Mπ The Mathematics and Physics Institute NEWSLETTER

Director: Richard Waring
Mathematics Coordinator: Richard Delaware

April 1, 1995 Vol. 9, No. 5

YEAR 11 - THE FIRST YEAR OF OUR SECOND DECADE

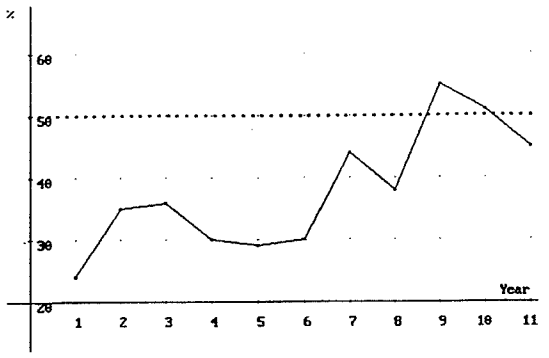
We began this year with a record MPI class of 86 students, out of whom 62 currently remain. In the past, 62 has been about what we started with! So, for the first semester we were forced to break our students into 5 sections instead of 4, have one high school mathematics teacher teach two sections, and hire a physics instructor. Although we managed, by the skin of our teeth, with barely enough physics lab set-ups and computers for calculus, we realize we may have to face increased numbers next year and beyond.

Although the MPI structure cannot handle more than about 90 students if we are to retain our level of personal attention, small section size, quality of instruction, and quality of students, we are pleased that our pool of potential students has grown, through a decision by the Kansas City MO School District to open the MPI program to district high schools other than just Northeast, East, and Van Horn. We may still have large numbers of students, but we can now hope that their quality will remain high.

In other changes, the new calculus textbook, **Calculus: Graphical, Numerical, and Algebraic,** has been a great success, as has the constant use by the faculty of a grading program, and we have learned to use our graphics calculators more wisely.

By the end of this 11th year, 536 students will have completed the MPI, of which 335 (62.5%) have been male, and the other 201 (37.5%) female.

The graph below shows the percentage of females finishing the MPI program, Years 1 - 11. The dotted line is the 50% mark.



CALCULUS READINESS EXAMS

During the first two weeks of April, and the first week in 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 Director by June 1.

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 expect that many of the approximately 157 students who visited us on our Recruitment Day Feb. 14 will decide to take the test.

RECRUITMENT DAY & A CONFERENCE

On Feb. 14, our Recruitment Day, we hosted 157 high school juniors, teachers and counselors from 10 different high schools. This is the largest number of guests yet, topping the 153 who attended last year. If as many students take the Calculus Readiness Test (see the article above) we will have next year yet another huge incoming class.

From April 4 - 9, Sheri Adams will attend the 75th anniversary national convention of the NCTM (National Council of Teachers of Mathematics) in Boston, MA. We hope she'll also get a chance to visit some of the MPI Alumni attending MIT, and other schools in the Boston area.

MATHEMATICS TECHNOLOGY REPORT

In the whirlwind of sheer gusto displayed by many mathematics teachers for the incorporation of graphics calculators and symbolic algebra programs into teaching mathematics courses, it is wise to remember that there are as many pedagogical dangers and student bad habits to be avoided as with all the other tried-and-true techniques of teaching mathematics.

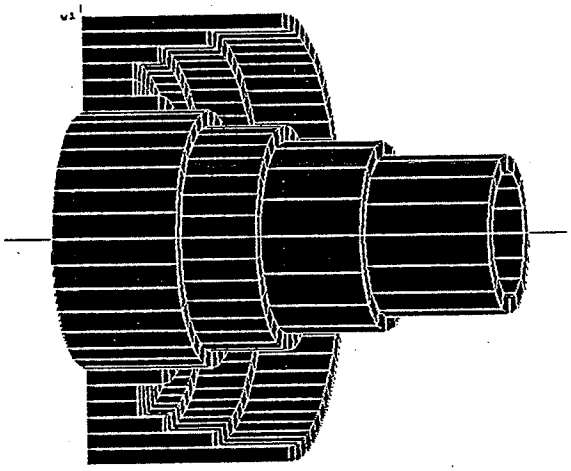
For instance, we have found that a sharp distinction must be drawn between what could be called RAM (Random-Access Memory) thinking and ROM (Read-Only Memory) thinking as applied to doing mathematics. "RAM" is what you hold in your head for quick and arbitrary access, while "ROM" is what must be looked-up elsewhere. As any experienced performer, whether in mathematics or not, can testify, the more RAM the better, since we can directly access our brains more quickly than we can access any outside source. However, our students, in their inexperience, need to be taught, or allowed to come to realize this fact.

Our experiment here at the MPI in the universal use of graphics calculators has made even more emphatically the point that RAM memory, i.e., real skill and thought, nearly always beats ROM efforts for speed, a valuable lesson in the limits of use of technology. If you can walk, then hopping along with a crutch, even a technologically superior one, is never faster.

EXAMPLE: Our students have discovered, as was inevitable, that they can type into their graphics calculators lists of equations, facts, etc. as "programs" that are not meant to RUN, but only to be read under EDIT. Yet, our impression is that test grades have not improved, in spite of what our students may think is their new, and enormous advantage. [Too much ROM, not enough RAM.]

EXAMPLE: In the computer lab, similar blunders are made. Assuming that every calculus computer lab assignment requires immediate, sole, and constant use of the symbolic algebra program turns out to slow our students down more often than not. [More ROM than RAM again.]

Of course this technology is enormously helpful when algebraic solutions are not easy or apparent, when rarely-used equations must be recalled, or when computing integrals would be tedious exercises. The fact that here at the MPI we've adopted the use of Derive and the SHARP EL-9300C graphics calculator attests to our positive attitude toward technology.



However we hope that in time our students will learn that only a blend of strategy, thought, and apt use of these "mathematical assistants" can forge an efficient, successful alloy of wisdom.

TO ALL MPI ALUMNI:

HAVE YOU GRADUATED FROM COLLEGE?

IF SO:
PLEASE CONSIDER BEING
AN **ENRICHMENT SPEAKER!**

CALL (816) 235-1272

ENRICHMENTS

FOLLOW UP

On Jan. 27th we had Anthony Hancock, a British chemist, and science administrator at Marion, Merrill, Dow, Inc. back to speak on **AGING: IT'S HAPPENING TO US!** Some specific student comments were:

--Some theories of how aging occurs include error accumulation of DNA in cells, damaged macromolecules, immune function loss, or apoptosis (it is written in the cells to die eventually). I loved his accent! He was a pretty good speaker. He knew what he was talking about.

--There are many opinions about what aging is. Other researchers are looking into the genes and DNA of different animals and humans. In some animals the cells only live a certain period of time. Then something in their body tells them to die. Internal programming, do humans have this? Human cells will split only 50 times. Yet, cancer cells will continue splitting forever. This and other questions are being researched.

--The speaker talked about the causes for aging. Aging is the decline of physiological function. It's probability of death, and the capacity to adapt to stress. The decline of the immune system causes colds to last longer, cuts or injuries to heal slower. The things that cause damage are radiation, free radicals (those are violently oxidized molecules), and glucose. A person who is in the 3rd trimester (of life) has 50% more oxidized cells than a person who is in the first trimester. The enrichment was interesting and very instructive. I liked it.

--I found it interesting to learn that a gene may be responsible for determining life span. The idea of free radicals produced by exercising that can attach to the body was new and astonishing to me. We are constantly reminded to exercise and stay in shape; yet if our systems that fight off free radicals were to shut down, we'd be in trouble.

--This was an excellent presentation given by a very knowledgeable and interesting doctor. I could tell he was experienced in giving presentations and also had an understanding of the psychology of learning.

On Feb 10, Lori Hill, Senior Software Engineer at Wilcox Electric Inc., just back from Paris, France, spoke on **LANDING PLANES USING SATELLITES: THE GLOBAL POSITIONING SYSTEM.** Students responded:

--This was a very interesting lecture. I had no idea that technology had advanced so far. This was fascinating, and I had no idea the calculus could be so useful. I'm sure this was absolutely wonderful for those students who have ambitions of becoming engineers.

--The system is accurate to within 100 meters. GPS uses 2 satellites to find latitude and longitude. It uses a 3rd satellite to find altitude.

--Since I was a little girl, I have ridden on planes. Before this enrichment, I had never really thought about how planes landed. I figured there was some kind of a tracking system, but I had no idea the system was so complex and sophisticated. I was astonished at the degree of error the federal government allows and was more astonished at the degree of error that the federal government inserts into the (GPS) system. I found the Wilcox Landing System to be phenomenal and was impressed with the accuracy. This was a very informative enrichment.

--She talked about the way airplanes land solely by instruments. She said there are about 31 satellites that the GPS system uses, and usually 8-10 are in sight at a given time. Ms.

Hill gave a little sales pitch about the Wilcox System to correct the natural errors in the GPS system. I am amazed at how accurate the GPS system is.

--The most interesting part of her talk was when she was describing to us how "someday" we will all have devices for our cars that will keep us from getting lost, find gas stations, etc... and so forth. The way it's used now - in airplanes - didn't really mean much to me, but when she brought it down to our automobile level, she caught my attention.

On Feb. 24, Ed Kiker, a Harvard graduate who majored in Lunar Geology, and a member of both the National Space Society and the Space Studies Institute, returned to speak on **ENERGY FROM SPACE.** Student comments were as follows:

--This was definitely one of the best enrichments we have had. I was very impressed with the scope of information that was provided. What I enjoyed most was that the speaker dealt with the technical aspect and the application of these techniques. I also found the information about the simulated space stations for children very interesting. I feel this is a wonderful idea and believe the project will be very successful.

--From lunar rocks, helium-3 can be mined. Helium-3 would be an ideal product for fusion reactions. It's rare on earth because the atmosphere blocks the solar wind. The concentrations on the moon though, could be used to provide worldwide power for about 4,000 years (from fusion reactors) with about as much total waste as what comes from a hospital CAT-scan. Another future power source will be solar power attained in orbit and transmitted with low density microwaves.

--One of the most interesting speakers we've had!

--Ed talked about a museum exhibit for children about space (the Wonder Scope Museum). He explained where the future was headed concerning space. Mr. Kiker mentioned an alternative energy source found on the moon, Helium-3, and how man could live on the moon using the resources available. Mr. Kiker was an excellent speaker on an interesting topic that I thought was dead - living in space. He seemed to capture everyone's attention in the audience. This enrichment opened up a whole new field of career opportunities in my mind.

--He works with Wonderscope museum, teaches science for kids. This has been the best enrichment so far. He was interesting and the material was awesome. The only improvement would be actual slides of the museum when it is finished.

--This was fantastic. I really enjoyed this enrichment. I was fascinated at all of the development that has been made in the past few decades. He was very logical and presented a lot of information. He was very open to suggestions and also very descriptive about the museum and space itself. He gave us a lot to think about.

--The moon has many minerals on it that we considering mining. We must send "camps" of men there to do the work though, so Mr. Kiker told us about what a lunar habitat will be like. They will be underground, protected from harmful rays and solar winds.

--I was surprised to learn that walking on the moon could be dangerous and that you could be injured from jumping on the moon. I was also amazed by the efficiency of helium three as compared to what we use now. The moon visitor's center was a very great idea.

--I enjoyed this enrichment thoroughly. I've always found space information to be very interesting, and I was impressed that Mr. Kiker was devoting his time and energy to inspiring future children. His ideas for hands-on learning experiences were quite impressive. I think many children will feel privileged to learn from his varied exhibits. Hopefully, what they learn about life on the moon from Kiker will stick with them for years to come.

--Will we ever live on the moon?

On Mar. 3rd we took our first Field Trip to the **UMKC PHYSICS DEPT.** to tour their laboratories in:

1. High Pressure Physics
(Michael Kruger)

"The high pressure laboratory ... is capable of applying pressures greater than 1 million atmospheres on samples of interest... There are 3 motivations for our work. The first is purely curiosity driven, to understand why and how matter reacts under such extreme compression. In the past this type of research has proven valuable in obtaining both a basic understanding of Nature as well as eventually resulting in technologically useful products. The second reason is applied, to try and synthesize novel and useful materials under high pressure. The third reason is to better understand the workings of the planets. Most of the material in planets is subjected to extreme pressure (for example, the pressure at the center of the Earth is at 3.6 million atmospheres) and behaves far differently from matter under ambient conditions. Thus, in order to understand the dynamics of planets, it is first necessary to understand the material properties of the matter within the planets.

High pressures may be achieved by using a device known as the Diamond Anvil Cell (DAC). Material is placed between 2 diamonds and a force is applied to both of the diamonds. Extremely high pressures may be achieved because diamond is very hard, and the samples that we study are very small. Remember that pressure = force per unit area (P = F/A). For extremely small samples, A is very small and the result is that the pressure P is very large, even for moderate forces. Through the use of the DAC, pressures of 5.5 million atmospheres have been achieved. Since diamond is transparent, we can visually study the samples as pressure is applied."

2. Photoelectron Spectroscopy
(Dave Wieliczka)

"The biological materials being studied have applications in the areas of restorative dentistry, implants, and bone growth. The field of dentistry is constantly trying to improve the materials used for restorative work. The development of a material to produce a stronger bond between the restorative and the tooth surface would provide a stronger and longer lasting restorative. The use of implants is becoming more common in both dentistry and orthopedics. Current implants are roughened surfaces of titanium which have been shown to not be incorporated into the body. Research is active in trying to coat the surface of the implant such that bone grows on the surface and incorporates the implant more intimately to the body. In all of these areas the chemistry at the surface is crucial in understanding the success and failures of the materials used for the various procedures."

3. Photoluminescence
(Jerzy Wrobel)

"Studies of optical properties of matter allow the scientist to predict the applicability of various materials for electronics (diodes, transistors, integrated circuits, ...), opto-electronics (lasers, light-emitting diodes, light detectors, ...) and optical devices (dye and solid state lasers, optical memory, optical processors, ...). Generally, a branch of science called optical spectroscopy is used to study optical properties. It includes measurements of absorption, reflection and emission of light by substances. In the photoluminescence lab you see the equipment required to perform spectroscopic studies at temperatures ranging from 2K (liquid helium) to 300 K (room temperature). You see luminescence of a semi-conductor (CdMnTe) at liquid nitrogen temperature and the spectrum of a mercury lamp."

4. Low Temperature Physics & Scanning Probe Microscopy
(Da-Ming Zhu)

"Low temperature physics: Here we measure the thermodynamic and electrical properties of different materials from below 1 K to 300 K.

Scanning tunneling and atomic force microscopies: We try to observe the configuration of single molecules absorbed on a substance. We measure surface forces with a sensitivity of 10^{-12} Newton."

5. Nuclear Spectroscopy
(John Urani)

"Energy spectra of gamma ray photons obtained using Na-I (Sodium-Iodine) detectors and a multichannel analyzer are shown for several radioactive isotopes including Cs^{137},

Na^{22}, Co^{60} and Sr^{90} - Y^{90}. The method of coincidence counting of emitted radiations is also demonstrated on the same analyzer system."

6. Computer Simulations & Chaos
(Jim Phillips)

"The application of contemporary mathematics to modern physics and engineering problems has experienced a revolution because of the advances in computers. Demonstrations and hands-on computer experiments are available. A brief discussion covers developments in nonlinear systems and chaos."

Here's a sample of what our students had to say about this field trip:

--I was impressed by the different speakers and their willingness to take time out to work with us. I especially enjoyed this enrichment.

--My favorite was the one about photoluminescence because I saw the way different items glow, and I also liked the guy's accent.

--I had the impression that the physics professors are somewhat like "lab rats" - they have to scrounge around and scavenge equipment to use in the student labs.

--We saw expensive equipment in several labs. We saw a super-conductor repel a magnet and make it float in the air. We also saw a computer-generated image of the surface of an atom. We saw the spectrum of radioactive substances. There were also cool lasers there.

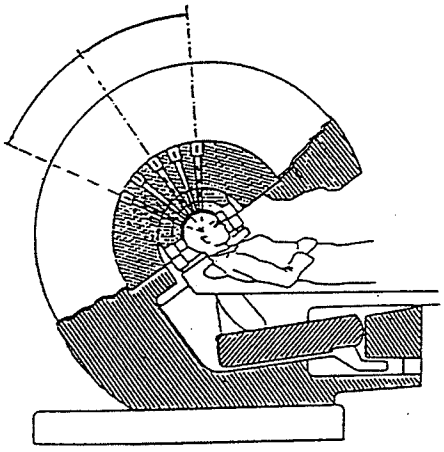
--Each room had computers in it. The physics experiments would be extremely hard to accomplish (without them). The computers give more accurate results and help to reduce error. All of the equipment is very sensitive and expensive. One such machine could actually trace over an atom - amazing!

--We went to several really neat labs. I liked the one on high pressure physics. He told us how diamonds are made and how much pressure he could get from his devices. I also liked the lab about cryogenics and the neon light. I really enjoyed the entire trip and hope to make more in the future.

--The visit to UMKC was an insightful one. Not only did it pique my interest, but it also enhanced my knowledge on specific aspects of physics. Each department had a type of lab we were able to watch or participate in to make learning more fun. This was the first enrichment that allowed for hands-on experience. There should be more like this one.

Finally, on March 24, nurses Beth Rice and Kim Moehle, with Physicist Stephen Slack, from the Midwest Gamma Knife Center at Research Medical Center in Kansas City joined us to speak on **NEUROSURGERY FOR THE 21ST CENTURY: THE GAMMA KNIFE.** (We'll have student comments in the August issue.)

The Gamma Knife aims 201 sources of Cobalt-60 photon (gamma) radiation at the specified target in the brain, sparing surrounding healthy tissue and other critical structures. These sources are focused on the brain tumor or vascular (blood vessel) malformation, and combine either to scramble the genetic code of the tumor cells, or to shrink the vascular malformation. The radiation dose is planned by a neurosurgeon, a radiation oncologist, and a medical physicist using state-of-the-art computers, and is tailored with high precision (using CAT scans, MRI images, etc.) to each patient's individual abnormality. The result is a therapeutic dose of radiation without the risk, pain, recovery period, or expense of traditional surgery.



The best size of a region for the Gamma Knife procedure is less

than 3 centimeters, and the treatment is available for a wide variety of neurological conditions, such as: Arteriovenous malformations (tangled arteries and veins) of which about 87% are completely obliterated in 2-3 years; Acoustic Neromas (tumors of the cranial nerve for hearing), with a control rate of 93%; Benign Tumors previously considered inoperable; and, Malignant Tumors of various sorts.

UPCOMING

Our speaker for April 28 is not yet confirmed, but will be either Bruce Barker, a professor of oral pathology in UMKC's Dental School, or Shelley Wolff, a Civil Engineer specializing in Highway Design.

Sun. May 7 will be our annual **WORLDS OF FUN PHYSICS DAY.**

Finally, we'll hold our annual **PICNIC/BREAKFAST** at McCoy Park on Wed. May 17, and our **AWARDS PRESENTATION** on Thurs. May 18, the last day of the MPI this year.

MPI E-MAIL ADDRESS:

rdelaware@cctr.umkc.edu

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

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) Audrey (Linville) Fox
apf1@psu.edu
PENN STATE UNIV.

(88-89) Jon R. Fox
fox@hbar.phys.psu.edu
PENN STATE UNIV.

(92-93) Andrea Slusser
MGBWO1C@prodigy.com
UMKC (soon KSU)

(93-94) Phanna Ly
phanna@umr.edu
UM-ROLLA

(93-94) Daisie Riley
daisie@umr.edu
UM-ROLLA

THE AUGUST 1995 ISSUE

The August 1 Mπ Newsletter will list the top ten MPI students for 94-95 and all those receiving awards at our May 18 Awards Presentation.

There will also be IMPORTANT INFORMATION and advice for the YEAR 12 class of 95-96. TAKE NOTE!

WE HEAR FROM PAST STUDENTS

DANIELLE GLOSSIP (89-90)
(BA, Anthropology,
Grad. School - Univ. of IL)

E-mail received 2-16-95:

"I am now in graduate school for Biological Anthropology at the University of Illinois at Urbana-Champaign. This is my first year here. I just graduated from Washington Univ. with a BA in Anthropology in May of 1994. I am doing very well in my courses here. I am now taking primate life histories, human evolution, an independent reading course criticizing The Bell Curve, and tropical forest ecosystems. I enjoy my classes, but unfortunately, I am feeling quite tired of taking classes. That is why I am taking a year's leave of absence beginning in May (this is not yet known to my advisors here, however, but they will be told soon).

I have been offered a job in St. Louis, at Wash. U., with my biology advisor, Jonathan Losos. The job will last about 18 months, and my job is formally called "Lab Technician". However, I will not be just any Lab Technician, I only will be doing the normal lab. tech. duties for 9 months. During the summers of 95 and 96, I will be introducing new populations of collared lizards to new glades in Missouri at a few sites 1-2 hours away from St. Louis (south). I will track them after I release the founder populations, and follow up on a project that I have been doing since the summer of 93:

home range tracking on a small population of collared lizards (about 35-40 animals) at Victoria Glade, in Hillsboro, Missouri. I am really excited to get back onto the lizard project. I thought I would have to forget it for a few years until I got my Ph.D.

I just don't know what I am really interested in anymore. One day, I am interested in NOTHING, the next, I am hot on the primate ecology and behavior stuff, the next, lizards are IT, the next, I want to forget education and start a band (me as lead singer, of course), and the next, I want to explore new areas that I have never before thought about, such as psychology.

I am 22 years old, and I am already in a Ph.D. program. Does that seem right? I think it is crazy. We are forced to decide what we want our life's work - and often in academia, life's love - to be, and there is just no way to know when you are only 22 years old. I may need more than a year off to figure this one out... but for now, I am just glad to be moving back to St. Louis."

E-mail received 2-27-95:

"Thanks for the reply. It is really nice to hear from you.

First, I would like to respond to some of your inquiries:

Biological Anthropology is slightly different from physical anthropology in that we deal with living animals - studying primate behavior, ecology, locomotion, distribution, life history, etc. etc., paleoanthropology and the study of modern human populations and osteology are better referred to as physical anthropology. In sum, I guess we (primatologists) are biological anthropologists because we deal with our work just as evolutionary biologists/ecologists/ animal behavioralists/etc., who would be over in the biology department, would deal with their work. It is all very cut and dry. Little room for strange interpretations as people get when they get a tiny piece of a miocene hominoid, for example, and try and determine locomotion, brain size, body size, ecology, distribution, etc. from that.

Well, I, too, am glad to be taking a year off. My surrogate advisor (my formal advisor is still in Costa Rica) approves, but he, too, wants me to keep in extremely close contact. He - and I - see this as a learning year. I plan to learn how to perform and interpret DNA fingerprinting, plus I want to learn how to use every possible software program I can get my hands on (i.e. MacClade, SAS, measuring programs, etc. etc.). Jonathan has more software in his lab than I even know about, plus two extremely powerful new Macs and two PCs. I am "fluent" on both, luckily, but I just want to learn everything I can right now. I don't feel really computer literate. Anyway, Steve (surrogate advisor) suggested that I do a fingerprinting project on how inbred the baboons, chimps, etc. are at the St. Louis Zoo. In essence, I would not take a leave of absence if I do this, I would be a part-time student who did all correspondence on the amazing Internet (also something I need to learn more about - I only know how to send letters). I just have to wait and see if my formal advisor, Paul thinks that it is a good idea. I haven't heard from him yet, as he has been having trouble accessing his e-mail in Costa Rica, but he is due back late this week, I believe.

So how are the students this year? Smart, I hope. Do you realize that I don't remember anything about calculus - or physics, for that matter - any more. I do, however, remember things from courses that I took with Al Morse - more conceptual stuff.

Anyway, I need to meet with Steve now, so I must run.

Thanks again for writing back!"

SHERI HARRISON-SMITH (90-91)
(Mathematics Major)

"I am preparing to move from our current home in Germany to a base (Air Force) in the United Kingdom; Mildenhall, England, to be exact. We are also eagerly awaiting the arrival of our 1st child in early April.

The instructors at MPI give much more individual attention than instructors at other colleges. At UMKC, the classes are so large, it's

impossible to do that! The current MPI students need to realize its not going to be so easy once they are in college, and they should appreciate the instructors at MPI for all that they do.

I'm happy to hear you all are still going strong! Keep up the good work!"

TODD CARTER (91-92)
(Drafting and Design Major)

"I have only taken a limited number of math courses since high school, but I can say the MPI courses are a step above the rest, simply because the instructors are more concerned with your success.

I regret to say that I didn't take MPI as seriously as I should have. I was a senior and had a bad case of burn-out. My plans for college at that time kept changing as I was a little uncertain what the future held. I did not understand how calculus could improve my status in life. However, I understand now, that you will get out of MPI what you put into it. And if you end up not going to college at least you will learn the importance of commitment. NEVER SLACK OFF (it's not professional). Luckily for me the Army helped me to understand the importance of commitment before I messed up too bad. I learned that if you don't give up, you will succeed. I am currently cured of slacking off, as I work full time as a baker while working towards a design career part time, and I have recently worked my way into a flight position (with the Army) placing me with the responsibility of the safety of several personnel and a $16 million helicopter.

Stress the point that you can't go through life expecting opportunities to find you. You must go out and work for it."

ANDREA SLUSSER (92-93)
(Architectural Engineering Major)

E-mail received 2-10-95:

"Hi! I hope this little note finds everyone well and enjoying the new semester. Unfortunately, I was unable to return your mailer in time for it to be useful, but I did receive it. I was mid-semester major changing so things were quite hectic. After MPI, I swore I would never open a calculus book again well... I was wrong. I traded in my art set for an engineering set in November. Architecture just wasn't what I wanted. I actually missed the calculus, and most of all I missed objective grading. I found Architecture far too ambiguous and subjective for my taste.

I left UMKC at semester, since they don't have the program I have decided to follow. I have decided on Architectural Engineering, the best of both worlds. Therefore I am picking up classes at Longview this semester, back to basics. I am taking Calculus I over again, only as a refresher since it has been a while. Incidently, I took physics over again last year. The professor was terrible, class average was 42%. I was not much higher than that. This was at UMKC by the way, and I must say you guys were much better than this guy. I have recommended those of you who teach at the University to fellow classmates and needless to say when they took classes from those of you they were much more successful. Just goes to show what a success the program is.

I may not have appreciated the work, or the exams while I was there, but I certainly do now. I wish there were other programs similar to that of MPI for other areas for the students qualified. It gave me an inside peek at college, not to say MPI was as intense as college, but that it started me on my way and helped prepare me for what has proven the biggest challenge in my life. Competition in Architecture was fierce, as I understand Arch. Engineering is as well.

I will be departing for Kansas State in August. That is where I will complete the Architectural Engineering program, so I wish everyone luck in this new semester, and if I fail to ship word before I leave, good luck next year!! Keep up the good work at MPI!!"

SOME FINAL 1994-95 STUDENT IMPRESSIONS

"MPI is not that easy, especially for Asians. My only

suggestion is keep up with your homework. Don't give up! You will find a good result if you save some time every day to study and do your problems. Good luck!"

Lam Phan
Northeast High School
Kansas City MO School District

"MPI is tough, it's hard work, and it will take quite a bit of effort, but it's worth it. Not only will you learn something about calculus and physics but also skills like time management, self-discipline and studying. Total responsibility is placed on the student. MPI has provided a very strong foundation from which I feel very secure about college next year. Do it, you won't regret it."

James McIntosh
Truman High School
Independence School District

"I still remember coming for the first week to MPI, a time that I didn't understand a single word Mr. Delaware would say and thought I never would be able to understand it.

To compensate the lack that I suffered in class, I would stupidly study hours and hours each day. Basically my life was being lived towards MPI until I realized and learned the right method to study. Since then my grades are much better, which obviously influences my opinion about this place.

If I owe something to the teachers working here, I definitely owe them a method and a theory, numerous times repeated by Mr. Waring and written in capital letters on the board: 'You may be whatever you resolve to be'."

Pipa Leite de Castro
Foreign Exchange/Portugal
Truman High School
Independence School District

"Being at MPI is an exasperating but rewarding challenge. You get college credits free, and even if you don't do good, you still get the material that will help you if you take the class again when you're enrolled at a college or university.

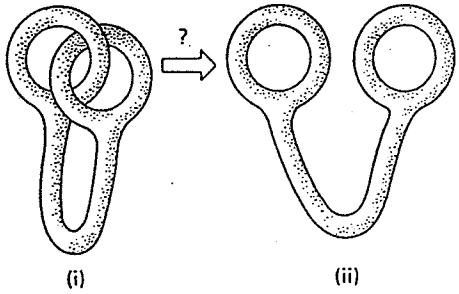
All through high school, I never had to study, and I always felt out of place. Here, I'm around my intellectual peers. This program is a great experience and shouldn't be passed up for any reason."

Jeleania Fields
Paseo High School
Kansas City MO School District

A SOLUTION TO MATHEMATICS CHALLENGE #37

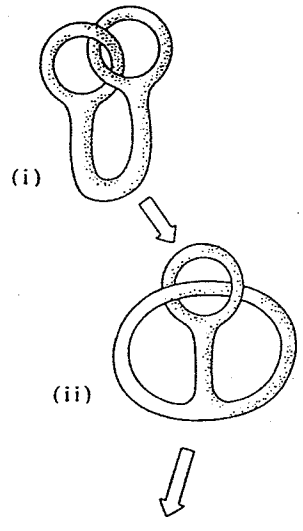
Recall the problem statement:

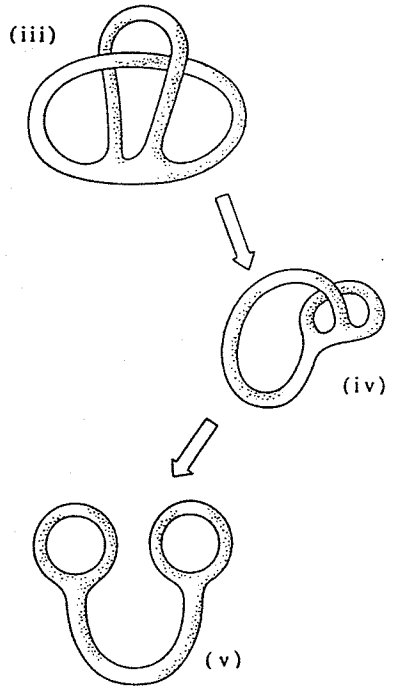
Imagine that figure (i) shown below on the left is made of perfectly stretchable, elastic material. Can you deform it into figure (ii), the one on the right, by stretching and manipulation but without cutting or tearing it? [Either show how it can be done, or prove it can't.]



SOLUTION:

Behold!





[From: All The Math That's Fit To Print, by Keith Devlin]

A SOLUTION TO PHYSICS CHALLENGE #28

Recall the problem statement:

SATELLITE OF THE SUN

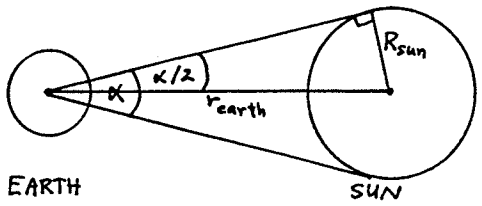
Calculate the minimum period of revolution of a spaceship around the Sun, given that the angular size of the Sun as seen from the Earth is $\alpha = 9.3 \times 10^{-3}$ radians.

SOLUTION:

First, let T = the <u>period</u> of revolution of the spaceship around the Sun, and r = <u>radius</u> of its orbit around the Sun. We are looking for T_{min}, the <u>minimum</u> period of revolution of our spaceship around the Sun.

Now, Kepler's 3rd Law, which holds true for the period and orbital radius of <u>any</u> object in orbit around the Sun, states that: $\frac{T^2}{r^3} = K$, a fixed constant not depending on the specific object. So, to find K we can just calculate the left side for any object in orbit around the Sun, such as the Earth, for which we know $T_{earth} \sim 365.25$ days (= 1 year, of course!), and $r_{earth} \sim 1.5 \times 10^{11}$ meters, so $\frac{(T_{earth})^2}{(r_{earth})^3} = K$.

Rewriting Kepler's 3rd Law as $T^2 = K \cdot r^3$, we see that T_{min} occurs exactly when the spaceship's orbital radius is at a minimum, meaning $(T_{min})^2 = K \cdot (r_{min})^3$. But, $r_{min} = R_{sun}$, the radius of the Sun, and since we are given the angular size of the Sun as seen from the Earth, $\alpha = 9.3 \times 10^{-3} = .0093$ radians, we see that:



So, $r_{min} = R_{sun} = \sin(\alpha/2) \cdot r_{earth}$.

Thus, $T_{min} = \sqrt{K\,(r_{min})^3}$

$$= \sqrt{\frac{(T_{earth})^2}{(r_{earth})^3}\left[\sin\left(\frac{\alpha}{2}\right) r_{earth}\right]^3}$$

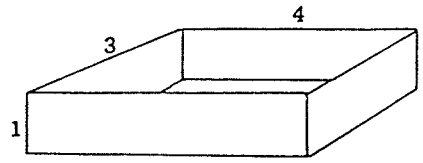
$$= \sqrt{(365.25)^2 \sin^3\left(\frac{.0093}{2}\right)}$$

$\sim$ .1158 days
$\sim$ 2 hrs 47 min.

[From: Quantum Magazine, Jan./Feb. 1995, p. 23]

MATHEMATICS CHALLENGE #38

A man has a bowl (not pictured) that holds a little <u>more</u> than a pint, and a flat rectangular straight-sided pan that holds <u>exactly</u> a pint, as shown below. He wants to put exactly 1/3 of a pint of water into his bowl, but he has no other means of measuring anything. He does have a supply of water and an ordinary kitchen table with an exactly level surface. How can he do it?



[From: Mathematical Brain Benders, by Stephen Barr]

PHYSICS CHALLENGE #29

TWO TEN-CENT BETCHAS

A dime is on the table beside a glass of water. Hand someone a straw and say, "Betcha can't pick up the dime with this straw and drop it into the glass."

Follow this with, "Betcha can't drop the dime several inches to the table so it lands and stands on its edge."

How would you do these and so win your bets?

[From: The Physics Teacher, Jan. 1995, p. 51, by Martin Gardner]

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