MPI

The Mathematics and Physics Institute NEWSLETTER

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A POST SCRIPT ON THE OPEN HOUSE

I want to thank those parents who attended our open house on November 8. I, as a parent, know it is sometimes difficult to take time from our busy schedules to attend something like an "open house." By attending you demonstrated to your son or daughter an interest in their activities and education. Through your support you have helped to mold their priorities and goals.

Although we believe everyone should have a solid basic understanding of mathematics and his/her physical environment, the study habits, reasoning ability and problem solving skills developed at the MPI are our highest priority since these qualities carry over to other disciplines and are essential in every productive individual.

You have likely found that the demands and expectations in this program may be a new experience for your son or daughter. Your continued help, support and encouragement will contribute immensely to their success.

Also, I want to thank the students who helped with the demonstrations, problems, laboratory apparatus, served as greeters and photographers, and the teachers and staff.

Anytime you have any questions or I can be of assistance, please feel free to call me.

Richard Waring
Director

OUR HIGH SCHOOL TEACHERS 1987-88

This month AL MORSE gets his due. After 25 years with the Independence District, 6 years at William Chrisman High School, his current home, and beginning his 4th year with the MPI as a Mathematics Instructor, it's about time.

Al received his BS and MS in Education at Central Missouri State, and has been teaching mathematics in junior high and high schools since that time. He sponsors the Math Club at Chrisman, coordinates all trips to contests and math relays, and seems to have an inordinate fondness for Games Magazine, scribbling in crossword puzzles, even over the breakfast table! In addition, as part of his continuing professional efforts, he recently received an honorarium from Addison-Wesley for notes and a solution key he created for a new Analytic Geometry text.

At the MPI, his enthusiasm for the program and for his students is huge, and for that we can all be grateful. He tells us he has learned tremendously during the last few years from the exchange of ideas and (very) different points of view of his fellow instructors at the Institute. We certainly see his students coming to us well-trained, and exhibiting the same high energy that we see in Al every day. To him we say: Stay with us Al. Your sheer enjoyment in teaching and in mathematics is infectious, and is very much in the spirit of the MPI.

ENRICHMENTS

First, a report on some enrichments since the last newsletter:

On October 14, Buford Baber was unable to come and discuss Financial Aid, but Dr. George Hauck found the time to present a very unusual talk about the civil engineering involved in Roman Aqueducts, the result of some of his latest archaeological researches in Europe.

October 29 saw the return of Jean Pedersen and Peter Hilton, who jointly shared with us some of their latest research concerning how Pascal's Triangle can be meaningfully extended into a hexagon. Their talk pointed out several fascinating relationships between the binomial coefficients in this famous triangular array, and the curiosity of many students seemed to be aroused.

On Nov. 11, we rumbled through our eventful all-day field trip to the Research Reactor and Physics Dept. of UM - Columbia. Once again we looked down into the cool blue glow of the Cerenkov radiation deep in the reactor pool, in our tour of the facility. At the Physics Dept. we were treated to laboratory visits wherein we saw: a racketball frozen in seconds by liquid nitrogen, which, when poured on the floor, skated about in the form of beads each on its own nearly frictionless cushion of sublimating nitrogen gas; a circuit board, computer, and speaker capable of digitally recording and analyzing any sound, including the voices of students in varying pitches and times; a surface physicist telling how atoms at surfaces are very busy hopping from place to place, and behave entirely differently than their counterparts inside objects; lastly, a powerful green laser, and a small diamond press able to produce pressures equal to those at the earth's center. After all these moments, even the fact that one of the two busses ran out of fuel on the way back, forcing us all to crowd into the other, was (more-or-less) bearable.

Finally, on Nov 25, before we adjourned for Thanksgiving, Dr. Henry Mitchell spoke to us about bats, bringing with him a live fruit bat which he carried around the room for us all to see at close range.

UPCOMING ENRICHMENTS:

Dec. 9 will see Buford Baber discussing College Financial Aid.

Dec. 18 we will hold our MPI Christmas party, with a laser show and film presented by Richard Waring, and live music, etc. presented by students.

Jan. 6, after the holidays, will be our annual Student Panel Discussion and Reunion day, when former MPI students return to see each other, and to report to this year's students what college is really like, how the MPI has affected their studies, and more.

No other enrichment dates are settled yet, but we look forward next semester to visiting the new GM Fairfax plant, and also hearing about topics ranging from superconductors to tornadoes.

MPI T-SHIRTS AND SWEATSHIRTS

Yes, they're out, and on the backs of many of our students! Look for the bright blue color, with an 'MPI" on the front, and a three-dimensional graph on the back followed by: We Solve Odd Problems!

MATHEMATICS AND SCIENCE VIDEOTAPES - AN UPDATE -

As we noted last April, the MPI has currently 8 videotaped presentations of scientists and mathematicians which we freely send to any high school in Missouri wanting to either show or make copies of the tapes - and the orders have been pouring in since nearly the day after we first mailed the notices.

In all, we have sent out over 437 tapes since last Spring, and the flood has not yet abated; the tapes on Radiation Properties and Polyhedra seem to be favorites.

QUOTES FROM OUR STUDENTS

"MPI has been a great experience so far. I have learned better studying skills. I will be better prepared than most when I go to college because of the atmosphere and attitudes of the students and teachers."

Yolanda Woods
Fort Osage High School
Fort Osage District

"The Institute has helped me prepare for the transition from high school to college by giving me first-hand experience of the college atmosphere. It has helped me in ideas for fields of study, college choices, and financial aid, through guest speakers and field trips."

Kevin White
Raytown High School
Raytown District

"When I was studying for the test to get into the Institute, I didn't think I would pass, but Mr. Kaifes kept saying, 'Everyone will pass,' so I kept working. When I found out I passed I wasn't sure if I was going to go anyway, but there was Mr. Kaifes saying, 'Sure you'll go,' so I decided to come, and see if I could handle it; and here I am trying to make sense out of all this work. I'm glad I decided to come to the Institute because it's a challenge and a rewarding experience."

Kim Greathouse
Van Horn High School
Kansas City, MO District

"The Institute is an excellent opportunity for advanced learning. It has an interesting and productive set of students, teachers and curriculum."

Jeremy White
Truman High School
Independence District

A SOLUTION TO MATHEMATICS CHALLENGE #2

Recall the problem statement:

PROVE that if the sides of a rectangle R are positive integers a and b, then the Perimeter of R = the Area of R only when this common value is either 16 or 18.

SOLUTION:

We begin by setting the Perimeter equal to the Area, and seeing where this leads us:

$$2(a + b) = ab$$

The left side is even, so the right side must also be even. Since a,b are positive integers, this means one of a,b is even. They are interchangeable in this

problem, so let's suppose a is even, i.e., a = 2c for some positive integer $c \geq 1$:

$$2(a + b) = ab$$

$$2(2c + b) = 2cb$$

$$2c + b = cb$$

$$2c = (c - 1)b$$

Now $c \neq 1$ (because c = 1 means 2•1 = 0•b, a contradiction), so we can divide both sides by c - 1:

$$\frac{2c}{c - 1} = b$$

$$2\left(1 + \frac{1}{c - 1}\right) = b \quad . \qquad (*)$$

Now, since $c > 1$, clearly:

$$0 < \frac{1}{c - 1} \leq 1 ,$$

so that, adding 1 throughout:

$$1 < 1 + \frac{1}{c - 1} \leq 2 ,$$

multiplying by 2 throughout:

$$2 < 2\left(1 + \frac{1}{c - 1}\right) \leq 4$$

and finally, substituting from the (*)-equation above gives:

$$2 < b \leq 4 .$$

Since b is a positive integer this means that b = 3, or b = 4. Returning to our first equation and solving for a:

b = 3: $2(a + 3) = a \cdot 3$

$2a + 6 = 3a$

$a = 6$

So, $2(a + b) = 18 = ab$, as expected, and:

b = 4: $2(a + 4) = a \cdot 4$

$2a + 8 = 4a$

$a = 4$,

yielding 2(a + b) = 16 = ab, also as expected.//

MATHEMATICS CHALLENGE #3

In how many different ways can you read the word ABRACADABRA in the following array, beginning at the top and moving downward a letter at a time?

```
          A
         B B
        R R R
       A A A A
      C C C C C
     A A A A A A
    D D D D D
     A A A A
      B B B
       R R
        A
```

This problem is due to George Polya, a well-known mathematician, and the answer is connected to some important mathematics.

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The MPI Newsletter is published 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) 276-1272. Please address all correspondence concerning this newsletter to 'Newsletter'.