



Director: Elizabeth Roth  
Associate Director: Richard Delaware

August 1, 2001

mpi@umkc.edu

Vol. 16, No. 1

### WELCOME TO YEAR 18

We welcome the 18<sup>th</sup> class to the MPI, representing 9 high schools: Central, Center Place Restoration, Engiewood Christian Academy, Fort Osage, Northeast, Paseo, Southeast, Truman, and William Chrisman.

### MPI STUDENT ORIENTATION

August 29-31, 2001

Each year the first three days at the MPI are spent in giving our students an overview of how we operate, a discussion of our policies on attendance, grading, etc., and two diagnostic tests. Time is then set aside for the instructors to informally 'get to know' their classes before we all become preoccupied with class work.

In particular, on the first day, August 29, 2001, we'll provide each student with a packet of information and have each of them fill out a personal data form.

If you have any questions, call our MPI secretary, Donna, Mon-Thurs., 8:00am to 1:00pm, at 235-1272. We look forward to seeing our 18<sup>th</sup> class on Wed., Aug. 29, at 7:00am in Room 207!

#### STUDENTS PLEASE BRING: ON AUG 29, 7am, TO ROOM 207

- Your Social Security Number.
- \$10.00 to rent a calculator.
- Your daily schedule of high school classes.
- Your schedule of extra-curricular activities.
- Your counselor's name.
- Ideas for Enrichment Speakers or topics.

### MPI GRAPHICS CALCULATORS

The MPI requires ALL students to have and use a graphics calculator in both physics and calculus. For our purposes we have selected the SHARP EL-9600. Although the SHARP is not the most powerful graphics calculator on the market, it is ideally suited to the MPI and its selection of students. One unique feature, even in older models, is the ability to enter fractions and exponentials exactly as you would write them on paper. Some features are:

- Pen-touch screen entry option.  
[A plastic stylus is included.]
- TABLE feature.
- Unique Rapid Graph, Rapid Window, and Rapid Zoom features.
- Connects to a TI CBL (Calculator Based Lab).
- Split Screen option.
- More pixels for a finer screen resolution.
- Slide show feature.

All MPI students are required to EITHER rent a SHARP EL-9600 from us, paying a \$10.00 one-time non-refundable fee for the entire academic year, with an option to buy the calculator outright at any time [the full price, after the rental fee is deducted, is \$60.00], OR, to provide themselves with an equal or better graphics calculator except for the TI-89, TI-92, and other calculators with computer algebra systems included. Please note that MPI support and an MPI calculator manual will only be provided for the one calculator we rent.

The MPI-rented calculators will initially be loaded with a set of AAA batteries, but as these fail over the course of the year, student-renters are entirely responsible for buying and replacing them. (Our experience has been that at most one or two replacements are needed over the year.)

**CALCULUS I & II**

NAME	SCHOOL
Mike Bowerman	Ft. Osage
Chris Gordon	St. Mary's
Emal Latifzai	William Chrisman

**CALCULUS II**

NAME	SCHOOL
Kevin Tisdale	Blue Springs South

**PHYSICS**

NAME	SCHOOL
Aaron Ballantyne	CPRS
Josh Bergsten	Truman
Mike Bowerman	Ft. Osage
Jamie Chapman	Truman
Christopher "Kit" Dawson	Truman
Scott Domsch	Lutheran
Chris Gordon	St. Mary's
Laura Hajj	Ft. Osage
Wyeth Killip	Truman
Nina LanFranca	Truman
Emal Latifzai	William Chrisman
Melinda Musil	Truman
Tu Nguyen	Northeast
Leslie Palmer	Truman
Megan Roney	Truman
Allison Scott	CPRS
Luke Whorton	Truman

**TO ALL MPI ALUMNI:**

**HAVE YOU GRADUATED  
FROM COLLEGE?**

IF SO:  
PLEASE CONSIDER BEING AN  
-ENRICHMENT SPEAKER -  
CALL 816-235-1272  
Or contact us at [mpi@umkc.edu](mailto:mpi@umkc.edu)

MPI Alumni who have spoken:

Doug Bullock	(84-85)
Brent Harding	(84-85)
Pam Deters/Stephen Koop	(84-85)
Seth McMenemy	(88-89)
Tony Thornton	(88-89)
Mitch Dobson	(89-90)
Rachel Allen	(92-93)

**2001 MPI AWARDS PRESENTATION  
AND  
TOP 10 MPI STUDENTS OF 2000-2001**

Our final awards presentation was held on May 10, 2001, during which we were pleased to present many of our students with the following variety of awards. Also present were administrators for Independence: David Rock, Superintendent and Cliff Mohn, Assistant Superintendent; Mrs. Hawa Latifzai, parent of Emal Latifzai, Steve Scott, principal of Fort Osage High School, Mike Jeffers, Vice Principal of Truman High School, Dave Sharp, Assistant Principal of William Chrisman, John Rounds, Counselor for William Chrisman High School, and Archie Gatrost, teacher at CPRS.

**CALCULUS I**

NAME	SCHOOL
Aaron Ballantyne	Truman
Josh Bergsten	Truman
Kevin Canning	Ft. Osage
Jamie Chapman	Truman
Laura Hajj	Ft. Osage
Wyeth Killip	Truman
Nina LanFranca	Truman
Chris Moore	Truman
Loc Nguyen	Northeast
Tu Nguyen	Northeast
Leslie Palmer	Truman
Megan Roney	Truman
Allison Scott	CPRS
Luke Whorton	Truman

We also honored the **TOP TEN** students (ranked according to the mean of their full-year college calculus and physics grades) by giving them a one year subscription to **Scientific American Magazine** and a copy of "What's Happening in the Mathematical Sciences."

RANK	NAME	SCHOOL
1	Emal Latifzai	Wm Chrisman
2	Jamie Chapman	Truman
3	Aaron Ballantyne	CPRS
4	Mike Bowerman	Ft. Osage
5	Wyeth Killip	Truman
6	Josh Bergsten	Truman
7	Chris Gordon	St. Mary's
8	Allison Scott	CPRS
9	Luke Whorton	Truman
10	Megan Roney	Truman

Finally, we list those MPI students planning to attend UMKC who received various scholarships from UMKC; included are those students to whom the MPI awarded Chancellor's Scholarships:

**UMKC Chancellor's Award Winners:**

Mike Bowerman	Ft. Osage
Stephanie Kelley	Wm. Chrisman

**UM Curators Award Winners:**

Aaron Ballantyne	CPRS
Josh Bergsten	Truman
Jamie Chapman	Truman
Christopher "Kit" Dawson	Truman
Lindsey Kleyh	Wm. Chrisman
Chris Moore	Truman
Megan Roney	Truman
David Smith	Truman
John Waldman	Ft. Osage

---

**ADVICE TO STUDENTS OF YEAR 18  
FROM THE STUDENTS OF YEAR 17**

At the end of this last year, in May, we decided once again to have our students write whatever they wanted in answer to the question:

**"What ADVICE would you give to incoming students about study, attitude, or any other aspect of surviving the MPI in 2001-2002?"**

We were pleased at how seriously and with what maturity they wrote, and so each incoming student will receive a complete set of these words of advice from the students of Year 17. Here are some excerpts from that document.

---

"Study constantly, and always do every assignment - NEVER think you can afford to miss one, or be able to turn it in late. That kind of attitude is a surefire way to destroy even the highest grade. Also, always get to MPI on time - thinking you can afford being five minutes late will lead to being ten minutes late, then twenty...and doing that when you have an exam in your first class is NOT good. Missing twenty minutes of lecture on a new topic doesn't help either."

**Jared Allen**  
Truman High School

---

"I know that it doesn't matter what I say because you already think that you know everything, you already think that if we didn't do well here it is because we were stupid. I can assure you that this is not the case. MPI has broken some of the smartest people to ever grace the earth. MPI has also had

some of the mediocre people rise to the top and succeed. What I say now doesn't matter because you won't listen, but on the off chance that you are listening, you should pick a partner and start studying every night. If you don't, you will start to fall behind and the longer you wait, the harder it will be to catch up. Other than that all I can say is don't forget to have fun - it's your Senior year."

**Kevin Canning**  
Ft. Osage High School

---

"When you come to MPI, study a lot. It will benefit you. When they give you homework or suggested problems, do most of them. They give you experience and let you get ready for anything that they give you on the tests. They give a lot of tests so improve your test-taking skills. Also, ask a lot of questions, remember the stupidest question is the one not asked. MPI was fun for me because it prepared me by showing a little what it is like in college. It also gives you the opportunity to meet other people from other schools which is a lot of fun."

**Nehemiah Hanson**  
Ft. Osage High School

---

"The most important thing to do is complete all of the homework, even if it is only suggested. I promise, you will be glad you did come test day. Second, find a friend to study with in both classes. This person will help to motivate you as you help with them. Good to every study session you can if you do not understand the subject matter. The teachers are here to help. At the beginning of the year, the stuff the teachers tell you will probably sound scary, but do not worry. The MPI is not that bad. It is a great experience. Enjoy it and do not stress about it too much. It is a great experience, and you will be prepared for college. Stick in there and don't let yourself get too far behind."

**Jamie Chapman**  
Truman High School

---

"Make sure you start the year by working hard. You need to understand the beginning for the end. Also, this ensures that as your effort inevitably declines, you still have enough left to end up with a decent grade.

Also, don't try to do everything at the same time. Make sure you cut down enough so you can get enough sleep to stay awake during tests."

**Chris Gordon**  
St. Mary's High School

"In the beginning there is study. After a while there is slacking, and by the end you are working to make up for what was missed. When MPI first started, I read the manual & everything that the class before us said, but I still didn't listen. Remember to study for each exam by doing the suggested problems. You will do a lot better on exams if you study."

**Stephanie Kelley**  
William Chrisman High School

"When you come to the MPI, come thinking you will have to put forth more effort than you ever have before, because if you expect to pass, you will have to. It takes studying, which for Ft. Osage students like myself, is somewhat of an enigma. I was completely unprepared for the MPI calculus. Physics wasn't so bad. I was near failing several times this year, and I have never had a grade lower than a "B" before this year. Although, with everything that I fought through, the MPI is not impossible. If you stay dedicated, unlike me, you will succeed in this environment."

**John Waldman**  
Ft. Osage High School

"For my opinion, you all have to come to class on time, pay attention in class, try to finish all the suggested homework for calculus, and all assignments that teachers hand out. You have to review well for tests. Spend time for homework, at least 1-2 hours. Try to keep it up and do not drop out because you know that you can do it."

**Loc Nguyen**  
Northeast High School

"Be honest with yourself when deciding what workload and academic expectation you can bear! Recognize that this course demands much much more than any other course offered at your high school. Become good friends with someone who you can study with. You will not survive alone! Recognize what your expectation of the course is. Be organized and on time!

Don't doubt yourself. This course is 75% confidence, 25% knowledge. I am serious. Everyone can do well, it just depends how well you think you know the information from the get go - the information is all encompassing.

Get adequate sleep! Get adequate sleep!  
Get adequate sleep!

Realize that you cannot do it all and by prioritizing you will see what activities and opportunities make you most happy!

If you think MPI is going to be too hard, just know that there is always candy on the secretary's desk. Personally I do not know how I would have

survived without it. If candy is not enough incentive, then just know that quite often someone brings donuts and, boy, are they um um good!

Good luck in all that you do and drive carefully in the MPI parking lot! (There are some crazy drivers every once in a while.)"

**Wyeth Killip**  
Truman High School

"Study a lot! At the beginning of the year you do study, but towards the end it's easy to slack off. Don't do that if you want your grade to be good! Don't drop out. Wait at least until second semester because if you can make it to there, the rest is much better. Have fun and don't stress out too much."

**Allison Scott**  
Center Place Restoration School

"Start training before school. Wake up at the crack of dawn and climb 4,000 stairs, then watch at least 3 hours of C-Span. Do this for a month or so. When MPI actually starts, then you need to keep up. If you don't keep up then it will all start to fall down around you. Oh yeah, DO THE CALC WORK! It's not required but it pays off. If you keep on top of things and stay awake during lectures you should do fine."

**Adam Sticley**  
Truman High School

## THE 2001-2002 CLASS (TO DATE)

### Section A (17)

NAME	SCHOOL
Kristen Carson	Englewood Christian Academy
Danielle Cole	Southeast High School
Tim Colyer	Fort Osage High School
Andrew Gibler	Fort Osage High School
Brian Hens	Truman High School
Reva Hertlein	Truman High School
Matt House	Fort Osage High School
Trang Le	Northeast High School
Justin Leopold	William Chrisman High School
Thiah Mai	Northeast High School
Ryan Main	William Chrisman High School
Juli Mischanko	Northeast High School
Benjamin Neal	William Chrisman High School
Aaron Scott	Center Place Restoration
Brian Smith	William Chrisman High School
Luke Ware	Northeast High School
Kari Wheelock	Truman High School

### Section B (16)

NAME	SCHOOL
Johnathon Bender	Fort Osage High School
Andrew Brink	Truman High School
Stephanie Davis	Fort Osage High School
Amanda DeBrot	William Chrisman High School
Aaron Hawes	William Chrisman High School
Andy Lind	Englewood Christian Academy
Shawn Mitchell	William Chrisman High School
Mounish Patel	Truman High School
Beth Patridge	Fort Osage High School
Mink Pham	Northeast High School
Kylie Regier	Center Place Restoration
Alex Saiyan	Northeast High School
Kenneth Steward	Central High School
Joshua Tanner	William Chrisman High School
Jeremy Wade	Fort Osage High School
Brandy White	Southeast High School

### Section C (7)

NAME	SCHOOL
Raoul Chung	Paseo Academy
Jacob Fulcher	Truman High School
Christopher Nevans	Truman High School
Timothy Skinner	Truman High School
Dustin Sullivan	Fort Osage High School
Leslie Tiensvold	Truman High School
Sean Tracy	Truman High School

### Section D (16)

NAME	SCHOOL
Jared Cameron	Center Place Restoration
Paul Datschewski	William Chrisman High School
Tien Dinh	Northeast High School
Drew Fetters	Northeast High School
Adrienne Guarino	William Chrisman High School
Jack Henry-Rhoads	William Chrisman High School
Tara Hughson	William Chrisman High School
Amy Launius	William Chrisman High School
Kymthien Nguyen	Northeast High School
Allen Rose	William Chrisman High School
Chris Rosson	Englewood Christian Academy
Devin Thompson	Fort Osage High School
Tim Todd	Truman High School
Alexander Williams	Fort Osage High School
Quiana Williams	Southeast High School
David Winfrey	Fort Osage High School

These are the total of 56 students (as of this newsletter) who will be enrolled. As usual, there will be additions and deletions through September.

### THE 2001-2002 STAFF

#### In PHYSICS:

Larry Harding (retired), from Fort Osage High School and Russell Clothier, a new Truman High School Physics teacher, with some assistance from our liaison Roy Cook of Northeast High School.

#### And, in CALCULUS:

Sheri Adams from Truman High School, and Libbi Sparks from William Chrisman High School.

Our University staff is listed in the heading of this newsletter, and our half-time secretary and assistant is Donna Dilse.

### MPI T-SHIRTS!

Beginning in about October, we will once again be selling MPI T-shirts and sweatshirts to our students. These shirts have a classy 3D graph ( $z = \cos x \sin y$ ) on the back and our student-designed MPI logo on the left front.

### ENRICHMENTS

#### FOLLOW UP

On April 6, Tina Niemi, UMKC Geosciences, spoke on **PALEOSEISMOLOGY AND PROBABILITIES OF FUTURE EARTHQUAKES.**

Student comments were:

■ Earthquakes occur often and are dangerous. They are created by naturally created seismic waves as well as large explosions. Seismology studies these occurrences and Paleoseismology studies ancient earthquakes. It is a branch of geology. They can tell about when prehistoric earthquakes occurred and can help prevent future earthquakes. At a fault line, a slip is a sudden release of stress and creates shaking of the ground. Stress and strain are important in the physics of seismology. Stress is a force over an area. The change in shape caused is its strain. The force is a compression force.

■ She used a wooden block with sandpaper on the bottom and attached a rubber band, which she pulled to show the proportion of the energy to the size of a quake. There is elastic energy that is released at once in earthquakes when the plate's friction is overcome. The greater the stored energy, the greater the Richter reading.

■ Good enrichment. Educating and interesting. I do wish she had time to delve into probability of earthquakes and predictions.

■ I think it would have been cool to see more pictures of what earthquakes can do and what to do in case of an earthquake. It is very interesting the way they can find places where earthquakes happened underground a long time ago.

---

On April 27 Brent Harding (MPI 1984-85), Engineer Specialist with Orbital Sciences Corp., spoke on **APPLICATIONS OF SATELLITE TECHNOLOGY**.

Students responded:

■ Sun sensors, earth sensors, star trackers, magnetometers, and gyroscopes are used for attitude determination. Three satellites are used to zone in to one location. Because of atmospheric conditions, satellite signals move around continually, but satellites can locate a position within 20 to 30 feet. For satellite control, they use thrusters, reaction wheels, solar sails, and magnetic controllers. To rotate a satellite with wheels, they spin the wheel the opposite direction of the way they want to turn the satellite (like we did in Physics class). The applications of satellite technology are communications, saving the earth, tourism, remote sensing, and exploration.

■ The Global Positioning System was first used for the army as a military project. They did this so that other countries couldn't use their technology to bomb us. GPS is the best and most accurate way to find a satellite. On a satellite they use magnetic controllers to let it align itself with the earth's field. Therefore, it enables the satellite to control itself to line up with the earth.

■ Mr. Harding started by talking about his educational and work history. Then he talked about putting a satellite together. He then talked about Navigation, the GPS system (complete with demonstration involving slinkys), sun sensors, earth sensors, star trackers, magnetometers, gyroscopes, thrusters, reaction wheels and magnetic controls. He also talked about solar sails and their possible use for controlling satellites. He showed video clips of the Mars Odyssey Launch. He also talked about problems from some satellites.

■ This guy was the best one all year!

■ A very interesting speaker. He kept the attention of just about everyone that was there. Along with helping in terms that we were able to understand.

■ He was great! The subject matter was interesting, and he interacted very well. Very funny and interesting.

■ What a fabulous way to end the year! He was great!

---

## UPCOMING ENRICHMENTS

One of the special features of the MPI is its biweekly enrichment series, in which on alternate Fridays either professionals in the sciences, engineering, mathematics, etc., speak to our MPI students, or, we take a field trip to such places as Linda Hall Library of Engineering, Science, and Technology, UMKC's Physics Department, or Worlds of Fun for some 'hands on' physics.

As part of our early MPI orientation, of UMKC, will speak on August 31, about college admissions in general, and the importance of thinking about applications EARLY. (This is not intended to be a recruitment for UMKC, but a general discussion to help sensitize our students to the importance for colleges of deadlines.)

On September 14, Douglas Carroll from the Dept. of Basic Engineering at the University of Missouri-Rolla will speak on **SOLAR CARS**. He has been the advisor for the UMR Solar Car Team since 1992, and has done research on composite materials. For more information, visit his website at: <http://www.UMR.edu/~dougcl/>.

We have not yet scheduled an Enrichment speaker for September 28.

The October newsletter will report on those speakers scheduled for October and beyond.

---

Continued after the Calendar →

# Mathematics and Physics Institute

## CALENDAR 2001-2002

### YEAR 18

MPI Begins	Wed, August 29, 2001
1 <sup>st</sup> Quarter Grade and Probation Reports Sent	Thurs., August 18, 2001
<b>MPI OPEN HOUSE</b> for Parents/Teachers/etc.	Sunday, November 4, 2001
Thanksgiving Holiday	November 22-23, 2001
Final Exam – Calculus I - (Math C Only)	Wed., December 19, 2001
2 <sup>nd</sup> Quarter/1 <sup>st</sup> Semester Grade Reports Sent	Thurs., December 20, 2001
Christmas Holiday	December 22, 2001-January 6, 2002
MPI Classes Resume	Mon., January 7, 2002
<b>PANEL DISCUSSION &amp; REUNION</b>	Tues., January 8, 2002
Martin Luther King Holiday	Mon., January 21, 2002
President's Day Holiday	Mon., February 18, 2002
3 <sup>rd</sup> Quarter Grade Reports Sent	Thurs., March 7, 2002
MPI Spring Break	Mon.-Fri., Mar 25-29, 2002
MPI Classes Resume	Mon., April 1, 2002
Final Exams – Calculus I (A,B,D) and Calculus II (C Only)	Mon., May 6, 2002
Final Exam – Physics	Tues., May 7, 2002
MPI Breakfast	Wed., May 8, 2002
MPI Awards Presentation/Last Day of MPI Classes	Thurs., May 9, 2002

---

## TO THE PARENTS OF THE 2001-2002 CLASS AT MPI

This newsletter is written for **YOUR** information, and there will be one sent to you every two months during this year, while your son or daughter is at the MPI.

We firmly believe that without your support and concern at home, students cannot succeed in such a rigorous program as the MPI. Our classes are **NOT** high school classes and require both study skills and a commitment that students still in high school, however talented, have not experienced before. In both of these areas **YOU** as parents can be of enormous help.

One of the first facts we have learned to face in the last seventeen years is that many bright students never learn to study efficiently; they have often gotten along very well with a 'wait and cram' attitude, giving textbooks only an occasional cursory look in time for testing and relying on their innate ability to absorb information and skills in the classroom. However, in coming to the MPI, these same students always find themselves at first, and suddenly, falling behind.

In general, in college classes **MORE MATERIAL** is covered, and **MORE SKILL** with concepts is required, i.e., **THINKING** is expected regularly. This comes as a shock to many talented students. One of the MPI's goals is to expose students to this shock, and help them overcome it by learning effective study skills in actual practice. But **YOU** as parents can help this transition enormously by suggesting that your children actually spend the minimum of one hour per subject, per night of study that we here at MPI urge. They must come to realize that longer study times reflect the new rigor of the **COURSES**, not their lack of talent. This is a point of view that many students find hard to accept at first. Your encouragement can help them over the hump. Encourage them to seek the help of all the teachers involved in the program and to put aside the false idea that only remedial students need to **TALK** about mathematics and physics. The fact is that true understanding comes only from learning to discuss and explain a subject, and this is **ESPECIALLY SO** in physics and mathematics.

Finally, we urge you to call us if you ever have a question, and we hope that you will find time to visit the MPI during our **OPEN HOUSE** on **Sunday afternoon, November 4, 2001**. (See the Calendar in this issue; more about this in the October newsletter.)

---

## WE HEAR FROM PAST STUDENTS

**Rachel (Gard) Wittenberger (94-95)**  
BS Physical Therapy  
University of Missouri-Columbia

"I am married to a 4<sup>th</sup>-year dental student who has been accepted into the Orthodontics program in Iowa. We will move there this summer where I will complete my MBA degree. MPI was a challenging, wonderful experience. My problem-solving skills were greatly developed, and I made some great friends in the process!"

---

**Hattie Williams (94-95)**  
BA Psychology, Philosophy, Sociology, UMKC  
MS Instructional Design & Technology  
Emporia State University

"I'm an MPI alumnus from way back in the 1900's. Yep, we thought only waiting 10 minutes for information from China to appear on your screen was sooooo kewl. I've been extremely busy since then. I graduated from UMKC with BAs in Psychology, Philosophy, and Sociology in 1999. I received my MS in Instructional Design and Technology from Emporia State University this past December. Currently, I am employed by Sprint PCS as an Educational Consultant, and so I found the followup on your enrichment speaker extremely interesting. ...Oh well, gotta go. Good Luck year 18 students!!! (I got through by the skin of my teeth.)"

---

**Lyndsey Main (99-00)**  
Computer Science Major  
UMKC

"Just wanted to drop a note to everyone at MPI and tell you that I am transferring to UMKC in the fall and getting my own place near the Plaza. School here [the University of California-San Diego] is great but it turns out it is just way too expensive. I am looking forward to the move (especially because the dorm rooms are so tiny here!) and I am planning on a Computer Science major (with possibly an art minor for some fun graphic design/imaging skills). I just registered for classes this week, and I am enrolled in Calc III so wish me luck. I'm a little scared! I am also taking digital imaging I and CS problem solving II. (I may have to wait on the CS classes until later though. I learned to program here in Java and they teach it in C at UMKC. Oh well, anyhow, I may see you around campus in the fall. Hope everything is going well there and don't take it too easy on the kids during finals. **RULE WITH AN IRON FIST. ☺**"

---



Audrey (Linville) Fox (88-89)  
MS Chemistry

"Since so much has changed in our lives after we were married in 1993, we decided to give you an update. In October 1998, I gave birth to our son Maxwell (named after James Clerk Maxwell of electromagnetics fame). As he has grown, the choice of his name has seemed fitting since he can count to 12 by himself (and in the correct order!) and he won't turn 3 until this October. After his birth, I left graduate school with a master's degree in Chemistry so I can care for him full time. Jon continued and was rewarded with his doctorate in Physics in 2000. In April of that year, he joined Research Support Instruments in Princeton, NJ. Jon can give you a better description of his research projects in another email. The New Jersey branch of RSI is small so he does his research in collaboration with the Applied Physics Group at Princeton University. He has shown that you can do physics and still eat relatively well. I have included our email addresses in order to update your records. I have also included our US Mail address so that we can receive the newsletters again."

**A SOLUTION TO  
MATHEMATICS CHALLENGE #68**

Recall the problem statement:

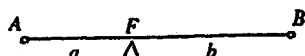
The arms of an equal-length balance are never exactly the same length. To eliminate the error due to this unavoidable fact, someone proposes that objects be weighed twice, once on each side of the balance, and then the average used as the correct weight of the object.

However, show that in fact the average of these weighings *never* gives the correct weight, unless the arms are exactly the same length! In view of this, determine how the weighings ought to be treated in order to truly give the correct weight.

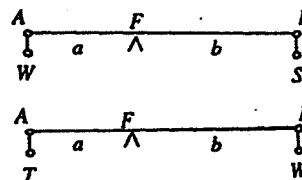
[From : Pi Mu Epsilon Journal, 1950, vol. 52, #2, as quoted in Mathematical Chestnuts from Around the World, by Ross Honsberger, MAA, 2001, section 6, problem #1.]

**SOLUTION:**

In the picture below, let the equal-length balance AB have its fulcrum (balance point) at F. Let the arm AF have length a, and the arm BF have length b, as shown.



Following the suggestion in the statement of the question, let us weigh an object of unknown (non-zero) weight W twice, once on each side of the balance. Suppose that when placed at point A, the weight W balances with a known weight S, and when placed at point B, the weight W balances with a known weight T, as shown below.



Then, by the Law of the Lever, it follows that both

$$aW=bS \quad \text{and} \quad aT=bW.$$

Dividing the first equation by the second equation then yields

$$\begin{aligned} W/T &= S/W \\ W &= \sqrt{ST}. \end{aligned}$$

The expression  $\sqrt{ST}$  is called the Geometric Mean of S and T, while the average mentioned in the statement of the question is  $(S+T)/2$ , called the Arithmetic Mean of S and T. It is well-known that

$$\text{Geometric Mean} \leq \text{Arithmetic Mean},$$

and these two Means are equal only when  $S = T$ . (The easy proof of this fact for two numbers S and T begins with the obvious inequality  $0 \leq (S-T)^2$ , followed by multiplying out the right side, rearranging terms, and eventually taking an appropriate square root.)

So, in general, the correct weight W is given by the Geometric Mean. The average (Arithmetic Mean) of these weighings S and T *never* gives the correct weight W, unless  $S = T$ . In that case, using the Lever equations above we can write

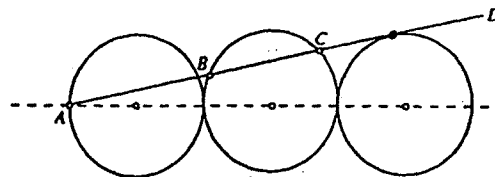
$$\begin{aligned} (a/b)W &= S = T = (b/a)W \\ a/b &= b/a \\ a^2 &= b^2. \end{aligned}$$

Since a and b are both greater than or equal to zero, we conclude that  $a=b$ , meaning the arms are exactly the same length, as predicted.

**A SOLUTION TO  
PHYSICS CHALLENGE #59**

Continuing on this same theme of Impulse and Momentum, consider this problem from one of our exams: Two boys in a canoe toss a baseball back and forth. What effect will this have on the canoe?

- None, because the ball remains in the canoe.
- The canoe will drift in the direction of the boy who throws the ball harder each time.
- The canoe will drift in the direction of the boy who throws the ball with less force each time.
- The canoe will oscillate back and forth always moving opposite to the ball's motion.
- The canoe will oscillate back and forth in the direction of the ball's motion.



What is the length of the intersection BC of that tangent with the middle circle?

### SOLUTION:

The answer is d. Assume the boys in the canoe are a closed system and that momentum is being conserved. When the first boy throws the ball, he exerts a force that gives the ball momentum in the direction of the other boy. In order for momentum to be conserved, there must be an equal amount of momentum to the boat in the opposite direction. So the boat will move opposite to the ball. Of course, the boat will NOT move as quickly as the ball because MOMENTUM is conserved and momentum depends on both mass and velocity. Since the boat (with the boys) is much more massive than the ball (unless they are throwing one VERY heavy ball!!), the boat will probably only move slightly. This motion will always be opposite to the ball's motion.

### MATHEMATICS CHALLENGE #69

In the picture below, three circles of radius 5 are arranged side by side in a row. From the point A on the first circle, which is in line with all three centers, a line AD is drawn which is tangent to the third circle as shown.

[From: The Mathematical Gazette, 1988, vol. 145, in a review of the book Mathematical Puzzling by Tony Gardiner, as quoted in Mathematical Chestnuts from Around the World, by Ross Honsberger, MAA, 2001, section 13, problem #2, p. 144.]

### PHYSICS CHALLENGE #60

Stuck on a windless day, a sailor decides to direct a powerful fan which he has on-board into the sail. If all the wind generated bounces backward off the sail, could this propel the sailor's boat?

Editor/Writer:

Richard Delaware

This M $\pi$  Newsletter is typed in Microsoft Word 97 and 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 (MPI), 600 W. Mechanic, Room 224, Independence, MO 64050, Phone: (816) 235-1272, E-Mail: mpi@umkc.edu. Please address all correspondence concerning this newsletter to 'M $\pi$  Newsletter'.

University of Missouri-Kansas City  
Mathematics and Physics Institute  
600 W. Mechanic, Room 224  
Independence, Missouri 64050-1799

