Mπ

The Mathematics and Physics Institute NEWSLETTER

Director: Jennifer Discenna
Associate Director: Richard Delaware

April 1, 1999 **Vol. 13, No. 5**

OUR 15TH YEAR

This 15th year of the MPI has been one of changes for us: Jennifer Discenna joined us as Director, replacing Richard Waring, Libbi Sparks arrived as Calculus instructor from Wm Chrisman High School, replacing Al Morse, and lastly we hired Suzanne MacDonald as secretary, replacing Doris Kirst. As you will also read later in this issue, two new Internet related projects (Virtual Office Hours, and an MPI web site) are underway to enable MPI students access to Calculus and Physics information and assistance outside of MPI class time, and there will be various other improvements for next year implemented over the summer, including a change of Calculus text. We'll keep you posted here in this newsletter about all such developments, and of course, we always hope to hear from all our former students...so if you're one, drop us a line (or e-mail)!

CALCULUS READINESS EXAMS

During the **last week of April and the first week of May**, the Associate Director 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 14** this year. All those details will be discussed when the Associate Director makes his visit.

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.

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)

THE ARRIVAL OF SUZANNE

Suzanne MacDonald joined the MPI on Feb. 22, during Doris' last week [See the article on Doris' retirement in the February issue], and has since leapt into the job with gusto. We are pleased to welcome her and hope she enjoys the MPI atmosphere. Suzanne comes to us from work as Operations Generalist for the U.S. District Court for the Western District of Missouri in Kansas City, MO, where among other duties she processed appeals for the District Court, and maintained a working database system to track all Early Assessment Program cases. She previously worked for the U.S. District Court for the District of Kansas in Kansas City, KS, and the U.S. Court of Appeals in St. Louis, MO. Here's what she has to say about joining the MPI team:

"I'm thrilled to be joining the MPI family but realize I have huge shoes to fill with Doris' retirement. I spent a week with her before she left, going over the basics, and I enjoyed her company so much that I hated to see her leave as much as the rest of the MPI staff.

I started working 25 years ago at the University of Virginia, and I've come full circle back to university work and couldn't be happier. The last year and a half has been very exciting for me; I moved from St. Louis, started a different job, fell and broke my leg and both ankles, got married, acquired four stepchildren and two step-grandsons and am now diving into my part-time MPI job with relish. My 13 year old son, Andrew, is ecstatic to have me home when he gets back from school everyday, and I'm looking forward to a long career with the MPI."

MPI TECHNOLOGY REPORT

1. On **Feb 1 & 9**, we surveyed 54 current MPI students about their **off-campus computer access**. The results were as follows:

50 (93%) have computers,
42 (78%) access Internet sites, and
26 (48%) access daily or weekly.

28 (52%) have e-mail addresses.

Of those 50 computers:

42/50 (84%) run Windows 95, 98 or NT
39/50 (78%) are located at students' own homes
34/50 (68%) have an Internet connection

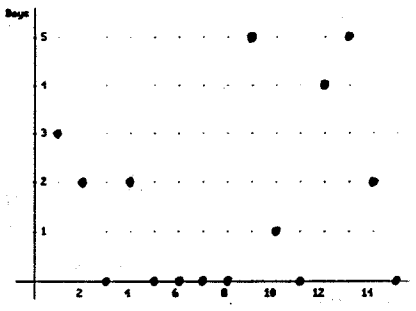
2. The survey above was intended to provide us with data for an experiment with what might be called **Virtual MPI Office Hours**, late this semester, and all of next year. The idea derives from a similar projects for College Algebra being piloted in the University of Missouri system, and is designed to offer online office hours evenings and weekends during which MPI students could share not only audio but live graphic whiteboard images (!) with MPI faculty to discuss Calculus and Physics as though at a blackboard. For MPI students to physically meet with MPI faculty at such hours at some site is impractical since students often study late, and being high school seniors, may have no transportation, or are not free to drive at such times. So, if we are to attempt to provide the blackboard tutoring experience, it will have to be through the Internet. If our experiment this semester is successful, we'll present the details here. [If you are curious about the ongoing UM project visit: http://www.system.missouri.edu/mathcid/]

3. Now that a new computer has arrived for our secretary, and a server location is available, we hope to finally have an **MPI Web Site** online by the end of the summer. Stay tuned!

ODDS AND ENDS

On **Feb. 10**, our **Recruitment Day**, we hosted 83 high school juniors, with about 7 other teachers and counselors, from 8 different high schools: Fort Osage, Paseo, Southeast, Van Horn, Truman, Wm Chrisman, Center Place Restoration, and St. Mary's. [A slight reduction from 104 juniors, 9 others, and 10 high schools last year.]

We've had no (!) cancellation "snow" days for this winter, but all was not so warm in the past, as the graph below shows:



Over two Saturdays, **Feb. 20 and 27**, Jennifer Discenna invited MPI students to participate in Toy Day at the Kansas City Museum, putting toys together for children and working in the Lego Room. Our MPI students were well received, and had a good time themselves. In fact, Jennifer reports there were even rumors that Derick and Laura were Lego professionals! The students were:

Tabitha Hanson	Fort Osage
Derick Rohr	Fort Osage
Laura Van Fleet	Fort Osage
Angelina Walls	Fort Osage
Dana Curran	Northeast
Suzanne Leslie	Truman
Mychel Varner	Truman
Lenora Coffee	Van Horn
LaKeeia Hawkins	Van Horn
Phuong Le	Van Horn
Monica Rayford	Van Horn

On **Feb. 22**, our new secretary, Suzanne MacDonald, [see the article in this issue] began, while Doris was completing her last week after nearly 11 years at the MPI. Thursday, **Feb. 25** was Doris' last day, and we greeted her that morning with cake, cards, and flowers. Just before she left at 1 pm, her daughters and husband showed up to celebrate.

On **March 10**, Libbi Sparks once again presented a talk on Internet sites in Mathematics & Science at the Independence District Professional Development Conference.

March 27-31, Jennifer Discenna presented a paper at the NARST (National Association for Research in Science Teaching) conference in Boston, MA.

On **April 6**, Jennifer Discenna and Richard Delaware will make a presentation to the School Board of Kansas City Missouri to update them about the impact of the MPI program on Kansas City Missouri MPI students over the last 15 years.

On **April 9**, Richard Delaware will give the Friday Invited Address, entitled "The Year 1000: What Mathematics Was Being Done at the Last Turn of the Millenium?", for the joint Spring meetings of the Missouri Section of the MAA (Mathematical Association of America), KCATM (Kansas City Area Teachers of Mathematics), and (MAT)^2 (Missouri Mathematics Association for the Advancement of Teacher Training) at Rockhurst College in KC, MO.

April 15-16, Sheri Adams will attend a conference on Calculus Reform and High School Curriculum Reform at the Lake of the Ozarks.

On **April 16**, Richard Delaware will speak on "From the 'Method' of Archimedes: The Area of a Parabolic Segment, by Levers and by Series" in the UMKC Dept. of Mathematics & Statistics Expository Talks Series.

April 22-24, Sheri Adams will attend the 77th Annual Meeting of the NCTM (National Council of Teachers of Mathematics) in San Francisco, CA.

Finally, from **April 30 to May 2**, Jennifer Discenna will attend the CILT (Center for Innovative Learning Technologies) conference in San Jose, CA.

THE AUGUST 1999 ISSUE

The August 1 Mπ Newsletter will list the top ten MPI students for 98-99 and all those receiving awards at our May 14 Awards Presentation.

There will also be **IMPORTANT INFORMATION** and advice for the YEAR 16 class of 1999-2000. TAKE NOTE!

ENRICHMENTS

FOLLOW UP

On **Feb. 12**, Eric Hess, an Environmental Engineer, discussed: **SCIENCE AND THE ENVIRONMENT**.

Students responded:

- Common sense is the most important thing he has learned. He investigates sites to find if they are hazardous to people. They use color tests to find the concentration of compounds; X-rays are used to detect metal in the earth. Laser induced flourescence is used to tell apart different chemicals; certain chemicals give off different lights. I think this was a really good speaker. Some of the things he talked about were things we know from the news. It was neat to meet someone from this field.

- Mr. Hess discussed with us the dangers and hazards that effect our environment. His job is to detect these dangers. He also showed us, in the slides, what kind of tools and instruments he used to detect the environmental hazards. It was interesting.

- He is a pedologist (nothing to do with kids). Mr. Hess enjoys the sweet aroma of tar. In fact, he keeps a vial of it on hand in his office. He had slides of different kits used to test for chemicals. They use bunnies to test for antibodies in the blood! Poor Thumper! The current problem with pollution is caused by pigs. Actually a very good enrichment. Well Done!

- The slides were very interesting and showed me that being an environmental scientist was not all about testing samples. He did a good job presenting the material and making the field look interesting.

- I truly enjoyed this enrichment speaker because it combined what we learn from text to applications in the environment. Since I enjoy both science and working in the outdoors, I approached this subject with special interest.

- Eric Hess was a great speaker, he knew what he was talking about, and he had a lot of experience in his field. I enjoyed learning about the different equipment and techniques he used.

On **Feb. 26**, Kathleen Kilway, a UMKC Organic and Organometallic Chemist, discussed: **FROM MOLECULES TO NANOMATERIALS: THEORY AND EXPERIMENT**.

Students responded:

- I thoroughly enjoyed this speaker. She kept my attention and not once did my head pose into sleep mode. I now also know that a soccer ball looks like a C_{60} molecule, and I doubt I'll forget that.

- Very good!! Though chemistry isn't my favorite topic, I felt interested. Well done!

- I enjoyed hearing about her background as well as about her current research.

We cancelled MPI classes on **March 12**, and hence our enrichment, due to the attendent traffic and the visit of Madeleine Albright, US Secretary of State, to the nearby Truman Library. One of our MPI students, Khushal Latifzai from Wm Chrisman High School was able to attend the NATO ceremony in the Library, shook hands with the Secretary of State, and got her autograph.

On **March 26**, we took our first mathematics-oriented field trip, visiting both UMKC and the world-class Linda Hall Library of Science, Engineering & Technology located in the center of the UMKC campus, though independent of it. We toured the Library, visited the Rare Book Room to view rare and historically signficant mathematics books, and at UMKC saw two mathematics videos on Everting a Sphere and The Pythagorean Theorem, and of course ate lunch (!). After the trip, students were required to complete a Calculus Writing Assignment by typing a paper about some of the mathematics books they personally examined. Among the 32 rare books (in English, Latin, French and Arabic) we viewed were the following:

- The first Calculus text, written in 1696 by L'Hospital.

- Books by Newton (1728, 1729, 1736) and

Leibniz (1684), the co-inventors of Calculus.

- Several versions of Euclid's Elements, including the first printed edition of 1482, a 1594 version in Arabic, the first English translation in 1570, and a completely visual version in color created by Oliver Byrne in 1847.

- Descartes' book (1637) in which he invented Analytic Geometry.

- The 1670 edition of Diophantus in which Fermat's Last Theorem was first printed.

Students commented:

- I thought the trip was a fun and interesting experience. The rare books were an especially interesting experience. If possible, maybe more time should be spent with the books instead of the videos.

- It was a great tour. More time in the Rare Book Room would have helped.

- I liked the video. It kind of reminded me about the man who did an enrichment on knots. The tricolorability tests are kind of like the turning point test. I never even imagined that you could turn a sphere inside out. That is awesome. I liked the graphics. They were very interesting and helped me to understand the whole concept of turning a sphere inside out. The second video was less exciting. I actually understood it more, though. I liked how they derived the Pythagorean theorem. It was neat to see it. Also, Laura and I liked the "fast math".

- The sphere video was somewhat good. I was fascinated. The next one was not so good. Lunch was pretty good (and fun). The rare book collection was pretty spectacular (I like that guy). I'm going to break in and steal some of those books since I solved their security system.

- In the Rare Book Room I looked primarily at "Analytical Institutions" (by Maria Agnesi). The "first calculus text to include all differential and integral calculus" but what seemed so different from our calculus text book was that it seemed more a piece of literature with a foreward and a dedication and not so much text.

- This was an excellent trip and we really enjoyed everything about it. My favorite part of the trip was the Rare Book Room. I really enjoyed looking at the books by Isaac Newton. The day was very informative.

- I thought the math books I looked at were pretty neat. Some of the books were over five hundred years old.

- Friday morning, after an exhilarating calculus review, the MPI students boarded an over-crowded bus and made their way to the UMKC campus. To build our endurance, Mr. Delaware had us stand in the cold for fifteen minutes and then let us into the Linda Hall Library. We spent some time learning about the library and looking at calculus books. Then we moved to the Rare Book Room, where we saw (and even touched!) Books from centuries ago! For lunch we went to a lecture hall with very confusing stairs and watched even more confusing math videos. Then we re-boarded the bus and returned to MPI.

UPCOMING

Our **April 16** speaker will be Tony Thornton (MPI 88-89), now an Electrical Engineer with Broadband Operating System Development at Sprint. His title is **"A Career Path: MPI to Sprint."**

Our **April 30** speaker will be Brent Harding (MPI 84-85), an Engineer Specialist with Stanford Telecom.

Sunday **May 2** will be our annual **WORLDS OF FUN PHYSICS DAY.**

Finally, we'll hold our annual

PICNIC/BREAKFAST at McCoy Park on Wednesday **May 12**, and our **AWARDS PRESENTATION** on Thursday **May 13**, the last day of MPI classes 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 ****

(84-85) Steven Koop
swkoop@surfline.ne.jp
UMR

(86-87) Pat Liang
patrick.liang@cwix.com
UNIVERSITY OF INDIANA

(96-97) Jay Farrington
x314@truman.edu
TRUMAN STATE UNIVERSITY

(97-98) Joe Davis
KITTYDOG98@hotmail.com
SOUTHWEST BAPTIST UNIV.

WE HEAR FROM PAST STUDENTS

Melissa (Steffens) Akey, (MPI 85-86)
(BA Mathematics; MA Mathematics Education)

E-mail received 2-20-99:

"I teach at Lahainaluna High School (in Maui, Hawaii.) About half of my students are freshmen. Now that we have turned in first quarter grade cards, a lot of the students are shaping up since they realize that I will actually put real grades on report cards. I do not put passing grades unless they have earned it. The nice part is that some of the students are starting to get interested in excelling in the class, not just passing...

You would love to see my new school. The campus is so beautiful. I even think the view out of my window is gorgeous and I am on the ugly side of the campus. My department chair..., is on the top floor of Building J, which probably has the best view. I was jealous when I saw her room and her view. Now that I have been here awhile, I see that it is probably good that I don't have her room, though, because I would probably never get any work done.

Out of the 900 students, 120 are boarders during the school year. In order to be boarders, they have to agree to a work/study program. The boarders work from 6 am to 7 am, cleaning the campus and planting gardens to keep the campus pretty. They go to classes and then do cleaning again from 2 pm to 4 pm. With all of these extra hands cleaning the campus, it resembles a nice college campus with landscaping.

Today the weather is about 75-80 degrees, sunny with a chance for a light spring shower which will feel refreshing. Yesterday the weather was about 75-80 degrees, sunny and we had a light spring shower which felt refreshing. The day before was about 75-80 degrees and we had a spring shower which felt refreshing. The day before... Weather is kind of a funny topic on the news. The focus is mainly on surfing conditions. Often the weather forecasters say things like we have a big wave from New Zealand coming so the surf will be up on the following beaches...etc. My mom is funny because she is always asking me what the weater is like and I keep giving her the same weather report.

I am glad to be on the mailing list for the **MPI**. I still tell people about my experiences with MPI. It was one of my best experiences in high school. It gave me the self-confidence to move from high school to college. Probably one of the best aspects of MPI is that there was no cost for the program which was important for students like myself who had no money. By completing 12 college hours for free, I was able to move past the barrier of cost for college. Before MPI, my mother could not believe that I would be able to go to college since we had no funds. After completing MPI, my mother could understand that I could pay for college completely with scholarship money. It made going to the University of Missouri an expectation rather than a just a wish. Pretty amazing for a young girl from

the projects...

I have completed my Master's in Education and Bachelor's in Mathematics. I taught at Truman High School for the last five years...Go Patriots!!!

For students eligible for C section of MPI...take the accelerated program. It is a wonderful experience. You get to experience the fast pace of college before you go to the university (and before you are distracted with other college courses, new friends, jobs, etc. Richard Delaware is an excellent professor who really cares about the material and more importantly, the students.

Well...time to go grade papers by the beach.

Aloha, Melissa"

Rob Crosby (MPI 86-87)
(BA Economics; MA Economics)

A Note from his Mom:

"Rob is working at Munder Capital Management. He has his Master's in Economics from Murray State and has his CFA license - passing the 3 parts in 3 consecutive years. He graduated from MU at Columbia, MO.

A very proud Mom"

Andrea Slusser (MPI 92-93)
(Architectural Engineering Major)

"MPI was a valuable learning experience that helped me make decisions about college later. I consider it one of the best experiences I had as a high school student. I am still working towards my degree in Architectural Engineering and will be graduating in about 1 ½ years. I will be looking for a position with a firm that will allow me to travel. I plan to take my F.E. exam next spring and plan to become a P.E. after my training period. I currently work as a technician for Compaq computers, a far cry from Architectural Engineering, but a decent job nonetheless. I use every opportunity here at KSU to "talk up" MPI, hoping that perhaps someday they could implement such a program for our community here, although it is doubtful, several processors were impressed with the idea.

I also believe that the MPI instructors, while I was in attendance, were some of the **BEST** instructors I have encountered in my college career. I can only hope you have continued with the same level of excellence that was exhibited while I attended. I also would like to thank all the wonderful instructors I had at MPI for always being supportive, Without that, I many not have chosen the career I have."

Ragan Buckley (MPI 95-96)
(Government Major)

"I got more individualized attention in the math courses at MPI than I do now, but I was in Section C which was a lot smaller than the math sections here. Topices covered (I took the equivalent of Calculus I and II here in college) were roughly the same.

MPI helped me get better grades, mostly because it made me familiar with the materials (since they don't take the college credit from UMKC at Harvard). I didn't have particularly good study habits while I went to MPI and I still don't; I typically procrastinate and cram at the last minute.

Sorry this is so late. I left the first copy at home over Christmas break and this one got lost in my dorm room (hence the wrinkles in the paper) until just now."

Jay Farrington (MPI 96-97)
(Biology Major)

"MPI has prepared me extremely well for college in terms of teaching me how to study. I would encourage all seniors to take MPI because it gives you a taste of what college is really going to be like."

Valerie Smith (MPI 96-97)
(Molecular Biology Major)

"I think the quality at MPI was very good. The pace was slower, there was more time to work with

the instructors to learn anything not understood. I think I really could have gotten a lot out of it if I had worked harder - or even tried a little.

"MPI helped me to realize that there are good ways to teach things and there are not so good ways. When you're in a class where the teachers know how to teach and want you to learn, do the work! Otherwise you end up retaking the class with a horrible teacher who makes it ten times harder to learn. I wish I would have taken advantage of the opportunity I had at MPI.

I don't really know what the MPI itself could do to be better. It really just takes initiative on the part of the student to want to learn and to do the work. There's really a lot to be learned all around us. We just need to open our eyes and see it. I think we get ground into us the idea that school is bad - but learning new things is really fun - not work. Makes you appreciate and respect life just a little bit more.

I plan to transfer to a pharmacy school - not sure yet which one. Idaho State University has a good program, but I have yet to learn of my other options. I want to get my doctorate in pharmacy and be a pharmacist somewhere. Eventually I want to establish my own pharmacy geared towards the elderly - free delivery, consulting, etc., but also serving the nursing homes to give them the best quality they can get - because they deserve it! A large percentage - too large for my comfort anyway - of people die every year because of fatal drug interactions - even two prescription drugs. I want to help reduce that number by having a higher quality pharmacy and by educating not only my own employees, but also my customers."

Joe Chapman (MPI 97-98)
(Behavioral Sciences Major)

E-mail received 2-17-99:

"Well, it has been awhile, hasn't it? I bet you thought you would never hear from me again and it would be a blessing. Well unfortunately you aren't that lucky. First I must state that the main reason I am writing is to inform you that you wrote down the wrong e-mail address for me. The address is:

ChapmanJD02.cs12@usafa.af.mil.

Alright, now that we got that all cleared up I can start telling you about what is going on up here at the Air Force Academy. Truthfully, and straightforward, I would have to say that attending the USAF is something you truly have to want to do or you will be left in the dust. I will start at the beginning since I have not had a chance to tell you anything about this experience since I came. You enter the first week of July, yes a very short summer break before you get here. The following six weeks is an adaptation to the military lifestyle here. During this period you are on strict watch, you get very little sleep and you have physical and mental training for what seems like an eternity. After Basic Training is done, however, you feel as though you have achieved something great. That is until you are confronted with the academic year.

The academic year starts one week after the end of Basic. They have a block schedule very similar to those at Truman, except there are 7 classes a day instead of 4. Breakfast and lunch are mandatory, as well as attendance at all required activities. Last semester I had Advanced Calc, Chemistry, Advanced French, English, History and Officership classes, and I thought the schedule couldn't get any worse. This semester I have Computer Science, Political Science, Engineering Mechanics, Chemistry, Physics, and Third Year French. All of these courses, excluding French, are core courses. You cannot even tell by my schedule that I am going for a Behavioral Sciences Major. I guess it is obvious I am going for a French Minor though. Thankfully, I validated many courses, many would not have been validated if not for the preparation that MPI had provided me, and next year I will be able to start taking majors courses instead of more core courses.

It is difficult keeping good grades in these courses, not to mention that as a freshman I am still confronted with training until Recognition, three days of the worst experiences I will ever encounter in my life (March 11-13). After Recognition we are officially considered upperclassmen and no longer have any more training, though, so it is worth it.

The MPI presented me with great skills to prepare me for college, and even then I was not prepared. Up here they present you with the skills to survive and you have no choice but to be prepared. Well, once again duty calls as I have to haul off to Comp

Sci. If you know anyone that might be interested in coming up here, have them drop me a line.

Cadet Fourth Class Joseph Chapman

Oh, by the way, this is not the last time you will hear from me."

Jenny Green (MPI 97-98)
(Chemistry/Pre-Med Major)

"(At the MPI) when I couldn't figure out a problem, I would start from scratch and write down what I knew and what I could solve for with this info and go from there. I felt that because of MPI I knew that I had to stay on top of my classes. I couldn't get behind. The best things about the MPI were the friends I made and the study groups. I also like the ability of the students to get help one on one with the professor. High school was too easy and can't prepare you the way MPI can.

MPI and the guest speakers have really helped me in deciding what to do. Because of the knowledge of jobs made available by the speakers, I knew that a chemistry major had more uses than a biology major, if I didn't become a med student or a doctor."

MPI E-MAIL ADDRESS:

rdelaware@cctr.umkc.edu

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

FINAL 1998-99 STUDENT IMPRESSIONS

"And we're expected to <u>think</u> at this ungodly hour? All I can focus on is whether or not I'm in the beginning stages of hypothermia."

Jordan Webb
William Chrisman High School
Independence School District

"When I think of MPI, I think of no sleep. At first I didn't think I could get up so early every morning and also function mentally. Now I realize this is possible, but only sometimes. Although this complaint is reasonable, I am also glad I took MPI so that I could be prepared for college next year."

Michelle Bailey & Josh Titus
Truman High School
Independence School District

"MPI has been a great inspiration to me. I have never really had to work hard for a grade but with being in MPI, I have no time to slack off and I am persuaded to strive further."

Sherri Campbell
Van Horn High School
Kansas City MO School District

"My favorite thing about MPI is that I was allowed to meet and work with students from other high schools who have the same interests that I do. For this reason I have made several new friends. MPI has also made me realize the value of study groups, learn how to manage my time more efficiently, and it offered me a challenge I would not receive at Fort Osage. I will not miss the early mornings, cold classrooms, or the stress, but overall, I believe MPI has been a great experience."

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

"I think that MPI has been a great program for me. The class structure is different from any I've ever experienced before and that, combined with the stringent schedule here, has really pushed me to work harder than I have in previous classes."

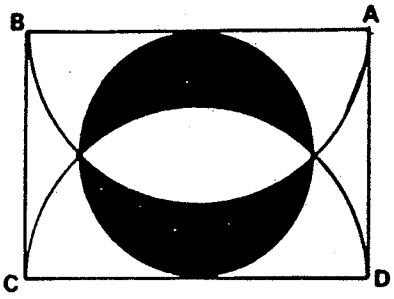
Suzanne Leslie
Truman High School
Independence School District

A SOLUTION TO MATHEMATICS CHALLENGE #57

Recall the problem statement:

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.

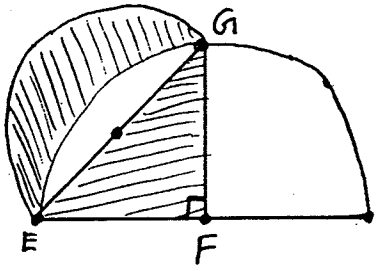
In the following sketch, ABCD is a rectangle, $AB=\sqrt{2}\cdot(BC)$, the two large semicircles have AB and CD as their diameters, and the center circle touches sides AB and CD, and passes through the two intersections of the semicircles as shown:



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

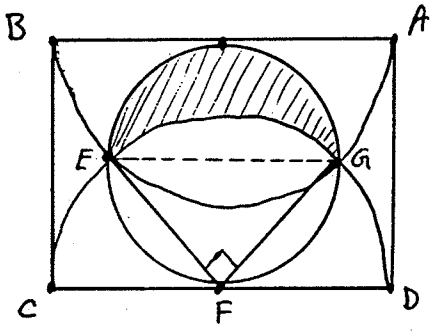
SOLUTION:

The neatest solution is to recognize here an application of the lune theorem of Hippocrates of Chios (c.440 BC), an ancient Greek mathematician. [See Chap. 1 of Journey Through Genius: The Great Theorems of Mathematics, by William Dunham, 1990, Penguin paperback, $14.00.] Hippocrates showed, as in the following sketch, that the area of the shaded lune below equals the area of the shaded right triangle below:



[**Proof**: By the Pythagorean Theorem, $(EG)^2 = (EF)^2 + (FG)^2$, and since EF, FG are radii of the same (larger) semicircle, they are equal, so we can rewrite: $(EG)^2 = 2(EF)^2$. Now the smaller semicircle (with diameter EG) has area $(1/2)\pi(1/2\cdot EG)^2 = (\pi/8)(EG)^2$. Finally, since the smaller semicircle (with diameter EG) shares an overlapping region (between E and G) with the larger quarter circle EFG, subtracting this shared region from both proves that the remaining shaded lune and shaded right triangle have equal areas.]

In our Japanese Temple Geometry problem here, note that the angle at F is a right angle since it is inscribed in the bottom semicircle EFG of the center circle. So, Hippocrates' theorem implies that the area of the upper shaded lune equals the area of the right triangle EFG, as labeled below:



Observing that as diameters of the center circle, EG (horizontal) = BC (vertical),
and recalling the given information that $AB = \sqrt{2}(BC)$, so that $BC = (1/\sqrt{2})(AB)$, we have:

Area (Triangle EFG)

$= (1/2) \cdot$ (horizontal base) $\cdot$ (vertical height)
$= (1/2) \cdot (EG) \cdot (1/2)\,(BC)$
$= (1/2) \cdot (1/\sqrt{2})\,(AB) \cdot (1/2)\,(1/\sqrt{2})(AB)$
$= (1/8)\,(AB)^2$.

Thus the total area of the two shaded lunes in our problem is: $2\cdot(1/8)(AB)^2 = (1/4)(AB)^2$, a very nice answer indeed.

A SOLUTION TO PHYSICS CHALLENGE #48

Recall the problem statement:

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.

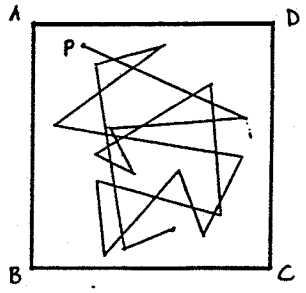
[From: Thinking Physics, Practical Lessons in Critical Thinking by Lewis Carroll Epstein, p.407]

SOLUTION:

The answer is: **c.** That is, the heat must go through both before it escapes (or the cold must come through both before it enters the bed). Heat flows from hot to cold places as electricity flows from high to low voltage. The blankets are heat insulators in series. Heat insulators in series act just like electric resistors in series. Suppose you have a big resistor and a little resistor in series (light bulbs can be used as resistors). Will more or less electricity flow through them if you interchange their order? Of course there is no difference. So understanding something about electricity lets you understand heat flow. Actually, heat flow was understood first and it helped people understand the flow of electricity.

MATHEMATICS CHALLENGE #58

Suppose S = ABCD is a square of side length 1, and inside S we draw a polygonal curve P (meaning P consists of only straight line segments), having total length greater than 10. P can be made up of as many line segments as you like, as long as their total length is greater than 10, and P could even intersect itself.



PROVE that some straight line L, parallel to one of the sides of the square S, must cross any such P at least 6 times.

HINT: Consider the projections (shadows) of the segments of P onto two adjacent sides, say AB and BC.

[Note: This question can be generalized if you like by replacing 10 by 2n, and 6 by n+1.]

[Modified from an exercise in Combinatorial Theory: An Introduction, by Street & Wallis, 1977, as reported by Honsberger in Mathematical Gems III, 1985, pp. 139-140]

PHYSICS CHALLENGE #49

HIGH VOLTAGE BIRD

Will this bird get a shock sitting on a bare high-voltage line?

a) Yes!

b) No

[From: Thinking Physics, Practical Lessons in Critical Thinking by Lewis Carroll Epstein, p. 409]

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