ACADEMIC
Outreach
College of Arts and Sciences
THE UNIVERSITY of TENNESSEE
Volume 3 Issue 1

Math Ambassadors: Enriching High School Learning

UT undergraduate Math Honors students will participate in a fresh approach to academic outreach this year in a program developed by **Dr. Conrad Plaut**, Professor of Mathematics, and made possible by a $1 million grant from the National Science Foundation. Known as Math Ambassadors, the program will send UT Math Honors students to Tennessee high schools to give talks about math-related issues in order to increase interest in mathematics and particularly the UT Math Honors program.

The Math Ambassadors program is an innovative approach to outreach because it creates an opportunity for UT's Math Honors students to share their expertise with local high school students through inventive presentations connected to high school curriculum. Dr. Plaut explains, "The program is intended to present students with interesting mathematics that they would not normally see in high school, and to encourage them to continue to study mathematics—we hope at UT." The program will broaden high school students' conception of mathematics as a discipline as well. "Students in high school don't often see the more abstract ideas behind mathematics and therefore may develop the incorrect impression that mathematics is all about memorizing formulas and standard methods for solving problems," Dr. Plaut says. "In addition, these talks will provide students with new ways to view mathematical concepts that they have already learned."

These enrichment talks, forty-five minutes in length, will address mathematical issues to which high school students can easily relate. Dr. Plaut, the creator of the program, is currently planning several talks. One presentation under development is entitled "Don't Ask Marilyn!" Aimed at appealing to high school algebra II or geometry students, the lecture concerns Marilyn vos Savant's *Parade* magazine column, "Ask Marilyn," in which she claimed that a recent solution of a 330 year-old problem in mathematics was wrong. Another talk, "How Big Is Infinity?", is also under development. This presentation describes a proof by the mathematician Georg Cantor that established there are different "sizes" of infinity. The proof shocked the mathematical world when Cantor completed it near the end of the nineteenth century, and Dr. Plaut hopes it will also capture the attention of high school students more than a century later. This talk seems particularly promising because, according to Dr. Plaut, "The proof is relatively simple and can be understood by high school students with little mathematical background."

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The speaking experience itself will also benefit the UT students serving as Math Ambassadors. Dr. Plaut asserts that some of the honors students already enjoy sharing math with other students, providing a foundation on which to build the program. He adds that the formal presentations will "give them experience working with high school students and presenting mathematics to people who do not have a great deal of background in the subject." Likewise, the program is advantageous for the university overall. Dr. Plaut insists, "One component of these talks is recruiting, and if we do attract talented students to UT, this is a clear benefit to our Math Honors program and the university as a whole. If these students choose to remain in Tennessee for their education, then the state will also benefit."

Eventually, the Math Honors program hopes to create a speakers bureau accessible to high schools coordinated through the Office of Academic Outreach. Principals or teachers interested in hosting a Math Ambassador for a presentation would request a speaker and choose a presentation topic. After the speaking engagement, teachers would then evaluate the overall experience in order to provide the math department with feedback on the value of the presentation, audience response to the event, and the number of attendees. Schools would have an opportunity to make suggestions about how to improve the presentation or program in general.

The Math Ambassadors program is one component of a five-year $1 million grant from the National Science Foundation. Overall, the grant is expected to help generate more interest about math among high school students and to increase the size of UT's Math Honors program by more than 50 percent. In addition, the grant will enable the program to offer scholarships to both incoming freshman and current UT students who become involved in the Math Honors program. The funding will also provide graduate students with the opportunity to serve as summer research mentors for undergraduates. •

From the Director

Dear Readers,

Recently some rather alarming news about the state of science and mathematics education in this country was released in a report prepared by the National Academy of Sciences (an executive summary of the report is available at www.nap.edu). One of the key recommendations calls for improvement in K-12 science and mathematics education.

This issue of Academic Outreach spotlights selected examples of faculty and students in the College of Arts and Sciences who are addressing this problem every day both individually and collectively. Individual faculty, such as Professor Sandy Echternacht, conduct workshops for teachers and speak to classrooms of students to educate them about science. In programs such as the Junior Science and Humanities Symposium, groups of faculty invest time in judging proposals, mentoring students conducting original research, and welcoming students and teachers into their laboratories to teach them about current research. Other faculty support the Science Olympiad State Tournament, which affords students a chance to challenge themselves and their understanding of science through participation in competitive events. As a group, the Math Ambassadors will visit schools to provide educational talks and encourage interest in the study of mathematics. Other mathematics students contribute individually by tutoring elementary students as part of their service learning requirements for a class. We invite you to explore the articles of this issue to discover how the talented faculty and students in UT's College of Arts and Sciences are doing their part to improve science and mathematics education in Tennessee.

Lynn J. Champion, Ph.D.
Director of Academic Outreach
College of Arts and Sciences •

Over Sixty UT Math Students Are Tutoring Local Students Fall Term 2005

The Department of Mathematics has significantly increased its participation in outreach teaching this year by offering more students the opportunity to participate in service learning projects in local schools. This fall, school principals asked for over 300 UT students to tutor their students in mathematics. In response, **Dr. Robert Daverman**, Professor and Head of the Department of Mathematics, invited staff from the Office of Academic Outreach to meet with faculty and instructors to acquaint them with the theory, practice and procedures of service

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The Junior Science and Humanities Symposium Joins Line-up of Science Outreach Programs

Through the mutual agreement of the College of Arts and Sciences and the College of Education, Health, and Human Sciences, the administration of the Tennessee Junior Science and Humanities Symposium (JSHS) was moved to the Office of Academic Outreach this year. UT's two largest colleges are now collaborating to bring faculty researchers and educators in science and mathematics to the program, which has been at UT since 1964. **Dr. Thomas Handler**, Professor of Physics, has been appointed as the new Director of the Tennessee JSHS. "Dr. Handler understands the goals of the program and is extraordinarily well qualified for the position," says Dr. Lynn Champion. "In particular, his established relationships with other scientists at UT and at the Oak Ridge National Laboratory will facilitate his engagement of faculty to serve as mentors for the high school students as well as of coordination of opportunities for students and their teachers to visit laboratories of practicing scientists. His position as Chair of the Faculty Senate's Research Council also provides a forum for communicating with other scientists on campus about the importance of science outreach and of working with teachers and students to improve science and mathematics education throughout Tennessee."

Modeled after scientific conferences, the Symposium encourages high-level achievement by high school students . . .

Modeled after scientific conferences, the Symposium encourages high-level achievement by high school students, requiring that they conduct and present original research. Students submit abstracts and papers describing their research, and a panel of judges comprised of UT scientists and mathematicians selects four to eight students as Symposium presenters. At the Symposium, student presentations are followed by a question and answer session. Because articulating research clearly is often difficult, Dr. Handler stresses the importance of the Symposium in providing students an early opportunity to speak in front of an audience: "whether students go into pure research, academics, or industry, they'll need to learn this skill." The top five presenters advance to the National JSHS, and the top three are awarded scholarships to study mathematics, engineering, or a science at the college or university of their choice.

Like many in the scientific community, Dr. Handler expresses concern over downward trends in science education and student interest in scientific careers. He comments that, in matters of science literacy and national security, "a lack of trained scientists will hurt us in the long run." The JSHS addresses such concerns in encouraging advanced scientific knowledge and providing a forum for discussing research. Dr. Handler emphasizes the benefits of the program in exposing students to scientific methodology, introducing them to a professional scientific environment, and encouraging excitement for scientific discovery. In doing so, the Symposium introduces students to possibilities

Contestants Showcase Teamwork in Science Olympiad

In fall 2004, the Science Olympiad State Tournament was moved to the Office of Academic Outreach after the retirement of Dr. Ken Monty, who directed the program for a number of years through the UT Office of Special Programs. **Dr. David K. Smith**, Associate Professor of Ecology and Evolutionary Biology, was named as the new Director of the State Tournament in November 2004. According to Dr. Lynn Champion, Dr. Smith was selected because of his knowledge of undergraduate education, his success as an advisor, and his ability to connect well with students of all ages stemming from his experience as Undergraduate Coordinator for the Department of Ecology and Evolutionary Biology and as faculty advisor in Arts and Sciences Advising Services. She notes, "Dr. Smith also has a good understanding of the tournament, having been a faculty volunteer for the Science Olympiad for many years."

The Science Olympiad State Tournament is a team competition with events that challenge students to use both theoretical and applied knowledge of science. One event, "Sounds of Music," asks students to build one percussion and one woodwind instrument, to play a musical piece with the instruments, and to answer questions concerning the physics involved in constructing the instruments. The thirty-seven tournament events also include Disease Detective, Astronomy, Forensics, Robot Ramble, Dynamic Planet, Practical Data Gathering, and Forestry. According to Dr. David Stanislawski, Director of the Tennessee Science Olympiad State Office, the competition presents an opportunity for "involving a large number of students by providing activities which appeal to students in all areas of science and technology." Dr. Champion says that the tournament receives additional support from a number of partners interested in science education and research: "We are particularly pleased to have other UT colleges supporting the tournament by involving their faculty as judges and contributing to the funding of the program as well."

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Science Olympiad Events

- Sounds of Music
- Disease Detective
- Astronomy
- Forensics
- Robot Ramble
- Dynamic Planet
- Practical Data Gathering
- Forestry

Science Olympiad 2005 Winners

Division B (Middle Schools)

1st Place
Bearden Middle School
Knoxville

2nd Place
White Station Middle School
Memphis

3rd Place
Friendship Christian School
Lebanon

Division C (High Schools)

1st Place
Oak Ridge High School
Oak Ridge

2nd Place
Montgomery Bell Academy HS
Nashville

3rd Place
White Station High School
Memphis

for careers in academic, industrial, and government communities, thereby seeking to increase the number of adults choosing careers in research and development.

Plans for the 2006 Tennessee JSHS include tours of UT laboratories, providing students, teachers, and parents the opportunity to interact with scientists, mathematicians, and graduate and undergraduate students, and to learn about advanced scientific research taking place at UT. A tour of the various research facilities at the Oak Ridge National Laboratory, with which a number of UT faculty are affiliated, is also planned. Dr. Bruce Bursten, Dean of the College of Arts and Sciences, explains that such activities will benefit UT as well as the Symposium participants: "We are hoping to involve some of our most distinguished faculty and to introduce students to cutting-edge research that is going on here, particularly what is unique to this campus." He adds that "we at UT want to attract the best and brightest students to study in science and mathematics departments, and one way we can enhance that likelihood is to invest time and effort in sponsorship of programs such as the JSHS."

High school students visit the laboratory of Dr. Stuart Elston, Professor of Physics.

In addition to promoting student interest and aptitude, the JSHS acknowledges the contributions of teachers by selecting one teacher mentor to be recognized for teaching and promoting research by high school students. The teacher is honored at the Symposium and receives a monetary award from the Academy of Applied Science. Dr. Bob Rider, Dean of the College of Education, Health and Human Sciences, expresses appreciation for the JSHS in offering "a way for us to encourage teachers who incorporate original research and writing about it in their classrooms." He adds that the JSHS encourages a collaborative effort between university faculty and educators in Tennessee's secondary schools, one that recognizes that "colleagues in middle schools and high schools are our partners in education."

The Tennessee JSHS is administered through the Office of Academic Outreach on behalf of the College of Arts and Sciences and the College of Education, Health, and Human Sciences, with the collaboration of UT-Battelle. The JSHS is sponsored on state and national levels by the United States Departments of the Army, Navy and Air Force through grants administered by the Academy of Applied Science. The next Tennessee JSHS will be held March 2-4, 2006, in Knoxville. For more information, please visit the Tennessee JSHS website at: http://jshs-tn.utk.edu/. •

Sandy Echternacht: Have Reptiles, Will Travel

A ball python, a bearded dragon, and a leopard gecko are the traveling companions of **Dr. Arthur C. "Sandy" Echternacht**, Professor of Ecology and Evolutionary Biology, when he visits area schools and community groups to speak about reptiles. Dr. Echternacht, who studies native and invasive species of the anole lizard and endangered iguanas in the Cayman Islands and Honduras, has been talking about reptiles to the community since his arrival at UT in 1975. "I always gave talks," he says, "and when the Faculty Speakers Bureau came about, it was natural to join," adding that the Speakers Bureau has increased the level of his speaking engagements. In the last five years alone, he has given more than twenty lectures at locations such as Austin-East Magnet School, branches of the Knoxville YMCA, the East Tennessee Unitarian Universalist Church, Seniors for Creative Learning, the Oak Ridge Institute for Continued Learning, and the Kiwanis Club of Newport.

Although the title of Dr. Echternacht's talk has remained the same, "Snakes: Objects of Fascination and Fear," the content varies. "Because I teach herpetology and keep information updated, it allows me to change speaking materials." For audiences of school children, he covers four or five main points, and students ask questions along the way. When he explains that the biggest snake is thirty feet long, he asks students to lie on the floor to make a length of thirty feet so they can literally see how long the snake is. One of his goals is to educate audiences about fears associated with snakes. Some are afraid to touch a snake because they think it might feel slimy, when in fact it feels more like a snakeskin belt. At a recent presentation at the West Side YMCA in Knoxville, the audience of an expected forty students grew to number 100, many of whom were afraid of or had never touched a snake. Dr. Echternacht asked volunteers to form a circle and passed around the ball python so that they could touch it. All but twelve did so, and for those students, he held the python so that they could also touch the snake.

While the majority of his audiences are K-12 students, Dr. Echternacht speaks to adults as well, giving a more in-depth lecture accompanied by slides and followed by discussion. He brings live animals to every speaking engagement. The ones he chooses are good to use for presentations because they are friendly and docile. He explains to audiences that these reptiles, which also do not grow to be very large, are the best choice for pets. The animals are also good attention-getters for audiences of any age: placing the ball python on the table at his 1997 Pre-Game Faculty Showcase immediately captured everyone's interest. The python, as its name suggests, simply curled up in a ball and remained on the table. However, the audience members, especially those in the front row, never took their eyes off the python.

He does have one rule for his speaking engagements: they have to take place in a large open space, and there must be six feet between Dr. Echternacht and the audience. The rule stems from an incident during a school visit. As he was holding an iguana, excited students rushed toward him, and the iguana became scared, scratching his arms as it tried to climb on top of his head. All in all, he feels that talking about reptiles is "just plain fun," and his favorite audience is 8-13 year olds because they are eager to see the animals, and they "learn without knowing they're being taught something."

Evaluations of his presentations attest to his popularity and reflect the enthusiasm and learning that Dr. Echternacht brings to others. One middle school teacher commented that his visit to the school was "Excellent! This presentation helped raise awareness for the different kinds of snakes in the Tennessee area as well as other areas." A group of senior citizens "loved him and his 'friends.' He could hardly get packed up to leave because of the crowd." Many groups have requested that Dr. Echternacht return, asking for "More reptiles, please!", and he has often accepted their invitations. Austin East High School in Knoxville is one of the schools he has visited most frequently. A primary motivation for Dr. Echternacht is encouraging students to become interested in science, especially minority students because of the low number of African-American science students and faculty members nationwide.

Dr. Echternacht stresses the educational value of outreach, commenting that "I don't see public service as different from teaching." He shares this view of teaching with new graduate students in a course that introduces them to college teaching. He tells them that even if they become researchers who never teach in a classroom, "you'll be teaching in some way, for instance when new people come into the lab. It's always teaching."

As department head, first of Zoology then of Ecology and Evolutionary Biology from 1985-1998, Dr. Echternacht requested

. . . the audience members, especially those in the front row, never took their eyes off the python.

that outreach be part of the departmental review, which had never happened before. "I wasn't trying to do anything new," he explains. "I assumed that outreach and public service were part of departmental program review." Acknowledging the outreach activities of colleagues such as **Dr. Gary McCracken** and **Dr. Susan Riechert**, as well as the annual Wildflower Pilgrimage, he thought that "the department ought to be evaluated on all three legs of the stool: teaching, research, and public service."

Further, he feels that outreach activities make important connections with the community. He comments that "there is a disconnect between what people think ivory tower scientists do and what they actually do," viewing his speaking engagements as an opportunity to give a different view of what a college professor is and does. There is also a need to demonstrate, in laymen's terms, "why reptiles are important, why we shouldn't kill them, and why farmers like them." He talks to audiences about research occurring at UT, its general importance, and why it is important to Tennessee. Dr. Echternacht feels that faculty outreach is a significant part of the university's image: "It puts a personal face on the university for a lot of the community."

In 2000, Dr. Echternacht received a Faculty Public Service Award (now the Academic Outreach Award) in recognition of his extraordinary service to the college and the community at large through his outreach teaching. He says, however, that he does not seek any reward: "I just like to do it." •

***Science Olympiad**, continued from page 3*

In addition to the intellectual challenges posed by the events, Science Olympiad emphasizes the importance of teamwork. Every team member competes in at least one event, and awards are given to the entire team rather than to individual competitors. Dr. Smith explains that working as a team "provides a model for how scientific research is done." Additionally, he stresses the importance of the tournament in demonstrating the value of working toward a common goal and encouraging respect among team members.

The 2005 State Tournament was held on Saturday, April 2. UT hosted 500 students, coaches, and parents from twenty-four statewide teams who traveled to campus to participate in tournament events. In Division B for middle schools, Bearden Middle School of Knoxville, coached by Bob Fabian, placed first; White Station Middle School of Memphis, coached by David LeMay, placed second; and Friendship Christian School of Lebanon, coached by Jason Miller, placed third. In Division C for high schools, Oak Ridge High School, coached by Nita Ganguly, placed first; Montgomery Bell Academy High School of Nashville, coached by Amy Seiters, placed second; and White Station High School of Memphis, coached by Paul Prather, placed third. The first place team in each division advanced to the National Science Olympiad.

One hundred seventy-four UT faculty and student volunteers assisted with this year's tournament. One volunteer, **Dr. Stan Guffey**, a Lecturer in Biology, has been involved with Science Olympiad at UT since 1997 in a variety of roles, including serving as assistant director. This year he assisted Dr. Smith with planning and coordinating the tournament. He describes Science Olympiad as "a major educational activity for the participating teams throughout the state," adding that "science education is what I do, and I work actively with middle and high school students and teachers whenever I have the opportunity."

Evaluations of the 2005 tournament were positive, and Dr. Stanislawski commends Dr. Smith for "putting together an excellent state tournament within a very short period of time."

Plans for future Science Olympiads at UT include expanding regional competitions in order to increase participation in the state tournament. The program's administrators also plan to provide opportunities for students, teachers, and parents to visit laboratories on campus, to talk with faculty about their research, and to learn about opportunities for studying science at UT. Dr. Champion acknowledges that "Hosting this many people is a challenge, but one we welcome because it brings students, teachers, and parents to campus." Dr. Stanislawski comments that UT's support of the program "sends a clear message to the science teachers in the state that science is important and we will work to help them involve students in science and technology." He adds, "I am excited about the commitment UT has shown and look forward to expanding Science Olympiad in Tennessee."

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The Science Olympiad State Tournament is sponsored by the College of Arts and Sciences Office of Academic Outreach, with support from the Division of Biology, the Department of Ecology and Evolutionary Biology, the UT/ORNL Science Alliance, the College of Agricultural Sciences and Natural Resources, the College of Education, Health and Human Sciences, the College of Engineering, the College of Veterinary Medicine, the Tennessee Academy of Sciences, and Lockwood Greene and CH2M Hill.

The 2006 Tennessee State Science Olympiad Tournament will be held on the UT campus on Saturday, April 1, 2006. For more information, please visit the Science Olympiad State Tournament website at: http://www.artsci.utk.edu/outreach/Academic_Olympiad.asp •

***UT Math Students**, continued from page 2*

learning. As a consequence, a total of five faculty and instructors incorporated service learning into their courses, an increase from two last year. From the five classes, 61 UT mathematics students are enrolled in service learning and are now placed in 22 local primary, elementary, and middle schools where they are engaging in group and individual tutoring. Through service learning, faculty extend the classroom beyond campus and provide opportunities for their students to provide a needed service related to the course in a community setting. Participating in service learning also creates an opportunity for UT students to enhance their own learning of course material. While the math department is making a significant contribution to meeting the requests of local schools for math assistance, the number of requests for UT student tutors consistently exceeds the number available. Dr. Daverman believes the number of faculty who incorporate service learning into their classes will increase as both faculty and students experience the benefits. The Department of Mathematics has long been committed to enhancing mathematics education in K-12 schools, and engaging their students in service learning is a significant part of that effort. •

TENNESSEE HIGH SCHOOL STUDENTS COMPETE IN UT/PRO2SERVE MATH CONTEST

Nearly 700 students from 71 Tennessee high schools converged on the University of Tennessee campus . . .

Nearly 700 students from 71 Tennessee high schools converged on the University of Tennessee campus for the seventh annual contest, co-sponsored for a fifth year by Pro2Serve® Professional Project Services, Inc., of Oak Ridge, Tennessee. The goals of the program are to promote interest in mathematics among Tennessee high school students, to encourage them toward careers in mathematics, science, and engineering, and to recognize their mathematical prowess. The competition is designed to challenge any student who has completed Algebra I, Algebra II, and Geometry, although these courses are not required for entry.

The contest features individual and team competitions: (1) FERMAT I: a multiple-choice exam for all participants; (2) FERMAT II (for the top 50 FERMAT I scorers): an exam demanding uncommon creativity and originality in problem solving; (3) the Math Bowl: a double elimination tournament for three-member teams in the style of a Scholars Bowl competition. A new rule added this year increases the challenges that students face: calculators may not be used in any of the events.

Winners of the individual competitions are chosen based on their FERMAT scores, with the top 10 receiving four-year, full in-state tuition scholarships to the University of Tennessee funded by the office of UT's Chancellor, Dr. Loren Crabtree. This year's winners were Phillip Andreae of Bearden High School, Knoxville; Yu Cao of West High School, Knoxville; Yuki Ichikawa of Maryville High School; Haris Krishnamoorthi of Ravenwood High School, Brentwood; Sean Maginnis of Dobyns Bennett High School, Kingsport; Sara Raju of Martin Luther King Magnet High School, Nashville; and Gregory Burnham, Tong Chen, Eric Chin, and Shawn Pan of White Station High School, Memphis. The scholarships can be used for any major at the Knoxville campus.

White Station High School was the overall winner of the Math Bowl, followed by Knoxville's West High School. Lausanne Collegiate High School, Memphis, placed first in the small school category, and Hume-Fogg Academic High School, Nashville, placed second. Pro2Serve® awarded $500 to each first place school and $250 to each second place school.

All winners received trophies, plaques, and certificates in recognition of excellence at different stages of the competition. In addition, UT-Battelle awarded summer internships at Oak Ridge National Laboratory to the top two winners who meet citizenship requirements, enroll at UT, and complete their junior year there with a 3.5 or higher grade point average.

The UT Department of Mathematics and Oak Ridge-based Pro2Serve® Professional Project Services, Inc. sponsor the contest, along with this year's media sponsors WBIR-TV 10 and WUOT 91.9 FM. ●

Academic Outreach is published by the Office of Academic Outreach in the College of Arts and Sciences at the University of Tennessee, Knoxville, 26 Alumni Memorial Building, Knoxville, Tennessee, 37996-1320; (865) 974-4676; FAX (865) 974-4352.

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PA# E01-1001-004-002-06