YEAR 13 DRAWS TO A CLOSE

Although this winter has felt like the longest in history, with the MPI missing 5 days of class due to bad weather, one of the bright spots has been the full commitment of the Kansas City MO District to actively advertise the MPI, and to encourage students to be tested from all 10 of its high schools. We look forward to a wide and robust participation from KCMO for Year 14.

We also arrive at the end of this year with 53% of our remaining 47 students being female, as seen in the graph below. Clearly, over the last 5 years we have reached gender equity.
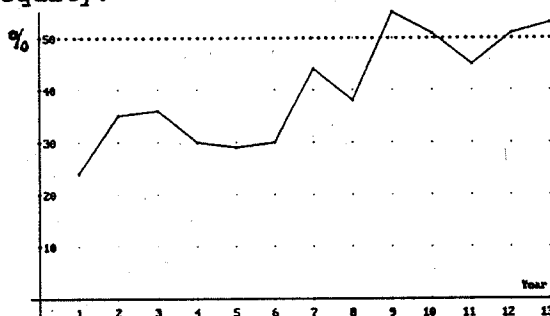
For next year we'll be upgrading graphics calculators, and selling off any current stock we still have, though we won't announce the new model here until the August issue. Also on the horizon is an MPI web site.

Finally, to all our readers: Have a good summer, and feel free to contact us at any time!

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 Director, all by Friday, May 16 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 132 students who visited us on our Recruitment Day Feb. 11 will decide to take the test.

ODDS AND ENDS

1. On March 12, the Mathematics Coordinator spoke to a meeting of the Kansas City MO School District high school and middle school chairs of mathematics and science, passing on information about the MPI. We hope that this will encourage the 10 KCMO District high schools to gather students to test for next year's MPI class.

2. On Sun. March 16, Jim Graczyk and Roy Cook represented the MPI at a table in Bartle Hall for the "Challenging Children" KCMO District event.

3. Sheri Adams has become a member of the NSF Missouri Undergraduate Faculty Enhancement Project designed to provide opportunities for undergraduate faculty "to review and consider the implications of emerging secondary and undergraduate curriculum reform/materials." She will be working with faculty from CMSU and NWMSU as they plan conferences for 1997-1999.

4. On Feb. 11, our Recruitment Day, we hosted 132 high school juniors, with about 15 other teachers and counselors, from 10 different high schools: Center Place Restoration, Central, Ft. Osage, Lincoln, Northeast, Paseo, Southeast, Truman, Van Horn, and Wm. Chrisman. Among the additional teachers were 2 members of the Gifted and Talented Dept. of the Kansas City MO School District.

THE AUGUST 1997 ISSUE

The August 1 Mπ Newsletter will list the top ten MPI students for 96-97 and all those receiving awards at our May 15 Awards Presentation.

There will also be IMPORTANT INFORMATION and advice for the YEAR 14 class of 97-98. TAKE NOTE!

ENRICHMENTS

FOLLOW UP

Our **Feb. 7** speaker was Sam Gill, an instructor at Johnson County Community College where he teaches Critical Thinking. He has also written for The Skeptical Inquirer magazine. His topic was **UNSOLVED MYSTERIES**, and he provided the following handout:

" **UNSOLVED MYSTERIES**
(do not have to baffle us)

JUST ASK YOURSELF: 1) *Why* do I believe what I believe? 2) What is the evidence *in favor* of that belief? 3) Is that evidence *any good*?

IN JUDGING THE *QUALITY* OF EVIDENCE, REMEMBER: 1) The burden of proof is on the *claimant* -- it's not up to you to *disprove* some claim. 2) Extraordinary claims require extraordinary proof. 3) Always look for the *simplest* explanation.

--Learn to distinguish *sound evidence* from *wishful thinking*.

--Be able to ask yourself "Is it possible I might be *wrong*?"

--Don't confuse something that's *possible* with actual fact.

--When you see a convincing demonstration of some paranormal power, ask yourself "Is it more likely the demonstrator has strange powers unknown to science -- or is it more likely the demonstrator just knows a trick or two I don't?"

--Apply the *same* evidence to something you *don't* already believe in, *then* judge how good you think it is.

--REMEMBER: *Sincerity* is not evidence; *conviction* is not proof.

--In judging the credibility of testimony, ask yourself, "Would I be influenced by such testimony if I were sitting on a jury making a life-or-death decision on a capital crime?"
     -BE PREPARED FOR
     STARTLING CONCLUSIONS-   "

Some student comments were:

■ He gave us a questionnaire and we talked about the unsolved mysteries on it, like reincarnation, the lost city of Atlantis, aliens, the Bermuda Triangle, etc. An Ad Verecundium is someone who says "I have experienced this so you should believe me." I

found him to be really interesting. His examples and evidence were really good.

■ An open mind is the ability to change. By using the scientific method you observe, form a theory, predict and test. If all of this works out you have a fact. Evidence must be in favor in order for people to believe. Wegener and his continental drift theory was not believed at the time, but more evidence has changed that. Belief does not make something true.

■ Mr. Gill said that if we are able to make critical judgements we won't be deceived into believing things that are not true. This enrichment made me realize how important good judgement is. Without good judgement, we could lose our legal and human rights.

■ Keep an open mind in discussing issues. Look at the evidence before making a judgement. Evidence is what changes people's minds.

■ He was very energetic in his approach to unsolved mysteries. He was interactive in his attempts to make us think critically. It was a subject to work with; always changing and never staying the same over a period of time.

■ For anything to be scientifically proven, it must be repeatable (experiment-wise). All in all, it was very thought-provoking. I was extremely tired and not once did I even start to doze... maybe it was because the lights were on. He was interesting and animated and seemed to have a good grip on the material he was presenting.

■ There are many things in this world that just couldn't be solved easily. This calls for a person like Sam Gill. To become a good solver you have to have an open mind, look for simple explanations first, and listen to the burden of proof without judgement. It just takes brain power to make decisions like this, but I think it's really fun. GREAT!!

■ Mr. Gill talked about different levels of evidence and three major questions that we must ask ourselves about unsolved mysteries. It was interesting to take apart famous mysteries and actually look at the hard evidence. I believe I had a

problem with distinguishing between something being possible and something being actual. I believe these concepts and steps will drastically improve everyone's critical thinking skills and judgement calls. Thank you Mr. Gill, for giving us a bibliography — now we can look up some of these concepts for ourselves. Excellent job!

_____

■ This response from **SAM GILL** arrived 2-23-97:

"Thanks for the opportunity to speak to your class. I thoroughly enjoyed it and I hope they did, too. Judging from the "selected" comments I received (I hope you didn't feel you had to *edit* anything for me!) it looks as if they had a pretty good morning as well.

It's hard to elicit student participation, interest and retention at 7:30 AM on *any* subject, but I was very pleased to see how much those who commented got out of "Unsolved Mysteries". I had thought my involvement with this particular class had just about run its course after 16 years, but your college class and another one I'm now giving to adults may cause me to reconsider. There's surely a need and some student receptivity, too. Maybe we're not entering a new Dark Age after all...

Anyway, thanks for letting me come, and sharing the student responses. You seem to have a good group there, and they were very nice to me.

Sincerely, Sam Gill"

_____

Friday, **Feb. 21,** UMKC Mechanical and Aerospace Engineering Professor Craig Kluever spoke about **THE SPACE SHUTTLE & NEW SPACE MISSIONS.**

Students responded:

■ He specialized in solid rocket boosters. His job was to simulate and analyze the separation dynamics of the space shuttles. (Control systems are used to control or guide a vehicle along a certain trajectory.) I thought it was kind of interesting to hear about some of

Kluever's experiences, and the way different parts of a space shuttle work.

■ Mr. Kluever said the biggest satisfaction he has had being an engineer, was working on the software for the first space shuttle to take off after the 1986 space shuttle accident. He said it was exciting to turn on the TV and see the shuttle he worked on take off. I learned some very interesting things from this enrichment. I was unaware that there were solar powered space shuttles. I was also unaware that aerospace engineering had so many job opportunities.

■ He told some of his life leading up to his job at Rockwell. While there, he was on the guidance and navigation systems group. They wanted to make the current G & N system better. It was a change to have a professor in the field of study that he talked about. The way he put it wasn't a lecture, but his experiences in life, the real purpose of enrichments. It was a good change.

■ Mr. Kluever basically explained to us what his occupation was. His job is to design programs and projects to improve the aerospace program. Practically, he's been to the major space centers in the U.S. He worked in California for 3 years designing a new program and space craft. This is a very successful guy.

■ He is a very good speaker and tells everything so it is easy to understand and is clear.

■ He worked with the space shuttle and its systems, particularly the ascent phase and the guidance, navigation, and control system. The guidance, navigation, and control system is extremely complex. He is continuing to work in research for NASA. It is possible to go to a decent engineering college and get into the aerospace field. This was an interesting subject.

■ Occasionally, he got to go to Johnson Space Center to work with the flight simulator and the astronauts. He got to do final verification on the first shuttle mission after the Challenger. The speaker also told us that he helped research ion-based propulsion and solar energy in shuttles. He has been directly involved with shuttle mission

concepts and even had one of his mission ideas presented to NASA (it wasn't approved). He enjoyed his past job, but has also found working at UMKC to be interesting. He does a lot of these same things he used to do, even though he's at UMKC.

On Friday Mar. 7, we made our third annual trip to the **UMKC PHYSICS DEPARTMENT.** We toured laboratories in: **Surface Physics** (Dave Wieliczka), **High Pressure Physics with Diamond Anvil Cells** (Michael Kruger), **Atomic Force Microscopy** (Da-Ming Dhu), **Photo-Luminescence** (Jerzy Wrobel), and **Scanning-Tunnelling Electron Microscopy** (Fred Leibsle).

Students commented:

■ I learned that you can freeze ice at room temp. by putting it under extremely high pressure and can create diamonds by placing granite under high pressure too. We also got to see actual pictures of molecules and atoms. It was so cool looking, I've never seen a picture of an atom before! We were also shown how they make semi-conductors by using lasers. Another professor worked with the reaction of atoms to a surface area. The practical use of this research was trying to discover a way to create faster computer chips and CPU's.

■ At the physics department at UMKC, we went to five labs. At each one, we saw and heard about a different experiment or project that was being worked on. Essentially, the idea behind all these experiments is to find ways to benefit mankind somehow. I learned a lot from this trip, and I do recommend it again for next year.

■ We learned about surface scanning and tunneling microscopy from two professors and we learned how scientists detect luminescence. My favorite part was the black gook that was liquid in normal surroundings, but was solid when placed in a magnetic field.

■ I was really interested in the High Pressure Physics Department. The speaker demonstrated how a certain substance would solidify in contact with a magnet, and how it would liquify without being in contact with the magnet. He explained that in ten years this substance could be used to

create a longer lasting brake system for some vehicles. I believe that this trip was very insightful. I learned that by applying the laws of physics, new inventions and discoveries about the world around us can be made.

■ In one lab they put things into a vacuum and they studied electrons by firing a laser into that object, and studying the electrons that came off. Another one showed us how they studied things at high pressure and the instrument they use to create the high pressure. The next guy talked to us about the scanning electron microscope, and how it works. he showed us pictures of past labs that he had done. The last man talked about spectrums of different elements, and again the luminescence of objects at low temperatures. We actually got to take a sample reading of Neon.

■ At the beginning of the tour I was somewhat unimpressed by the facility. I was expecting a much larger and more up-to-date building. Although during the tour I could see that the research was high-tech and current.

■ We learned how scientists are trying to make everyday technology to make our lives easier. Like, by inventing a device that could scan the surface of a material they are able to develop a substance to keep that material from oxidizing, such as rust on metal. Then there was another guy who was looking at window samples, so he could develop a type of glass that adapts to the weather. Heat enters during the winter season, while only light enters during the summer. But my favorite part was the guy with that nasty black liquid that turns into a solid when it is near a magnet. He said this could be one of the breakthrough technologies for a better braking system.

■ One of the speakers talked about pressure, and diamonds. I never knew that we could make diamond. Under high pressure, diamonds can be synthesized. That's really cool. I want to be a physicist to figure out things like that.

■ My favorite was the guy who did the photoluminescence (or however you spell it). He used a black light to make things glow.

On **Mar. 21**, Ed Kiker, a Harvard graduate who majored in Lunar Geology, a member of the National Space Society, and the CEO of Outer Space Industrial Resources Investigations Systems, returned to speak on **FUTURE STUDIES**. [Comments will appear in the August issue.]

UPCOMING

April 11, David Wieliczka, of the UMKC Physics Dept., will return with his popular **LASERS AND HOLOGRAPHY** talk.

On **April 25**, Brent Harding (MPI 84-85) an Engineer Specialist at Stanford Telecom will speak on: **SOME NASA PROJECTS**.

Sun. **May 4** will be our annual **WORLDS OF FUN PHYSICS DAY**.

Finally, we'll hold our annual **PICNIC/BREAKFAST** at McCoy Park on Wed. **May 14**, and our **AWARDS PRESENTATION** on Thurs. ay 15, 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 list of known MPI Alumni e-mail addresses is available on request.]

** NEW **

(89-90) **Ivan Bird**
isb@haj.com
BABCOCK & WILCOX NUCLEAR
ENVIRONMENTAL SVCS. INC.

(91-92) **Rodney Caudle**
c591765@showme.missouri.edu
UNIV. OF MO - COLUMBIA

(91-92) **David Young**
arkaynen@sky.net
AVILA COLLEGE

(92-93) Amanda Koster
        n084@academic.truman.edu
        TRUMAN STATE UNIVERSITY

(92-93) Valerie Summers
        c663771@showme.missouri.edu
        UNIV. OF MO - COLUMBIA

(93-94) Matt Cianciolo
        matthew@creighton.edu
        CREIGHTON UNIVERSITY

(93-94) Charity Coney
        chc6805@griffom.mwsc.edu
        MO WESTERN STATE COLLEGE

(94-95) Ahmad Latifzai
        latifzai@umr.edu
        UNIV OF MO - ROLLA

(95-96) Cris Dykeman
        dykeman@graceland.edu
        GRACELAND COLLEGE

(95-96) Scott Preston
        univac@kcmo.com
    or c689860@showme.missouri.edu
        UNIV OF MO - COLUMBIA

(95-96) Don Vaught
        c689354@showme.missouri.edu
        UNIV OF MO - COLUMBIA

** CHANGES **

(86-87) Pat Liang, MD
        patliang@worldnet.att.net

WE HEAR FROM PAST STUDENTS

TODD JOHANN (92-93)
(Economics Major)

    "Knowing calculus before entering college is of great benefit in all courses. Especially courses that try to use extensive algebra to make points and derive formulas easily done with knowledge of calculus."

MATT BARROWS (93-94)
(Civil Engineering Major)

E-mail received 2-4-97:

    "I just thought that I would send you all my annual letter to let you know how things are going. I'm glad I got a chance to make it by for the reunion over the break. I had a good time seeing people I have known for a while, and enjoyed the chance to meet a few new faces.

    I can't believe that this is the third year of college, especially in Rolla! It just seems like yesterday there was a Calc I book on the desk in front of me, and Mrs. Adams was saying that when you differentiate cosine you get sine with a different sign (see, the little things do stick!). Classes have been going good, and have gotten more interesting since they deal with my major. It is just great to be out of the straight math courses, but they have a way of haunting me every day!

    Just thought that I would pass on a little something to the current MPI students. Make sure when you go to college, remember what you are there for (hopefully an education for most of you!). Just make sure that you get your head out of the books, and make it out to look around. You have four years (five or six for a few of us!) to get out and meet some of the most diverse and interesting people that you have ever been exposed to. Do not just sit around and let that opportunity go to waste. I have seen people that have spent the last two years sitting in their rooms, never leaving except for class. Also, be sure to become friends with the people that are sitting around you now. A few of my closest friends I met at 7:00 in the morning (maybe 7:10 after spring break!).

    If anyone has any questions about Rolla feel free to contact me: e-mail mbarrows@umr.edu, call at 573-364-9783, or if you are in Rolla stop by the Sigma Pi house at 206 East 12th St. I'm sure if I can't answer your question, I will find someone that can. If anyone needs a place to stay over the upcoming preview weekends or over St. Pats, just contact me. Good luck with classes!"

KELLY (NANCE) JOHNSON (87-88)
Van Horn High School graduate

E-mail received 2-11-97:

[NOTE: "<g>" is e-mail slang for "grin".]

    "Hello, long time, no write, I know. But as you well know, the life

of a teacher is a busy one, and if you add in having to change the diapers on two of my students, well... <g> I find it hard to read over the MPI Newsletter and realize that it's been *nine* years since I was there; it doesn't seem that long ago. But then, I look at my oldest son and realize that he turns seven next month!

Christian's just begun seriously practicing multiplication. He learned the concept last year, and given enough time, can multiply any two single digits pretty well. Now we're just working on expanding it and speeding it up. So far he is following his father well in that he loves both mathematics and computers. He's like his mother too much, though, in that he has a terrible temper (remember that?) and hates work. His favorite computer game is Marathon 2 (it encourages problem-solving and independent thinking while improving his hand-eye coordination — see, I can do eduspeak — it's a shoot-the-bad-aliens game, ported from the Mac for Win95, first person, but it really does have great puzzles that make him think, though I occasionally help him on the really hard ones), but Math Blaster does still get a workout on occasion. He just discovered Quake recently, but I'm not encouraging it too much, as it doesn't require as much thought as Marathon. He does like trying to find all the secrets, though, which Marathon doesn't have many of.

Rose just turned five last week, and is beginning phonics and addition. Grace, being only 2.5, is learning basic grammar and pronunciation, along with Obedience 101. The newest addition to the Johnson clan was born last July 1, Josiah Abel Johnson. He's busy learning to use his feet as more than chew toys.

Have you heard from **Sheryl (Nance) [MPI 84-85]** recently? The new Mrs. Durst? <g> Did you ever picture her choosing librarian as a career? The woman who ended up with a math major because it was what she had enough credits for after taking three years of whatever tickled her fancy? She just got a new job recently — corporate research librarian; I don't know the company's name.

Could you send me the listing of alumni e-mail addresses? I would appreciate it, as there are a few people I'd like to get in touch with. You don't, by any chance, have a recent (within the last few years) address for **Cynda Kleeman-Rosa [MPI 87-88]**, do you? Please?? I've been trying to find her for quite a while; we lost touch after she got married, and being in the Air Force, she could be *anywhere* by now.

Oh, I was about to send this and I just thought of something you could probably answer for me — is Mr. Brooks still principal at Van Horn? I guess I've been thinking about the old place a lot lately, realizing that my ten year reunion should be next year. Weird... do years keep getting shorter the older you get, or do they reach a standard shortness once you're "grown-up"? Sometimes I feel like my four years of high school were longer than my eight years of marriage have been... is that a commentary on how great my marriage has been or how bad my adolescence was? <g> Or just how busy motherhood is?"

AMANDA KOSTER (92-93)
(Medieval Studies Major)

E-mail received 2-16-97:

"Hi! I know it's been ages since you've heard from me, and yes I do have that last survey you sent out (and I will get it in the mail, promise!). However, this time I have a fairly good reason for procrastinating, or at least for falling behind in the first place.

First off, I've only been back in the US for a bit over a month. I got into the exchange program to Newcastle, Australia, and had a great semester there (though my grades aren't exactly top notch). It was a blast, and if any of the students have a chance to go through AFS or anything, I have to say study in another country is the single most exciting and most rewarding thing I've done, and I don't just mean good as far as academics are concerned.

Second, I am engaged, to an Australian who was here in the US the previous year, and after I graduate in May, I'm moving back there permanently. I tried to talk him into coming to the panel with me in

January, since he's just completed a double degree of computer science and digital engineering, but we ended up having schedule conflicts, and I couldn't make it either. Sorry!

It's good to hear the MPI is doing well, and keeping up with the technology (or as current as the budget allows!). I was wondering if you have a list of 1992-93 MPI students' e-mail addresses which you could forward to me; I'm trying to touch base with a few people before I leave the US. I'd really appreciate any info you have.

(And as always, please tell Mr. Morse hi from me; the more professors and educators I encounter in life, the more I'm made aware of how fortunate I've been to have had instructors like him.) Thanks!"

E-mail received 3-10-97:

"Hello again! Sorry it took me so long to reply! With it being midterm week, and then midterm vacation, I've been a bit busy!

I've just gotten my official approval for graduation, and with all the energy that comes from that good news, I'm catching up on my e-mail. :)I was waiting on the grades from Australia to arrive, and they finally got here. While the lack of timeliness isn't encouraging, my actual experiences with the Australian post-secondary educational system were very good. I'm hoping to pursue a MMS, Master's of Medieval Studies, or at least an MA in Medieval Studies at the University of Melbourne. Then, if I want to, I can continue with either a PhD in English Lit or, more likely a PhD in Linguistics. However, I plan on taking a year or two off, to get both work experience and get a break from studying. (As much as I like learning, 16 years in a row is about as much as I can handle.)

I haven't decided yet what to do, as far as a career is concerned. Teaching is one of the most common choices, but I'm not sure I'm really teacher material. Besides, the work I've done here at the university (research with and for professors, grant and stipend proposals, etc.) suits me quite well. I've also had some fun with writing up directions for computer software etc. for some of the freshman classes. I'm looking

at working with a publishing organization or a technical writing group during the time before I take up my MA studies. Hopefully that will help me find some direction.

That pretty well sums up things for me, aside from the fact that I have actually gotten published for some of the research work I did, and I have another project underway which may end up in print as well. Oh, and along with the graduation approval, I found out this morning I have a chance at getting my BA summa cum laude, if I can keep up my grades this semester!

Hope things are going equally well there at MPI!!"

———————

ROBERT DAVIS (95-96)
(Engineering Major)

"MPI taught me to actually do my homework! They also forced me to wake up earlier, which helped during my 8:00 chemistry course last fall.

I learned how to work in groups better. They also hinted what it is like to be in college.

These are some of the best teachers I have had throughout my schooling. Keep up the good work!"

———————

ROSA NUÑEZ (94-95)
(Psychology Major)

"The MPI gave me a taste of what college life was going to be like. Also, the MPI taught me that in order to succeed in life one must act as a mature, responsible individual.

I miss the MPI in general, it was a good experience for me. I also want to say HELLO to everybody.

A comment that I would like to make about the MPI, is that those students who had the luck to attend the MPI should feel grateful for having participated in such a program. I also hope that the MPI program continues for many years to come."

———————

CRIS DYKEMAN (95-96)
(Science/Secondary Ed. Major)

"MPI has greatly prepared me for college. I know now that I need to study for courses that I don't have a firm grasp on.

I appreciated the efforts of all of the MPI staff.

Even though my 2nd semester grades did not reflect my overall accomplishments well, I learned a great deal in Physics and Calculus.

Thank you for this program and I hope you all have a wonderful summer. ☺"

SCOTT PRESTON (95-96)
(Atmospheric Science Major)

"It prepared me for the next step. In high school, they treat you more like kids than adults. At MPI, you treat us more like adults — a nice way to bridge the gap between H.S. and college.

Thanks for the subscription of Scientific American. There's some really cool stuff in there.

Do you really want to confuse students? Switch to Mathematica. Now THAT would be fun!"

FINAL 1996-97 STUDENT IMPRESSIONS

"I'm very glad I was able to spend this year at MPI. Since I don't plan to be a scientist, I may not need the knowledge about physics and calculus I gain here, but I have learned things about responsibility, asking for help, and about learning that I will use through college and through life."

Mary Comeau
Paseo High School
Kansas City, MO School District

"MPI is the most demanding and intense program that I've participated in. Fortunately, the teachers are helpful enough to make the courses more understandable."

Rachel Cianciolo
Truman High School
Independence School District

"Attending MPI is not that bad, even though I complain about it every day, every hour, every minute, and every second. At first, I thought it was going to be hard but it gets easier when you have friends like Samantha Webb and Jenny Coonts. MPI has made my list of responsibilities longer, and I hope to benefit from it."

Jigna Patel
Truman High School
Independence School District

"These courses have certainly taught me a lot this year. At least I will have better study skills for college, regardless of whether I retain any of the course information. It's a great program for those who want to do their best."

Michael Flowers
Wm. Chrisman High School
Independence School District

"Everyone at MPI was selected to come here because of our aptitude and the fact that we're top students. Being accustomed to that at "regular" school, MPI sure is a humbling experience. The classes here are like no others in that they are really challenging. You can't succeed unless you do homework outside of class and put in a few hours of studying. But even though we students might grumble and complain, MPI is a very valuable experience because it gives us a real taste of what college is like."

Sarah Thompson
Ft. Osage High School
Ft. Osage School District

"MPI is definitely a step above high school. The classes are more challenging, but there is always help from teachers or other students. MPI will help me next year when I go to college because I now know what to expect from college-level classes."

Whitney Meagher
Truman High School
Independence School District

A SOLUTION TO
MATHEMATICS CHALLENGE #47

Recall the problem statement:

Suppose you have 6 points in the plane, and each point is joined by either a blue string or a red string to each of the other five points.

Prove that there <u>must</u> exist at least one completely blue triangle, or one completely red triangle.


SOLUTION:

We first sketch the 6 points in the plane, labeling them A through F as shown, and draw all possible strings (segments) connecting them.
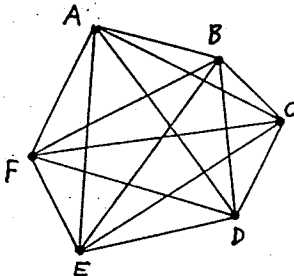
Now picking any point, say A, there are 5 strings leading away from it to the other points. Since each of these strings is colored either blue or red, this means that at least 3 of them are the same color, say, red, connecting A for instance to points C, D, and F.

Now consider just the 3 strings connecting C, D, and F (dashed below):
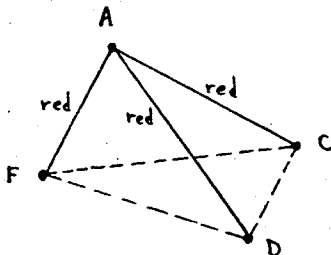
If these strings are all blue, then they form the desired completely blue triangle. If at least one is red, say the one from D to F, then

the triangle $\triangle ADF$ is completely red, as desired. This argument is completely general, and so we're done.

NOTE: This problem is an example of Ramsey Theory in combinatorics, often interpreted as the Party Problem:

"If there are 6 people at a party, then there are at least 3 people all of whom <u>know</u> each other, or, all of whom are <u>strangers</u> to each other."

(The 3 people of course correspond to the 3 sides of the blue or red triangles above.)

A SOLUTION TO
PHYSICS CHALLENGE #38

Recall the problem statement:

A homogeneous bar of mass M and length L begins to move downward along an inclined plane that makes an angle α with the horizontal.
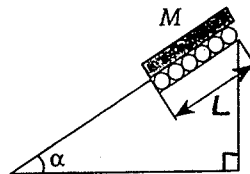
The initial portion of the inclined plane of length L is occupied by closely packed rollers made of tubes of mass m and radius r << L, which rotate on ball bearings without friction. The rest of the inclined plane is frictionless.

Find the dependence of the bar's acceleration on its position as it moves.

[From: A. Stasenko, Quantum Challenges in Physics & Math, March/April 1996, p. 16]

SOLUTION:

Let "x" be the distance of the <u>upper</u> end of the bar measured from the top corner of the inclined plane, as in the sketch.

CASE 1: If x < L, meaning the bar is still in contact with the rollers, we

can write the equation for its acceleration a_x along the inclined plane, using Newton's Second Law, as:

[Force on the bar]
= [Force due to gravity]
- [Frictional force of the rollers]

$M \cdot a_x = M \cdot g \cdot \sin(\alpha) - F_f \cdot N(1-x/L)$,

where

M = the mass of the bar,
g = the constant acceleration due to gravity,
α = the angle of the inclined plane (as shown),
F_f = the <u>f</u>rictional <u>F</u>orce on the bar from <u>one</u> roller,
N = L/2r = the number of rollers (each roller has diameter 2r, where r << L), and,
N(1-x/L) = the proportion of the number of rollers that contact the bar when its upper end is at position "x".

Assuming that the bar doesn't slide on the rollers, the frictional force F_f imparts a tangential acceleration $|a_x|$ to each roller that is in contact with the bar. So, on the <u>one</u> hand, the torque T on each roller at this point of contact is by definition just $F_f \cdot r$, where r = the radius of one roller. On the <u>other</u> hand, the torque satisfies:

$T = I\omega = (m \cdot r^2) \cdot (a_x/r)$

where

$I = m \cdot r^2$ = the moment of inertia,
$\omega = a_x/r$ = the angular acceleration, and,
        m = the mass of one roller.

Thus we have:

$F_f \cdot r = (m \cdot r^2) \cdot (a_x/r)$,
$F_f = m \cdot a_x$.

Substituting in the force equation <u>above</u> this expression for F_f, while replacing N by L/2r, and solving for a_x , we finally get:

$M \cdot a_x = M \cdot g \cdot \sin(\alpha) - m \cdot a_x \cdot (L/2r) \cdot (1-x/L)$

$a_x = g \cdot \sin(\alpha) - (m/M) \cdot a_x \cdot (L/2r) \cdot (1-x/L)$

$a_x \cdot [1 + (m/M) \cdot (L/2r) \cdot (1-x/L)] = g \cdot \sin(\alpha)$

$a_x = g \cdot \sin(\alpha)/[1 + (m/M) \cdot (L/2r) \cdot (1-x/L)]$

So, for x < L, we now have the bar's acceleration a_x expressed strictly as a function of its distance x on the inclined plane.

CASE 2: If x ≥ L, the bar no longer has contact with the rollers, and so it slides along the frictionless inclined plane with constant acceleration: $a_x = a = g \cdot \sin(\alpha)$.

So, in general, the graph of the function $a_x = a(x)$ has the form shown below:

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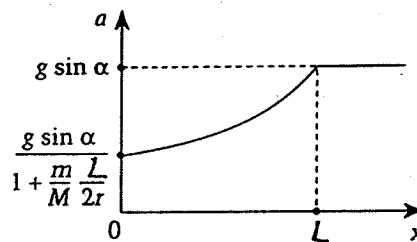
MATHEMATICS CHALLENGE #48

This problem (circa 1810) 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:

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A right triangle ΔABC is given as shown, with point C' chosen on the hypotenuse AB such that BC' = BC. Suppose that point P is placed on BC so that C'P divides triangle ΔABC into two parts of equal area.
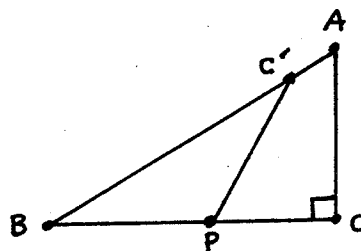
Show that 2C'P = AB.

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[From: Japanese Temple Geometry Problems, by Fukagawa & Pedoe, 1989; Ex. 4.1, p.46]

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PHYSICS CHALLENGE #39

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During opposition, Mars is located at a distance $L = 5.56 \cdot 10^{10}$ m from the Earth, and its angular

diameter is $\alpha = 25.1"$. [Recall that: $1" = (\pi/180)\cdot(1/60^2)$ radians.]

Find the acceleration due to gravity on the Martian surface, g_M, if the maximum angular distance between the center of Mars and its moon Phobos is $\beta = 34.5"$, while the period of revolution of Phobos around Mars is $T = 2.76\cdot10^4$ s.
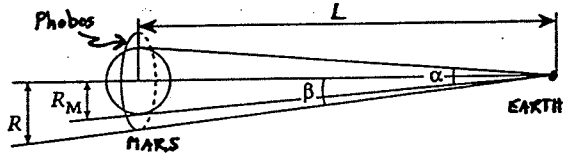
Here, R_M = the radius of Mars, and R = the radius of the orbit of Phobos.

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