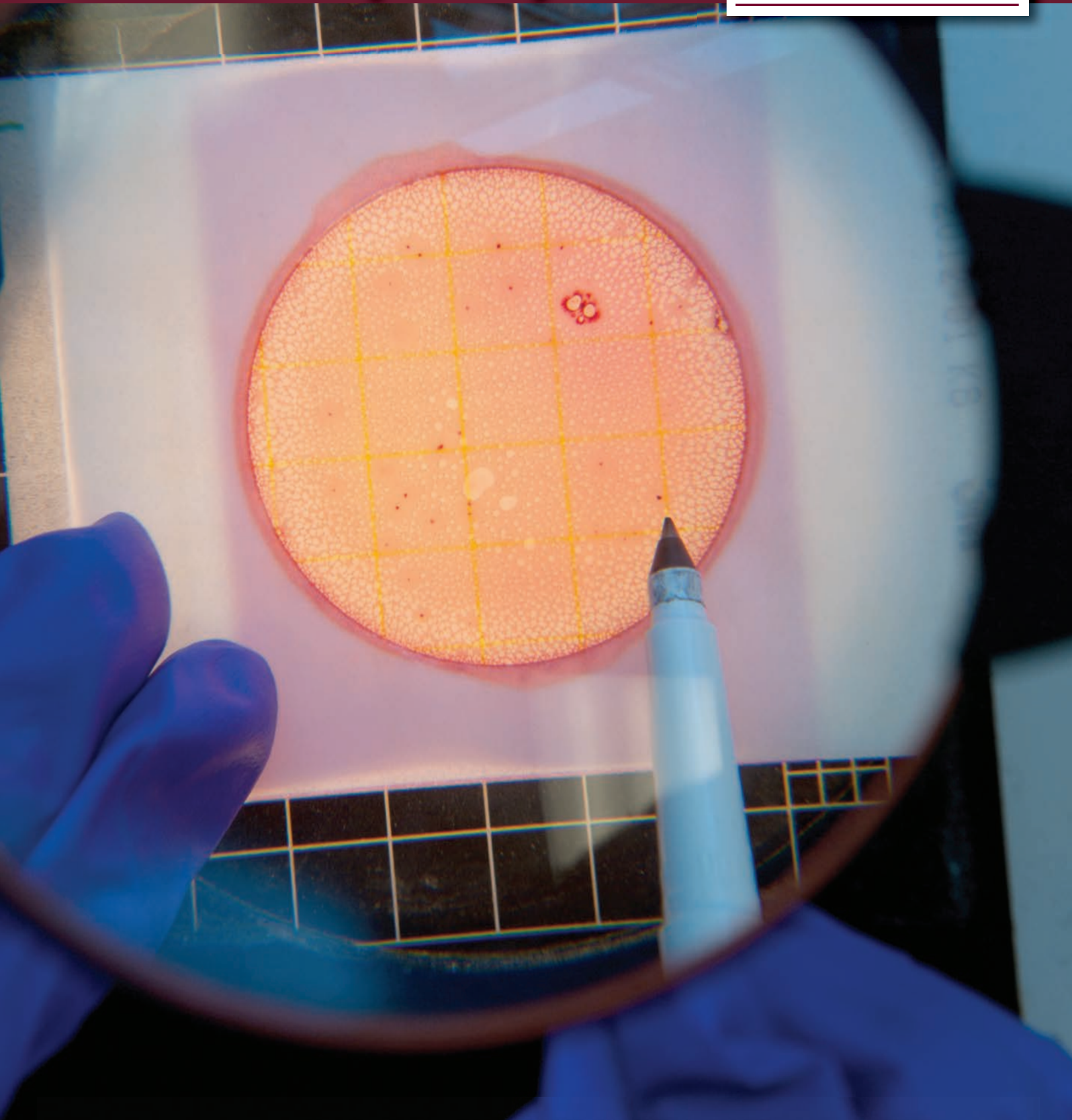


Research Capability



UNIVERSITY of MARYLAND
EASTERN SHORE



UNIVERSITY of MARYLAND EASTERN SHORE

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A Message from the Administration

As the state of Maryland's 1890 land-grant institution, the University of Maryland Eastern Shore's (UMES) research enterprise forms a critical component of its mission. This was recently emphasized by the creation of the Division of Research and Economic Development in response to the specific research goals outlined in the 2012-2016 UMES Strategic Plan. The division manages the research portfolio of the university, and its mission is to support and enhance an academic environment that promotes excellence in research, scholarship, and creative endeavors while optimizing economic development opportunities.

UMES is the doctoral degree-granting research university on the Eastern Shore of Maryland and a national model for producing globally competent citizenry in the 21st century. This research capability statement, therefore, provides information on some of the university's core research areas. Coming on the eve of the 125th anniversary of the signing of the second Morrill Act, this statement is symbolic in that it highlights the tremendous unique capabilities and potential that UMES has developed over the years. Furthermore, as a University System of Maryland institution, UMES engages with other system campuses and enjoys many partnerships and collaborative arrangements with other universities, the government, and external agencies and constituencies.

Within various academic units and centers, our faculty are engaged in diverse areas of cutting-edge research. Additionally, the recent accreditation of the Pharmacy and Engineering programs has further strengthened UMES' research profile, signaling the university's commitment to moving from excellence to eminence.

We are available to you and invite you to partner with us as we strive to create and apply solutions to the many challenges faced by our state, the nation, and the world.



Dr. Juliette B. Bell, Ph.D.
President



Ronald Nykiel, Ph.D.
Provost and Vice President
for Academic Affairs



G. Dale Wesson, Ph.D.
Vice President for Research
and Economic Development

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Biomedical Sciences

Many diseases that affect the general public are especially deadly among minority populations. The faculty in the School of Pharmacy at the University of Maryland Eastern Shore has been engaged in performing research on a number of such diseases and on existing health disparities based on race, socioeconomic status, sex, age, etc.

Faculty within the school have knowledge and expertise in a wide range of biomedical related topics, including molecular and cellular biology, immunology, physiology, medicinal chemistry, biochemistry, pharmacokinetics, nano-medicine, etc.



Research interests comprise infectious diseases, neurological disorders, cancer treatments, and more, with targeted interests centering on viral encephalitis, keratitis, epilepsy, prostate cancer, Alzheimer's disease, and mycobacterial infection.

Current Funded Grants:

Research activities within the school have been funded by federal agencies such as the National Eye Institute (NEI) and the National Institute of Neurological Disorders and Stroke

(NINDS) at NIH. In addition, faculty members have built research

collaborations with other universities such as Johns Hopkins, Louisiana State, Howard, Georgetown, the University of Toledo, and the University of Maryland at Baltimore to name a few.

Specialized Research Equipment:

The School of Pharmacy has state-of-the-art research equipment, which includes high resolution microscopy, the ChemiDoc Ultra High Sensitivity Image Capturing System, fluorescent inverted microscopy, real-time PCR, HPLC, a programmable thermal cycler, gel electrophoresis equipment for nucleic acid analysis, the 20/20 luminometer, the Nikon Eclipse Ti-E inverted fluorescent microscope with quantitative analysis software, a UV imaging station, refrigerated high-speed centrifuges, a Barnstead Max Q 4000 SHAKER 120V bacterial incubator, BSL-2 certified laminar flow biosafety cabinets, and a NanoVue UV spectrophotometer.

From Excellence to Eminence

Childhood Obesity



Reducing the Incidence of Childhood Obesity in Child Care Centers through the Promotion of Healthy Eating and Increased Physical Activity. *National Institute of Food and Agriculture*

Select Activities:

Development of replicable strategies for enhancing eating habits that promote health and prevent childhood obesity, especially among at-risk, minority preschoolers

Implementing replicable multi-level programming targeting childhood obesity prevention that will promote sustainable behavior changes in the school and home environments

Empowering Head Start staff to influence behavior through a healthful lifestyle educational program

Empowering parents to influence self-health and their children's health behaviors through a healthful lifestyle educational program

Establishing an education and communication system for personal protective technology

Creating best practices for promoting healthy eating and physical activity among young children in both child care centers and the home

Specialized Facilities:

Child and Family Development Center

The incidence of childhood obesity in the U.S. has more than tripled over the last 30 years. According to the National Center for Chronic Disease Prevention and Health Promotion, the prevalence of obesity among children ages 6 to 11 increased from 6.5% in 1980 to 19.6% in 2008. The prevalence of obesity among adolescents ages 12 to 19 increased from 5% to 18.1% during the same period of time.

Research by UMES scientists, therefore, addresses childhood obesity as one of the most pressing health issues affecting children today. Family-centered prevention programs are produced by the Expanded Food and Nutrition Education Program team at the university and implemented in the community Head Start Centers, where they affect preschool children, their families, and their caregivers and teachers. Along with developing a set of comprehensive experiential learning

strategies for promoting the inclusion of fruits and vegetables as an integral part of the daily diet of preschoolers and their families, physical activity is a part of the multi-level programming targeting prevention. Future research will target grade school, after school, and community-based programs.

Dietetics Facility:

Within the Department of Human Ecology, teaching and research efforts are focused on the basic sciences of nutrition and foods, dietetics, and child development as well as the application of knowledge in these disciplines to the health and wellbeing of human beings throughout the lifespan.

Current Funded Grants:

Head Start: Jump Start on Healthy Lifestyle Program in Somerset County, Maryland. *National Institute of Food and Agriculture*

From Excellence to Eminence

Commercial Food Product and Process Development

The emerging trend toward consuming locally produced food offers great opportunities for farmers and small processors on the Delmarva Peninsula. Fertile soil and mild climate conditions are favorable for the production of all kinds of fruits and vegetables. By virtue of its location between the Atlantic Ocean and the Chesapeake Bay, the Peninsula hosts a large number of seafood operations. Additionally, densely populated areas such as Washington D.C., Baltimore, Philadelphia, and New York form abundant markets that are situated in close proximity.

The UMES Food Science and Technology Program is uniquely positioned to address challenges that may impede farmers and small processors from being equal partners with larger players in the food and fiber market. The program uses its faculty expertise and suitable facilities to assist food processors, small producers, and entrepreneurs in developing products and processes for value added agriculture. Much is accomplished through delivery of food safety training and certification programs, expert food science consultation, the development of business start-up solutions, and original research. The approach is designed to meet the commercialization needs of small, rural farmers and producers seeking to take advantage of the movement toward eating locally

produced food products. Collaborations have been established with the Rural Development Center at UMES and the Small Business Development Center at Salisbury University to complement the activities of product and process development with business plan development, the sourcing of funding, and marketing.

Current projects include the Maryland Crabmeat Quality Program (MDCMQP), which supports the regional industry in developing and maintaining safe production environments and products. The development of Heirloom tomato juice products, one of which won the SofiTTM Finalist award at the 2013 Fancy Food Show in New York City, is another project conducted at UMES. Finally, UMES researchers are investigating how to best process the aronia berry to capture its abundance of antioxidants.

Current Funded Grants:

Heirloom Tomato Micro-Batch Plant Development. *Maryland Industrial Partnerships*
Scale-up process for Heirloom tomato juice and nectar. *Maryland Industrial Partnerships*
New thermal processing system for a small company. *Maryland Industrial Partnerships*



Specialized Facilities:

The Food Science and Technology Center is a state-of-the-art facility designed to fulfill the research, teaching, and outreach components of the land-grant mission. The 37,250 square foot facility contains processing rooms with select processing equipment such as kettles, heat processing equipment, packaging equipment, and walk-in refrigerators and freezers. In addition to the the processing rooms are laboratories designed for the quantification and identification of pathogenic and spoilage microorganisms, product testing and product development, food composition analysis, and for supporting research in food safety, food quality, process development and food handling and packaging.

From Excellence to Eminence

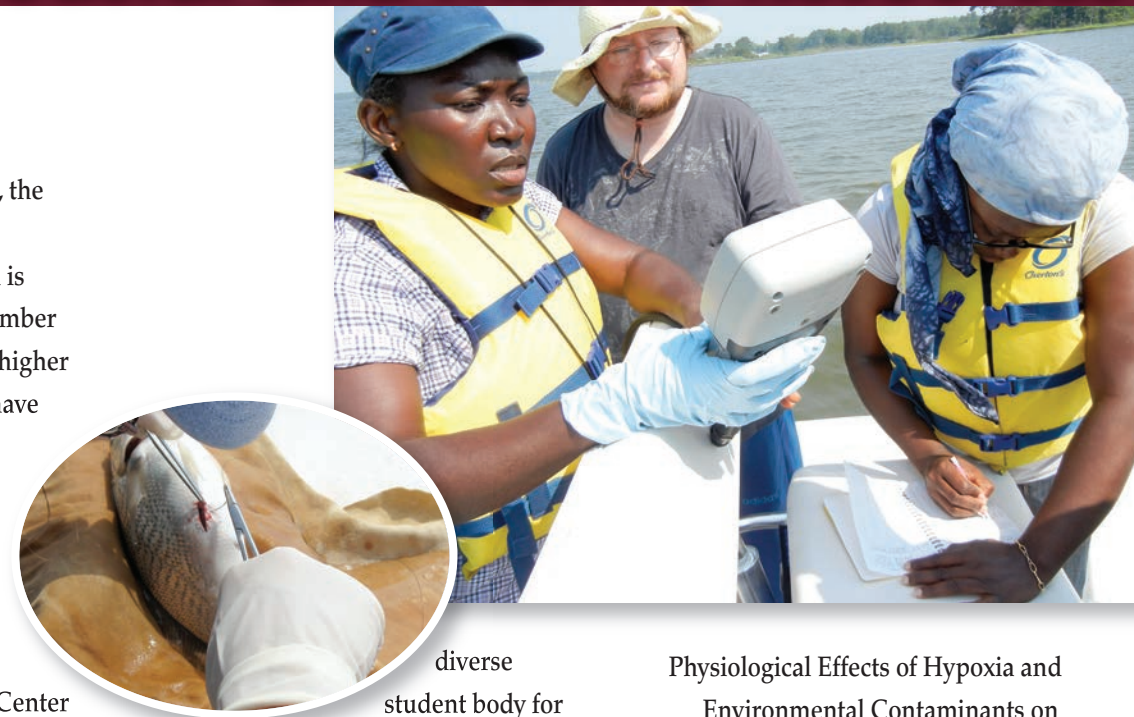
Conservation and Use of Coastal and Marine Resources

In a 2008 report to Congress, the U.S. secretaries of commerce and education reported that the nation is experiencing a shortage "in the number of people pursuing and obtaining higher education in fishery science who have the ability to conduct high quality research in fishery population dynamics, stock assessments, and related fields."

At UMES, the \$5 million Center for Research Excellence in Science and Technology (CREST)-Center for the Integrated Study of Coastal Ecosystem Processes (CISCEP) in the Mid-Atlantic region has been established, with UMES serving as the lead institution for the consortium that includes the Virginia Institute of Marine Science (VIMS), the Institute for Marine and Environmental Technology (IMET), and Morgan State University.

To help ensure another generation of marine scientists who are both well trained and reflective of America's diversity, the CREST Center provides training and financial support to graduate students, undergraduates, high school teachers, high school students, and postdoctoral fellows each year for five years.

Conversely, the mission of the Living Marine Resources Cooperative Science Center (LMRCSC) at UMES is to develop exemplary academic and research collaborations that prepare a



diverse student body for careers in marine and fisheries sciences. The LMRCSC, which provides a pipeline to careers in science, was established October 2001 as a result of a cooperative agreement between the NOAA Educational Partnership Program, the University of Maryland Eastern Shore as the lead institution, and six other universities.

Current Funded Grants:

Land Use and Climate Variability: Effects on Nutrient Dynamics in the Coastal Waters. *National Science Foundation*
Understanding the Dynamics of Phytoplankton and Macroalgae Species Including HABs in Maryland Coastal Bays. *National Science Foundation*
Dynamics of Zooplankton Community in Maryland Coastal Bays and Their Driving Mechanisms. *National Science Foundation*

Physiological Effects of Hypoxia and Environmental Contaminants on Atlantic Croaker in the Chesapeake and Coastal Bays. *National Science Foundation*

Select Activities:

Modeling and predicting the effects of land use and climate change on the mid-Atlantic coastal ecosystems
Improving infrastructure for research and education in marine and environmental sciences
Increasing public awareness of the interdependence of humans and the coastal environmental

Specialized Facilities:

The following centers provide state-of-the-art laboratories and equipment:
CREST Center for the Integrated Study of Coastal Ecosystem Processes
Living Marine Resources Cooperative Science Center Virtual Campus
Paul S. Sarbanes Coastal Ecology Center

From Excellence to Eminence

Economic Development, Trade, and Agricultural & Natural Resource Policy



Survey of Mennonite Farmers in Corozal, Belize



Surveying farmer at his farm in Belize

Current Funded Grants:

Factors Affecting Blue Crab Fishery in Maryland. *UMES Marine Estuarine Environmental Sciences (MEES) Program*
Agricultural Law Education Project. *State of Maryland*

Moving Integrated Pest Management in Maryland to Greater Economic and Ecological Sustainability. *National Institute of Food and Agriculture*
Documenting and Designing Integrated Pest Management Program for Underserved Communities: The Case of Maryland Eastern Shore and Delaware Small Farmers. *Northeastern Integrated Pest Management Center*

Enhancing the Viability of Underserved Small Farms and Rural Communities Using Emerging Network Science. *National Institute of Food and Agriculture, Capacity Building Grant*

Developing Ecological Pest Management Plans for Weed and Insect Pests of Leguminous and Solanaceous Vegetables. *National Institute of Food and Agriculture*

Select Activities:

Analyzing socio-economic factors affecting blue crab fisheries in Maryland
Studying agricultural law and its impact on Maryland farmers
Evaluating economic development of Maryland underserved communities
Analyzing market and enterprise budgets for ethnic vegetables in the U.S.
Analyzing demand and supply of agricultural produce in Ghana
Analyzing and enhancing agricultural extension service in Belize.
Strengthening the capacity of agricultural degree offerings at the University of Belize
Analyzing the contribution of the Congolese diaspora to the economic development of the Democratic Republic of Congo

Specialized Facilities

UMES is equipped with computer labs and econometric software package capability.

A country's standard of living depends on its ability to produce goods and services. Most variations in living standards are attributable to differences in productivity, which depends on each country's adoption of new technology, access to affordable education, and design of efficient policies, among other factors. While advanced economies, like the U.S., have made considerable progress, more is yet to be accomplished in developing economies such as Belize, the Democratic Republic of Congo, Ghana, etc., which are under tremendous pressure to catch up.

Economic development, nevertheless, brings challenges, including negative externalities (such as poor air quality, pollution, environmental degradation, etc.) and market failure that hinders the efficient operation of markets (i.e., poor conditions for private sector investment due to poor governance, lack of infrastructure, etc.) Such challenges must be addressed by researchers as well as policy makers. Otherwise, small businesses, including farmers and fishermen, will be affected by unfavorable policies within the already globally competitive environment in which they operate.

Research at UMES addresses these issues of economic development, trade, and agricultural and natural resource policies.

From Excellence to Eminence

Economic Policy and Financial Markets



Today's temperamental economic landscape is concerning, to say the least, leaving businesses and investors uncertain about the future. The role of financial markets and their bearing on economic policy is therefore paramount to the research focus of faculty within the Department of Business, Management and Accounting (DBMA).

The department is accredited by the Association to Advance Collegiate Schools of Business (AACSB), and many members of the faculty hold impressive academic credentials and strong industry backgrounds, including backgrounds as former managers and executives of various Fortune 500 companies. Conducting high-impact research by using state-of-the-art methods of analyses is fundamental to all members of the faculty.

Moreover, DBMA faculty members are regular contributors and serve as editors or referees of reputable peer-reviewed journals in the fields of finance,

accounting, economics, management, business education, and computer science. Consequently, faculty research has been cited in leading peer-reviewed journals, national and international conferences, and popular media outlets such as Bloomberg, the Washington Post and the Chicago Tribune. In addition to attending high-profile meetings and conferences hosted by prestigious organizations such as the World Bank, the International Monetary Fund (IMF), and the Federal Reserve Bank, DBMA faculty members are regular guest-speakers at various national and international conferences.

Research Areas:

- Spill-over effects of economic policy uncertainty on stock markets around the world
- Dynamic response of business and consumer confidence to monetary policy shock
- Impact of economic policy uncertainty on the U.S. housing sector
- Effects of policy uncertainty and macroeconomic dynamics on the U.S. unemployment conditions
- Dynamic effects of business and consumer confidence on stock market risk premiums
- Economic uncertainties and financial crises around the world
- Socially responsible investment strategies

- Earning management and asset prices
- Economic growth, regional savings and FDI in sub-Saharan Africa
- Macroeconomic volatility and macroeconomic indicators among Sub-Saharan African Economies
- Corporate profit growth, macroeconomic expectations and fiscal policy volatility
- Macroeconomic factors in entrepreneurial climates
- Experiential studies of financial literacy
- Currency exposure and the firm's performance
- Spillover effects of exchange rate volatility on stock markets around the world
- Modeling the impact of resource utilization on agricultural products and production
- Trade policies and import and export of agricultural products

Access to Key Databases:

DBMA faculty have access to the following key databases: Wharton Research Data Services (WRDS) Databases, Global Financial Data, Thomson Reuters Worldscope, IMF eLibrary Data, World Bank Open Data, FRED Database, Federal Reserve Economic Data (FRED), FIDC Bank Data, Eurostat, OECD StatExtracts, and UN Data Library.

From Excellence to Eminence

Engineering and Aviation Sciences



Research conducted within the Department of Engineering and Aviation Sciences is focused on the close interaction of humans and technology, addressing diverse areas ranging from unmanned aerial systems for precision agriculture to on-chip optical interconnected computer architectures.

UMES scientists are committed to developing optimally configured products that integrate mechanical design, instrumentation and data acquisition, control theory, soft computing, computer aided engineering, information technology, robotics, machine vision, and flexible automation. In addition, they are involved in fundamental research and education that will enable innovative processes for the sustainable production of electricity. Other research focuses on development of sustainable energy technologies, including biomass conversion, biofuels, and bioenergy; photovoltaic solar energy; wind energy; and advanced batteries for transportation. Human factors research addresses aerospace communication and data transfer between air traffic control facilities and aircraft crew members throughout all phases of flight.

Current Funded Grants:

BEAT (Bio-Energy Academy for Teachers) the Energy Crisis and Enhance BLT (Bio-Energy Literacy for Teachers). *National Institute of Food and Agriculture*

BioFuels, Sustainability, and Geospatial Information Technologies to Enhance the Experiential Learning Paradigm for the Precision Agriculture. *National Institute of Food and Agriculture*

Building a Vertically Integrated Multidisciplinary Team to Enhance Research and Extension Efforts in Precision Agriculture. *Maryland Space Grant Consortium/National Aeronautics and Space Administration*

Sparsity Aware Adaptive Radar Sensor Imaging in Complex Scattering Environments

MRI: Acquisition of an Acoustical Measurement System for Structural Health Monitoring Research and Teaching at the University of Maryland Eastern Shore

Air-propelled Instrumented Robotic Sensory Platform for Assateague Coastline Environmental Studies

Applied Research and Agricultural Field Experiments Utilizing Variable Rate Nitrogen Application, Remote and In Situ Sensing, and Drought Tolerant Corn Seeds

Signal Processing for Detection and Monitoring of Electrical Power Signals
REU Site: EXERCISE – Explore Emerging Computing in Science and Engineering

Select Activities:

Aerial imaging and remote sensing for precision agriculture and

environmental stewardship
Design and development of on-chip optical interconnected computer architectures for multicore and many core systems

Dynamics modeling and controls of nonlinear systems (aircraft, spacecraft, etc.)

Trajectory optimization and guidance (path planning using mobile robots, omni vehicles)

Optimal control theory and numerical simulation (feedback algorithms)
Verification and validation of model-based control (laboratory aspects)

Acoustical measurement system for structural health monitoring

Human factors research in aerospace communication and data transfer between air traffic control facilities and aircraft crew members throughout all phases of the flight

Asynchronous digital system design and analysis

Fault modeling and reliability analysis of systems realized with nanoscale technologies

Specialized Laboratories for:

Mechatronics and Automation, Design Computer and Simulation, Advanced Aviation Simulation, Air Traffic Control, Analog Circuitry, Digital Circuitry, Instrumentation and Control, Advanced Communication, Fluid and Thermal Systems.



Environmental Toxicology

Estuarine and Coastal Ocean Modeling

Chemical stressors such as tobacco, alcohol, gasoline, and a host of synthetic drugs are detrimental to the environment as well as to humans, triggering adverse health effects. For UMES researchers, toxicological research is focused on the evaluation and testing of harmful effects of chemical, physical, and biological agents on living organisms, mechanisms of toxicity, prevention of chemical induced diseases, risk assessment, and environmental protection through governmental regulations for the control and monitoring of hazardous chemicals. The toxicology research underpins a vibrant graduate program (M.S., Ph.D.) in toxicology whose goal is to increase the number of minorities with terminal degrees in this area

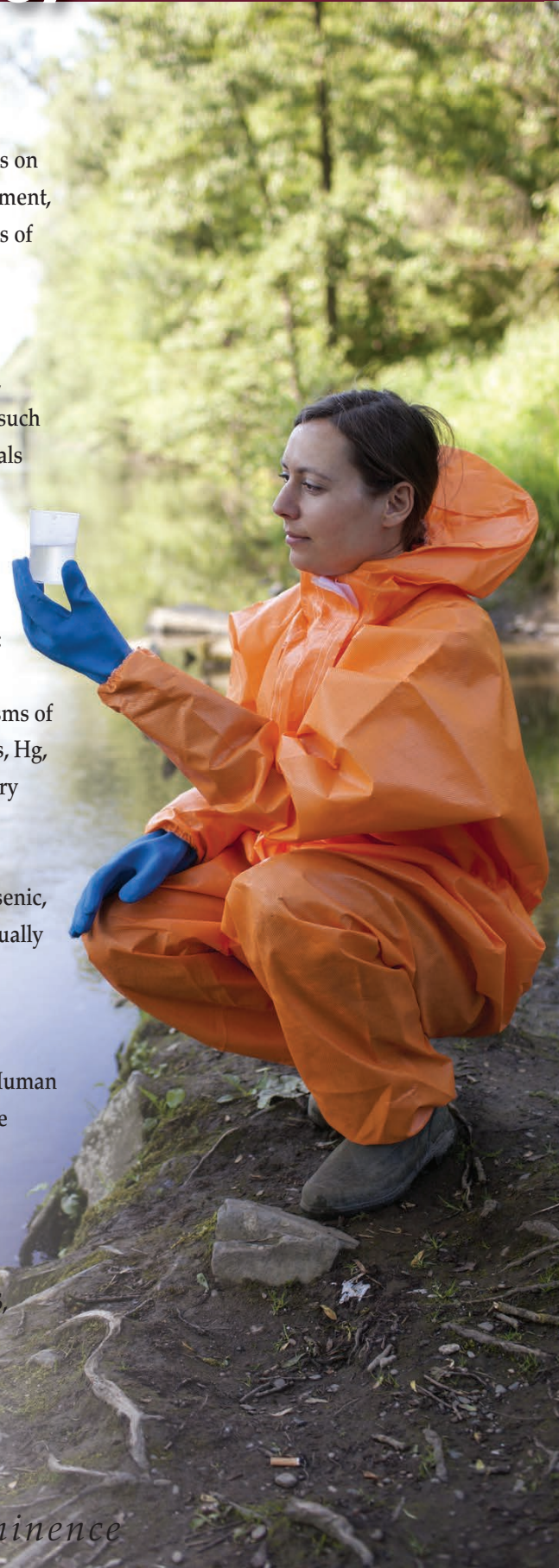
Select Activities:

- Impact of *Lactobacillus reuteri* strains with antioxidant supplementation on cancer cell proliferation and oxidative stress *in vitro*
- Mechanism of IL-6 Induction of T-type Calcium Channel Expression in Prostate Cancer Cells.
- Characterization of Enzymatic Activity of an Aconitase Orthologue from *Perkinsus marinus*.
- In vitro* Ramifications of Aluminum Laced Drinking Water: Involvement of Oxidative Burdens and Neurodegeneration in Human Neuroblastoma Cells

- Adverse impacts of toxic substances on human health and the environment, Deciphering the mechanistic details of genetic circuits and how their derailment by environmental carcinogens leads to cancer, mechanisms of carcinogenesis,
- The roles of environmental agents such as pesticides, particulates, metals and endocrine disrupters in human disease outcomes.
- Interactive Effects of Hormonally Active Agents on Expression of Estrogen Responsive Genes: Role in Carcinogenesis
- Oxidative stress pathway mechanisms of four cytotoxic heavy metals (As, Hg, Cd and Pb) and their quaternary mixtures on MCF7 breast cancer cells
- Genotoxicity Effect of Atrazine, Arsenic, Cadmium and Nitrate, Individually or in Mixtures at Maximum Contaminant Level on Breast Cell Lines
- Cytotoxic Effect of Naringenin in Human Breast Cancer Cells ER-Positive MCF-7 and ER-Negative MDA-MB-468

Specialized Facilities:

Laboratories equipped with GCMS, ICP-MS, HPLC, GC-ECD, Micro-injector, Ultracentrifuge, thermal cycler, RT-CES, RTC – DP, FACS and Micro Array.



Estuarine and coastal areas within the United States are among the world's most treasured natural resources. Environmental stewardship dictates that this generation manages and protects the nation's coastal resources on behalf of future generations.

Estuarine and coastal ocean modeling studies at UMES answer complexities specific to ocean engineers, environmental consultants, regulatory agencies, and anyone concerned with coastal and estuarine resource development and management.

UMES scientists are using numerical modeling (high resolution computer simulation) and observational data to understand estuarine and coastal ocean dynamics, such as the hypoxia dynamics, eutrophication, estuarine and coastal ocean circulation, and storm surge simulation.

Current Funded Grants:

- Development of a Model to Predict Short-Term Impacts of Climate Change on Delmarva's Coastal, Wetland and Upland Forests. *National Institute for Food and Agriculture*
- The Geophysical Survey at the Maryland Coastal Ocean. *Maryland Energy Administration (Subcontract from CBI)*
- The Effect of Climate Change to the Coastal Bay Dynamics. *Maryland Sea Grant*
- Impact of Wave on the Dynamics of a Coastal Plume. *National Sciences Foundation*
- Biophysical Model to Forecast Yellow Perch Recruitment Success in Lake Erie. *Great Lakes Fishery Commission*

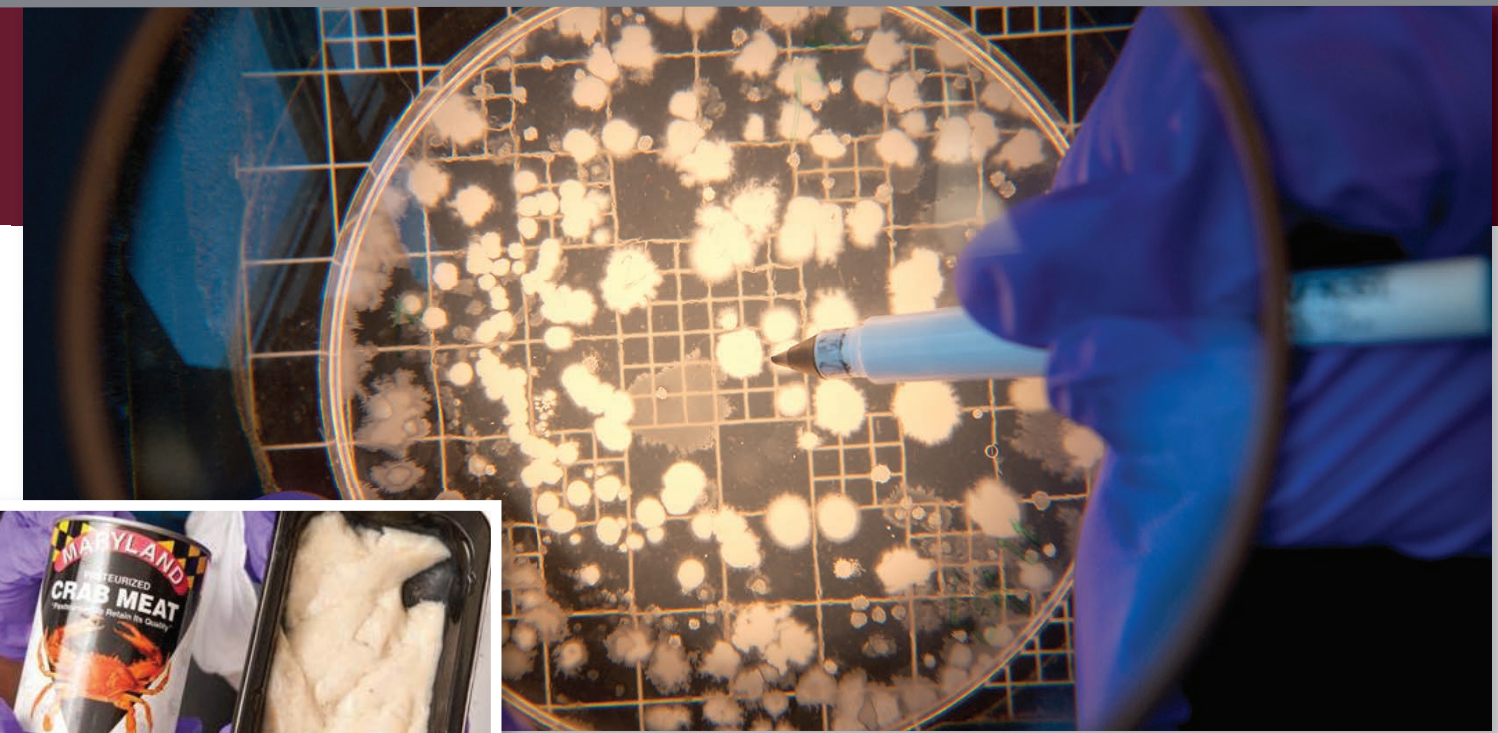
Select Activities:

Scientists and graduate students conduct basic and applied research on estuarine and coastal systems including: estuary circulation and plumes; hypoxia dynamics and eutrophication processes; impact of hurricanes on estuarine and coastal ocean; storm surge, waves, and tides; data assimilation; trajectory and dispersion modeling, larval transport, and fish recruitment modeling; watershed modeling; and high-performance computing and scientific visualization.

Special facilities:

- Estuarine and Coastal Ocean Modeling Laboratory
- Access to Supercomputer Resources

Food Safety



The Center for Disease Control estimates that 48 million people in 2011 fell ill and 3000 died from food-borne pathogens attached to produce, meat, and dairy products. The staggering numbers are alarming, and the impact on the nation's economy is also alarming, with estimates ranging from \$51 million to nearly \$78 million.

On the Delmarva Peninsula of Maryland, poultry production and processing and blue crab picking and

processing play a vital role in the economy. Research, teaching, and extension efforts at UMES therefore combine to ensure the safety and quality of foods important to the region.

Pathogens commonly studied in the labs include *Salmonella*, *Campylobacter*, *Listeria*, *Vibrio* and *E. coli*. Research projects are designed to better understand the growth, survival, or the death of these pathogens under various time, temperature, and other processing

conditions. Other projects conducted are designed to characterize antibiotic-resistant *Salmonella* spp. isolated from chicken carcasses and to reveal the mechanism of pathogen transmission and the location of pathogens on poultry carcasses during processing.

Very little is known concerning the seasonal distribution of *Vibrio parahaemolyticus*, a pathogen frequently associated with oysters and Chesapeake Bay seawater. Projects analyzing oyster

and water samples throughout the year are providing information necessary to ensure the safety of this important shellfish.

Likewise, UMES scientists are working to reduce food borne illnesses associated with fresh produce, which is a priority for the national food system. Food safety research projects aimed at addressing the need for foods that are wholesome is multi-institutional and trans-disciplinary in nature. They focus on the development and implementation of integrated teaching programs for students, on training for industry leaders, and on improving the food safety and biosecurity of agricultural crops, especially vegetables and fruits.

Current Funded Grants:

- Evaluation of Practical Post-Harvest Mitigation Strategies to Reduce the Abundance of *Vibrio* Bacteria in Molluscan Shellfish. *National Institute of Food and Agriculture Capacity Building Grant*
- Food Safety Risks for Leafy Greens and Tomatoes from Small Farm

Environments Exposed to Manure Dust, Soil Amendments, Insects, and Creek Water. *National Institute of Food and Agriculture*

Pathogen Testing Metrics for Gaps in Delmarva Leafy Greens-Fresh Produce and Poultry Litter Compost. *National Institute of Food and Agriculture*

Select Activities:

- Comparing field practice audit criteria or metrics as applied to produce and environmental samples from the Delmarva region
- Developing outreach and extension programs for control of Vv and Vp in postharvest oysters
- Providing outreach and technical training to growers and others in good agricultural practices related to the safe production of fresh market produce
- Evaluating pathogen reduction efficacy in minimally managed poultry litter composting

Specialized Facilities:

The Food Science and Technology Center is a state-of-the-art facility designed to fulfill the research, teaching, and outreach components of the land-grant mission. The 37,250 square foot facility contains laboratories for the quantification and identification of pathogenic and spoilage microorganisms; research in good preparation and handling, product testing, and product development/enhancement; food composition analysis and research in food safety, food quality, and product shelf life; process development and research in food handling and packaging; and isolation and characterization of microorganisms at the genetic level. An animal exhibition hall is also available for unloading, housing, and short-term maintenance of animals for use in teaching, research, and demonstration.

Geospatial Information Technologies

The UMES Geospatial Information Technologies (GeoTech) Laboratory was created in 1996 to provide students, faculty, and staff with opportunities to learn about and participate in one of the most rapidly growing technologies in the world. The GeoTech Lab is a university-wide facility designed to foster outreach projects with the community and provide training and out-of-classroom learning experiences for undergraduate and graduate students; faculty, staff, state and federal agency personnel; and other members of the community on the Eastern Shore.

The GeoTech Lab is an interdisciplinary center established to support research and teaching projects focused on nutrient management, precision agriculture, watershed management, and land use change.

Current Funded Grants:

Science and Technology Based Literacy Training Among Youth and Communities on Maryland's Eastern Shore. *National Institute of Food and Agriculture*

Development of a Model to Predict Short-Term Impacts of Climate Change on Delmarva's Coastal, Wetland and Upland Forests. *National Institute of Food and Agriculture*



Watershed Level Examination of Urea Use as Fertilizer and the Production of the Biotoxin Domoic Acid. *National Institute of Food and Agriculture, Capacity Building Grant*

Bio-Fuels, Sustainability, and Geospatial Information Technologies to Enhance Experiential Learning Paradigm for Precision Agriculture Project. *National Institute of Food and Agriculture*

Effects on Nutrient Dynamics in the Coastal Waters. *National Science Foundation*

Select Activities:

Land change on the Lower Eastern Shore Water quality and nutrient management in the Chesapeake and Coastal Bays Precision agriculture project to improve yield and reduce movement of harmful nutrients (phosphorus, nitrogen, arsenic, copper, lead, etc.) to surface waters and watersheds and eventually the Chesapeake Bay and its tributaries

Remote Sensing project to improve delivery of aerial imagery for precision agriculture using UAVs

(unmanned aerial vehicles) Nutrient management project using GIS to track and reduce the movement of phosphorus, nitrogen, arsenic, copper, lead, etc.) to surface waters due to overland flow and soil profile movement using traditional and new innovative methods of application of manures (liquid cow and dry poultry litter).

Improving GIS and STEM knowledge and interest in middle and high school students

Special facilities:

Faculty, staff, and students have access to the following: ESRI ArcGIS Software, including extensions, server technology, and online services; ERDAS IMAGINE Software (Image processing); Mobile Mapper Office (GPS Software); SMS Advanced Software (AgLeader-Precision Agriculture); GPS (Global Positioning Systems), with different accuracy and data logging capabilities: 12 Garmin ETrex, 5 Mobile Mapper Pros, 1 Mobile Mapper CX, 2 Mobile Mapper10; a wide format plotter; and a digitizer.

From Excellence to Eminence

Infectious Diseases



Infectious parasitic diseases continue to be a serious cause for mortality and morbidity across the world. These include tropical diseases that generally receive much attention, like malaria, as well as others that have ignominiously received less attention, like leishmaniasis. The inattention to some of these diseases has earned them the title – neglected tropical diseases.

In addition to malaria, scientists at UMES are researching several neglected tropical diseases, including leishmaniasis and schistosomiasis. UMES scientists are also studying other model systems such as the dinoflagellate parasite *Hematodinium perezi*, an important disease agent in blue crabs and other crustaceans, and *Perkinsus marinus*, the causative agent of Dermo disease in oysters.

Overall, UMES research in the area of infectious disease focuses on

understanding aspects of both vector and parasite biology. This includes aspects such as the ecology of disease transmission, host-parasite interactions, parasite metabolism and gene expression, and vector biology and population dynamics.

Current Funded Grants:

Effects of Environmental Factors on Blue Crab (*C. sapidus*) and its Relation to Infection by *Hematodinium* sp. *National Science Foundation*

Dinoflagellate Community Structure Within a Maryland Coastal Bay Ecosystem. *National Oceanic and Atmospheric Administration*

Colonization of *Phlebotomus orientalis* in Kenya. *World Health Organization*

Select Activities:

Evaluation of the impact of feedthrough insecticides on the transmission of

Leshmania donovani in Birhar, India Colonization and studies on the breeding sites of sand fly vectors of visceral leishmaniasis in India Development of an Early Warning System for the epidemic of visceral leishmaniasis in Sudan and South Sudan

Genetic differentiation of *Anopheles arabiensis*, a major vector of malaria in East Africa Validation of Gene Products Detected in the *Anopheles Gambiae* Brain Proteome

Specialized facilities:

UMES has specialized research laboratories for molecular studies on disease vectors and parasites. In addition, scientists at UMES are working in collaboration with scientists at other institutions to conduct whole mosquito proteogenomic studies using High Resolution Mass Spectrometry analyses.

From Excellence to Eminence

International Development



The first commercially produced tissue cultured cassava at Ekona, Cameroon.

Over the past four decades, UMES has provided expertise to limited resource communities in many developing countries. The university has positioned itself for participation in international projects, carefully developing the faculty and staff expertise needed to negotiate complex activities associated with projects in developing nations. Africa has remained the main geographic focus of UMES' international activities.

UMES has extensive experience in project design, implementation, and/or evaluation of institutional development programs in Cameroun, Egypt, Ghana, Kenya, Namibia, Sudan, Zambia,

Zimbabwe, Burkina Faso, Senegal, and Liberia as well as Jamaica and Barbados. UMES is now expanding and building partnerships in other parts of the world, including Brazil, China, and the Caribbean, to name a few.

Current Funded Grants:

Africa Emergency Locust/Grasshopper Assistance (AELGA) Project. *United States Agency for International Development*

Mega PASA-Africa. *United States Agency for International Development*

Urban Disaster Mitigation. *United States Agency for International Development*

Select Activities:

Application of biotechnology in rapid multiplication of clean and uniform planting materials, especially for root and tuber crops (cassava, yams, cocoyams and sweet potatoes)

Agricultural demand-driven technology development, transfer and commercialization

Formation and development of producer/commodity organizations of small rural enterprises

Technical agriculture (crop, soils, animals, and aquacultural sciences) and production systems development

Production support and financial services for rural enterprises

Develop safe and effective means of controlling emergency trans-boundary outbreak pests

From Excellence to Eminence

Mathematics and Computer Science



Minorities and women continue to be underrepresented within the STEM (science, technology, engineering, and mathematics) disciplines.

Accordingly, the Department of Mathematics and Computer Science faculty work to impact the numbers of minorities and women enrolling in and graduating from the STEM disciplines and other interdisciplinary fields: parallel processing, artificial intelligence/machine learning, numerical methods, mobile robotics, mobile applications, actuarial science, network security, algebra, data mining, logic,

topology/algebraic topology, applied mathematics/physics, statistics, and mathematics education.

Current Funded Grants:

National Science Foundation (NSF)

Historically Black Colleges and Universities Undergraduate Program (HBCU-UP) Program

Select Activities:

Enhancing existing curriculum with co-curricular faculty/student research projects

Creating awareness and stimulating

interests in further graduate study or appropriate employment in the STEM market

Increasing the participation of African Americans in computer science with particular interest in robotics

Assisting students in learning about the multi-processing environment and provide skills for further research in parallel processing

Enabling students to complete their academic work as well as research efforts

Providing resources for students in advanced computer science courses

Utilizing advanced software packages for modeling, simulation, and computational research activities such as MatLab, Mathematica, SAS, SAS Miner, and Scientific Workplace

Specialized facilities:

Advanced 20-seat computer laboratory designed to provide resources for students in advanced computer science courses. The lab provides computers with multiple operating systems, computational software, and more.

Programming Laboratory – a high-quality laboratory with 25 16GB Intel I-7 processor computers. Fundamental programming courses are taught in the lab and students receive instructor-led training.

From Excellence to Eminence

Poultry Research and Education



Poultry is the largest agricultural enterprise in Maryland. Research related to the poultry industry, therefore, forms an integral part of UMES' food and agriculture mission.

For many years, UMES faculty have carried out a broad range of research that is germane to the industry. Food safety, meat quality, and processing issues warrant on-going research. Food safety research is specifically focused on the prevalence, sources, and control of *Salmonella* in poultry. Other research focuses on ways to minimize major quality defects in chicken breast meat such as PSE (pale, soft, exudative) and hard breast and on improving the bio-accessibility of antioxidants in corn DDGS (dried distillers grain with solubles) in order to enhance the health of the broiler and its meat quality.

UMES scientists are also researching technologies to prevent the leaching of nutrients from poultry litter, especially nitrogen, arsenic, and phosphorus, into the Chesapeake Bay, the largest estuary in the United States. Finally, research related to applied poultry production with an emphasis on developing strategies for reducing the impact of broiler production on the environment, best management practices of broiler systems, broiler nutrition, and alternative energy for broiler farms is being conducted on behalf of the industry.

Current Funded Grants:

Watershed Level Examination of Urea Use as Fertilizer and the Production of the Biotxin Domoic Acid. *National Institute of Food and Agriculture*

Evaluation of a Wood Furnace System as an Alternative Heat for a Broiler Farm. *University of Maryland Extension*

Developing And Evaluating An Innovative Litter Amendment Application System For Poultry Operations. (U of DE, Lead Institution). *Agriculture and Food Research Initiative*

Radiant and Manure Building Heat System for Ammonia Control. *Mtech: Maryland Industrial Partnerships*

Specialized Facilities:

UMES Poultry Research Center

From Excellence to Eminence

Precision Agriculture



Increasing food production to meet the demands of a growing population will require greater expansion and intensification of agriculture. At the same time, it will be critical to ensure that increased food production does not negatively impact on the environment. This is particularly critical in environmentally sensitive areas such as the Chesapeake watershed. Thus, a gubernatorial mandate concerned with the restoration of the Chesapeake Bay, the largest estuary in the United States, includes recommendations for implementing precision agricultural practices for effective nutrient management on at least 100,000 acres of land in the state of Maryland in the coming years.

Precision agriculture is a knowledge-based system that enables farmers to apply precise amounts of fertilizers, pesticides, seeds, and other agricultural resources to specific areas where and when needed for optimal crop growth. Support from the USDA has established the basic foundation for precision agriculture related infrastructure at UMES. The infrastructure has in turn provided a launching pad for several related endeavors, including the Aerial Imaging and Remote Sensing for Precision Agriculture and Environmental Stewardship Project. The project integrates many advanced engineering

technologies, including GPS receivers; GIS data bases; grid soil sampling; variable-rate application equipment for seed, fertilizers, and pesticides; irrigation; yield monitors; sensors for detecting soil fertility and weed populations; and remote sensing imagery.

In the course of scientific discovery, UMES scientists are providing active learning and research opportunities for the next generation of scientists through experiential learning projects and summer internships at UMES and at the USDA in the field of precision agriculture.

Current Funded Grants:

AIRSPACES2 (Aerial Imaging and Remote Sensing for Precision Agriculture and Environmental Stewardship). *Maryland Space Grant Consortium/National Aeronautics and Space Administration*

Applied Research and Field Experiments Utilizing Variable Rate Nitrogen Application, Remote and In Situ Sensing and Drought Tolerant Corn Seeds. *National Institute of Food and Agriculture*

Biofuels, Sustainability, and Geospatial Information Technologies to Enhance Experimental Learning Paradigm for Precision Agriculture. *National Institute of Food and Agriculture*

Building a Vertically Integrated Multidisciplinary Team to Enhance Research and Extension Efforts in Precision Agriculture. *Maryland Space*

Grant Consortium/National Aeronautics and Space Administration

Environmentally Conscious Precision Agriculture: A Platform for Active Learning and Community Engagement. *National Institute of Food and Agriculture*

Select Activities:

Integration of advanced technologies in agricultural practices with a view to improve productivity with emphasis on research, education, and outreach
Environmental stewardship and remote observation and analysis
Development and delivery of a multidisciplinary team-taught course in Environmentally Conscious Precision Agriculture (ECPA)

Development of infrastructure through acquisition of scientific instrumentation and systems as well as providing active learning and research opportunities through experiential learning projects and summer internships in precision agriculture

Outreach to local farmers to promote environmentally friendly agricultural practices through the gradual adoption of site-specific farming practices

Integration of outreach to K-12 institutions to promote the appropriate image of agriculture

Specialized Facilities:

Equipped Research Farm
Engineering Laboratory

From Excellence to Eminence

Renewable Energy

A seemingly endless amount of opportunities for energy efficiency use exists worldwide. Besides the obvious, the rising prices of petroleum, electricity, and water and the current population explosion beg the nation and the world to search out alternative and renewable sources of energy.

Renewable energy research at UMES has the potential to substantially impact fuel production in the state and eventually in the nation. The ultimate goal of the research is to perfect the ability to produce bio-fuel from waste products such as used cooking oil or from biomass such as algae and switchgrass. The use of plant species for biofuel production will contribute to a more lasting solution to reducing the region's and the nation's energy dependence on extremely uncertain sources, while introducing suitable genotypes of crop plants to the Delmarva region; not only for the fuel production potential, but also for the positive socio-economic impact it will have on Delmarva's farmers and on the enhancement of soil and environmental health. The crops selected for one part of the research can be grown locally.

Overall, UMES scientists are committed to strengthening the nation's education and science curricula as it relates to renewable energy and particularly as it relates to the newly emerging bioeconomy.

Current Funded Grants:

Characterizing Certain Grass Plants and Forage Soybean Genotypes as Sources of Biofuel and Their Potential for Phosphorus Hyperaccumulation. *National Institute of Food and Agriculture*

Diverse Grass Species as Potential Sources of Biofuel, Phosphorus Hyperaccumulation, and their Impacts on Soil Organic Matter Dynamics. *National Institute of Food and Agriculture*

Select Activities:

Identifying grass genotypes that are non-food sources for high potential alcohol production

Conducting multilocational trials to determine genotype adaptation

Analyzing plant genotypes for biofuel yield relative to soil, carbon, nitrogen, and phosphorus dynamics

Microbial activities



From Excellence to Eminence

Rural Development



The UMES Rural Development Center (RDC) services nine Eastern Shore counties, with emphasis on the four lower shore counties to include Somerset, Wicomico, Worcester, and Dorchester. It provides financial and technical information for business startup and expansion projects, develops county and regional marketing materials, supports regional tourism cooperation and resource-sharing among counties, assists counties in promotional efforts to attract new business to the area, and supports studies in select industries. The RDC collaborates with local higher education institutions, governments, and the private sector to accomplish its mission.

Touted as a model program, the RDC was established in 1990 and is currently responsible for funneling more than \$2 million dollars to over 220 local economic development projects, thereby leveraging some \$25 million in investments. In 2007, the center received the C. Peter Magrath/W.K. Kellogg Foundation Engagement Award from the National Association of State Universities and Land-Grant Colleges for its FARMS® Project. The award is reserved for "institutions that have redesigned their teaching, research, extension, and service functions to become more productively involved with their communities."

Economic Development Activities:

Providing Connectivity. UMES has been a long term advocate and participant in efforts to enhance network access in the region. Past efforts include completing the original ShoreNet Study that pointed out the need for enhanced

access for high speed networking on the rural Eastern Shore, providing seed funding for the Maryland Broadband Cooperative through the RDC, and working with Bloo-surf LLC to revitalize the Lower Shore Broadband Coop-erative.

Bolstering Technology. Hardwire LLC, located in Pocomoke City, was twice a borrower of the RDC. The private company, a manufacturer of primary metal products, was established in 2003 and has used RDC funding to move through two development and expansion phases. It is responsible for a Humvee prototype that is designed to protect American troops from homemade bombs used in Iraq and Afghanistan. The technology is currently being tested by Pentagon officials.

Local Economic Impact. The Burley Oak Brewing Company, also an RDC borrower, is part of the positive economic growth happening on Main Street in Berlin, Maryland, according to Governor Martin O'Malley. The company once manufactured wooden barrels used to ship local produce and seafood in the early 1900s. Today, the barrels will be used in manufacturing beer. The company, which currently employs four to six employees, plans to expand its employee base to 15 over the next couple of years. The RDC also funded a business expansion for The Evolution Brewery, a small batch brewery located in Salisbury, Md. Both breweries use local agricultural crops.

Promoting Economic Development. Maryland Capital Enterprises and the Maryland Hawk Corp. are both business incubator projects on

Maryland's Eastern Shore that received seed funding from the university to promote economic development.

International Reach. Through its Maryland Hawk Corporation and the Hawk Children's Fund, the RDC has won a Palmer Foundation Grant that will fund the development of water, sanitation, and health initiatives at the Bunabumali Orphanage in Eastern, Uganda. The Hawk Children's Fund, in partnering with the non-profit One School at a Time, has successfully raised \$12,000 for the Kyamulinga School Project, which resulted in the construction of a school in the Kyamulinga Village in Uganda.

Preserving Local Industries. The Hooper's Island Oyster Aquaculture Company is the first of its kind to set up shop in the state of Maryland. Owners Johnny Shockley and Ricky Fitzhugh raise oysters to sell in a market that's prime for shellfish farming. The RDC settled a \$55K loan for the firm, which was used to recondition a 36' boat specifically designed to do oyster aquaculture. More specifically, the company will harvest its branded Chesapeake Gold Oysters year-round.

Contributing to the Eastern Shore Community. Hot Spot Cool Eats, financed in part by the RDC, is situated on Rt. 50 in Dorchester County, Maryland, where droves of potential customers are sure to see it. The food service operation offers premium, real soft serve ice cream; gourmet hot dogs; boardwalk fries; and beverages at reasonable prices. Business owner Eric Ploeg "intends to become an important contributor to the Eastern Shore community."

From Excellence to Eminence

Small Ruminants

The production of small ruminants, especially goats and sheep, to fulfill the needs of niche markets is becoming an increasingly important economic activity in the U.S. Grazing small ruminants are regularly exposed to internal parasites and are therefore generally very susceptible to infection by parasites.

The UMES Small Ruminant Program is focused on research and adoption of practices and technologies that enhance the management of small ruminant farms in Maryland. It also involves the development of educational programs about small ruminant husbandry for sheep and goat producers as well as youth and professional agriculturists (land-grant extension educators, subject matter experts at governmental agencies, and non-profit technical advisors).

In addition, the extension program aims at establishing links between local production, marketing, and the utilization of meat and meat products from small ruminant species, recognizing that the demand for and utilization of lamb and chevon will promote the survival of the family farm and enhance food security in the region.

Current Funded Grants:

Impact of Possible Natural Anthelmintics on Meat Quality in Sheep and Goats. *National Institute of Food and Agriculture*

Select Activities:

Addressing internal parasites affecting sheep and goats
 Conducting estrus synchronization and breeding during the anestrus phase of the reproductive cycle
 Using sheep and goats to manage unwanted vegetation

Specialized Facilities:

An experimental sheep flock of Katahdin and Dorper breeds and a meat goat herd of Kiko, Boer, and Spanish breeds.
 Adequate farm support infrastructure, including buildings, pasture, and laboratory facilities.



Sustainable Food Production and Security



With the challenge of a growing population, predicted to reach some 9 billion people by 2050, the need to develop sustainable food systems has never been more urgent. Agricultural scientists and engineers are charged with developing new technologies aimed at fulfilling the demand for more and more nutritious food. Research initiatives at UMES address ways to fulfill the important need of developing alternative crops for sustainable crop production.

Parallel to studies on sustainable food production are studies that address the global need for performance-based protective clothing for workers who come into direct dermal contact with substances that are potentially harmful to the body. Award-winning research in protective clothing for pesticide applicators is the basis of a comprehensive database that includes data for more than 130 fabrics that were evaluated at UMES as well as the basis of

the many efforts trained on the standardization of test methods, the development of performance specifications, and studies related to the development and evaluation of personal protective equipment for hot climates.

Current Funded Grants:

Enhancing Cowpea Production in Delmarva Region to Increase Bio-Diversity and Food Security. *National Institute of Food and Agriculture*
 Integrating Specialty Crops in Organic Culture on Delmarva. *National Institute of Food and Agriculture*

Enhancing Utilization of Watermelon as Juice and Agricultural Wine. *National Institute of Food and Agriculture*
 NC170: Personal Protective Technologies for Current and Emerging Occupational Hazards. *National Institute of Food and Agriculture*

Select Activities:

Exploring cowpea as an additional crop in the Delmarva agrosystems
 Testing the production of specialty crops in compost and other organic media
 Processing watermelons that are not normally picked for commercial use as juice and agricultural wine
 Studying drought tolerant crops
 Identifying optimum and safe practices for growing specialty crops such as vegetables, fruits, herbs, and spices under conditions such as organic culture
 Searching out alternative uses for watermelon in a geographical area where they rank as using the second largest amount of harvested acreage in the state of Maryland

Water and Environmental Quality

The impact of agricultural practices on the water quality of drainage ditches and the receiving waters of the largest estuary in the United States, the Chesapeake Bay, is of the utmost importance to residents of the region. Collaborative work between Agricultural Research Service (ARS) scientists from the U.S. Department of Agriculture and UMES scientists has facilitated sophisticated assessment systems that examine surface runoff, subsurface and lateral movement, and intrusion of water containing various chemical elements into wells. Projects are designed to improve the health of the Chesapeake Bay, while simultaneously supporting crop and poultry production sustainability.

From the collaboration, two new technologies have emerged: inserting dry poultry manure below the soil surface using a technology referred to as “the Subsurfer” and the instillation of gypsum curtains, which block the movement of phosphorus from reaching ditches or receiving waters. The Subsurfer, which inserts manure below the surface of the ground, eliminates 90% of the phosphorus movement into drainage ditches; increases plant uptake of nutrients (P, N) in the plant root zone, which increases corn yields as much as 30% on Delmarva soils; and holds

promise for reducing the amount of fertilizer required to produce major crops grown in the region. Both technologies were developed in collaboration with three ARS units (at Arkansas, Alabama, and Pennsylvania) and tested at UMES and other schools of the southeast region.

Current Funded Grants:

- Development of a Dry Poultry Litter Incorporation Technology to Protect Air and Water Quality. *National Institute of Food and Agriculture*
- Dry Poultry Litter Incorporation into No Till Soils to Minimize Trace Elements and Nutrient Movement to the Chesapeake Bay. *National Institute of Food and Agriculture*
- Development and Implementation of a Multimicrobial and Multifunctional Inoculant for Enhancing Soybean Productivity and Environmental . . . *National Institute of Food and Agriculture*

Select Activities:

- Testing the feasibility of the subsurface application of dry poultry litter to soils on Delmarva and pioneering its introduction to the Chesapeake Bay watershed.
- Refining a second generation subsurface application technology and the



applicator, namely the Subsurfer. Creating faculty expertise in odor science and developing associated teaching curricula. Examining the effect of manure injection on ammonia volatilization reduction, reduced odor emissions, and improved crop yields. Introducing proposed inoculant to the soybean farming to enhance soybean productivity and improve environmental quality.

Specialized Facilities:

UMES Research & Teaching Farm

Contact Information

Dr. Juliette B. Bell, Ph.D.

President

J.T. Williams Hall, Suite 2107
Phone: 410-651-6101
Email: jbbell@umes.edu

Ronald A. Nykiel, Ph.D.

Provost & Vice President for Academic Affairs

J.T. Williams Hall
Phone: 410-651-6508
Email: rnykiel@umes.edu

Kimberly Dumpson, Esquire

Executive Vice President

J.T. Williams Hall, Suite 2116
Phone: 410-651-7686
Email: kdumpson@umes.edu

Ronnie E. Holden, Ed.D

Vice President for Administrative Affairs

J.T. Williams Hall, Suite 1106
Phone: 410-651-6230
Email: reholden@umes.edu

Anthony L. Jenkins, Ph.D.

Vice President for Student Affairs and Enrollment Management

Student Services Center, Suite 2169
Phone: 410-651-7838
Email: aljenkins@umes.edu

Stephen L. McDaniel

Interim Vice President for Institutional Advancement

J.T. Williams Hall, Suite 2104
Phone: 410-651-7789
Email: slmcdaniel@umes.edu

G. Dale Wesson, Ph.D.

Vice President for Research and Economic Development

J.T. Williams Hall, Room 1101
Phone: 410-651-8371
Email: gdwesson@umes.edu

Ayodele J. Alade, Ph.D.

Dean, School of Business and Technology

Kiah Hall, Suite 1111/1113
Phone: 410-651-6067
Email: ajadale@umes.edu

Ellis Beteck, Ph.D.

Dean, Library Services

Frederick Douglass Library
Phone: 410-651-6621
Email: ebbeteck@umes.edu

Nicholas Blanchard, Pharm.D.

Dean, School of Pharmacy and Health Professions

Somerset Hall, Room 122
Phone: 410-651-8327
Email: nrblanchard@umes.edu

Ray J. Davis, Ph.D.

Dean, School of the Arts and Professions

Richard F. Hazel Hall, Suite
Phone: 410-651-6083
Email: rjdavis@umes.edu

Moses T. Kairo, Ph.D., DIC

Dean, School of Agricultural and Natural Sciences

Director, Agricultural Experiment Station
Richard F. Hazel Hall, Suite 3055
Phone: 410-651-6072
Email: mkairo@umes.edu

Jennifer Keane-Dawes, Ph.D.

Dean, School of Graduate Studies

Child Development Center, Room 1137
Phone: 410-651-6507
Email: jmkeanedawes@umes.edu



UNIVERSITY of MARYLAND
EASTERN SHORE

Hazel Hall, Room 3044
Princess Anne, Maryland 21853



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For more information about research at the University of Maryland Eastern Shore,
visit our website:

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