



Director: Elizabeth Stoddard, Ph.D.
Associate Director: Richard Delaware, Ph.D.

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YEAR 19 - WE BEGIN

Currently 31 students are enrolled at the MPI, consisting of 4 from Center Place Restoration, 4 from Fort Osage, 1 from Hickman Mills, 3 from St. Mary's, 10 from Truman, and 9 from William Chrisman High School. Of these 8 (26%) are females and 23 are males.

A WIDER MPI RECRUITMENT NET

In this 19th year of the MPI, we are expanding our recruitment of students from the traditional districts of Fort Osage, Independence, and Kansas City Missouri, which have been the primary support for the MPI since we began in 1984. Although Raytown district participated for the first four years of our existence, and two years ago Blue Springs district sent us students for one year, the "big three" districts have been our foundation over the years. But times change, and to survive in the face of the many options now available to capable high school seniors, we need to cast our net more widely.

!! MPI OPEN HOUSE !!

Sunday, Nov. 10, from 1-3 p.m., 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 MPI.

We'll be in the Truman Campus Building of UMKC behind the Truman Library, just north off of Hwy. 24 in Independence. There will be:

- 1) Physics demonstrations and laboratory set-ups.
2) Mathematics demonstration problems on chalkboards with SHARP graphing calculators on display, and
3) the MPI Calculus Lab in Room 223 will be open with MPI student assistants ready to demonstrate mathematics software to our visitors.

In Room 207 at 1:30p.m., the MPI Director and Associate Director will make some brief remarks and introduce the MPI teachers. And of course, there will be refreshments. If you have any questions please call 235-1272. You're invited!

Toward that end, the Director, Elizabeth Stoddard, and the Associate Director, Richard Delaware, have been visiting other school districts, introducing them to the uniqueness and consistent high quality of the well-established MPI experience, hoping they will agree to offer the program for their gifted and talented high school seniors. To date we have met with representatives or superintendents of the following districts:

- 20 Sept. 2001 - Hickman Mills
25 Sept. 2001 - Liberty
2 Oct. 2001 - North Kansas City
26 Apr. 2002 - Center
29 July 2002 - Kansas City Kansas
24 Sept. 2002 - Grain Valley

What has been our success so far? Hickman Mills and North Kansas City have agreed to offer the MPI, and Hickman Mills has been the first to send us students this year. Liberty declined, but Center is highly interested in offering the program. In fact, on Sept. 18, 2002, the Associate Director paid Center a second visit to talk to mathematics and science teachers about the MPI. Kansas City Kansas and Grain Valley have expressed strong interest and are in the process of making a decision now. We also hope to reinstate contact with Blue Springs district soon.

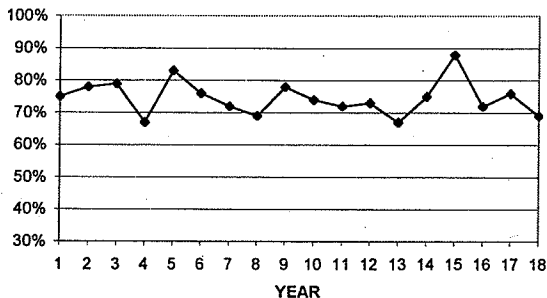
!! MPI OPEN HOUSE !!
SUNDAY, NOV. 10, 2002, 1-3 P.M.

Gathering students over the years from 5-11 high schools, from several districts, urban, suburban, and rural, has always been a source of MPI uniqueness and strength. Each year we enroll a diverse collection of gifted and talented seniors who for nine months learn Calculus and Physics, as well as college study habits, together in a vibrant group larger than possible at any one high school. Our exceptional teaching staff of two Ph.D.s in Physics, one in Mathematics, and several teaching-award winners now look ahead with anticipation toward including a fresh infusion of students from new participating districts. The future of the MPI is promising, as are our students.

SOME STATISTICS FROM OUR 2001-2002 ACADEMIC YEAR REPORT

- 820 students have completed the MPI program (Years 1-18, Sept. 1984 – May 2002); 497 (61%) of these were male and 323 (39%) female.
- On average, 75% of all MPI students who start the program actually finish.

PERCENTAGE FINISHING MPI

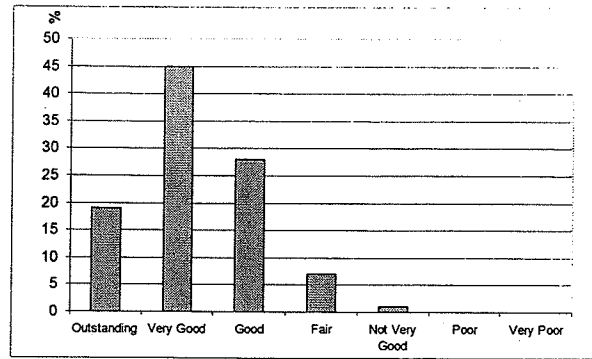


- Of the 624 MPI Alumni from Years 1-13 (1984-97) (excluding foreign-exchange students), 583 (93%) entered college, receiving 466 college degrees (to the best of our knowledge), including at least 229 degrees in Science, Mathematics, or Engineering, 9 Medical Doctors, and 3 Ph.D.'s.

■ Where 72% of MPI Alumni Go:

- 24% UMKC
- 16% UM-Columbia
- 11% UM-Rolla
- 5% Truman State Univ. (NEMSU)
- 4% University of Kansas
- 3% Central Missouri State University
- 3% Penn Valley Community College
- 3% Rockhurst
- 1% Northwest MO. State University
- 1% William Jewell College
- 1% Washington University – St. Louis

■ How Students rate the MPI when they finish:



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

MPI Alumni who have spoken:

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

ODDS AND ENDS

During Summer 2002, the MPI was featured in an article in the Linda Hall Library of Science, Engineering, and Technology (LHL) newsletter Hedgehog, issue No. 19, Summer 2002, pp. 3-4, titled: "The Mathematics and Physics Institute Annual Visit." Bruce Bradley of LHL wrote about the annual MPI field trip to LHL in March, when we visit the Rare Book Room, which Bruce directs. There our students see, touch, and read old and rare books of mathematics authored by some of the famous mathematicians and scientists whose works they have studied at the MPI. They are then assigned to write a short paper about this experience and what they discover. The article includes quotations from some of those papers.

Sheri Adams and Libbi Sparks will continue for another year to administer a Missouri

Incentive Grant for Truman and William Chrisman High Schools to improve student mathematics performance on Missouri State Assessment tests. **Libbi Sparks** also continues as Instructional Specialist for Mathematics at William Chrisman High School.

In **September**, both the Director, Elizabeth Stoddard, and the Associate Director, Richard Delaware received State of Missouri teacher certification, through the Ph.D. route, to teach their specific subjects (Physics and Mathematics, respectively) in Missouri high schools. They will also soon both receive **provisional Gifted and Talented endorsement**, allowing any district participating in the MPI program to apply for reimbursement of a significant percentage of their MPI salaries. Both are currently engaged in taking a series of 4-5 three-hour courses at Webster University to achieve full Gifted and Talented endorsement.

In **September**, we mailed to all participating districts **course descriptions** of the four UMKC courses offered by the MPI so that they might update their various "Program of Studies" listings for seniors. For the record, the UMKC courses taught are Math 210 (Calculus I), Math 220 (Calculus II), Phys 210 (General Physics I - Algebra based), and Phys 240 (Physics for Science and Engineering I - Calculus based).

September 19-20, Libbi Sparks heard Robert Manzano speak on "Effective Instructional Strategies in the Classroom."

On **September 20**, Elizabeth Stoddard gave a presentation of her current research work in a UMKC Physics Department Physics Colloquium titled "Research Opportunities in Physics." She is currently pursuing Inservice Teachers Training with the Kansas City Missouri School District, as well as conducting research in nuclear physics.

On **September 27**, Richard Delaware spoke in the UMKC Department of Mathematics and Statistics Expository Talks Series on: "The Longest Curve with Increasing Chords (whose Endpoints are a Unit Apart) Has Length $2\pi/3$."

On **October 4-5**, Richard Delaware will attend the 12th Annual Kansas City Regional Mathematics Technology EXPO at Rockhurst University. He has been a member of the EXPO steering committee since 1991 when the EXPO began.

ENRICHMENTS

FOLLOW UP

On Friday, **September 13**, we were lucky enough to have Ernest E. Angino, retired Professor of Geology and Civil & Environmental Engineering from the University of Kansas speak on "**GLOBAL WARMING: FACT AND FICTION.**"

Students responded:

■ Dr. Angino discussed the effect humans have had on global warming. He said that the earth is actually getting warmer, but that it has been higher in the past. During the early 1900s, the average temperature began to decrease. During the mid 1970s, it began to go back up. Oddly enough though the arctics have been getting colder over the last 25 years. He described glaciers as layers of snow that never fully melt, and he explained that they determine the temperature of different time periods by analyzing air bubbles in an ice core. 45% of CO₂ emitted by humans is unaccounted for which makes it difficult to determine if humans cause global warming. Dr. Angino thinks we may have some effect, but not a massive effect. Some geologists predict that another ice age might be in the near future.

■ We know the temperature has been changing in the years past because we can test the CO₂ trapped in layers of ice in glaciers. The ratio of $\frac{O^{16}}{O^{18}}$ Isotopes is related to the average temperature of the year; by testing this, the warming/cooling of the earth over the past millions of years can be determined.

■ I thought he did a great job and was able to keep my attention because of his enthusiasm. I like how he gave us facts about warming, some fiction, and even gave his opinion that "no" we aren't warming the globe at an alarming rate - the world isn't ending.

■ He was Fantastic.

■ I thought it was pretty interesting and realized that it would be hard to find out just how much effect humans have on global warming.

■ What I did like is when he explained the media blowing things out of proportion. I've always thought you say "there is global warming" but there are no long unusual heat waves. He told how that is because there are rising temperatures then recessions, but yes there's global warming.

■ It seemed to have a lot to do with chemistry more than anything. Maybe try to tie it in with physics. I still enjoyed it though because I love chemistry!

On Friday, **September 27**, paleontologist and "dinosaur hunter" Craig Sundell of KU spoke on **THE REAL JURASSIC PARK: A WINDOW INTO PALEOECOLOGY**.

Students responded:

■ Dr. Sundell says that most of our views on dinosaurs are incorrect because they are based on books and movies we have seen. No one actually knows what color they were. He says that 80% of dinosaurs died from climate changes instead of a meteor. The climate is always changing and 50 million years ago the oceans were higher and covered the central part of America.

■ The guy was talking about how he goes to this one site every summer and digs up lots of dinosaur bones. He told us that the continents are always moving and he showed us some pictures of how the earth used to look.

■ Mr. Sundell talked about the three big discoveries made by the field of Paleocology. They are: 1) The earth is 4 billion years old. 2) The earth is always changing and 3) Small changes over time lead to big changes in the future.

■ Craig Sundell is a Palentologist at KU. He has found 40 good dinosaurs. He discussed how old the earth is. The earth has been dated at 4.6 billion years old by 3 different ways. Craig Sundell discussed how no one knows what the color of a dinosaur's skin is. He said DNA hates time and heat.

■ I thought he did a very good job!. It was very interesting.

■ There was so much information I feel he needed more time. I would have liked to see more of the slides.

■ I really enjoyed the speaker. I think he came well prepared and held my attention throughout the speech. The only suggestion I could offer would probably be make more time for him to speak because we kinda rushed it through the end, but overall it was good.

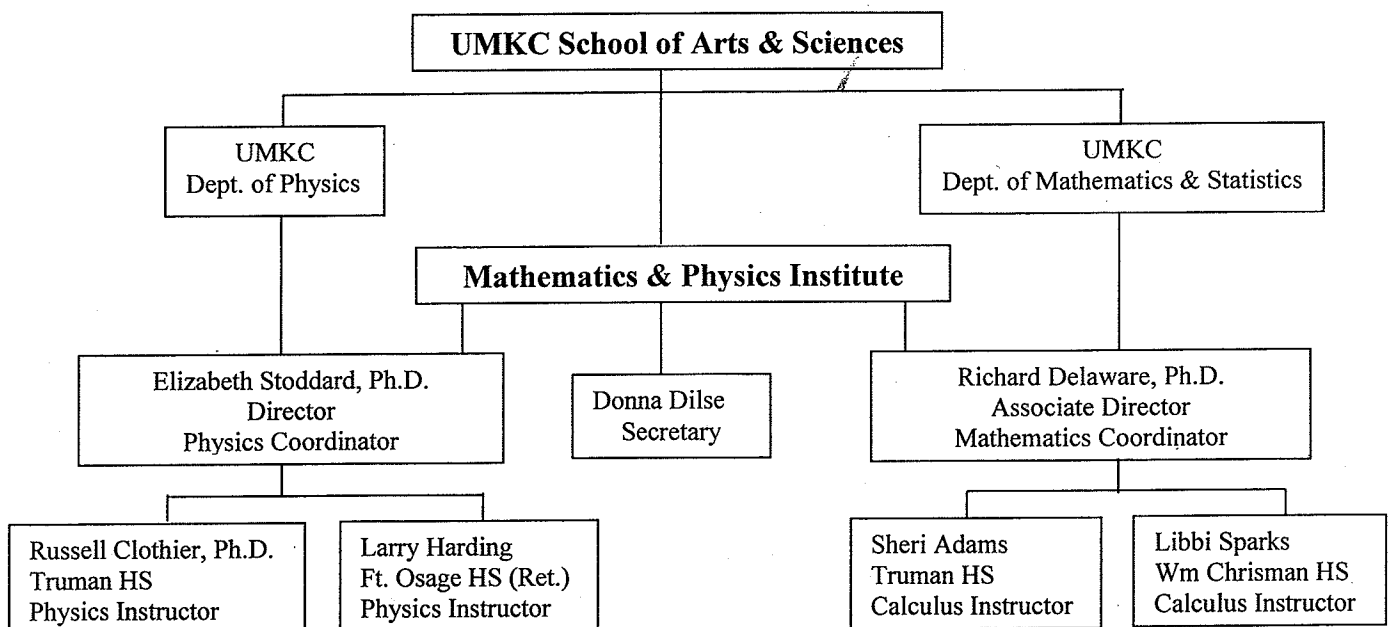
■ Craig has found 40 dinosaurs in Wyoming. Contrary to popular belief, birds do not come from dinosaurs. The only dinosaur DNA that has been found is only 100 gene pairs long, but most small animals have at least 2 million gene pairs. If we put dinosaur DNA in frog DNA, we'd get FROGS!!

■ Very nice presentation.

■ More time to have him talk. And play with little plastic dinosaurs.

UPCOMING:

On **October 11**, Darrin Ingram, Project Manager and Senior Associate at Gould Evans Goodman Associates Architects, and member of the American Institute of Architects, will speak on, **"ARCHITECTURE: DESIGNING THE ENVIRONMENT."**



On **November 8**, the UMKC Dept. of Physics will discuss opportunities in Physics at UMKC.

On **November 22**, Douglas Carroll from the Department of Basic Engineering at the University of Missouri – Rolla, will speak on **“POWER MANAGEMENT FOR SOLAR CARS.”** He has been the advisor for UMR Solar Car Team since 1992, and has done research on composite materials.

WE HEAR FROM PAST STUDENTS

Dustin Sullivan (01-02)
University of Missouri - Columbia
Electrical and Computer Engineering dual Major

Email received 8-22-02:

“Hey I’m just dropping you a line. I am here now at MU and having great fun. Class starts Monday. I am retaking Calculus 2. I am still a little shaky on it even though I passed it with a B. And also, I don’t have Leslie [Tiensvold] helping me late at night and all. She had to be a jerk and go down to Tennessee for school. Anywho, I hope you have fun this year with the new MPI class. I hope they annoy you as much as the 2001-2002, section C.”

Email received 8-30-02:

“I have made it through my first week of school. Classes are not scary at all, probably because I survived MPI. Though I have received much homework this week, I am using your suggestion of using my time to focus on work. Most days I have classes one right after another in the mornings. So when I am done with classes, all of my friends are still in class sessions. I use that time to do my studies. Because I have all of my studying done in the afternoons, I do not have to sacrifice any time socializing. Yay.

I do not like my calculus professor much. She has sloppy notations. She does know what she is doing, do not get me wrong, but she gives us notes in awkward order. She uses math vocabulary wrong. For example, instead of writing a theorem on the board, she will call it a fact, and then not prove the theorem. I do not like her teaching style. I guess I am too accustomed to your teaching style and standards of math. (i.e., proper notation, proper format, et cetera).

My other classes are all good. I do not like Philosophy too much. It seems to me to be a bunch of smoke and mirrors, in which nothing is true or even useable. My programming and chemistry classes are all good.

Well, I am going jet, going to hit the books. Just telling you that I am doing well and that I am not overwhelmed mainly because of my difficult

schedule last year, mainly centered on MPI. Talk to you later.”

Leslie Tiensvold (01-02)
Freed-Hardeman University
Biochemistry Major

Email received 9-4-02:

“Hi!!! So is MPI off to a good start? I know it can’t be nearly as good as last year’s start, because I am not there!! Well, I am in Tennessee. I love it here. I have been here for nearly a month. I had to get here early for soccer practice. I don’t think I will be returning home until Thanksgiving. So how do the numbers look for this year? Is it a good size, or is it low? Do you expect a lot of this group to drop out? I told Nick [Dryer] to mention my name if he wanted to start off on the wrong foot! He isn’t a bad guy, just don’t let him talk your ear off. I worked with him at Science City over the summer.”

Johnathon Bender (01-02)
Virginia Military Institute
Mechanical Engineering Major

Email received 9-5-02:

“Wow, I haven’t talked to or sent an email to anyone from MPI yet, don’t you feel special? Oh yeah, this is Bender. I’m here at VMI and have been here for a few weeks now. School is good and I enjoy it. Time for class now, bye for now.”

Email received 9-5-02:

“Thanks for emailing my grades to Cmdr. Quisenberry, but all of this is for next semester, I just want to get it all done before I forget – you remember how I forget things (or did you forget?) It’s good to keep in touch with some of my old teachers, it gives me hope that there really is an outside world. Tell Dr. Stoddard that I said, “hi”, if she didn’t get my email. Please don’t have me say something corny in the newsletter. Thanks again.”

Laura Redi (Dilley) (91-92)
Ph.D. Candidate
Speech and Hearing Bioscience and Technology
Harvard-MIT Health Sciences Technology Program
BS Brain & Cognitive Sciences
MIT

Email received 9-17-02:

“Hi! Great to hear from you! I’m currently starting experiments for my thesis and hope to be done late next year. I’m developing a theory of

intonation in speech which proposes that the way that listeners encode pitch contours in speech is very similar to and adheres to the same principles as the way they encode musical melodies. I'm pretty excited about it, since it's very original. I came up with the basic ideas while I was still an undergrad.

P.S. I'll be putting up a web page soon, and will let you know when I do!"

Sheryl Nance-Durst (84-85)
BS Mathematics
University of Missouri – Kansas City

Email received 9-18-02:

"Yep, I'm married – my last name is now Nance-Durst. I'm working as a reference librarian at the Kansas City, Kansas Public Library. We've got a house up north of the river in Oakview (it's a tiny little village smack in the middle of Gladstone that has resisted being absorbed)."

Jake Fulcher (01-02)
University of Missouri – Columbia
Mechanical Engineering Major

Email received 9-21-02:

"I have my first Calc III test on Monday, and decided to take a little break. Thus far, we have not covered anything too complex. For the most part, we have discussed things from previous classes, only in three dimensions. I feel like I couldn't have been prepared better. I also like my Calc professor a lot. He's no Dr. Delaware (heh, heh) but he is a very good lecturer. At first I didn't think I was going to be able to understand him, but I kind of like his accent now. His accent is different too. I talked with him when I saw him eating lunch the other day, and he told me he was born in Moscow, lived there for 19 years, then moved to Israel, then came to America. So he has a Russian/Jewish accent. He is funny and great at describing the visualizations we have gone over. Well I don't want to keep you. I just wanted to let you know how things are going. And they're going good. I also have Dustin Sullivan [MPI 01-02] in my programming class. He's as talkative as ever.

Talk to you later."

2002-2003 STUDENT FIRST IMPRESSIONS

"I knew the MPI would be both difficult and demanding when I signed up. At first, I was really worried, especially when I saw the "2 hour homework for every 1 hour of lecture" because I thought that would be an every day thing. So far, though, I have enjoyed it, and I think all the instructors here have been a great help. The only

thing that bothers me is waking up at 6am, but it's not a bad sacrifice for the college hours and knowledge."

Matt Perry
Truman High School
Independence School District

"My initial reaction to the MPI was a very good one. I was afraid at first that the atmosphere in the class would be tense because of the speed that we would get our information, but it is not that way. I'm beginning to be very excited for the rest of the year."

Joey Hare
St. Mary's High School
Independence School District

"Through most of my life at school I have had to endure long drawn out classes which could have easily taken a few weeks to complete until I got to MPI. My first impression of MPI was relief that I am in classes now which are up to my speed instead of me dragging myself out in a "normal" class. I enjoyed this feeling because we have covered a lot of material in the amount of time we have been in session. Sure there are some of this I dislike, such as even when my school is closed, I still go to MPI. But those are made up for on the days my school has class and MPI does not, so I am OK with that. So far it seems like MPI is the beginning of the journey of life to college, faster paced then one might expect, but if you are prepared it will be a great experience."

Nicholas Dryer
Ft. Osage High School
Ft. Osage School District

"Honestly, my first impression of MPI was, 'What am I doing here?' Since then we've had a couple weeks of classes and it's apparent that it will be a challenge, but it can be done. We're here because someone thinks that we can handle this. I don't intend to disappoint them."

Caleb Postlethwait
Center Place Restoration School
Ft. Osage School District

"Coming into MPI, I expected it to be just like any other college class – lecture halls, professors that cared little about your studies, and material that would be difficult enough to be painful. Yet, I was proven quite wrong. The first thing I noticed was the small class size. The fact that the professors actually sat down and got to know you was surprising. And the work – well, it wasn't much more difficult that what I've had in Calculus and Physics classes I've

had before. (In some cases, even easier.) I was genuinely surprised. I went in with my preconceptions of a class from hell, wondering whether I was mad to take it. However, now that I'm here, I think I'm going to get along just fine, and I actually like it here."

Matt Quinn
William Chrisman High School
Independence School District

**A SOLUTION TO
MATHEMATICS CHALLENGE #74**

Recall the problem statement:

A teen-age boy is now n times as old as his sister, where $n > 3.5$. In 3 years he will be $n - 1$ times as old as she will be then. If the sister's age in years is an integer, find the present age of the boy.

[From: Challenging Problems in Algebra, Alfred S. Posamentier and Charles T. Salkind, 1970 (1996 Dover), pp. 36 & 155, #11-6.]

SOLUTION:

Let's start by letting s represent the sister's present age. So the boy's present age is ns . Then, the boy's age in 3 years will be on the one hand plainly $ns + 3$. On the other hand, as described in the problem statement above, his age will also be $(n-1)(s+3)$. Thus:

$$\begin{aligned}(n-1)(s+3) &= ns + 3 \\ ns - s + 3n - 3 &= ns + 3 \\ 3n &= s + 6 \\ n &= s/3 + 2.\end{aligned}$$

Since we are given $n > 3.5$, it follows that

$$\begin{aligned}s/3 + 2 &> 3.5 \\ s/3 &> 1.5 \\ s &> 4.5.\end{aligned}$$

Further, since the boy is presently a teenager, using $n = s/3 + 2$ we have:

$$\begin{aligned}13 &\leq ns \leq 19 \\ 13 &\leq (s/3 + 2)s \leq 19 \\ 13 &\leq s^2/3 + 2s \leq 19 \\ 39 &\leq s^2 + 6s \leq 57.\end{aligned}$$

Adding 9 throughout in order to "complete the square" in the center expression, gives:

$$6 = \sqrt{36} < \sqrt{48} \leq s + 3 \leq \sqrt{66} < \sqrt{81} = 9$$

Since s is an integer, this means

$$\begin{aligned}7 &\leq s + 3 \leq 8 \\ 4 &\leq s \leq 5.\end{aligned}$$

But, we know $s > 4.5$, forcing $s = 5$. So, $n = s/3 + 2 = 5/3 + 2 = 11/3$. Therefore the present age of the boy is

$$ns = (11/3)5 = 55/3 = 18 + 1/3 \text{ years old.}$$

**A SOLUTION TO
PHYSICS CHALLENGE #65**

Recall the problem statement:

Let's discuss the Doppler Effect. We have all experienced the Doppler Effect in sound waves when an ambulance's siren sounds higher pitched as it approaches than as it recedes. This effect is general to all types of waves, including light. Observation of the universe shows that all bits of matter in the universe are receding from each other as shrapnel in an explosion, and this explosion is known as the Big Bang. Can you think of a way astronomers could use the Doppler Effect in light to estimate how long ago the Big Bang occurred?

SOLUTION:

Here is an example of how astronomers can use the Doppler Effect to estimate the age of the universe: Let's say an astronomer sees a galaxy known to be 5×10^9 light years away. Characteristic light waves emitted from a nebula in that galaxy (sodium lines for example) have frequencies 20% lower than they would be if the source were at rest. This effect is called "red shift" since red is the visible color with the lowest frequency and the Doppler Effect lowers frequency of light when the source is receding, shifting that light toward the red end of the spectrum. The relationship between the observed Doppler shifted frequency and the frequency emitted by the source of waves is $f_{\text{obs}} = \frac{\sqrt{1+v/c}}{\sqrt{1-v/c}} f_{\text{source}}$,

where v = relative velocity of source and c = speed of the waves. After some algebra we find that $v = .92 \times$ speed of light. Since it appears we were all in the same location at the time of the Big Bang, our present separation should equal our relative velocity times the time since the Big Bang, or

$$\begin{aligned}\text{distance} &= vt \\ t &= \frac{\text{distance}}{v} = \frac{5 \times 10^9 \text{ lt} \cdot \text{yr}}{.92 \text{ lt}}\end{aligned}$$

By this approximation the age of the universe is 5.4×10^9 years.

MATHEMATICS CHALLENGE #75

If each point of the plane is colored red, white, or blue, prove that some unit segment will have both its endpoints the same color.

[From: Mathematical Chestnuts From Around the World, by Ross Honsberger, MAA, 2001, problem #26, p. 71.]

PHYSICS CHALLENGE #66

In 1905, Einstein produced the Special Theory of Relativity that says that the speed of light as measured by any observer will be the same, $c = 3 \times 10^8$ m/s. Consider the following paradox:

You are in a very fast (nearly the speed of light!) ship flying above the surface of the earth. If you turn on the lightbulb located precisely at the center of your compartment, you expect the light waves will simultaneously strike the front and back wall of your compartment. Meanwhile, I am watching this happen from earth, and I see that the light moves forward at 3×10^8 m/s from the bulb toward the front wall and backward at 3×10^8 m/s toward the back wall. But, since the ship is moving forward, the back wall is moving forward to meet the light wave sooner. Also, the front wall is moving forward and away from the light wave, so the light hits the front wall later.

So, did the light waves hit the wall simultaneously as you observed or did they hit the back wall first as I observed? Which was it?

Editor/Writer:

Richard Delaware

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