will list the top ten MPI students for 97-98 and all those receiving awards at our May 14 Awards Presentation.

There will also be IMPORTANT INFORMATION and advice for the YEAR 15 class of 98-99. TAKE NOTE!

SOME STATISTICS OVER 14 YEARS

Total Number of MPI Instructors Each Year (UMKC & High School).

	Calculus	Physics	
Year 1 (84-85)	7	5	
Year 2 (85-86)	4	4	
Year 3 (86-87)	5	3	
Year 4 (87-88)	5	3	
Year 5 (88-89)	4	3	
Year 6 (89-90)	4	3	
Year 7 (90-91)	4	3	
Year 8 (91-92)	4	3	
Year 9 (92-93)	4	3	
Year 10 (93-94)	4	3	
Year 11 (94-95)	4	4	(+1)*
Year 12 (95-96)	4	3	(+1)
Year 13 (96-97)	3	3	(+1)
Year 14 (97-98)	3	3	(+1)

*Northeast liaison.

Current MPI Instructors

	Year 14 (97-98)		Year 15 (98-99)	
	Calculus	Physics	Calculus	Physics
UMKC	Delaware	Waring	Delaware	(NEW)+
FO		Harding*		Harding*
IND	Adams		Adams	
	Morse**		Sparks+	
KCMO		Graczyk (Cook++)		Graczyk (Cook++)

* = Retired from FO High School.
** = Retired from WC High School.
\+ = New for Year 15 (98-99)
++ = Northeast Liaison

UMKC = Univ. of MO - Kansas City
FO = Fort Osage School District
IND = Independence School District
KCMO = Kansas City MO School District

ENRICHMENTS

FOLLOW UP

For our **Jan. 30** enrichment, David Wieliczka, of the UMKC Physics Dept., returned to speak on **THE PHYSICS OF DENTISTRY.**

Students responded:

■ The speaker was involved with a study of how much mercury was released from a tooth filling, and to see if the amount was dangerous. He showed us his method in measuring the amount of gas released and the equations involved in measuring the amount. He also discussed the problems of finding a new substance for fillings. The main problem was how to attach the adhesive to the tooth. He then showed us two products (adhesive) and their tests of how they would work on attaching the filling to the tooth.

■ They take silver, copper, and tin, and grind them up into a metal powder. The liquid mercury then dissolves the metals. He told us how a quartz watch works. Quartz is a piezoelectric – when it is put under stress, it creates an electric current. It also works in the opposite direction. He did research on the amount of poison released from mercury amalgams. His finding: the amount released is more than 100 times <u>less</u> than that acceptable by modern standards.

■ He talked about how quartz can be used to determine the amount of mercury coming off amalgam fillings, how infinitesimal it is, and how that made amalgams much better than plastic fillings, which may decompose in a matter of years. This guy was pretty interesting.

■ Every one of the speakers have been extremely knowledgeable and enthusiastic of their field. David was no different.

[Continued on page 5...]

WHERE MPI STUDENTS COME FROM:

THE DISTRIBUTION OF STUDENTS FINISHING THE MPI Years 1-14

District ⟶	FO	IND		KCMO							RAY	
High School ⟶	FO	T	WC	C	E	L	NE	P	VH	Other	R	RS
Year 1 (84-85)	8	14	9	-	1	-	8	-	7	-	2	6
Year 2 (85-86)	3	13	12	-	3	-	7	-	14	-	2	3
Year 3 (86-87)	3	7	10	-	0	-	11	-	4	-	8	2
Year 4 (87-88)	4	5	10	-	2	-	6	-	12	-	3	1
Year 5 (88-89)	10	10	13	-	2	-	8	-	5	-	-	-
Year 6 (89-90)	14	12	11	-	0	-	9	-	4	-	-	-
Year 7 (90-91)	5	11	15	-	0	-	6	-	6	-	-	-
Year 8 (91-92)	11	10	12	-	0	-	10	-	5	-	-	-
Year 9 (92-93)	5	11	10	-	0	-	10	-	4	-	-	-
Year 10 (93-94)	11	9	13	-	1	-	7	-	4	-	-	-
Year 11 (94-95)	12	15	18	0	1	0	10	1	4	1 (SM)	-	-
Year 12 (95-96)	8	12	5	0	0	0	8	0	12	2 (LU,SM)	-	-
Year 13 (96-97)	5	17	8	0	0	0	6	2	6	1 (CPR)	-	-
Year 14 (97-98)	6	7	13	1	0	3	6	1	2	-	-	-
High School Totals:	105	153	159	1	10	3	112	4	89	4	15	12
District Totals:	-105-	---312---		----------223----------							--27--	
(Rounded %)	(16%)	(47%)		(33%)							(4%)	

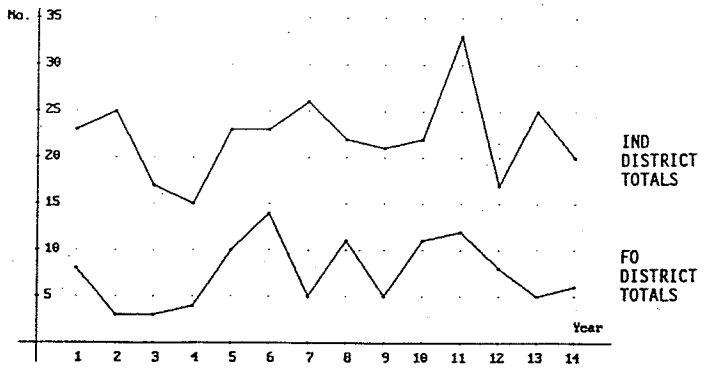
MPI FOUNDATION STONES

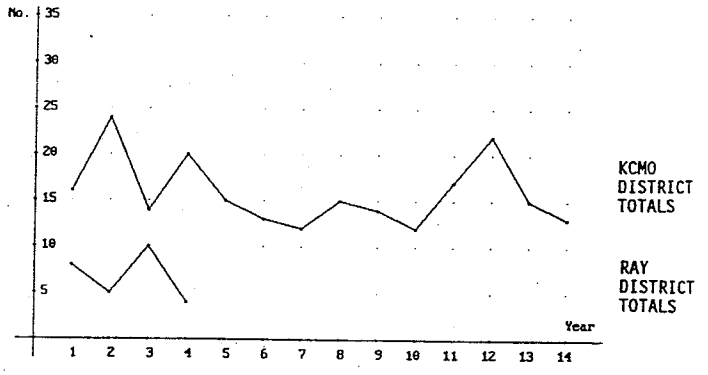
FO	IND	KCMO	RAY
16%	47%	33%	4%

HS = High School
FO = Fort Osage School District, or Fort Osage HS
IND = Independence School District
RAY = Raytown School District
KCMO = Kansas City, Missouri School District
C = Central HS E = East HS L = Lincoln HS NE = Northeast HS
P = Paseo HS VH = Van Horn HS LU = Lutheran HS SM = St. Mary's HS
CPR = Center Place Restoration HS

T = Truman HS WC = Wm Chrisman HS
R = Raytown HS RS = Raytown South HS

- In Year 11, KCMO opened enrollment to all its high schools. No students from Southeast HS or Southwest HS in KCMO have ever attended the MPI, and 4 students from Metro HS and Westport HS started, but did not finish.





■ Talked about the use of mercury in dental work. He went through the process of proving that the amalgams were very safe. He explained how they were going off the market because of the lawsuits. There is new proof that they are totally safe. By the year 2000 there will be no more amalgams made. The new materials are the plastics which are weaker than amalgams, but contain no toxins. Was actually a fine lecture. Was pretty interesting and informative.

Friday, **Feb. 13** Ed Kiker, a Harvard graduate who majored in Lunar Geology, member of the National Space Society, and the CEO of Outer Space Industrial Resources Investigations Systems, spoke on **OUR FUTURE IN SPACE.** Some student comments:

■ Mr. Kiker came to talk about the future possibilities of us in space. He discussed the importance of mining for minerals in space (from meteors or planets). He also discussed how the future in space depends on us and how we could take charge of this future. He brought many interesting books and models to show in more detail how important space exploration is. He was very interesting and did well at keeping the discussion moving.

■ Mr. Kiker had a very organized presentation. He knew exactly what he was going to talk about and how it all related. First he talked about the human race (not just U.S.) as space-faring. We do it for several reasons, for example: music/art inspiration, survival, and communication. Because we are a space-faring people, we are now able to prove that a very large meteor killed the dinosaurs. Second, Mr. Kiker told how models and experimentation help save money. Their models are made out of common household items. Once all problems were solved then the actual object could be built. Theoretically, we were told how we could make a difference by sending letters to Congress and other high important people. Lastly, we were told everyone is a leader and that we lead by example. This was really neat. It was organized. He had models and explanations. He has been one of the best speakers so far.

■ Our speaker is in the business of dealing with space. His talk was on various things. He talked about satellites in space and how close to the earth they are. He discussed the space stations on the Moon. He showed us the model for a station. He also discussed the mining possibilities in space. He brought a piece of a meteorite to show us.

■ He discussed the many reasons for going into space. He talked about the possibility that an asteroid could wipe out all life on earth. If we had human civilizations in other places, like the Moon or Mars, then this event would not wipe out all of humanity. He showed us part of a meteor that hit in Arizona long ago. It was really heavy. He talked about how space affects us every day.

■ I. We are space-faring. We are in space to stay. Satellite imagery helps immensely. It can see how much acreage is being burned in the rain forest, it can also see if trees are "sick". Space stations are about 230 miles above the atmosphere. 236,000 miles away to take a picture of how fragile the earth is. There is now a super gun to shoot stuff out into space much faster than we used to; you can't have people in it though. II. Modeling and simulation is all math and physics. A model is an engineering tool that allows for big mistakes cheaply. III. YOU. Kids fresh out of college get the big bucks for engineering because they have the newest knowledge. Get out on the fringes of applications to get in on the good stuff. IV. LEAD. Lead by example. Go against people if it's what you believe in. Impossible is not an option. Besides leading others, lead yourself. Assess things constantly. I liked his tie! I liked that he kind of gave some of his philosophy: save money early. Listen to your parents. If you don't build yourself, no one else will.

■ As of right now, we on Earth are making serious progress with life, travel, and our future in space. We're going to be making a lot more. It will be expensive, but worth it. Also, we in the United States are in competition with other countries such as Russia. I think we're ahead. As the future comes our way, there will probably be a time where humans will be living in places in space other than Earth. We will probably also find other living beings in this

universe.

■ First off he made it very clear that he does not play with toys. he uses models, or engineering tools, as teaching aides. When he got a Bachelors in Lunar Geology, his professor said it was a waste of time. Some good advice he gave for self-assessment was to ask yourself what you need, what do you have, then determine the difference. After your self-assessment – Go Get It!! (Whatever you are striving to do.)

■ We go to space for resources, inspiration, environmental care, communications, awareness, and survival of the species. According to the speaker, it is proven that an asteroid hit the Earth and killed the dinosaurs. There are also other asteroids coming pretty close to Earth – if we had colonies in space, some humans would survive, even if an asteroid hit the Earth. Space affects us all the time, like when we see weather reports. Leadership is simply setting an example for others. "Impossible is a stupid word." This was one of the most interesting speakers we've had this year. I'm a little worried about all those asteroids out there, though.

Ron Schuchard, Professor of Ophthalmology and Physics at UMKC, joined us on Friday, **Feb. 27** to speak on **VISUAL INFORMATION PROCESSING: HOW DOES THE BRAIN SEE?** Ron provided us with a few surprising comments from low vision patients:

- When I try to catch fly balls while playing baseball, the ball disappears and then reappears but not always in time for me to catch it.

- When looking at a door or window frame, the door or window frame appears bent.

- When looking at words/sentences on a page the letters/words to the right of where I am looking are so blurry that I cannot recognize them.

- I cannot walk straight or stand up straight; things (chairs, fences, etc.) seem to leap out and hit me.

Students responded to Ron's talk:

■ The eye receives (and sends) messages of images to the brain, where they are processed. "Rods" and "cones" are used to see colors and at night, respectively. Colors are divided into a spectrum. This spectrum ranges into all colors of the rainbow. The colors go to different channels on the way to the brain. The visual information involves all of the complex modeling, this is where mathematicians and physicists come in.

■ We learned how our brain allows us to see colors. We also learned that every one of us has a blind-spot, and we learned how to find it.

■ At night you can see something better if you don't look directly at the object. That is because the cones of the eye aren't as active as the rods. At night there is not enough light to activate the cones so all we see is black and white. He showed a picture to prove that we see black in the sky due to the lack of light, but the sky is actually blue.

■ Macular degeneration causes people to have blind spots; but we all have physiological blind spots. I liked the demonstrations, especially the (green and yellow) flag.

■ I thoroughly enjoyed this presentation. The subject matter was very interesting and Mr. Schuchard presented the information in an easy-to-understand fashion.

■ He told us how we were able to see colors and why they are vivid during the day and grey at night. He also described how rainbows and sunsets are created by moisture splitting up the colors in the light from the sun. The second half of the lecture was about people with blind spots and the way the eye makes up for these problems. He showed many examples of how the eye can change things in order to compensate for a blind spot. His lecture was interesting and his "hands-on" examples were nice. He had lots of information and was able to keep everyone's attention.

■ Newton was the first to discover that white light is all colors. By looking through a prism it broke the light up into a rainbow. Parallel light goes out from a point at a 42° angle, a rainbow is at a 42° angle. This point is called the anti-solar point.

■ He kept me awake and paying attention. He did a very good job.

■ Stand with the sun behind you to take a picture of the rainbow. The sky is blue. Sunsets are pretty with dirt and loads of smog. Paint black and white pictures on the eyes to see what part of the retina they use. He was pretty good.

Friday, **March 13**, William J. Fields, Jr., Director of UMKC's Chemical, Biological, and Radiation Safety Department, presented a talk on **RADIATION PROPERTIES.** Here are a few of the students comments:

■ The speaker told us about the different types of radiation and what each type can do to our bodies. He showed us how a geiger counter works, and how radiation can be used in the medical field.

■ Alpha radiation is the most harmful to the human body, but only if ingested internally. Beta radiation is identical to electrons. They are less harmful, but can penetrate skin more easily. Gamma rays are very difficult to stop and resemble x-rays. There is also background radiation, which consists of both natural and man-made radiation particles. Fields also discussed the possibility that radiation could be beneficial in some cases.

■ Mr. Fields explained to us what radiation is, and what it can do to people. He explained to us that there are 3 types of radiation: alpha, beta, and gamma. Alpha is the most dangerous, but is the easiest to stop (1 sheet of paper). Beta is not as dangerous, but is harder to stop (a book). Gamma is the least dangerous, but the hardest to stop (1/2 inch of lead).

■ This speaker was good. The geiger counter was the highlight of the performance.

■ There are two types of radiation, ionizing and non-ionizing radiation. Non-ionizing radiation includes microwaves, radio waves, etc. There are three types of ionizing radiation; alpha, beta, and gamma. Background radiation is a combination of natural and man-made radiation, this is radiation that we can not avoid. Sources include radon, cosmic radiation, terrestrial, and other man made sources. Some terrestrial sources are higher than others... from 70 mrem/year in Florida to 5000 mrem/year in India!

■ When I saw the subject matter, I didn't think this would be that great, but it was actually pretty interesting. The short stories about people and places radiation has affected was good.

On **March 27**, we took our fourth annual trip to the **UMKC PHYSICS DEPARTMENT.** We toured laboratories in: **Surface Physics** (David Wieliczka), **Superconductivity** (Michael Kruger), **Photo-Luminescence** (Jerzy Wrobel), **Chaos Demonstration on PC's** (James Phillips), and **Scanning-Tunnelling Electron Microscopy** (Fred Leibsle).

Students commented:

■ We went to UMKC and looked at several labs in the Physics Department. We learned about light waves that come from different substances, and how they "glow" (including our human bodies). We learned that if a substance is in contact with light, electrons gain energy and are projected off of the surface. If the laser is more intense then there will be more electrons projected, but if the wave changes, then the amount of energy the electrons gain, changes. We saw one lab where they grew crystals and dealt with studying super-conductors. We talked to two people that want to develop a way to project single atoms. We also looked at non-linear mathematical patterns and the chaos a graph like that creates.

■ The guy that dealt with laser beams was really neat. What he said made a lot of sense since we've already had two speakers talk about light. The example of how magnets are used to lock doors by computers was interesting. The fact that keys would no longer be needed to get into a place would mean that is one less thing to worry about.

■ I thought some of the labs were very interesting. I liked the way we could use the computers to study chaos.

■ Even though some parts were more advanced than what we could

comprehend, we still learned a lot. The most interesting lab was with liquid nitrogen, where the speaker poured liquid nitrogen all over our feet, and it just evaporated.

■ The use of computers was an excellent tool to draw interest. The speakers seemed genuinely interested in their subjects.

■ We visited a lab in progress, in this lab they were constructing the highest resolution microscope in the world. Next we went to a lab and viewed the magnification of a semi-conductor. In this lab we also got to see a liquid that changed state to a solid without freezing. Finally we went to a lab where photo luminescence was studied. We got to see a laser and we saw how the body gave off light.

■ It was really fun – much better than the long MU Nuclear Reactor trip. The hands-on computer chaos demonstration was really neat. They showed us a crystal that they had grown in some kind of liquid. There was also a liquid mixture of oil and iron filings that became solid when exposed to a magnetic field. They also told us about electron microscopes, and how they are used in surface physics. The best part of the tour was when we saw the laser lab, with it argon-ion laser. It was really cool how they could change its wavelength, thereby changing its color from green to blue.

■ All the professors seemed excited and happy to have us and most were well-prepared with their demonstrations with handouts about their labs.

UPCOMING

Our **April 17** speaker has not been confirmed as of this printing.

Sunday **April 26**, will be our annual **WORLDS OF FUN PHYSICS DAY.**

On **May 1**, Brent Harding (MPI 84-85) an Engineer Specialist at Stanford Telecom will speak on: **APPLICATION OF SATELLITE TECHNOLOGY.**

Finally, we'll hold our annual **PICNIC/BREAKFAST** at McCoy Park on Wed. **May 13**, and our **AWARDS PRESENTATION** on Thurs. **May 14**, the last day of the MPI this year.

NEW (OR CHANGED) MPI ALUMNI E-MAIL ADDRESSES

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

**** NEW ****

(92-93) Christy Cramer
legal.diva@juno.com
KANSAS UNIV

(96-97) Crystal Gearke
cgearke@cctr.umkc.edu
UNIV OF MO-KANSAS CITY

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

(96-97) Brian Johnson
bwj@umr.edu
UNIV OF MO-ROLLA

(96-97) Thanh Phan
thanhep@hotmail.com
PARK COLLEGE

**** CHANGES ****

(95-96) Beth Hontz
aeh52020@cmsu2.cmsu.edu
CENTRAL MO STATE UNIV

WE HEAR FROM PAST STUDENTS

Doug Bullock (84-85)
(BA Mathematics,
PhD Mathematics)

Interview at AMS Meeting in Manhattan, KS 3-28-98:

The mathematics coordinator was pleasantly surprised to encounter Doug at this American Mathematical Society meeting, and met with him for coffee at Starbucks to catch up on his career since he received his PhD in Mathematics from the University of Iowa in Iowa City, IA. Although he has a tenure-track position at Boise State University in Idaho, this year and next Doug enjoys a post-doctoral fellowship from the NSF (National Science Foundation) to do research on Representation Theory, specifically Discrete Gauge Field Theory in Low-Dimensional Topology. For the time being, he is living in Washington, DC

and has given over 50 talks on his research at various colleges, universities and meetings. He recalls that he was surprised to discover as a student that "Math is actually something you can do for a living. I continue to be amazed by this." He is also thankful for his courses at the MPI, and the path they started him on.

Christy Cramer (92-93)
(BA Political Science and History)

"I am currently in my 1st year of law school. Despite the endless hours of reading and sleepless nights, I am doing well. I will graduate in May of 2000. I will probably focus my legal practice on contract and banking law (I find these areas the most fascinating). Are you wondering if MPI has helped me in law school? Well surprisingly it has. Calculating damages for breach of contracts is a rather intricate, complex process. The process is one big calculus problem. And I have to say that I was the only one that could solve the problems the first day we began studying them. My contract professor even asked me if I had studied damage calculation before. I told him no, I just had some great calculus teachers when I was in high school and took MPI.

My family and myself are doing well. I will close for now. Property Law is calling my name — reading awaits."

Leslie Gross (94-95)
(Education Major)

"MPI was outstanding compared to the courses I have taken at both my private colleges. I appreciated them a lot more after my first two years of college.

It kept me going through later courses. I kept telling myself that I got through MPI and I can get through this."

Nathan Haynes (94-95)
(Mathematics/Env. Studies Major)

"The quality of instruction I received in my MPI courses was equal to the quality I have received in my other mathematics and physics courses.

Learning how to use my Sharp calculator and Derive have helped me more than I can express. Many of my peers have those nice calculators and they don't know how to utilize them to their advantage. Being a math major I have also been able to use many of the extra programs included in the MPI "Notes and Programs" book for the Sharp. I would love to see any new programs you have written for the Sharp. Thank you again for empowering me with the knowledge to use these tools.

Keep up the good work. You are providing students with not only a sneak preview of what college courses are like but also a head start if college is the direction they choose. I don't know if I would be a math major today if I had not participated in the MPI program. Thank you for giving me some direction."

Amanda Benavidez (95-96)
(Business Major)

E-mail received 2-10-98:

"Yes, I have been a slacker, I haven't written since I left, but I have thought of you guys. I was saddened to hear of Waring leaving and I could not deny a man his final wish of hearing from all past students, so here I am! Ha.

Well, after leaving MPI I went to MU where I was a journalism major, but I just recently changed to business. Thanks to MPI I don't need to take any more math! All I need are Statistics, which aren't fun either, but I really appreciated not having any more math. I really appreciate all that you have done for me, and how you continue to help others. Personally, I didn't feel ready for college coming from the Kansas City School District, but somewhere I went right. You guys gave me a view of how college classes were going to be, and though I didn't always do my best in MPI (you know); talking all the time, and interrupting class, I really think that I did get something out of it, or, honestly I wouldn't be here today. And, I was proud to see two Nor'easters on that top ten list,

sort of showing that KCSD isn't second rate, we're just as smart as the rest of them. I'm proud that the KCSD is a part of MPI, helping some of the kids that have a great talent.

Lastly, I would like to thank Mr. Waring for starting MPI and helping so many kids. I hope that you know how much we really do care and cared when we were there. So, thank you MPI for all that you have done and will continue to do."

Corey Baker (95-96)
(Mechanical Engineering Major)

E-mail received 3-16-98:

"Since I haven't answered that questionnaire or kept in touch, I thought that I should let you know what's going on in my life. I'm still attending UMKC and majoring in Mechanical Engineering. This is my second year and I'm on track to finish in four years total. I've been doing pretty well lately and made the Dean's list last semester.

Recently I started a new job with the Marley Cooling Tower Company. It's the same company my older brother Ryan works for (a little nepotism never hurt anyone). I'm currently the fifth intern they employ at their Development Center in Raytown. The facility is in a mine off 63rd Street, near the Swope Park area. My first two days were last week, so there's still a lot of settling in to do. The job will definitely supply me with invaluable experience, not to mention some fun.

I also wanted to take this opportunity to say that the retirement of Richard Waring is a loss which MPI can never replace. He is an asset not only to the program itself, but to each and every student that has ever walked through the doors of MPI. The students from this point on will be deprived of a great man as an instructor and friend. I'd also like to mention that I'm going to try in every way possible to be at his open house in May."

Crystal Gearke (96-97)
(Pharmacy Major)

E-mail received 3-26-98:

"I miss all of you. I am very sorry that I haven't kept in touch. During the alumni meeting I was having my wisdom teeth removed. I have been very busy with Pharmacy school and my sorority. I am still the same old me. I have noticed college makes me not want to study. When I was in MPI I had to study all the time, but in college I can not study and still pull off a B in most of my courses. I am so happy that I got out of Calculus and Physics in college. All my fellow classmates are always busy and worrying about these classes and I get to help them. I'm sorry to say but these classes are a joke at UMKC, I could ace both of these classes. MPI is MUCH harder than the UMKC curriculum for these. My best friend is in Calculus and I help her and the teacher lectures all of the time. I catch his mistakes. Thanks for letting me get to know both Pharmacy classes by letting me jump ahead to Medical Anatomy and Microbiology. I will never forget you guys. Thanks for everything, I hope to see everyone shortly."

Thomas Gregory (96-97)
(Pharmacology Major)

"If you can't pay attention you won't last the first day (at the MPI) ... (but) I enjoyed the program. When friends of mine say they want to go just for a challenge, they're in for a rude awakening. It's your life for the entire 9 months. You eat, sleep, drink, and think MPI. If you can survive till the end, that in itself is a great milestone in school and life!"

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

"At MPI I realized what the word "FINAL" really meant and it helped me to focus even more energy on studying for them in college. I began to realize how math, science, and the real world converged. I saw related concepts and it is easier for me to grasp abstract thoughts. It reinforced my self-discipline because I had to get up so early and be prepared to learn. I discovered that a positive attitude can help focus you on problems and looking for their solutions, instead of complaining. Your attitude is everything. Being successful in this rigorous program

builds confidence as well as knowledge.

Thank you for all your enthusiasm and support for my continued success in math, physics and college."

MPI E-MAIL ADDRESS:-

rdelaware@cctr.umkc.edu

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

FINAL 1997-98 STUDENT IMPRESSIONS

"It is the best of times, it is the worst of times; it is early in the morning. It is <u>really</u> early in the morning. With a little pressure from my parents and some encouragement from Mrs. Adams, I signed up for MPI last year, not knowing what I was getting into. Six months later, I'm a lot more tired than normal, but I can figure out how far my car is going to slide on the ice in the parking lot at a certain velocity. I think MPI will be very beneficial to my preparation for college. Plus I really appreciate sleeping in on Saturdays now."

Matt Woolf
Truman High School
Independence School District

"MPI has been a new experience. I have had to learn to study and be more responsible. It has been a challenge, but it has been fun as well. I am glad that I chose to take these courses."

Jason Kleyh
Wm. Chrisman High School
Independence School District

"MPI is a place where I've learned not to complain about too much homework. It really changed my attitude toward my educational goal. Usually, things are difficult before they're easy, but the learning process starts in the opposite way, things getting harder as we move on with the chapters, and the only way to catch up is to try hard and even harder each time. Usually my study time is limited, but I know I have to try my best and prepare myself for the worst on the exams, and if I study hard enough, anything is possible."

ViSach Son
Northeast High School
Kansas City, MO School District

"I can't believe that the year is already almost over. With less than 8 weeks left in the school year, it's hard to believe that we the class of 1998 will be graduating. Yet while a lot of classes will be starting to wind down, MPI reminds that we are still here to learn until the very last day. Every time we think things are starting to get a little easier, we learn a new twist to that calculus problem. Or we learn that in Physics there is always something extra you can throw into a problem that makes your equation just a little harder.

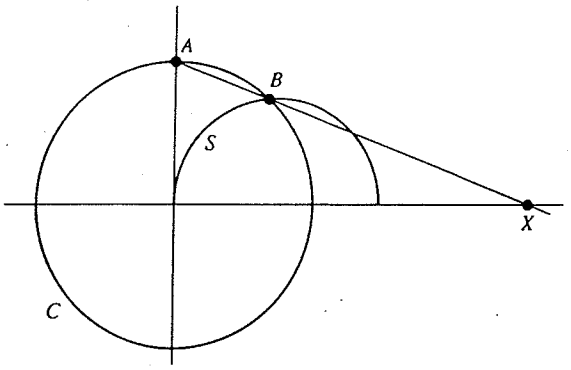
When I look back on this experience, I will remember the scholastic things I've learned, the study habits I've acquired, but most of all the people I've met and the friendships I've made. Not only will I remember the students, but the amazing teaching staff as well. This was a great experience."

Tabitha Kremer
Truman High School
Independence School District

A SOLUTION TO MATHEMATICS CHALLENGE #52

Recall the problem statement:

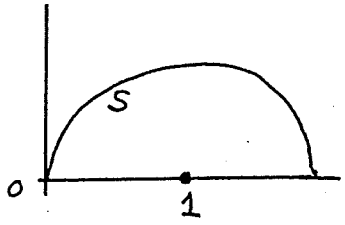
Let S be a semicircle rising from the origin and lying on the positive x-axis, as illustrated. Consider also a circle C centered at the origin and let A and B be the points of intersection of C with the positive y-axis and with S, respectively. Extend the line AB rightward, letting X be its intersection with the x-axis. What happens to X as C becomes smaller and smaller, its radius approaching zero?



[From: Which Way Did the Bicycle Go? and Other Intriguing Mathematical Mysteries, by Konhauser, Velleman, and Wagon, 1996, Problem #5, pp 2 and 67.]

SOLUTION:

Without loss of generality, and to make our argument specific, we can assume that semicircle S has radius 1.



So, its equation is just that of the unit circle (centered at (0,0)) $x^2 + y^2 = 1$, which has been shifted <u>rightward</u> 1 unit, meaning:

$$(x - 1)^2 + y^2 = 1$$
$$x^2 - 2x + 1 + y^2 = 1$$
$$x^2 + y^2 = 2x \ .$$

Suppose circle C, which is centered at (0,0), has radius r, so that its equation is:

$$x^2 + y^2 = r^2 \ .$$

Then point A = (0,r). Now, point B is the intersection of semicircle S and circle C, meaning where:

$$2x = r^2$$
$$x = \frac{r^2}{2} \ .$$

Next, we solve for the y-coordinate of B using, say, semicircle S's equation, getting [<u>NOTE</u>: We only take <u>positive</u> square roots throughout]:

$$x^2 + y^2 = 2x$$
$$y^2 = 2x - x^2$$

(positive) $\quad y = \sqrt{2x - x^2} \ .$

Substituting $x = \frac{r^2}{2}$, we continue:

$$y = \sqrt{2\left(\frac{r^2}{2}\right) - \left(\frac{r^2}{2}\right)^2}$$

$$= \sqrt{r^2 - \frac{r^4}{4}}$$

$$= \sqrt{r^2\left(\frac{4 - r^2}{4}\right)}$$

$$= \frac{r}{2} \cdot \sqrt{4 - r^2} \ .$$

Thus, point $\quad B = \left(\frac{r^2}{2}, \frac{r}{2} \cdot \sqrt{4 - r^2}\right)$.

Hence, <u>on the one hand</u>, the slope of line AB is:

$$\frac{\frac{r}{2}\sqrt{4 - r^2} - r}{\frac{r^2}{2} - 0}$$

$$= \frac{\frac{r}{2}\left(\sqrt{4 - r^2} - 2\right)}{\frac{r}{2} \cdot r}$$

$$= \frac{\sqrt{4 - r^2} - 2}{r} \ .$$

But, if we write point $X = (x_0, 0)$, then <u>on the other hand</u> the slope of line AB (also known as line AX) is:

$$\frac{r - 0}{0 - x_0}$$
$$= \frac{-r}{x_0} \ .$$

Equating these slopes we get:

$$\frac{-r}{x_0} = \frac{\sqrt{4 - r^2} - 2}{r}$$

$$\frac{x_0}{-r} = \frac{r}{\sqrt{4 - r^2} - 2}$$

$$x_0 = \frac{r^2}{2 - \sqrt{4 - r^2}}$$

$$= \frac{r^2}{2 - \sqrt{4 - r^2}} \cdot \left[\frac{2 + \sqrt{4 - r^2}}{2 + \sqrt{4 - r^2}}\right]$$

$$= \frac{r^2(2+\sqrt{4-r^2})}{4-(4-r^2)}$$

$$= 2+\sqrt{4-r^2} \ .$$

So, as circle C becomes smaller and smaller, with its radius r approaching 0, the point

$$X = (x_0, 0) = (2 + \sqrt{4 - r^2}, 0)$$

approaches the point

$$(2 + \sqrt{4 - 0}, 0) = (4,0).$$

Thus, the point X gets closer and closer to, but never reaches 4.

A SOLUTION TO PHYSICS CHALLENGE #43

Recall the problem statement:

When a driver brings a car to a stop by braking as hard as possible, the stopping distance can be regarded as the sum of a "reaction distance," which is initial speed times the driver's reaction time, and a "braking distance," which is the distance covered during braking. The following table gives typical values:

INITIAL SPEED (m/s)	REACTION DISTANCE (m)	BRAKING DISTANCE (m)	STOPPING DISTANCE (m)
10	7.5	5.0	12.5
20	15	20	35
30	22.5	45	67.5

a) What reaction time is the driver assumed to have?
b) What is the car's stopping distance if the initial speed is 25 m/s?

[From: Fundamentals of Physics Extended, by Halliday, Resnick, and Walker, problem #52P, p 39.]

SOLUTION:

a) One would expect the reaction time to be independent of the initial speed and indeed it is:

$d = vt$ where d = reaction distance, v = initial speed, and t = reaction time, so

$$t = \frac{d}{v} \ ,$$

and substituting numerical values,

$$t = \frac{7.5 \text{ m}}{10 \text{ m/s}} = \frac{15 \text{ m}}{20 \text{ m/s}} = \frac{22.5 \text{ m}}{30 \text{ m/s}}$$

meaning in every case

$t = .75$ s, the driver's reaction time.

b) The car's stopping distance, d, is the "reaction distance", d_1 , it travels at its initial speed during the reaction time, plus the "braking distance", d_2 , it travels while breaking from its initial speed to a stop. Thus:

$d = d_1 + d_2$, and

$d_1 = v_0 t$,

where v_0 = initial speed and t = reaction time from part a), and from

$2ad_2 = v^2 - v_0^2$ we get

$$d_2 = \frac{v^2 - v_0^2}{2a} \ ,$$

where a is the deceleration (negative acceleration) and v is the car's final velocity. So:

$$d = v_0 t + \frac{v^2 - v_0^2}{2a}$$

The deceleration, a, must be found from the data given. It is fair to assume the deceleration of the car is the same for all braking distances, and the data bears this out. Thus:

$$2ad = v^2 - v_0^2$$

$$a = \frac{v^2 - v_0^2}{2d}$$

and substituting numerical values,

$$a = \frac{(0 \text{ m/s})^2 - (10 \text{ m/s})^2}{2(5\text{m})} =$$

$$\frac{(0 \text{ m/s})^2 - (20 \text{ m/s})^2}{2(20 \text{ m})} = \frac{(0 \text{ m/s})^2 - (30 \text{ m/s})^2}{2(45 \text{ m})}$$

meaning in every case

$a = -10 \text{ m/s}^2$.

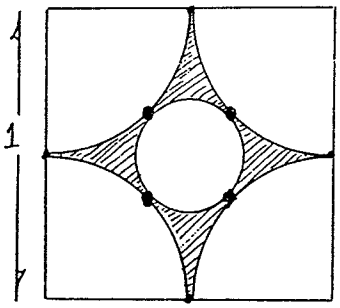
Substituting this value of "a", into the equation for the stopping distance we get,

$$d = (25\ m/s)(.75\ s) + \frac{(0\ m/s)^2 - (25\ m/s)^2}{2(-10\ m/s^2)}$$

= 50 m, the car's stopping distance.

MATHEMATICS CHALLENGE #53

Suppose you threw a dart at random into the dart board shown below:



This dart board is a square of side 1, the arcs are circular arcs from 4 identical circles each of radius 1/2, centered at the 4 corners of the square, and the center circle meets these 4 circular arcs at their midpoints as shown.

What is the probability (in %) that your dart will land in the shaded region?

How does this probabilty vary if the 4 identical circular arcs shrink together in radius from 1/2 down to 0, while the center circle correspondingly grows?

[This is an example of a geometric probability problem.]

PHYSICS CHALLENGE #44

The box of a well-known breakfast cereal states that one ounce of the cereal contains 110 Calories (1 food Calorie = 4186 Joules). If all this energy could be converted by a weight lifter's body into work done in lifting a barbell, what is the heaviest barbell that could be lifted a distance of 2.0 m?

[From: Cutnell/Johnson Physics, 3rd Edition, problem 43, p. 358.]

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