MPI

The Mathematics and Physics Institute **NEWSLETTER**

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YEAR 7, IN BRIEF

Currently enrolled in the MPI are 57 students, all 57 in Calculus, and 51 in Physics, from Fort Osage (10), Northeast (9), Truman (13), Van Horn (6), and Wm Chrisman (19). Of these, 27 (47%) are women, and 11 (19%) are minorities. This is most definitely the largest percentage of women we have ever had! Perhaps encouragement in the early grades is beginning to take effect.

This year we've added two diagnostic tests to our panoply of beginning paperwork. In addition to the Calculus Readiness Test which all prospective MPI students must take at the end of their junior year, and the Lawson Test of Cognitive Reasoning Skills that we give at the beginning and end of their year at the MPI, we now also give to all MPI students a Basic Algebra Test, and an Advanced Algebra Test to further refine our knowledge (and theirs) of any specific background deficits. With the results of these four tests in hand, we hope to better prepare our students early for the rigors of Calculus and Physics later in the year.

!MPI OPEN HOUSE!
SUNDAY, NOV. 4, 1990, 2-4 PM

Sunday Nov. 4, from 2-4 pm, the MPI will hold its annual OPEN HOUSE for parents, teachers, counselors, administrators, and anyone else interested in talking to the faculty, staff or students of the Institute.

We'll be in the Truman Campus Building of UMKC behind the Truman Library just North off Hwy 24 in Independence. We plan to have several rooms organized with physics demonstrations and laboratory equipment, mathematics demonstration problems on chalkboards, and videotapes of recent problem-solving sessions and past enrichment speakers. We will have our new MPI computer system on display, and can look in on the UMKC Engineering PC Lab which we have arranged to use. In Room 102 at 2:30 pm, there will be some brief remarks by the MPI director and the introduction of the MPI teachers, followed by a 10-minute slide presentation. And of course, there will be refreshments (!), all staffed by this year's students and faculty. If you have questions, please call 235-1272. We invite you all and look forward to seeing you on:

SUNDAY, NOV. 4, 1990
2-4 PM

THE CALCULUS PC LAB

Section C, the only section planning to take both Calculus I and Calculus II over the course of the year, is experimenting this semester with the mathematical software known as DERIVE, and CALCULUS from True Basic. Through an arrangement with the Engineering School on the Truman Campus, we are allowed access to 5 IBM-compatible PC's, into which these programs have been loaded. Once a week on Friday afternoons, Section C has a laboratory assignment, either from a DERIVE laboratory manual, or from a CALCULUS workbook. So far there have been two such sessions, and the enthusiasm among the students is high. They talk, discuss possible solutions, check them against machine-produced graphs, try again, and seem to be teaching each other as much as doing the assignments. A

section on 'mystery graphs' (graphs presented without equations, for which students must produce an equation) was particularly enlightening. The experiment is going well so far, and this newsletter will keep you posted on any new developments.

ENRICHMENTS

Our four one-hour sessions on Study Skills presented by David Arendale of Student Academic Support Services, and the Mathematics Coordinator, seemed well received by this year's critical group. Some written comments regarding our guest, Mr. Arendale were:

- I enjoyed the handouts. It gave us a chance to plot out our own personal time management.

- I thought he did a good job. I learned some things like not cramming your notes together and leave 1/3 of your paper blank for things in the book.

- Lots of info. Very polished.

On Sept. 26 we began our regular enrichment days with a field trip, for a change, bussing ourselves to the Downtown Airport to visit the NASA Exhibit at Unique Science Adventure (USA). USA is a very new group, with an entire series of hands-on science (Exploratorium-type) projects of its own, and a gift shop, and in addition hosts special traveling exhibits such as the present one from NASA. Among the exhibits we visited were: An 'animal' room with rabbits, chicks, an iguana, and a blue and yellow macaw named 'Hubble'; a Van de Graff generator, which stood many students' hair on end with static electricity; a whole series of visual phenomena tests, from color afterimages and mirror-image tracing to holograms and liquid crystals; Tesla lights in plasma; a probability machine; the Bernoulli effect; a 1/5 scale model of the Hubble telescope; Space Station Freedom; several computer linkages to a NASA information network, the National Weather Service, etc. This list only scratches the surface of what we saw, and we encourage other groups to support this important addition to Kansas City Area Science Education. Some student comments were:

- This was the best field trip I have ever been on and I think everyone learned a lot from it.

- I feel we should go down there again next spring.

- I think the freedom gave us the chance to do what we wanted to.

- There were so many things to do!

UPCOMING ENRICHMENTS

On Oct. 10, Frank Booth from the Kansas City Regional Crime Lab will be our speaker on Science in the Crime Lab, discussing such topics as blood chemistry, DNA testing, firearms, fingerprints and the scientific principles involved.

Oct. 24 brings back Sam Gill, our exponent of critical thinking for Unsolved Mysteries and Extraordinary Phenomena, to teach our students how to critically and skeptically judge the evidence for extraordinary claims on the fringes of science, and of living. This two hour presentation always generates an enthusiastic response from students. After all, if this is where they wonder, why not encourage a scientific attitude just there?

On Nov. 8, Henry Mitchell will return for the seventh time to give his polished and erudite lecture on Bats, Strange Creatures of the Night. His reputation as a biologist and bat-authority is always borne out in his stimulating talk.

Finally, on Nov. 21, a new speaker joins our roster, David Frayer from KU, an anthropologist, will address the Emergence of Modern Man (Homo Sapiens), touching on such popular topics as Neandertal Man, Homo Erectus, the question of whether there was an 'Eve' based on mitochondrial DNA, etc. This too promises to be exciting.

PROFILES IN SUCCESS

by Richard Waring

Mark Caples participated in the MPI in 1984-85 while a senior at Truman High School. Mark received his degree in Mechanical Engineering from UMKC in 1989. After graduating he received a graduate assistant-ship at UMKC and by last summer had completed all the course work for his Master's Degree. Now, Mark has taken a job as a mechanical engineer with Delavan Manufacturing Company which manufactures fuel injection systems in Des Moines, IA. Mark and his wife, Stephanie are now in the process of buying a home in Cambridge, Iowa.

Last year, Mark left us with some sound advice:

"Make absolutely, positively sure that students enrolling in Calculus I and Calculus II are exceptional and mature enough to accept the responsibility."

Although Mark did well in those courses, he found that he, perhaps, did not realize the importance of mastering the subject to the extent that he could recall what he had learned and apply it two, three, or four years down the road. This is sound advice indeed.

Mark Scott was another of our 1984-85 students, from Raytown High School. Mark studied Electrical Engineering at UM-Rolla, where he received his BS degree in 3 1/2 years with a grade point average of 3.90. Mark is now a commissioned officer in the US Navy, and a graduate of the Navy's Nuclear Power School in Orlando, FL., where he finished first in a class of 120. Mark says the MPI gave him an edge in college which combined with hard work put him in a position to do very well in a competitive career area.

Best wishes to both Mark Caples and Mark Scott for continued success.

STUDENT QUOTES

"So far, I've found the MPI to be quite a challenge compared to the normal high school curriculum that I'm used to. It's a terrific way to prepare for college and the different people and many activities gives an interesting variation to the normal school day. MPI is great!"

Kendra Van Tuyl
Wm Chrisman High School
Independence School District

"The first three weeks at MPI have been an experience in note taking. But I have never been so enthused about taking down so much information. Looking back on these weeks, I feel that I'm in store for a challenging year."

Anthony Hall
Van Horn High School
Kansas City School District

"Well, let's see, first I think the program is great! Why? It's because I think it helps introduce me to college life and what to expect when I go to college next year. Just from the last three enrichments I

learned how to adjust myself on study and other stuff better than before.

In the MPI I get a chance to meet students from another school, (learn) how their schools are different from mine, and so on. Plus, we have an enrichment once every week which is exciting because the Institute brings in a speaker."

Mao Vath
Northeast High School
Kansas City School District

"I think that this will be a very good experience and help prepare me for college."

Maggie Don Carlos
Fort Osage High School
Fort Osage School District

A SOLUTION TO MATHEMATICS CHALLENGE #14

Recall the problem statement:

Find three consecutive integers such that when all six possible fractions are formed from these integers, the sum will also be an integer. Prove that your answer is unique.

SOLUTION:

You may have quickly guessed that the sequence 1, 2, 3 works. However, in case you didn't so guess, and to determine whether or not 1, 2, 3 is unique, we'll use some algebra. Let our integral sequence be n-1, n, n+1. Then we are asking that

$$\frac{n}{n-1} + \frac{n+1}{n-1} + \frac{n-1}{n} + \frac{n+1}{n} + \frac{n-1}{n+1} + \frac{n}{n+1}$$

$$= \frac{6n^2}{n^2 - 1}$$

be an integer. [NOTE: The addition and simplification here takes a few moments.] Notice that since $n^2 - 1$ and n^2 have no divisors, other than 1, -1, in common, this forces $n^2 - 1$ to divide 6 exactly, meaning $n^2 - 1 =$ 1, -1, 2, -2, 3, -3, 6, or -6. But only the cases $n^2 - 1 = -1$ or 3 yield an integer for n, namely n = 0, -2, or 2. These yield the sequences -1, 0, 1, -3, -2, -1, and 1, 2, 3. The first must be discarded, since the forbidding of division by 0 prevents the requirements of the problem being met. The other two sequences give, respectively:

$$\frac{-1}{-2} + \frac{-3}{-1} + \frac{-2}{-3} + \frac{-2}{-1} + \frac{-1}{-3} + \frac{-1}{-2} = 8$$

and

$$\frac{1}{2} + \frac{1}{3} + \frac{2}{3} + \frac{2}{1} + \frac{3}{2} + \frac{3}{1} = 8$$

So, the 1, 2, 3 sequence can be considered unique only if we demand strictly positive integers. Otherwise, both -3, -2, -1 and 1, 2, 3 are legitimate solutions.

A SOLUTION TO PHYSICS CHALLENGE #5

To make a hard line drive in baseball you must get the bat into the proper position for the collision with the thrown ball. How much error can you stand, both in the vertical direction and in time, and still be able to get the hit? For example, would it be all right if your timing is off by some small amount such as 0.01 second?

SOLUTION:

Since the ball is over the plate for only about 0.01 second the timing should be to about $\pm$ 0.01 seconds. The error along the

vertical axis must be less than 1 millimeter.

As a historical note: "The 1962 world championship was finally determined by an otherwise perfect swing of a bat which came to the collision 1 millimeter too high to effect the transfer of title."

[From: The Flying Circus of Physics by Jearl Walker.]

MATHEMATICS CHALLENGE #15

A jailer, carrying out the terms of a partial amnesty, unlocked every cell in a prison. Next he locked every second cell. Then he turned the key in every third cell, locking those cells which were open and opening those cells which were locked. He continued this way, on the nth trip turning the key in every nth cell. Those prisoners whose cells eventually remained open were allowed to go free. Who were the lucky ones?

PHYSICS CHALLENGE #6

Every driver will occasionally have to make a quick decision whether or not to stop at a yellow light. Her intuition about this has been built up by many tests and some mistakes, but a calculation might reveal some situations where intuition will not help.

For some given light duration and intersection size, what combinations of initial speed and distance require you to stop (or run a red light)? What range of speed and distance would allow you to make it through in time?

Notice that for a certain range of these parameters you can choose either to stop or not. But there is also a range in which you can do neither in time, in which case you may be in a lot of trouble.

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The MPI Newsletter is published five times a year on the first of the month during the months of August, October, December, February, and April at The Mathematics and Physics Institute, 600 W. Mechanic, Independence, MO 64050, phone (816) 235-1272. Please address all correspondence concerning this newsletter to 'MPI Newsletter'.
