

RESEARCH CAPABILITY



Tuskegee University Research Capability

Message from the University Administration

Thank you for your interest in Tuskegee University and its research capabilities.

Tuskegee University has long been a leader in the areas of basic and applied research. Today, through such fields as advanced materials, atmospheric science and remote sensing, biotechnology, information security and space agriculture, Tuskegee is finding new ways to advance the safety and security of our world's citizens. Within our academic units and centers, we are engaged in many areas of cutting edge research. Our faculty, students (both graduate and undergraduate), and staff are engaged in research critical to addressing the needs of today's governments, corporations and citizens. We seek to answer the most pressing questions facing modern society. The following pages outline for you the varied capabilities and programs at Tuskegee University. We are available to you, and invite you to utilize our services in advancing your programs.

The Division of Research and Sponsored Programs, which was established in 1996, coordinates the research activities of university faculty, students and staff. Over the past, 16 years, the office has not only sought to increase the level of sponsored research funding, but to also increase the total number of grants awarded. Our staff works closely with the center directors and academic leaders to facilitate Tuskegee University's sponsored research projects.

In the following pages, we have provide you a glimpse of Tuskegee University's research capabilities.

Additional information on our faculty expiries and their current research interests may be viewed on our web site www.tuskegee.edu/research, by clicking on the "Faculty" button on pages that describe our capabilities.

After familiarizing yourself with our capabilities, be sure to contact us regarding your particular research requirements. We have a host of individuals ready to address your needs.

Thank you.



Matthew Jenkins, D.V.M.
Acting President



Shaik Jeelani, Ph.D., P.E.
Vice President for Division of Research
and Sponsored Programs

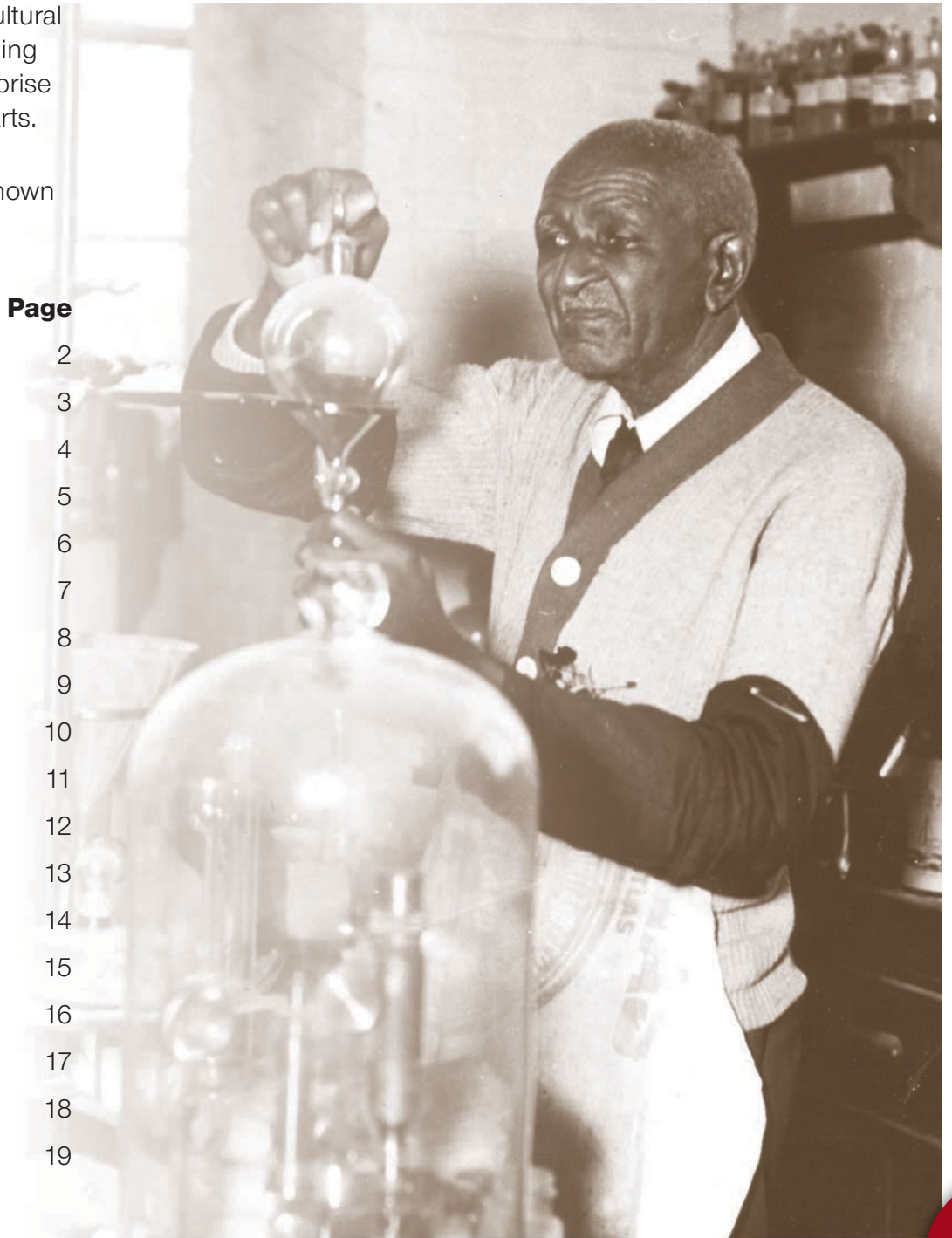
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The legacy of George Washington Carver, who established agricultural research and new farming techniques at Tuskegee and surrounding areas, continues. We have expanded our current research enterprise to include all other areas of science and engineering and liberal arts.

The research expertise of most of our faculty falls under the list shown below.

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Animal and Poultry Sciences

The Animal Sciences program in the College of Agriculture and Environment and Nutrition Sciences (CAENS) has major research programs in animal nutrition production and disease prevention in small ruminants.

Research activities include:

- Developing goat breeds which are adapted to southern US conditions
- Understanding parasitic diseases prevalent in small ruminants and developing novel drugs to combat these diseases
- Developing sustainable small ruminant production and marketing systems
- Agroforestry
- Animal biotechnology

Funding for these research programs has come from multiple and diverse sources including United States Department of Agricultural (USDA), National Institutes of Health (NIH), National Science Foundation (NSF), the State of Alabama and private industries etc...

Current funded grants focus on:

- Effect of *Toxoplasma gondii* Gra 10 Protein on Ovine Immune Response to Infection
- Genetic and Molecular Characterization of Phospholipid Biosynthetic Pathways as Drug Targets in the Livestock Parasite *Haemonchus contortus*
- Integration of Sustainable Resource Management, Nutrition, Reproduction & Goat Health for Production Efficiency, Meat Quality and Marketing
- Effect of Natural Polyphenol-containing Diets (e.g. pine bark and others) on Internal Parasites Control and Animal Performances in meat goats, Methanogen Archaea Population and on Greenhouse Emission

- Year-round Forage Productions Associated with Sustainable Meat Goat Production Systems

The animal research program as part of the Department of Agricultural and Environmental Sciences (DAES) has significant impacts on community outreach and education. DAES works collaboratively with the Tuskegee University Cooperative Extension Program and the Alabama Cooperative Extension Service in outreach to Alabama in general and the Black Belt Region in particular to assist farmers, individually and in groups in providing training and technical assistance. Scientists and researchers are involved in graduate training at the M.S. and Ph.D. level. The Ph.D. program in Integrative Biosciences prepares underrepresented minority Ph.D. graduates with the ability to engage in independent and scholarly inquiry and the capacity to make original contributions to various bodies of knowledge. This Ph.D. program helps to create an environment within the university that attracts and produces outstanding graduates and faculty who possess excellent skills and knowledge in their specialization, training and experience in interdisciplinary problem solving and the abilities and a commitment to teach others.

Equipment and facilities available for these activities include the following:

The Caprine Research Facility, Bio-Rad Gel Doc XR image system, Bio-Rad Real-Time PCR, PCR thermal cyclers, LI-COR 4300 DNA Analyzer, Nanodrop spectrophotometer, In vitro gas production systems, Fiber analyzer



Tuskegee University faculty in the Department of Biology have been engaged in conducting research on diseases that disproportionately affect minority populations. Areas that are of interest are prostate, breast, kidney, and pancreatic cancers. Additional faculty interests include immune related diseases such as lupus, viral-based diseases and cardiovascular disease.

Research activities conducted within these areas utilize:

- High Resolution Imaging
- Confocal Imaging
- Live Cell Imaging
- Real Time In Vivo Imaging
- Real-Time PCR
- Nano-materials for Drug Delivery

These research activities have been funded by federal agencies including the National Institutes of Health (NIH), the National Center for Minority Health Disparities (NCMHD), the Research Centers for Minority Institutions (RCMI), the Department of Defense (Prostate Program), and the National Science Foundation (NSF).

Current funded research grants focus on:

- Repair/Regeneration of Thymic Nurse Cells
- Epigenetic Regulators of Prostate and Breast Cancer
- Discovery of Early Detection Biomarkers for Minority Cancer Patients
- miRNA profiling in African American Prostate Cancer Patients

The Biology Department also makes a significant impact on education and outreach activities. Faculty in the department contribute significantly to the preparation of undergraduate students for careers in biomedical

science. These efforts are supported by two federally funded programs. The first is the NIH funded Minority Access to Research Careers (MARC) program. This program seeks to increase the number of highly-trained underrepresented biomedical and behavioral scientists in leadership positions. The second is the NSF funded Historically Black Colleges and Universities-Undergraduate Program (HBCU-UP). The underlying purpose of the HBCU-UP is to develop pedagogies and methodologies for training undergraduates in the STEM areas. In addition, emphasis is placed on interdisciplinary enrichment of quantitative skills (mathematics and physics) of students in the biological sciences.

The department also offers a Master's of Science (M.S.) Degree program, which is concentrated in health disparity related diseases. In addition, the faculty serve as pre-doctoral advisors to Tuskegee University's first Biomedical Ph.D. program in Integrative Biosciences, which aims to significantly increase the number of African Americans with Ph.D.s in that area.

Equipment and facilities available for conducting these research activities include:

Laser Scanning Confocal Microscope: High resolution imaging of immunofluorescence phase contrast images, as well as three-dimensional reconstruction of imaging of the X, Y and Z planes.

Spinning Disk Confocal: Live cell imaging with 37 degree heated stage and CO₂ incubation for up to 72 hours.

Real-Time PCR: Also called *quantitative real time polymerase chain reaction* (qPCR) or *kinetic polymerase chain reaction* is a laboratory technique based on the PCR, which is used to amplify and simultaneously quantify a targeted DNA molecule. We currently have the ABI 7500 Fast System, which has capabilities of 96 reactions per run.



Biomedical Research

The overarching but complementary goals of the Tuskegee University Center for Biomedical Research/Research Centers in Minority Institutions (TU CBR/RCMI) are to support and promote biomedical



research on Tuskegee's campus by strengthening its research infrastructure, and the research foci on reducing and/or eliminating health disparities (e.g. cancer, HIV/AIDS and other autoimmune diseases, cardiovascular disease, and obesity) that disproportionately burden the inhabitants of Alabama's Black Belt counties and the United States. This research theme is consistent with the mission of Tuskegee University, which involves a longstanding commitment to improve the health and health care of residents in the rural and medically underserved areas of Southeast Alabama. The TU CBR/RCMI Program builds upon a vision of studying health-related problems through novel approaches utilizing *in vivo*, *in vitro* and computational modeling.

Shared Instrumentation Core Facility

The TU CBR/RCMI Shared Instrumentation Core Facility (Core 1) provides researchers with state-of-the-art equipment to conduct high quality research. Two full-time staff members facilitate on-site use of core equipment and maintain operational readiness of shared resources.

Current capabilities include:

- Confocal , Time-lapse and Light Microscopy
- High-throughput Plate Reading
- Flow Cytometry
- In vivo Imaging
- Chromatography
- Cell Culture
- Molecular Biology
- Digital Imaging

The cytometry instrumentation within the core includes an Accuri C6 and a BD FACSCalibur. Both instruments have dual excitation lasers (one blue and one red) and multiple optics filters that allow for the use of a wide range of fluorophores. This core facility also houses several pieces of equipment necessary to conduct experiments requiring cell culture techniques. These include biosafety cabinets, CO2 incubators, centrifuges, vacuum pumps and microscopes.

The IVIS Lumina XR is the newest acquisition within the core facility. This small animal optical imaging system has multimodal functionality for *in vivo* imaging. It offers researchers the ability to take photographs, obtain X-rays, visualize fluorescence, and observe luminescence simultaneously. The flexibility of this system will prove invaluable to the university's research community and collaborators.

Computational Biology and Bioinformatics Core Facility

The Computational Biology/Bioinformatics Core Facility (Core 2) affords our researchers with computational and informatics tools, software packages, computational clusters, servers, and workstations. It also provides computational biology, bioinformatics, experimental design and modeling, and statistical analysis for the Tuskegee University research community. The facility's hardware and software resources are available to the end-users 24/7.

Data and Information Management:

- Development of databases, data warehouses and web applications
- Database searching and data retrieval
- Data sharing
- Statistical analyses support

Molecular Modeling:

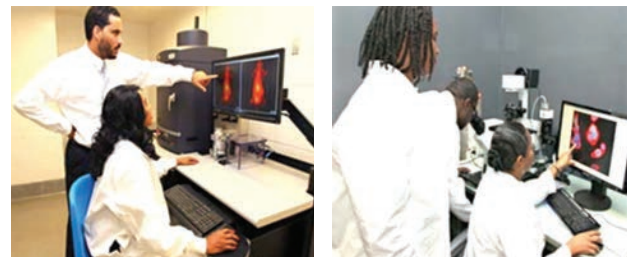
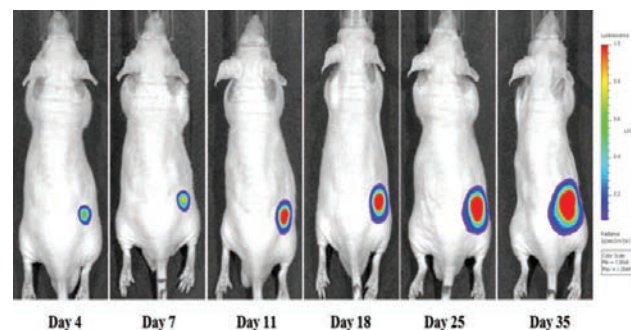
- Protein structure/property prediction and analysis
- Homology modeling of proteins
- Molecular docking

- Molecular dynamics simulations
- QSAR analysis
- TRANSFAC analysis
- Antigenic epitope prediction

The Staff of the Core Facility:

- Consult users in utilizing bioinformatics and biomedical informatics tools and methods, and molecular modeling techniques
- Participate in collaborative research
- Teach bioinformatics-related disciplines
- Develop and support cancer-specific registries
- Educate investigators on the requirements, standards and approaches that enhance data collection, management, mining, and sharing.

The TU CBR/RCMI Program is funded by the NIH NIMHD grant number G12MD007585.



Food and Nutritional Sciences

Tuskegee University Food and Nutritional Sciences (FNS) Programs encompass basic, applied and translational research. Specifically, our research targets critical needs areas relative to prevention of chronic diseases and other food related issues at the local, regional and national level. In the southern Alabama Black Belt counties and across the nation, diet related chronic diseases disproportionately affect African-Americans more than Caucasian Americans. Food and nutritional sciences research has focused on reducing the prevalence of chronic diseases in four major areas: Cardiovascular (CVD), Cancer (CA), Diabetes (DIB) and Food Safety (FS).

Significant research areas are:

- Dietary impact on chronic disease biomarkers;
- Bioactive compounds in fruits and vegetables in disease prevention;
- Development of value-added food products;
- Food availability and accessibility in the Black Belt counties of Alabama;
- Obesity prevention in at risk populations;
- Food safety assurance of fresh, refrigerated, and ready to eat products; and
- Green packaging from biodegradable compounds and natural antimicrobials.

Research Funding from several agencies include:

National Institute of Health—National Center Minority Health Disparities (NCMHD)/ Excellence in Partnership for Community Outreach, Research on Health Disparities and Training (PROJECT EXPORT), National Heart, Blood and Lung Institute (NHBLI)/Alabama Collaboration for Cardiovascular Equality (ACCE) and the United States Department of Agriculture (USDA)/ National Institute of Food and Agriculture (NIFA)/ Agriculture Food and Research Institute (AFRI), Alabama Association of Land-grant Alliance (AALGA)

and Alabama Department of Public Health. Equipment and facilities available for these activities include:

- **Food Chemistry/Analysis:** Liquid Chromatography Mass Spectroscopy (LCMS), High Pressured Liquid Chromatography (HPLC), Gas chromatography Mass Spectroscopy (GCMS), Texture Analyzers, Fat and Moisture Analyzer, Large Capacity Centrifuge, Spectrophotometers, Atomic Absorption Spectrophotometer, Protein Analyzer, Soxhlet Apparatus, Element Analyzer, Infrared spectrophotometer, CEM Smart Trac Fat and Moisture Analyzer, Fluorescence (RF 5301 PC) Spectrometer and Ultra Violet Visual (UV-VIS) Spectrophotometer (UV-4201) .
- **Food Microbiology:** Biology for microbial identification; Bio-Tek Plate Reader; Biosys 32 for growth and detection of microbes, UV Microscope, Bax system (Qualicom) for polymerase chain reaction measurements, Automated Plating Device for preparation of plates; Automated Dispenser and Automated Plate Reader, Luminometer used for detection and quantification of microbes; Isotemp Incubators for precise temperatures; Brabender Homogenizer, Autoclave, etc...
- **Food Engineering:** Balance, Pycnometer, Rheometer, Texture Analyzer, Thermal Property Analyzer, Vernier calipers, Water Activity Measurement Instrument, Ovens, Freeze Dryer, Environmental Controlled Chamber, etc...
- **International Research Focus:** food preservation and maintenance of nutrient quality, and reduction of post-harvest food losses in Ghana, West Africa. Other countries for FNS involvement are Malaysia and Kenya.



Computer Science and Engineering and Information Technology

Several faculty members at Tuskegee University strive to preserve, refine and develop new bodies of knowledge in computer science and engineering and information security. Moreover, the faculty aims to discover new knowledge within this fast growing discipline to contribute to the enrichment of the University and the society. Our faculty has been engaged in research in many areas including:

- High Performance Computing
- Biosensors Electronics and Security
- Computer Graphics and Gaming
- Cloud Computing
- Mobile Computing and Security
- Circuits Design and Simulation
- Robotics
- Information and Network Security
- VLSI Yield, Reliability, and Testing
- Computer Forensics
- Bio-informatics

These research activities have been funded by federal agencies including National Science Foundation (NSF), National Security Agency (NSA), National Aeronautics and Space Administration (NASA), Department of Homeland Security (DHS), Department of Defense (DoD), Department of Commerce (DoC), etc. Our faculty have been involved in collaborative research with various academic institutions—Auburn University, Alabama A&M University, Mississippi State, Iowa State, University of Tennessee at Chattanooga, Purdue, and Carnegie Mellon as well as government labs—Argonne National Laboratory (ANL), Jet Propulsion Lab (JPL) and Oak Ridge National Laboratory (ORNL). In addition, research activities supported by several industries including: Xerox, Microsoft, Hewlett Packard, Proctor & Gamble, Boeing, Union Pacific, Raytheon, Caterpillar and Google have been carried out as well.

Current funded grants focus on:

- High Performance Computing with Cluster
- High Performance Computing with GPGPU
- Detection of Biological Pathogens and Chemicals on Portable Smart Platforms
- Design and Simulation of Mixed-Signal
- Mobile Security
- Information Assurance

These research programs also make a significant impact on the university's education and outreach activities. Tuskegee University's Department of Computer Science has been designated as the Centers of Academic Excellence in Information Assurance Education (CAE/IAE) by the National Security Agency (NSA). The CAE/IAE at Tuskegee University serves as organizing body to offer resources for faculty, students, and community in conducting teaching, research, training, and other activities in Information Assurance. An inter-disciplinary graduate program, a master degree in Information Systems and Security Management (MS-ISSM) have been approved. The MS-ISSM program allows students to use methods and tools to make strategic decisions about information security issues. The department maintains excellent computing facilities. The research labs include:

The Information and Network Security Lab which is equipped with high performance workstations and state-of-the-art network facilities. It supports research in the areas of Virtual Internet Simulation, Intrusion Detection, Cryptography and Wireless Network Security.

The Digital Forensics Lab has Forensic workstations, portable computer forensic workstation, and other hardware for data acquisition. It supports research in the areas of evaluation of mobile device tools, development of digital forensic toolkit and Investigation the usage of GUP in various digital forensics applications.

The High Performance Computing Lab has a 8-compute node plus one master node cluster. It supports research in the areas of High Performance Computing (HPC) and provides computing cluster to all faculty and students of Tuskegee University.

The Computer Graphics and Gaming Lab is equipped with state of the art PCs and high-end workstations, installed with the latest software for building games. It supports research in the areas of High Performance Computing with GPGPU, Computer Graphics and Gaming Technology.

We also have Vex Robotics Systems, installed with the latest software for designing, building and programming robot. The Vex Robotics Systems provide a dedicated space for faculty and students to integrate and promote excellence in robotics research at Tuskegee University.



Tuskegee University faculty members have been conducting cutting-edge research in numerous aspects of energy generation, storage and distribution. These efforts are geared towards developing new technologies to address the challenges brought on by the increasing global energy demands. The innovations resulting from these efforts are of great interest to societal endeavors and will increase the nation's technological and economic competitiveness at the global stage.

Research activities in the energy area at Tuskegee University include:

- Generation – Biofuels, PV Solar Cells, Hydrogen Production Technologies
- Storage – Secondary batteries, Supercapacitors, Hydrogen Storage Technologies
- Distribution – Smart grid technologies,
- Fuel Cells

Tuskegee University's energy research initiatives have been funded by federal agencies including National Science Foundation, Army Research Office, Office of Naval Research, and Florida Hydrogen Initiatives, among others.

Current funded grants focus on:

- Flexible Solar Cells
- Transparent Solar Energy Harvesting Coatings
- Thin-film Paper Supercapacitors
- Biofuel Cells
- PEM Fuel Cell Performance and Membrane Degradation at Subzero Conditions
- Materials for On-board Hydrogen Storage
- Transportation Fuel Generation by Sunlight Assisted photo-reduction
- Phase Change Materials for Thermal Storage
- Materials for Solar Collectors
- Smart Grid Technologies

These initiatives are making a major impact, in terms of research and development of new technologies in energy-related areas, and in education. Tuskegee University's various engineering and science graduate programs are educating and training M.S. and Ph.D. degree students in renewable and alternative energy technologies. Tuskegee University has become a leading producer of well-trained African-American professionals, contributing to the advanced technology workforce in the energy sectors. Through its various research, education and outreach initiatives in energy, Tuskegee University is now at the forefront of the global energy effort.

The state-of-the-art equipment and facilities available for TU's energy research activities include:

Materials Synthesis and Characterization:

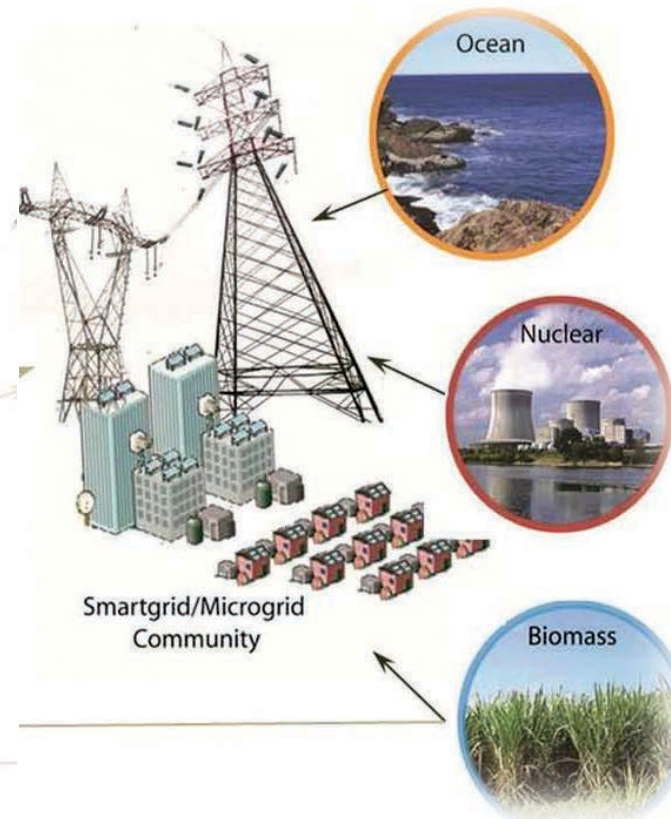
Electrospinning, Force Spinning, Hand Layup, Resin Infusion Molding, Three-roll Mill, Thinky Mixer, Compression Molding at Elevated Pressure and Temperatures, Rheometer, Dynamic Mechanical Analyzer (DMA), Differential Scanning Calorimeter (DSC), Thermal Mechanical Analyzer (TMA), Thermogravimetric Analyzer (TGA), High-performance Liquid Chromatography (HPLC), GC-MS, Impedance Spectrometer, X-ray Diffractometer (XRD), Fourier Infrared Spectrometer (FTIR), UV- Vis Spectrometer, Optical, Scanning and Transmission Electron Microscopes (SEM & TEM), Dynatup Low-Velocity Impact Test System, Split Hopkinson Pressure Bar Setup for High Strain Rate Testing, Gas-Gun High Velocity Impact Setup, UV chamber, Ultrasonic C-scan, Acoustic Emission, Thermography, Nitrogen filled glove box, BET Surface Area Analyzer, Quadruple Mass Spectrometer, High Pressure Hydrogen Sorption, Tubular and Muffle Furnace, Planetary Ball Mill, High Pressure and High Temperature PARR Reactor, Chemical Fume Hood, Horizon's Fuel Cell Research and Demonstration Kit.

Device Development, Fabrication and Testing:

Electrochemical work station, Photolithography tools, Spin-coater, Dry and Wet Etching tools, Micro-fluidic Direct Writer, Radio Frequency and Direct Current Sputter Coater, Solar Simulator, Electric Current and Voltage Probe Station, Capacitance meter, Hall Effect measurement system, custom designed UV-Vis Photocatalytic reactors.

Phenomena, Process and/or System Modeling and Simulation:

COMSOL Multiphysics modeling and simulation software suite, MATLAB software for engineering and system analysis, AspenTech software suite for process modeling and simulation.



Environmental, Natural Resources and Plant Sciences

The environmental, natural resources and plant scientists and researchers at Tuskegee University are engaged in critical research aimed at addressing challenges in the State of Alabama and the nation in food systems, agriculture, environment, natural resources and climate change. This research has resulted in pioneering work in biotechnology, crop production systems and alternative energy from biomass, economics of production and marketing for maximum returns and agricultural and social policy issues that impact socially disadvantaged and limited resource farmers, processors and consumers.

Research activities include:

- Development of improved production practices to enhance the quality and nutrition of traditional and new vegetables crops and small fruits in Alabama
- Identifying geonomic and DNA markers in peanut, sweet potato, Miscanthus, and date palm
- Development of biofuels from starch, sugar and cellulosic biomass
- Development of soil quality indices
- Climate modeling to predict extreme weather events
- Assessing impact of climate and land use on water resources in the Black Belt counties of Alabama and limited and socially disadvantaged communities
- Solid hazardous waste management
- Water and waste water treatment
- International research and development programs in Africa, India, South America and the Caribbean

Funding for research has come from multiple and diverse sources including the United States Department of Agriculture (USDA), The State of Alabama, Department of Energy (DOE), Environmental Protection Agency (EPA), the National Science Foundation (NSF) and United States Agency for International Development (USAID), Funding is also received from other public and private companies

Current funded grants focus on:

- Genomics of crop plants for bioenergy production
- Organic farming methods and biology

- Developing indices for soil quality using soil enzymatic assays
- Evaluating impacts of agricultural and environmental practices on soil microbial diversity and health
- Agro-forestry and biological forest vegetation management
- Irrigation systems for limited resource and socially disadvantage farmers
- Analysis of natural and anthropogenic systems, as well as the development of technologies for solid and hazardous waste treatment and management
- Application of advanced oxidation processes for the removal and destruction of organic contaminants in industrial wastewater for recycling
- Development and evaluation of solid adsorbents for water and wastewater treatment

These research programs have significant impacts on community outreach and education. Tuskegee University scientists work collaboratively with the Alabama Cooperative Extension System in outreach to Alabama in general and the Black Belt Region in particular to assist farmers, individually and in groups in providing training and technical assistance. Our scientists were the first to identify genetic polymorphism in cultivated peanut using DNA markers and were also the first to develop transgenic sweet potato and peanut plants. The scientists associated with these programs actively participate in the Ph.D. program in Integrative Biosciences in producing underrepresented minority Ph.D. graduates in agricultural, environmental sciences and biomedical fields.

Equipment and facilities available for these activities include the following:

Greenhouse Complex, Controlled Environmental Growth Chambers and Rooms, Bio-Rad Gel Dec XR image system, Bio-Rad Real-Time PCR, PCR thermal cyclers, LI-COR 4300 DNA Analyzer, Nanodrop spectrophotometer, ICP-MS, HPLC, GCs, Ion Chromatograph, Carbon Analyzer, High performance work stations with multiple, Rs software, and real-time satellite remote sensing ground station consisting of tracking and geostationary antenna systems.



Geospatial Science and Climate Change

The Tuskegee University Geospatial Science and Climate Change program is a multidisciplinary research activity with tools and resources for research and teaching in critical need areas of earth observatory, geospatial information systems, climate change, hydrology, environmental and natural resources studies and decision support systems.

Specific Research Areas and Activities

- Satellite Remote Sensing (RS) and Earth Observation (EO)
- Geographic Information Systems (GIS)
- Global Positioning Systems (GPS) and Precision Agriculture (PA)
- Hydrology, Ecohydrology, Watershed and Water Quality Modeling
- Land Use land Cover Change
- Climate Variability and Change, Extreme Weather Events
- Decision Support Systems and Early Warning Systems
- Environmental and Natural Resources Monitoring
- Agricultural Ecosystems and Services



- Agricultural Decision Support Systems
- Water Resource Management
- Weather and Climate Data Analysis for Agricultural and Environmental Applications

Current Research Projects

- Impact of climate change on water resources within the Mobile River Basin and overlapping Black Belt regions of Alabama
- Tuskegee University mapping
- Water resources mapping and accounting using remote sensing
- Digital Climate Atlas of Alabama
- Socio-economic Atlas of the Alabama Black Belt
- Weather extreme events over the Southeastern USA: trends and predictability
- Varied independent graduate student research and study projects

Resources

Hardware: Eighteen high performance workstations, High volume processing printer, Video conferencing and projector systems

Software: ArcGIS 10.x site license, ERDAS IMAGINE HEAK License, MultiSpec RS software, climate and hydrologic modeling and other software.

TU Earth Observatory (TUEO)

TUEO is a real-time multi-satellite remote sensing receiving ground station consisting of a geostationary station for NOAA's Geostationary Operational Environmental Satellites and a TeraScan® X/L-Band tracking antenna system for polar orbiting satellites, including NOAA's AVHRR and NASA's MODIS Terra & Aqua sensors. TUEO will provide researchers the resources to carry out temporal and spatial analysis, data fusion and data mining of remotely sensed

imagery in a high performance computing and high bandwidth environment.

TUEO Research Activities and Applications

- Early warning and mitigation of a wide range of biogenic and anthropogenic disasters
- Monitoring, analysis and mitigation of epidemics and epizootics, public health
- Effective analysis and management of environmental issues including; climate change and its impacts, land use land cover changes, water resources, flooding, storms, forest fires, disaster management, vulnerability assessment, post-disaster damage assessment

Ongoing International Research Projects

TU is implementing the NATO sponsored Science for Peace Mediterranean Dialogue Earth Observatory project in Morocco, which establishes a network of real-time satellite remote sensing ground stations at Al Akhawayn and Abdelmalek Essaadi Universities in Morocco.



International Research and Development



Engagement of Tuskegee University scientists in international research and development dates back to 1900, when university faculty spent a considerable amount of time in Togo assisting scientists in developing research and educational programs in agriculture. Building on the legacy of international engagements through research, development, and global service activities, Tuskegee University faculty have developed active collaborations with their counterparts at educational institutions and research organizations in various countries including:

Australia, Bangladesh, Benin, Brazil, Burkina Faso, Canada, Chile, China, Columbia, Costa Rica, Egypt, Ghana, India, Indonesia, Iraq, Kyrgyzstan, Liberia, Macedonia, Malaysia, Mali, Morocco, Nigeria, Paraguay, Philippines, Senegal, South Africa, Tanzania, Turkmenistan, Uruguay, the United Kingdom, Uzbekistan, Vietnam and Zimbabwe.

Current areas of collaborations with various international organizations under Collaborative Agreements (CAs), Partnership Agreements (Pas) and Memoranda of Understanding (MOUs) through funding from the National Institutes of Health (NIH), National Science Foundation (NSF), North Alliance Treaty Organization (NATO), U.S. Agency for International Development (USAID), U.S. Department of Agriculture (USDA) are:

- **Atmospheric Science** (Egypt and Morocco)
- **Capacity building and economic and social development** (Burkina Faso, Ghana, Iraq, Mali, Senegal and Tanzania)
- **Cochran Faculty Exchange Program** (Chile, China, Columbia, India, Indonesia, Kyrgyzstan, Macedonia, Malaysia, Paraguay, Philippines, Turkmenistan, Uruguay and Uruguay)
- **Course Offerings** (Brazil)
- **International Students & Faculty Exchange Program** (Brazil, Costa Rica, Egypt, India, Iraq, Tanzania and United Kingdom)
- **High Performance Computing** (South Africa)
- **The Norman E. Borlaug International Agricultural Science and Technology Fellowship Program** (Egypt, India, Macedonia, Morocco, Vietnam)
- **The Global Youth Innovation Network** (Benin, Canada, Ghana, India, Senegal, and Zimbabwe)
- **Collaborative Research** (Brazil, Egypt, India, United Kingdom)
- **Joint Conferences and Workshops** (Bangladesh, Brazil, India).



Mahammad Bhuian, Shamima Amin, USAID Administrator, Dr. Rajiv Shah, USAID, 2006 Nobel Laureate Mohammad Yunis, President, Gilbert Rochon, Marjorie Williams, and Chairman of the Board of Trustees, Charles E. Williams

Materials Science and Engineering

Tuskegee University faculty members have been engaged in conducting research on advanced materials that are of interest to military, automotive, construction, sporting goods and health care industries for more than 30 years. The materials that have been extensively studied include: metals, super alloys, ceramics, polymers and composites.

Research activities with these materials include:

- Synthesis and processing
- Static and dynamic characterization
- Studies of environmental effects
- Fatigue, fracture and creep
- Nondestructive evaluation
- Thermal and thermomechanical characterization,
- Welding and corrosion
- Corrosion and coatings

These research activities have been funded by several federal agencies including the Air Force Research Laboratory, Army Research Laboratory, Construction Engineering Research Laboratory, U.S. Army Cold Regions Research and Engineering Laboratory, Department of Energy, Defense Advanced Research Projects Agency, Federal Aviation Administration, National Science Foundation, Missile Defense Agency, National Aeronautics and Space Administration, Office of Naval Research and Oak Ridge National Laboratory. In addition, research activities supported by several industries including Boeing, General Motors, Lockheed Martin, McDonnell Douglas, Nucor and Raytheon Missile Systems have also been carried out.

Current funded grants focus on:

- Fiber reinforced polymers, ceramics and nanocomposites
- Sandwich constructions and analysis
- Advanced green composites
- Materials for energy efficient electronics

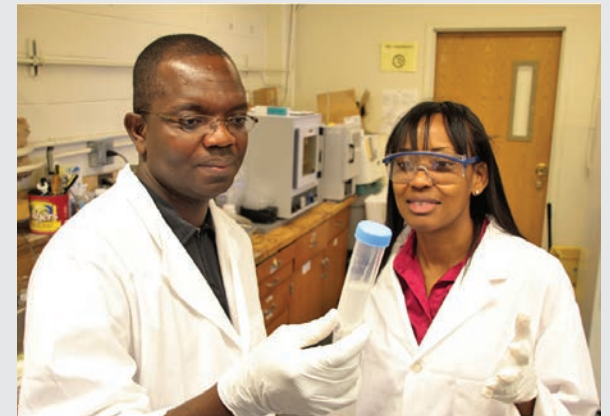
- Materials for microelectronics and solar collectors
- Welding and repair of rail steels
- Nuclear energy systems and materials under extreme conditions
- Corrosion and degradation of materials under extreme environments
- Flood damage resistive materials

The Materials Science and Engineering program also makes a significant impact on the education and outreach activities. Tuskegee University's first Ph.D. program in Materials Science and Engineering, which aims at significantly increasing the number of African Americans with Ph.D.s in this field, was developed and implemented by the faculty associated with this program. Tuskegee University is now recognized by the National Science Foundation and the White House as the largest producer of African American Ph.D.s in Materials Science and Engineering.

Equipment and facilities available for these activities include: **Processing and Fabrication:** Autoclave, electrospinning, forcespinning, hand layup, resin infusion molding, sonicator, three-roll mill, Thinky mixer, compression molding at elevated pressure and temperatures.

Thermal, morphological and the mechanical characterization: TA Instruments rheometer, dynamic mechanical analyzer, differential scanning calorimeter, thermal mechanical analyzer, thermogravimetric analyzer, X-ray diffractometer, Fourier Infrared Spectrometer, Optical, scanning and Transmission electron microscopes.

Mechanical, and Nondestructive Characterization and Studies of Environmental Effects: Several materials test systems with environmental chamber (20N-100KN capacity), Dynatup low-velocity impact test system, Split Hopkinson Pressure Bar setup for high strain rate testing, Gas-Gun high velocity impact Setup, UV chamber, Ultrasonic C-scan, Acoustic Emission and Thermography.



Nanotechnology

Synthesis and characterization of nanoparticles with unusual physical, chemical and biological properties has played a major role in the advancement of nanoscience and nanotechnology. The research capabilities in nanobiomaterials at Tuskegee University are in the areas of structural nanocomposites, biodegradable materials, drug delivery, biomedical, bone regeneration, dental fillings and pharmaceutical applications. Research activities of these materials include: synthesis of materials using wet chemical methods, sonochemical irradiation, microwave heating, microfluidics, chemical vapor deposition, and mechano-chemical milling.

These research activities have been funded by federal agencies including Air Force Research Laboratory, Army Research Laboratory, Construction Engineering Research Laboratory, U.S. Army Cold Regions Research and Engineering Laboratory, Department of Energy, Defense Advanced Research Projects Agency, National Science Foundation, Missile Defense Agency, National Aeronautics and Space Administration, and the Office of Naval Research.

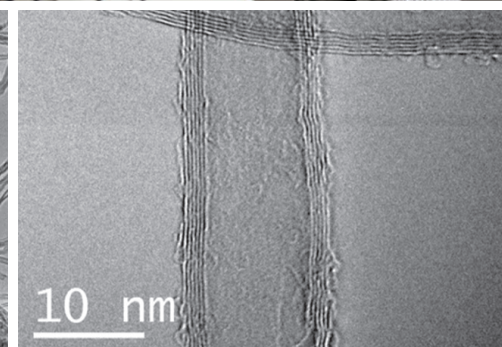
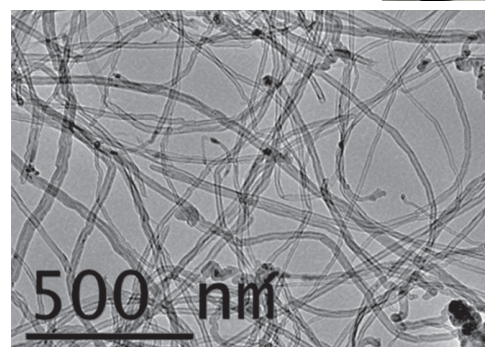
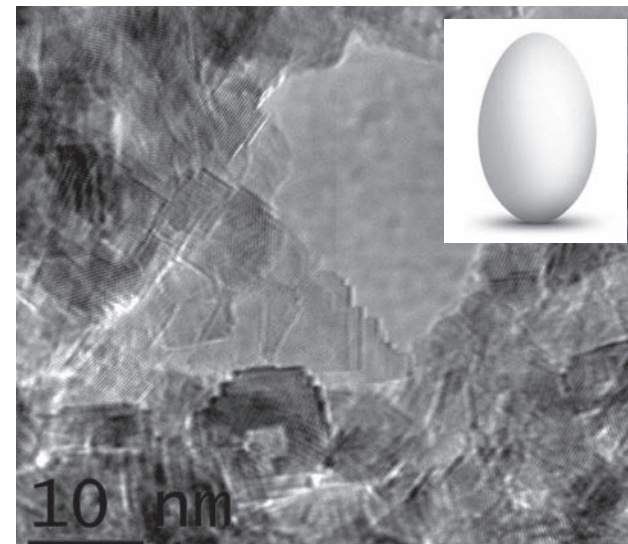
Current funded grants focus on:

- Development of structural nano-composites for military and industrial applications
- Synthesis and characterization of biodegradable composite materials
- Synthesis and characterization of super paramagnetic nanoparticles for drug delivery, hypothermia and MRI contrasting agent in imaging applications
- Extraction of calcium carbonate nanoparticles from egg shells, and sea shells
- Improve the oral and topical absorption of bio-based calcium carbonate nanoparticles and their drug delivery applications
- Bio-based calcium silicate, calcium hydroxyapatite infused electrospun fibers for bone regeneration scaffold applications

- Design and Development of Novel Dental Composite Restorative Systems using calcium based Nanoparticles
- Synthesis of metal and metal oxide coated CNTs and fabrication of their polymer nanocomposite single fibers for antimicrobial/antifungal/UV absorption textile applications

Facilities and Equipment available for

Nanobiomaterials Research: Ultrasonic liquid processor for large volume applications (VCX 1500HV), High power Batch Microwave Oven (Model BP-210), First nano-300 Easy Tube CVD, SPEX CertiPrep 8000-series-Ball Mixer/Mills, Thinky Defoam Mixer, Autogenic pressure reactor, Electrospinning, Force Spinning, Rheometer, Wayne Yellow jacket two station goddet set single screw extrusion system, Dynamic Mechanical Analyzer (DMA), Differential Scanning Calorimeter (DSC), Thermal Mechanical Analyzer (TMA), Thermogravimetric Analyzer (TGA), High-performance Liquid Chromatography (HPLC), GC-MS, X-ray Diffractometer (XRD), Fourier Infrared Spectrometer (FTIR), UV-Vis Spectrometer, Optical, Scanning and Transmission Electron Microscopes (JEOL-SEM & TEM-2010), Atomic force microscope, UV chamber, Thermography, BET Surface Area Analyzer, Quadruple Mass Spectrometer, High Pressure Hydrogen Sorption, Tubular and Muffle Furnace, Chemical Fume Hood, IVIS Lumina XR in vivo imager, Spinning disk and laser scanning confocal microscopes, Inverted and Upright fluorescent microscopes, Transmission light microscopes, Microplate readers with absorbance, luminescence and fluorescence reading capabilities, NanoVue and NanoDrop micro-volume spectrophotometers.



Semiconductor Devices and Microelectronics

Tuskegee University faculty are conducting research in advanced materials, composites and processing methodologies for microelectronics and semiconductor technology. These areas are of importance in many aspects of human life with applications ranging from energy devices, computers, mobile phones, consumer electronics, healthcare, industrial automation, and avionics among others. The research endeavors at Tuskegee University include:

- Semiconductor device fabrication technology
- Thin film synthesis and characterization
- Solar cell technology
- Micro-electro mechanical systems
- Micro- and nano-fabrication

These research endeavors have been funded by federal agencies including the National Science Foundation,

U.S. Army, Department of Defense, Department of Homeland Security and National Aeronautics and Space Administration.

Currently funded research activities are focused on:

- Development of Germanium photodetector devices
- Wearable energy devices (flexible solar cells and supercapacitors)
- Semiconductor thin film and device fabrication processes
- Micro- and nano-scale fluidic devices for chemical and biological sensing
- Mixed-Signal Application Specific Integrated Circuits for the Application of Flight Electronics
- Bio-electronics



The Microelectronics and Semiconductor Devices program at Tuskegee University continues to have considerable influence on education and outreach endeavors. This program has graduated several Ph.D. and M.S. students who have gone on to work in academia and industrial enterprises including Intel, Siemens, among others. Several undergraduate students have parlayed their research experience from this program into successful



graduate study and professional pursuits. Ever since its inception, this program has played an important role in terms of generating well-trained graduates and providing diversity to the nation's technological workforce involved in research and development.

Device / Thin film fabrication and processing:

Ultra-violet (UV) lithography mask aligner, sputtering depositions System, reactive ion etcher, spin-coater, Sonoplotter direct writing tool, wafer dicer, thermal oxidation furnace, diffusion and ion implantation furnaces, rapid thermal annealer

Device and thin film characterization:

Hall effect measurement system, surface contact profiler, probe station for current-voltage and capacitance measurement systems, semiconductor parameter analyzer, solar simulator, optical microscope

Device and process modeling and simulation:

COMSOL multiphysics modeling and simulation software suite, PSPICE electronic circuit simulation software, MATLAB for engineering analysis, NI/ LabVIEW

Veterinary Sciences



Faculty in the College of Veterinary Medicine, Nursing and Allied Health (CVMNAH) at Tuskegee University are engaged in various research projects mostly designed to promote the “One Medicine-One Health” framework that guides the college’s strategic research agenda from local, national and global perspectives. The current areas of research include: cancer, stem cell biology, obesity/diabetes, catfish diseases and vaccine development, HIV/AIDS, environmental and reproductive toxicology, computational epidemiology and risk analysis.

To ensure systematic, analytic and sustained exposure of students to a wide array of biomedical research, research activities are funded by the following federal agencies: National Institutes of Health, National Science Foundation, Department of Health and Human Services/ Human Resources Services Administration, Department of Homeland Security, U.S. Department of Agriculture (USDA) National Institute of Food and Agriculture, USDA Animal and Plant Health Inspection Service, and USDA Foreign Agricultural Service. Funding is also provided by private foundations. The annual Biomedical Medical Research Symposium provides a venue for the sharing of research within the university’s academic family. It also underscores the college’s overall strategy of advancing biomedical research through trans- disciplinary teams, creative partnerships and collaborations.

Current funded research is focusing on:

- Basic and applied cancer research utilizing a multi-pronged approach to understand the molecular mechanisms involved in tumor growth and metastasis as well as therapeutic approaches
- Research on biocompatible nano-materials for drug delivery, as well as molecular research on the potential of bioactive compounds to synergize with chemotherapeutic drugs and antibiotics
- Potential of spermatogonial stem cells in regenerative medicine at molecular level- focusing on delineating the mechanism(s) of differentiation of these cells
- Mechanisms of certain gastrointestinal peptides or hormones to determine roles in limiting meal size and regulating inter-meal interval (three gut peptides: cholecystokinin, PYY, and gastrin-releasing peptide); Immunochemical and PCR methods to identify and analyze the peripheral and central nerve sites and pathways mediating the satiating and satiety actions of these agents
- Research to develop an effective vaccine against HIV
- Other areas of infectious disease research include: molecular mechanisms of pathogenesis by food animal and catfish pathogens including transcriptional activation of genes for cytokines, other inflammatory mediators and development of attenuated mutant bacterial pathogens as vaccine candidates



The Center for Computational Epidemiology and Risk Analysis is developing models that can be used in epidemiologic problem-solving and in decision-making of animal and human diseases and risk associated with import of animals and animal/agricultural products.

Research in the Embryo Technology Laboratory focuses on the characterization of acetyl CoA carboxylase expression in oocytes to test the hypothesis: the treatment of oocytes with inhibitors of lipid uptake and synthesis reduces intracellular lipid content, and hence improves cryosurvival and subsequent development of the oocytes.

The Comparative Medicine Resources Center provides excellent biomedical research opportunities for studies requiring the use of laboratory animals, both regular and transgenic animals.

TU Outreach-Research Experience for High School Students

Tuskegee University faculty offer several outreach programs to involve high school students in their research. The Research Experience for High School Students program is designed to involve highly motivated 9th-12th graders from schools within and outside Alabama in the cutting-edge research that is carried out throughout the campus. The students conduct research under the direct supervision of faculty and their graduate students in the cutting edge areas of Science Technology, Engineering and Mathematics (STEM).

The broad goal of the program is to prepare and motivate high school students to pursue college studies leading to careers in STEM fields. Structured activities in this program include research, assistance with data analysis and technical writing, workshops on time management, critical thinking and SAT and ACT preparation and field trips to industrial sites.



TU-Outreach-Research Experience for K-12 Teachers

The Research Experience for Teachers (RET), offered at Tuskegee University through various grants and contracts, supports active involvement of K-12 teachers during the summer in various research laboratories. The teachers are provided with an intense and in-depth involvement in research designed to bring the knowledge of science, engineering and technology innovation into their classrooms. Teachers work with faculty in the research laboratories as a team to understand equipment usage and data analysis.

The overall goal of RET is to excite teachers about STEM research and allow them to take the excitement, teaching materials and modules, which they develop, back to the students. The long-term partnership that develops between the K-12 teachers and the university faculty leads to building the STEM pipeline which is essential for increasing the enrollment of minority students in STEM education at the college level.



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TUSKEGEE
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"Tuskegee University is accredited with the Southern Association of Colleges and Schools Commission on Colleges to award baccalaureate, master's, doctorate, and professional degrees. Contact the Commission on Colleges at 1866 Southern Lane, Decatur, Georgia 30033-4097 or call 404-679-4500 for questions about the accreditation of Tuskegee University."

