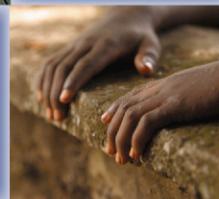
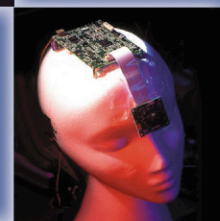
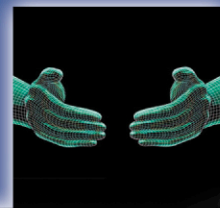


TENNESSEE STATE UNIVERSITY

RESEARCH HORIZONS



2004 ANNUAL REPORT





RESEARCH
HORIZONS
2004



RESEARCH HORIZONS

TSU Publication Number TSU-05-001 6(B)-3-225015

TABLE OF CONTENTS

Letter from the President

James A. Hefner, *President, Tennessee State University* **1**

Letter from the Vice President

Marcus W. Shute, P.E., Ph.D., *Vice President, Research and Sponsored Programs* **2**

Letter from the Director

Maria Thompson, Ph.D., *Director, Research and Sponsored Programs* **3**

A Brief History **4**

Timeline **4**

Areas of Expertise

TSU Research Competencies and Capabilities **5**

Research– Education and Schools **6**

Otis L. Floyd Nursery Research Center **7**

IAgER's Point of Pride **8**

Center for Health Research **9**

Human Bodies Contain Natural Killer **10**

Center Of Excellence:

Information Systems and Engineering Management **11**

A New Horizon:

Robots and Robotics **12**

Microbial Ecology:

An Umbrella for a TSU Lab **13**

Awards and Submissions Fiscal Year 2004

Submissions by Center/College/School **14**

Submissions by Agency/Corporations/Foundations **14**

Submissions by Project Type **15**

Submissions by Source **15**

Awards by Project Type **15**

Awards by Source **15**

Awards by Center/College/School **14**

Awards by Agency/Corporations/Foundations **14**

TENNESSEE STATE UNIVERSITY
RESEARCH & SPONSORED PROGRAMS

3500 John A. Merritt Blvd.

Nashville, Tennessee 37209

Phone 615.963.7631

FAX 615.963.5068

Web Site www.tnstate.edu/research



From the President

As the president of Tennessee State University, I take great pride in the accomplishments we have made in the area of research and the tremendous potential for future success that we possess. Despite the increasing competition for research dollars, our research enterprise continues to thrive because research is a high priority at TSU.

The array of projects reviewed in this report represents the efforts of both senior and junior researchers. Their mission is not only to create new knowledge, but to disseminate their findings to produce a new generation of scientists and scholars and to serve the local and greater communities. Our researchers have more than met the challenge of this three-fold task. They have created a new benchmark for commitment to achievement in research, teaching and service.

Our University's research program is entering into a new era as current research fields expand and new ones emerge. As you read this report, you will see the continued success of longstanding projects and accomplishments in new areas of scientific inquiry and creative thinking. Join me in celebrating these outstanding achievements at Tennessee State University.

Sincerely,

A handwritten signature in blue ink, reading "James A. Hefner".

James A. Hefner

President, Tennessee State University



From the Vice President

It is an honor and a privilege to introduce the inaugural issue of Research Horizons in a new, innovative, informative format. This edition highlights some of the outstanding research programs involving our students, faculty, and staff. We trust that the information provided will entice you to further explore research opportunities at Tennessee State University (TSU).

Research at Tennessee State has experienced phenomenal growth during the past decade. Research and sponsored program awards have averaged approximately \$40M annually over the past three years. In order to sustain this growth, the University must continue to seek and exploit interdisciplinary collaborative relationships both internally and externally. Collaboration is critically important in continuing our success in research areas that represent our strengths as well as developing new research initiatives that will propel the research enterprise at TSU to new heights. We anticipate the development of new research programs in high-growth areas such as nanotechnology, biotechnology, learning sciences, and computational science through collaboration with various federal agencies, national laboratories, corporations and other universities.

We also believe it is critically important to incorporate our students in research activities to develop skills in research techniques. Some of the programs that incorporate outstanding student research component to provide this type of training are featured in this issue.

Several new research initiatives and programs have been announced that are not highlighted in this edition. The Tri-State Research Collaboration was initiated to leverage the research expertise of Tennessee State University, Jackson State University and Alabama A&M University as well as other institutions in the areas of nanotechnology, environmental science and homeland security, health research, and learning sciences. An interdisciplinary program was launched to provide future human capital for the U.S. intelligence community. This effort has led to the formation of an Intelligence Community Center of Academic Excellence at TSU involving the College of Engineering, the College of Arts and Sciences, and the College of Business.

On behalf of the Division of Research and Sponsored Programs, I commend the outstanding efforts of our researchers, faculty, staff and students in making new discoveries and significant contributions to human knowledge. At Tennessee State, we believe research is essential to excellence in education and enhances the learning experience of our students. We continue to be committed to excellence in every way!

As always, I remain

Sincerely,

Marcus W. Shute, P.E., Ph.D.

Vice President, Research and Sponsored Programs
Tennessee State University





From the Director

In the Office of Research and Sponsored Programs (RSP), it is our goal to foster a campus culture that enables faculty and staff to conduct research at the highest level. Toward that end, we have taken steps to ensure that our researchers are able to develop and submit top-notch, fundable proposals, run productive labs and projects, and still allow time for them to maintain high-quality interactions with students in the classroom. This is no small feat.

Fiscal Year 2004 was filled with a number of activities designed to move TSU forward in the research arena. We have updated and streamlined our policies and procedures and published them in our PI Handbook, that is easily accessible online. To provide training for our researchers and their staff, we established the RSP Academy that consists of workshops on successful grant writing, responsible conduct of research, research compliance issues, and technology transfer. Thus, the RSP Academy provides training support for researchers from the conception of an idea through its commercialization. Other FY04 efforts include providing funds for laboratory equipment in areas of high growth as well as detailed planning for upgrading of existing laboratories and construction of new research facilities. Also, we have made a concerted effort to stay in close communication with funding agencies so that we can stay abreast of and prepare for future funding trends. Additionally, we worked with our Congressional delegation to obtain the necessary resources to further develop the University's research infrastructure.

Our FY04 efforts laid the groundwork for a new era of research success for the University but we realize that we have much hard work ahead to stay the course. My staff and I are committed to one thing – growing the research enterprise at TSU. It is both a joy and a privilege to serve this great University, its staff, students and the community. We look forward to the day when TSU is classified as a research-extensive institution and we have every intention of making this vision a reality.

Sincerely,

A handwritten signature in blue ink, appearing to read "Maria Thompson".

Maria Thompson, Ph.D.

Director, Research and Sponsored Programs
Tennessee State University

Tennessee State University (TSU), a major urban and one of the Historically Black Colleges and Universities, comprehensive institution, is an 1890 land grant university founded in 1912 as a normal school. This unique combination of characteristics distinguishes it from other academic institutions in the state of Tennessee. TSU is located in Nashville on two campuses; the main campus serves the majority of the traditional students and the Avon Williams campus, located in downtown Nashville, primarily serves the needs of non-traditional students, although other educational programs are based on the Williams Campus. TSU is mandated to provide instruction, research, and public service to a broad clientele within the state of Tennessee,

has produced 16 college/university presidents; more than 35% of all Tennessee black engineers; more than 75% of African American principals and teachers in state of Tennessee; approximately 250 holders of doctoral degrees and 300 physicians and dentists; several urban superintendents; more than 300 Air Force Officers and a significant number of CEOs, directors and managers of corporations.

Tennessee State University displays a broad spectrum of sponsored research projects, ranging from basic to applied, and from single Principal Investigator grants to major team, contractual collaborations. It has more than 100,000 sq. ft. of floor space designated for scientific and technological research. Current projects include research in computer modeling and simulations, condition-based maintenance, biomedical applications of signal processing, hazardous waste management, neural networks and fuzzy logic, robotics and machine vision, artificial intelligence/expert systems, computational science, conformations of DNA, gene expression, plant genetics, animal science, agricultural biotechnology, and nanoscience. TSU also conducts research in software engineering, advanced manufacturing and packaging, materials processing, drug-binding to DNA, topology, large scale control and distributed computing systems, astrophysics and astrobiology, forestry, organic synthesis, transportation planning and modeling, and several other fields of study. In addition, the faculty is involved in scholarly activity in the arts and has a state-of-the-art performing arts center that is an integral part of ensuring a well-rounded educational experience for students at TSU and the community.

Tennessee State University seeks to provide the best environment for study and research through a creative association of faculty and students, as a community of scholars, in expanding the boundaries of science, education, and technology.

Tennessee State University

A Brief History

but welcomes students from some 45 states and 50 foreign countries. The resulting campus atmosphere is a fascinating blend of American customs and foreign cultures. Because of its unique history and mission, the University has a compelling obligation to prepare minority students for entry into positions of responsibility in a multicultural society. TSU is broadly comprehensive at the baccalaureate and master's levels with schools and colleges in agriculture, health sciences, arts and sciences, business, education, engineering, technology and computer science, nursing, public administration, and graduate studies. The University offers doctoral degrees in the biological sciences, engineering, education, public administration, and psychology. It has more than 400 full time faculty members with more than 9000 students.

Diversity at TSU is a research asset and an academic strength. It is diverse in both student and faculty population. TSU has more than 36,000 alumni. Many its graduates hold high level positions of leadership in the United States and abroad in business, science and engineering, government, education, law, performing arts, industry, the military, and professional sports. TSU

The TimeLine

1909

An act of the Tennessee General Assembly established four state Normal Schools in Tennessee.

1911

Professor William Jasper Hale was elected principal (president) of Agricultural and Industrial State Normal School at Nashville.

1912

Agricultural and Industrial State Normal School at Nashville opened its doors to admit 247 students.

1915

Enrollment surpasses 1,000

1922

Agricultural and Industrial State Normal School was raised to the status of a four year teachers college and was empowered to grant the bachelor's degree.

1924

Commencement exercises were held for the first college class, composed of seven men and one woman.

1927

The institution's name was changed to Tennessee Agricultural and Industrial (A&I) State Teachers College.

1943

Dr. Walter S. Davis, an alumnus of the College, appointed its second president.

Tennessee A&I State College achieved university status

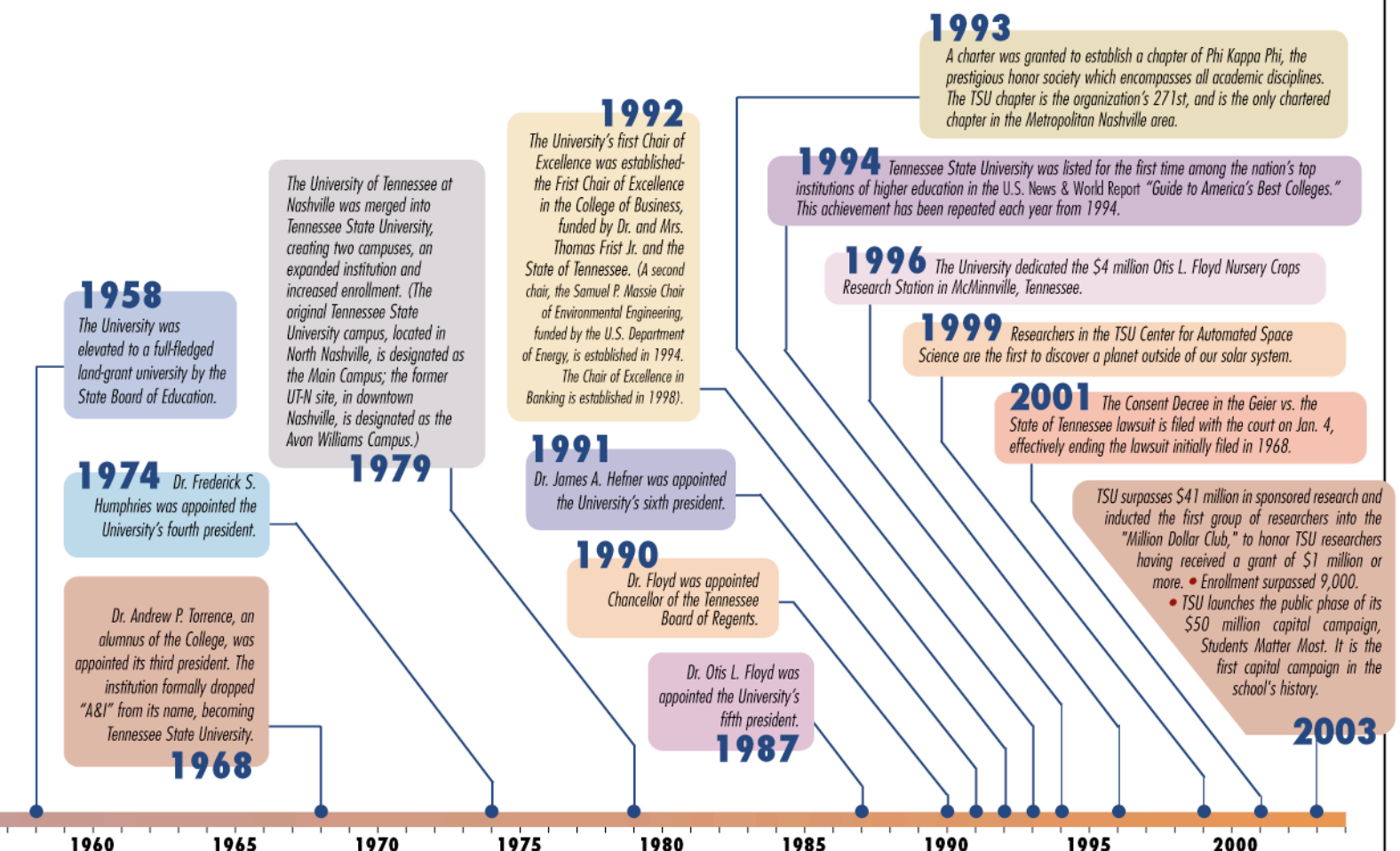
1951

1910 1915 1920 1925 1930 1935 1940 1945 1950 1955

Areas of Expertise *TSU Research Competencies and Capabilities*

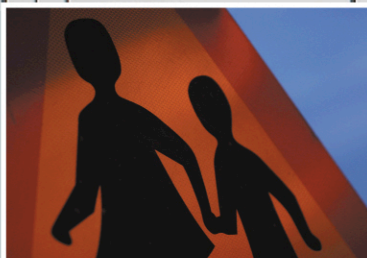
Advanced Manufacturing Technology	H	Engineering Economics/Life Cycle Analysis	L	Nanodevices/Nanomaterials/Nanofabrication	M
Agricultural Biosecurity	H	Environmental Engineering/Science	H	Nanotechnology/Nanophotonics	M
Agro-business/economics	M	Field Sensors (for agro-terrorism)	M	Neural Engineering/Neural Networks	H
Alternative Energy/Energy Conversion	L	Food Safety	H	Optical Communications/Optical Engineering	H
Animal Science	H	Genetics	M	Photonics	M
Animal/Plant Diagnostic Labs	H	GIS	H	Plant Science	H
Artificial Intelligence/Fuzzy Logic	H	Hazardous Waste Management	M	Probabilistic Design Methodologies	H
Astronomy/Astrobiology/Space Science	H	Health Research/Minority Health Disparities	H	Public Health Research	H
Bioinformatics	M	High Performance Computing/Modeling	H	Public Policy on Science, Tech	L
Biological Agent Testing	M	HIV/AIDS Research, Education, Prevention	H	Radiological Basic	L
Biological Basic	H	Homeland Security Academic Courseware	L	Radiological Decontamination	L
Bioremediation	H	Homeland Security Policy	L	Remote Sensing	L
Biotechnology/Biomolecular Science	H	Homeland Security Training	L	Robotics/Automation	H
Chemical Agent Testing	L	Human Computer Interaction	M	Software Development	H
Chemical Basic	H	Human Factors	M	Surface Water/Groundwater Hydrology	H
Classified Research	L	Indoor Air Quality	M	Systems Engineering	H
Community Outreach	H	Information Security	M	Technology Transfer/Commercialization	M
Computational Fluid Dynamics	H	Information Technology	H	Training Hazmat	L
Computational Sciences	H	Lab Instrumentation	L	Water/wastewater operations	H
Control Systems	H	Law Enforcement Training	M	Wireless Communications	H
Economic Impact/Needs Assessment	M	Learning Sciences	M		
Education/Distance Education	H	Marine Tech Research	L		
Educational Outreach/Dissemination/Assessment	H	Mental Health Recovery	L		
Emergency Medical Services	L	Multi-modal Transportation	M		
Emergency Response Technology	M				
Engineering	H				

L = Low M = Medium H = High



*Center Of Excellence
for Research and Policy
on Basic Skills
Improving Child Development*

Research— Education and Schools



The Center of Excellence for Research and Policy on Basic Skills has as its core multidisciplinary research. Types of research include student achievement in reading, mathematics, and science, school reform, school structures and policy, health prevention and promotion, economic self-sufficiency and welfare reform, rural education, early intervention, and many more. An on-going initiative funded by the National Science Foundation is the academic achievement and teacher development study which investigates the relationship between teacher development and student achievement and the relationship of curriculum and fidelity of implementation to student achievement.

Early intervention research includes an Early Head Start Demonstration Program and Tennessee Early Childhood Training and Technical Assistance (TECTA) program that develops a comprehensive system for professional development as well as a system to improve child development for more than 500,000 children in out of home care. Other early intervention programs are an injury prevention study, infant toddler model site development, Tennessee child care provider training, a program for economic and family self-sufficiency among low-income families, health practices studies, and early literacy and reading studies.



The Tennessee State University Otis L. Floyd Nursery Research Center, located in McMinnville, Tennessee, is a research facility dedicated to the improvement of the nursery crop industry. It is operated through a cooperative effort between TSU and the United States Department of Agriculture/Agricultural Research Service. The mission of the TSU Nursery Research Center is to provide leadership in the strengthening and expansion of the regional nursery industry through research in the areas of pathology, entomology, genetics, horticulture, biotechnology, and related sciences.

The 87-acre site of the Nursery Research Center was formerly a commercial nursery. Facilities in the 20,000 square foot Nursery Research Center include 10 laboratories, a 200 seat auditorium, and 6,000 square feet of greenhouse space. Other facilities include an equipment/maintenance shed, shade houses, propagation houses, irrigated container yards, and a pot-in-pot yard. The entire site is plumbed for irrigation using either well water or municipal water.

Programs at the Nursery Research Center include identifying and addressing major insect problems of field production nurseries in the southeast United States and developing new cultivars through genetics and breeding that will benefit commercial growers and consumers. There is also a four-pronged horticulture program that investigates

physiological processes associated with horticultural characteristics such as cold and heat tolerance and water stress, addresses problems with container production, develops improved propagation methods for hard to propagate nursery plants, and evaluates landscape woody nursery plant cultivars, selections, and breeding.

*Improving the
Nursery Crop
Industry in
McMinnville, Tennessee*

Otis L. Floyd Nursery Research Center

Biotechnology research at the Nursery Research Center includes plant pathology.

The plant pathology program is focused on integrated disease management of powdery mildew in nursery crops. Objectives of this program include understanding the epidemiology of the disease, examining alternatives to traditional fungicides for powdery mildew control, identifying sources of powdery mildew resistance, and developing integrated pest management strategies that can be used for powdery mildew disease management. An additional component of this program is the continual monitoring and identification of diseases with potential economic significance to the nursery industry. The significance of this research will be a reduction in the amount of chemical pesticides released into the environment and a sustainable disease management system for small and large scale productions.



Dr. Ahmad Aziz

The partnership between CSREES-USDA and Tennessee State University (TSU) has resulted in a cutting-edge biotechnology with state-of-the-art laboratories in TSU's Institute of Agricultural and Environmental Research (IAgER).

IAgER's Point of Pride

IAgER scientists are actively engaged in research, teaching, and outreach activities related to agricultural biotechnology. They are identifying and characterizing DNA sequences involved in plant stress resistance and genetically improving plants by transformation with disease resistance and other genes of economic importance. The scientists are efficiently detecting Bovine Spongiform Encephalopath (BSE) (more commonly known as Mad Cow Disease) through antibody mediated assays as well as detecting the inactivation of BSE infectivity under various beef processing conditions. IAgER scientists analyze food animal genomes and their interactions with the environment to improved production and reproductive efficiencies.

In the biotechnology program, students receive excellent experiential training. IAgER scientists are also demonstrating the significance of biotechnology to stakeholders and potential end-users by conducting field trials of genetically improved crops on farms in Middle Tennessee. High school and middle school teachers from across Tennessee are engaged in IAgER's intensive summer training sessions in biotechnology techniques and in biotechnology curriculum development that complements and enhances their existing science curriculum. Participating teachers are successfully incorporating these modules into their respective curricula, increasing their students' knowledge and creating a new enthusiasm for the agricultural sciences.

As a result of all of this, TSU has established a Ph.D. program in agricultural biotechnology to contribute to the Land-Grant effort for preparing the future agricultural workforce.

Do your students think that DNA looks like the multicolored pretty ladders drawn in most textbooks? Are they confused as to how DNA can be separated out of cells and manipulated in the lab?

This is the introduction TSU has used to offer Tennessee middle and high school teachers help to teach about the highly relevant, important topic of biotechnology in

summer workshops. Thirty-five teachers extracted DNA from plants as well as from their own cheek cells and analyze it by gel electrophoresis. An application of microorganisms was demonstrated by making root beer. The teachers also received two kits to do the cheek cell extraction with their students in the fall. They also learned about the applications of biotechnology in the field of agriculture. This included a tour of agricultural biotech labs at Tennessee State University and a chance to hear from the researchers themselves. Throughout the week, teachers built on their understanding of biotechnology, became familiar with the best resources available for teaching about biotech, and learned how to meet the state learning expectations in this area.

His own particular interest in biotechnology is molecular genetic theory. His specialty is plant breeding using molecular markers and developing new varieties. Dr. Aziz describes this as merging old and new ways of breeding, combining the classical techniques with new technologies.

Dr. Ahmad Aziz defines biotechnology as any biology (living organism) based technology used for human consumption. He says this very broad definition extends from root beer making to individual drugs.



The Center for Health Research at TSU was established by Dr. Baqar Husaini in 1976. As a free-standing research center, the Center is funded exclusively by external grants from state and federal agencies, such as the National Institutes of Health, Agency for Healthcare Research and Quality, Centers for Medicare and Medicaid Services, and Centers for Disease Control. A multi-disciplinary team of researchers at TSU and other universities work with the Center through various research projects and collaborative arrangements. The Center continues to develop a long-standing and active relationship with the local minority community in addressing its health-related needs. The Center represents a strong asset for TSU as a thriving hub of research activity and training for faculty and students.

The Center for Health Research directs collaborative health research projects aimed to improve health outcomes and the delivery of physical and mental health services in the local community (especially among low-income and minority populations) and to inform policy at the state, national, and international levels. In particular, the research conducted at the Center has focused on areas of mental health, preventive health, healthcare services, HIV/AIDS, and racial/ethnic health disparities. In addition, the Center provides health research training to junior faculty, graduate students, and undergraduate students at TSU and other collaborating institutions. The Center strives to maintain a close, interactive relationship with the low-income and minority communities in the greater Nashville area and in rural Tennessee.

Center for Health Research

Specific projects include:

THE GOAL OF THE MINORITY RESEARCH INFRASTRUCTURE SUPPORT PROGRAM (M-RISP) FUNDING

is to enhance further the research infrastructure at TSU and Meharry Medical Center and to strengthen the capacity of new individual investigators to conduct high-quality, health services research in the area of healthcare quality and disparities. This project consists of two components: (a) the Institutional Research Development Core ("Core"), and (b) Individual Investigator Research Project proposals. All projects focus on aspects of healthcare quality that relate to health disparities and/or prevention.

UTILIZATION AND PROVISION OF CLINICAL PREVENTIVE SERVICES FOR CHILDREN ENROLLED IN TENNCARE

which estimates the effects of individual, community, and healthcare system factors on the utilization of Early and Periodic Screening, Diagnosis and Treatment (EPSDT) well-child visits and dental screenings, particularly variation by age group, racial/ethnic group, geographic area, and Managed Care Organization (MCO).

EXAMINING HEALTH DISPARITIES IN TREATMENT AND OUTCOME OF ACUTE MYOCARDIAL INFARCTION (AMI) AMONG TENNESSEE MEDICARE ELDERLY

which is a study that describes patterns in the treatment for AMI in order to identify modifiable determinants of premature morbidity and mortality in vulnerable subpopulations.

THE PURPOSE OF COMMUNITY PARTICIPATION, NEIGHBORHOOD CONTEXT, AND ADOLESCENT MENTAL HEALTH: RACIAL/ETHNIC COMPARISONS

is a project to examine the potential of various types of community participation to function as protective factors for the mental health of adolescents, and whether these protective functions vary across racial/ethnic groups and across different neighborhood contexts.

Other research studies explore the effect of race on colorectal cancer survival, the relationships among religion, social support, stress and depressive symptoms, impact of depression on a nursing intervention among elderly African-Americans with type 2 diabetes, church-based educational intervention program on prostate cancer screening for African American males, and a study plan for "Burden of Cardiovascular Disease in Tennessee."

*Addressing
Health
Related
Needs*



Dr. Margaret Whalen

Human Bodies Contain Natural Killer

Human bodies contain natural killer (NK) lymphocytes, which play a central role in the immune defense against virus infections and the formation of primary tumors. NK cells are capable of killing tumor cells,

virally infected cells, and antibody coated cells. They are responsible for limiting the spread of blood-borne metastases as well as limiting the development of primary tumors. Any agent that interferes with NK cells' ability to destruct and dissolve their targets could increase the risk of tumors and viral infections.

Dr. Margaret Whalen, Associate Professor of Chemistry, and her graduate and undergraduate students are assessing the capacity of a variety of compounds known to contaminate the environment to interfere with this crucial immune function. There are a

wide variety of man-made compounds that contaminate the environment as a consequence of their use in industrial and agricultural settings. Recently the Centers for Disease Control and the Environmental Working Group have issued reports indicating measurable levels of these compounds in human tissues. Dr. Whalen's purpose has been to investigate whether any of these compounds are able to interfere with the function of human natural killer cells to destroy tumor cells.

From their studies, it is clear that a wide variety of environmental contaminants are capable of interfering with the tumor cell reduction capacity of the NK cells. A next step is to see if it is possible for the NK cells to regain any of their capacity to destroy tumor cells, virally infected cells, and antibody coated cells. Results of an initial study indicate that NK cells can recover their ability to enhance immune function, but more investigation is needed.



The Center of Excellence in Information Systems is home to the Tennessee State University Automated Astronomy Group, part of a multidisciplinary research laboratory founded in 1986. The Center consists of researchers, support staff, and students in the areas of astronomy with automated telescopes, advanced control systems and systems identification, applied mathematics, and management information systems. Graduate and undergraduate students are drawn from the computer science, physics, mathematics, and engineering curricula.

The Automated Astronomy Group conducts a variety of research projects with automated telescopes (robotic telescopes) located in southern Arizona. This research program began in 1988 with a NASA grant from Marshall Space Flight Center to study chromospherically active stars in collaboration with Vanderbilt University. An additional automatic telescope is under construction at the Dyer Observatory.

Funding for the construction and operation of the telescope comes from the TSU Center of Excellence in Information Systems, NASA, and NSF.

Other telescopes are dedicated to monitoring a few

Sun-like stars with short-period planets in orbit about them. The data will be used to search for transits of these planets, to search for reflected light from the planets, and to search for very-low-amplitude stellar variability.

*Dyer Observatory
TSU and Space*

Center Of Excellence: Information Systems and Engineering Management

These other telescopes are located in the Fairborn Observatory in southern Arizona. The Fairborn Observatory provides astronomers with a reliable source of high quality scientific data. Benefits include high equipment utilization, dedicated instruments for long time sequence for data analysis instead of operating telescopes, minimized travel costs and time, reduced errors through automation, and reduced costs of shared facilities such as power, communications, weather sensing, and security. The Fairborn Observatory is located on 40 acres in the Patagonia Mountains of southern Arizona with another adjacent 20 acres available if needed. The land consists of privately owned patented mining claims surrounded by national forest. This minimizes environmental impact studies for new construction.



Ali Sekmen



TSU's Ali Sekmen, Assistant Professor, Computer Science, has been researching and building robots for quite a while. He's "teaching" them how to communicate with humans in human languages; he's having many of them work together as a large team, and he's improving engineering education with desktop robots built from everyday, "off-the-shelf" components. Dr. Sekmen's research is interdisciplinary; it reaches into education and psychology as well as electrical and mechanical engineering and computer science and health sciences.

A New Horizon: Robots and Robotics

One project is to enable robots to communicate with humans. The objective is to integrate the robots into our society and make them an integral part of our daily lives. The robots are being "taught" (programmed) to both recognize and understand natural language and environment by real time image processing and voice recognition. From this, they will learn to perform tasks that will help humans. This project has potential to assist disabled individuals. The robots can be trained to do their shopping, and, perhaps, chores around the house.

Sekmen's research team, comprised of undergraduate and graduate students, as well as postdoctoral staff members, is also working on multiple robot interaction on both a small scale and large scale. They are developing the tools to work as a team to perform specific tasks. They have more than 25 mobile robots to test different scenarios. A large scale project, which will ultimately include hundreds of robots, is a battlefield simulation in which the robots act as soldiers. The battlefield project imitates the real environment,

including the hierarchy and communication.

Dr. Sekmen's team members use a component-based software development approach that enables operating system and programming language independent robot programming to operate their robots. This means that one does not need to know a specific operating system and programming language to work with these robots; also these robots will be able to "talk" to robots with different operating systems.

Tennessee State University has been awarded a \$2.5M (budgeted), multi-year research award from the Department of the Army to establish a Center of Excellence for Battlefield Capability Enhancement to study methods to improve the soldier's capability on the battlefield through the use of sensors, robotics and other technologies.

Dr. Amir Shirkhodaie, Associate Professor, Mechanical Engineering, will lead this effort which begins the first quarter of FY2005.



Drs. Terrance L. Johnson and Anthony O. Ejiofor describe their lab and lab work as a means to the understanding of the interaction between microorganisms and the biotic (living) and a-biotic (non-living) environments in which they exist. It is also a place where Ph.D. students help and teach undergraduate students in the same lab, thus enhancing the education of all of the students.

One project being investigated in the lab is bacterial source tracking. The scientists are using specified methods and techniques to determine the source of fecal contamination in streams, waterways, and watersheds in Middle Tennessee. Most of the research comes from the Duck and Stones Creeks rivers. Several tributaries of these rivers are on the "303(d)" list, which identifies streams that are impaired due to contaminate loading. Scientists are interested in fecal contaminated streams and are making source determinations to provide sufficient information for authoring best practices.

Another research project involves the *Bacillus thuringiensis* (BT). The

BT is an organism that is an insect pathogen. There are different strains of BT that are being used today to control mosquitoes and agricultural pests. These strains are what are commonly known as bio-pesticides or natural insecticides. Fifty-six strains of BT have been isolated in Middle Tennessee. They are being characterized genetically, morphologically, and physiologically. The BT organism produces a toxic protein that is responsible for killing insect larvae. As a result, these strains are being characterized for the presence of these toxic proteins. As a result of these studies, there are two strains of BT that have been isolated from the Middle Tennessee area. These strains have been found to be unique in their genetic make-up and the toxic proteins that they carry. The Copper Basin in Polk County, Tennessee, is an area that once was denuded (void of life) due to copper mining activities. Today there are efforts to restore this area to its original habitat. Our scientists' interest in this is to understand the impact of change in the environment, including restoration activities, on the microbial communities in that area. The results of this study indicate the presence of a new group of non-culturable micro-organisms known as OP11. Also, two strains of an organism that produces a purple pigment have been isolated. These strains are being investigated for medical significance.

Other experiments in the lab include testing extracts from plant materials for anti-microbial activity that kills or deters the growth of other micro-organisms. This project comes out of the Tri-State Research Collaboration (Tennessee State University, Jackson State University, and Alabama A&M University). Drs. Johnson and Ernest Izevbogie (Jackson State University) are conducting this research and are developing a comprehensive program to look at the biological activities from plant parts.

TSU scientists are also testing ancient medicinal plants that were used by Native Americans for anti-microbial activities. Their question is "What is the mechanism of action for these plant extracts on microbial activity?"

Support for these projects has come from the Tennessee Department of Environment and Conservation, TSU Title III program, National Institutes of Health, and the United States Geological Survey.

Microbial Ecology: An Umbrella for a TSU Lab



Annual Report for Fiscal Year 2004

AWARDS

by Center/College/School

Agriculture and Consumer Sciences	\$ 110,590
Arts and Sciences	1,296,339
Business	646,340
Cooperative Extension Program	2,735,793
Center for Health Research	949,832
Center of Excellence – ISEM	2,440,792
Center of Excellence – RPC	8,114,301
Education	465,241
Engineering, Technology, and Computer Science	3,177,749
Health Sciences	1,200,413
Institute of Agricultural and Environmental Research	4,041,035
Massie Chair of Excellence in Environmental Engineering	1,759,329
Nursing	187,135
RIMI Center for Neuroscience	616,756
Other: Athletics	112,915
Career Development	4,500
Special Events	261,380
Research & Sponsored Programs	60,588
Title III	8,057,013
TRIO	560,996

Total \$36,799,037

AWARDS

by Agency/Corporations/Foundations

Corporations and Foundations	\$ 1,622,451
National Aeronautics and Space Administration	3,170,188
National Science Foundation	4,014,351
Tennessee State Agencies	7,675,289
U.S. Department of Agriculture	6,045,078
U.S. Department of Defense	560,552
U.S. Department of Education	8,676,977
U.S. Department of Energy	310,000
U.S. Department of Health and Human Services/NIH	4,384,664
Others	339,487

Total \$36,799,037

SUBMISSIONS

by Center/College/School

Agriculture and Consumer Sciences	\$ 2,321,367
Arts and Sciences	10,317,871
Business	1,499,415
Cooperative Extension Program	1,071,113
Center for Health Research	2,116,757
Center of Excellence – ISEM	1,681,997
Center of Excellence – RPC	26,616,797
Education	595,318
Engineering, Technology, and Computer Science	7,741,564
Health Sciences	1,787,737
Institute of Agricultural and Environmental Research	8,747,082
Massie Chair of Excellence in Environmental Engineering	475,000
Nursing	2,913,055
RIMI Center for Neuroscience	650,000
Student Affairs	30,782
TRIO	560,996
Other	524,929

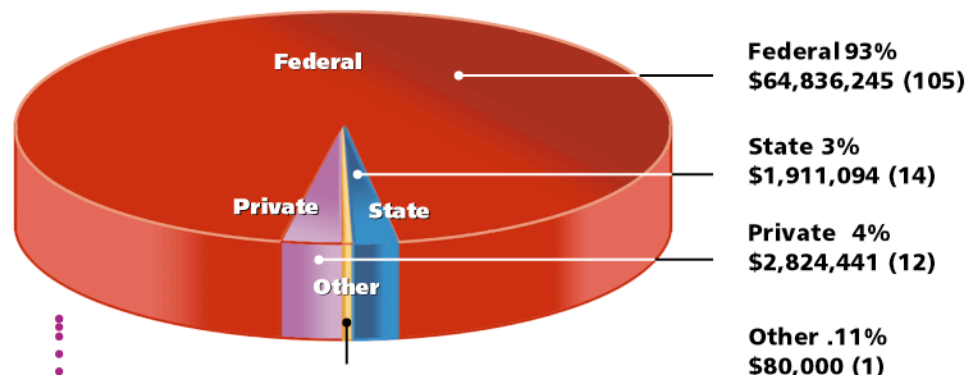
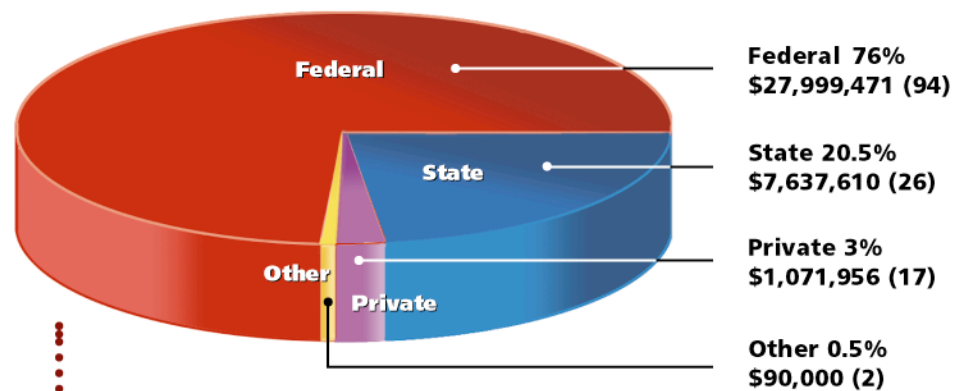
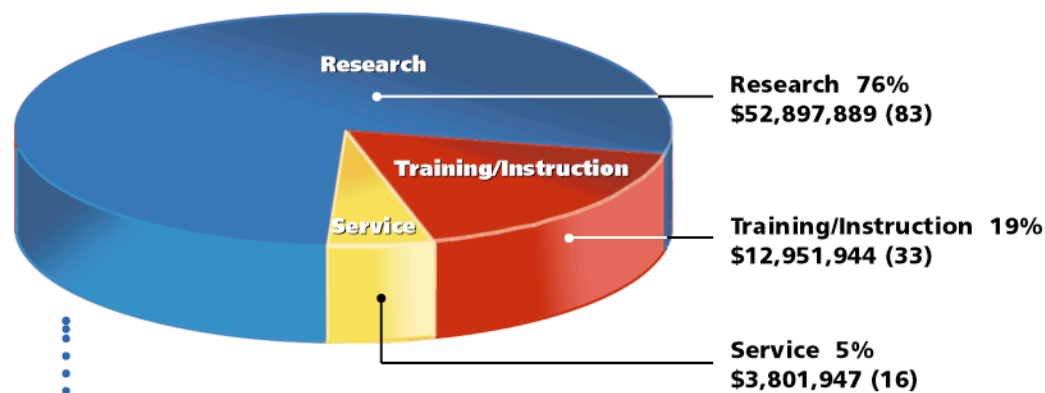
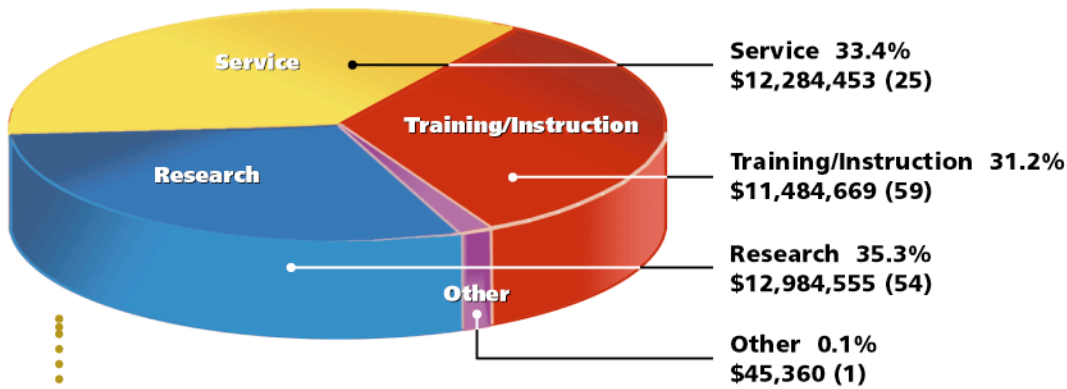
Total \$69,651,780

SUBMISSIONS

by Agency/Corporations/Foundations

Corporations and Foundations	\$ 2,824,441
National Aeronautics and Space Administration	2,213,791
National Science Foundation	30,648,930
Tennessee State Agencies	1,911,094
U.S. Department of Agriculture	10,975,683
U.S. Department of Defense	780,000
U.S. Department of Education	619,964
U.S. Department of Energy	496,160
U.S. Department of Health and Human Services/NIH	12,784,762
Others	6,396,955

Total \$69,651,780





TENNESSEE STATE UNIVERSITY

Research at Tennessee State University utilizes the diverse skills and expertise of our researchers, faculty, staff, and students to make significant and sustained contributions to the knowledge of humankind through new discoveries that have positive impact on our community, our nation, and the world in which we live. At Tennessee State, we believe research is essential to excellence in education and enhances the educational experience of our students.

Marcus W. Shute, P.E, Ph.D.
Vice President



3500 John A. Merritt Blvd. • Nashville, Tennessee 37209 • Phone 615.963.7631 • FAX 615.963.5068 • Web Site www.tnstate.edu/research
TSU Publication Number TSU-05-0016(B)-3-225015

Tennessee State University, in compliance with Title IV of the Civil Rights Act of 1964 and Title IX of the Education Amendments of 1972, does not discriminate on the basis of race, color, national origin or sex in any of its policies or procedures. Tennessee State University is committed to the education of a non-racially identifiable student body. An Equal Opportunity/Affirmative Action Employer M/F Tennessee State University: A Tennessee Board of Regents Institution.