Delaware State University
Capability Statement
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OVERVIEW
Delaware State University (DSU) is an Historically-Black, 1890 Land Grant, Carnegie classified R2 university with a strong and growing research portfolio. It is the second largest research university in the state (after University of Delaware) with a diverse population of about 6,400 students and a growing population of about 800 graduate students. Since 2016, DSU has strategically invested in interdisciplinary research areas including neuroscience, biomedical sciences, AI and data science, optics, chemistry, public and community health, and behavioral sciences, with research activity integrated directly into undergraduate and graduate education. DSU has the characteristics of an "Institution of Emerging Research Excellence". Over the previous 10 years from 2015 - 2024, DSU's total research expenditures have increased 3-fold from about $16 million in 2015 to almost $44 million in 2024, as the institution transforms from a teaching institution to one focused on integrating research and teaching. The University's strategic plan emphasizes achieving excellence in undergraduate education, offering an array of top-quality master's and doctoral degree programs, becoming nationally recognized for the research and scholarship of its faculty, and starting on a path to becoming a Carnegie-classified Research 1 university.

WORKFORCE TRAINING
DSU offers nine associate degree programs, 46 undergraduate degree programs, 26 master's degree programs and seven doctoral degree programs. Signature programs include DSU's Aviation Program which prepares students for careers in the aviation industry with a Bachelor of Science degree with concentrations in Aviation Management, Professional Pilot or Professional Helicopter Pilot. DSU is the only HBCU to offer PhDs in Neuroscience and in Optical Science, and the only institution in Delaware to offer an MS degree in Occupational Therapy.

RESEARCH CAPABILITIES
DSU has significant capability in numerous signature research areas.
Optics/Biophotonics
- Laser-based detection of nuclear & environmental materials
- Ultra-high precision sensing of isotopic signatures
- Nanoparticles & biomacromolecules in biopolymeric systems

Quantum Sensing
- Cold-atom-based systems & quantum entanglement in magnetometry, accelerometers & atomic clocks
- Nitrogen vacancy in diamond solid-state quantum sensors

AI and Machine Learning
- Medical Image Analysis and Machine Learning Methods
- Computational protein biochemistry
- Automated cell segmentation
- Phytochemical applications and discovery

Material Science
- Nanoporous and microporous polymer systems for gas capture and storage
- Thin films for uncooled infrared detection
- Carbon-Carbon Composites for Thermal Management

Neuroscience

- Neurodegeneration & neuroprotection in animal models of Alzheimer's disease, Parkinson's disease, Spinal Muscular Atrophy, ALS and FTD
- Role of astrocytes in synaptic regulation

Agricultural genetics and genomics
- Pathogen detection in food & environment
- Genetic mapping & improvement of blueberries
- Transgenic plants for production of biofuels & medicines
- Engineered microalgae
- Genetic mapping of sugar maple

Chesapeake Bay Fishery Restoration
- Atlantic sturgeon telemetry & restoration
- American eel telemetry & restoration
- Shellfish aquaculture
- Bycatch reduction

Health Disparities
- Sleep disparities and health
- Disparities in gestational diabetes
- Biology of disparities in triple-negative breast cancer

FACILITIES & INSTRUMENTATION

The Delaware Institute of Science and Technology (DIST) is a unit of Delaware State University focused on advancing the development of DSU's research and innovation enterprise in support of the University's mission. The mission of DIST is to advance interdisciplinary science and technology-related research, education, and outreach at Delaware State University, while promoting innovation and economic development, and serving the University's mission of education, knowledge generation, and service to the community. The Institute, supports five research core facilities that provide state-of-the-art equipment and services to researchers at Delaware State University, other partner universities, government agencies, nonprofit organizations and industry. The core facilities are the OSCAR Imaging Core, the Delaware Nucleotide Analysis (DNA) Core, the Cell Electrophysiology Core, the Nanomaterial-based Integrated Circuits and Electronics (NICE) Center, and a high-performance computing (HPC) Core. The major instrumentation in these core facilities is described below.

OSCAR Imaging Core
- <u>Zeiss780 Confocal Microscope</u> – with a motorized stage, DIC II, III and lasers for six wavelengths, Z-stacks, time series, tile scan; four color simultaneous; FRET, FRAP; FCS; Spectral imaging, and unmixing. Coherent Chameleon Ultra 2 laser for 2-Photon and Multi-photon imaging, NDD detection for Secondar Harmonic Generation imaging.
- <u>DeepSim Super-Resolution Microscope</u> (Crest Optics, Italy): Structured illumination micro-lens system, motorized stage, DIC II, III; four lasers for four wavelengths; Z-Stacks, Time Series, Tile scanning, Camera: ORCA-Fusion BT GEN III 95QE sCMOS, VisiView acquisition software
- <u>Xlight V3 Spinning Disk Confocal</u> (Crest Optics, Italy): Inverted Microscope Stand; Motorized stage, Piazo Z insert for high-speed Z stacks; TruFocus stabilization, DIC II, III; lasers for seven wavelengths; Z-Stacks, Time Series, Tile scan; 2 Camera system ORCA-Fusion GEN III sCMOS; UGA-42 FireFly FRAP system; Ludl XY stage; VisiView acquisition software.
- <u>Cytation 10 with BioSpa</u> (Agilent Technologies USA): All in one high content screening widefield, and confocal microscope with plate reading capabilities. Fully automated scheduling BioSpa incubation system with 8 simultaneous experiments. 4X – 60X air objectives, four wavelength LDI laser system.
- <u>XplaRA Plus Raman confocal (Horiba)</u>: Motorized stage, motorized z, reflected, transmitted light paths, DIC, Polarized light, Dark field, Epi-Fluorescence imaging, Easy-Nav, Montage and Z stacks. Raman Spectrometer is a Synaps EMCCD (cooled).
- <u>Quanta 250 FEG SEM</u> (FEI corporation-Thermofisher): with secondary electron and central back-scatter detection; gaseous secondary electron detection for E-SEM; scanning transmission microscope detection (STEM); environmental SEM; Peltier stage (cooling and heating, 21C- -20C); heating stage (1000C); Oxford X-man electron Dispersion spectroscopy (EDS) (80mm window); Plasma Cleaner.
- <u>Innova AFM</u> (Bruker USA): contact mode; tapping Mode; STM; lateral force microscopy; phase imaging; liftmode magnetic force and electric field microscopy; surface potential; liquid imaging in contact and tapping mode.
- <u>Anasys NanoIR AFM</u> (Bruker USA): tapping and contact modes; surface sensitive AFM-IR; tapping AFM-IR; scattering (SNOM); polarization control for nano scale orientations; environmental enclosure

<u>Spectrometers:</u>
- ALPHA FT-IR Spectrometer (Bruker): ZnSe ATR, Diamond ATR, Specular and diffuse reflectance

- Cary 630 FTIR (Agilent): Diamond ATR, Germanium ATR, Specular and diffuse reflectance
- Cary 6000+ UV-VIS-NIR (Agilent) : Transmission, absorption, specular and diffuse reflectance, Temperature control with liquid stirring.
- Cary Eclipse Fluorescence Spectrometer (Agilent): Transmission and absorption, temperature control
- K2 Fluorescence Spectrometer (ISS): Life time measurement, Steady State, Absorption transmission

DNA Core
- PacBio Sequel II System - delivers high-accuracy, long-read sequencing ideal for: de novo genome assembly; full-length transcript sequencing; and epigenetic analysis (e.g., DNA methylation).
- Illumina MiSeq System - offers fast, high-throughput sequencing with short-read capabilities, excelling in applications such as small genome sequencing; amplicon sequencing (e.g., 16S rRNA); and targeted gene panels.
- BluePippin - enables precise DNA fragment size selection, critical for optimizing next-generation sequencing library preparations. Key uses include: high molecular weight DNA isolation; size selection for long-read sequencing libraries; and removal of small fragments to enhance sequencing quality.
- Bio-Analyzer - offers high-resolution separation and quantification of DNA, RNA, and proteins, providing sample integrity and purity analysis, accurate sizing of DNA fragments for sequencing, and RNA quality checks for transcriptome studies.
- Covaris - designed for controlled DNA fragmentation for next-generation sequencing library preparation.
- epMotion 5075 - automated liquid handling for PCR setup, and next-generation sequencing library preparation.
- QIAcube - automates the extraction of DNA, RNA, and proteins using QIAGEN spin-column kits.
- SeqStudio Genetic Analyzer – ideal for Sanger sequencing for DNA mutation detection; microsatellite and STR analysis; and SNP genotyping.
- Agilent Femto Pulse System - provides ultra-sensitive, high-resolution analysis of DNA and RNA fragments, excelling in high molecular weight DNA analysis, quality control of long-read sequencing libraries, and RNA integrity evaluation.
- StepOne Plus Real-Time PCR System - for quantification of DNA and RNA, supporting gene expression analysis, SNP genotyping and pathogen detection.

Cell Electrophysiology Core
- Traditional patch clamp rigs with MultiClamp amplifier and Digidata, two channel stimulus generator Scientifica SliceScope Motorized Microscope with 3 color fluorescence and fiber optics for optogenetic stimulation.
- MEA 2100 multi electrode system from MultiChannel Systems – a very compact solution with integrated amplifier and stimulus generator, temperature control, and the option for real-time signal detection and feedback.
- Axion Muse MEA system - 64 stimulating and recording channels; Fast MEA insertion with auto MEA identification; Ultra-thin, transparent, single-well plate compatible; Fully integrated heater; cell culture incubator-compatible
- IonFlux Mercury 16 automated patch clamp system – with in-plate microfluidics, this system is specialized for ion channel assays

Nanomaterial-based Integrated Circuits and Electronics (NICE) Center
- Rigaku XRD Smart-Lab SE - a multipurpose X-ray diffraction system with intelligent guidance
- Linseis thermal conductive measurement system - optimized to measure thermal conductivity, specific heat, emissivity, electrical resistivity, and the Seebeck coefficient
- Keysight Device Parameter Analyzer B1500A - an all-in-one device characterization analyzer designed for comprehensive semiconductor testing.
- Keysight PXA Signal Analyzer N9030A - provides frequency coverage up to 50 GHz
- AixCCT TF 2000E - thin film analyzer for measuring ferroelectric, piezoelectric and pyroelectric properties of thin film.
- SR560 Low noise and SR810 DSP Lock-In amplifiers from Stanford Research – for high performance, low-noise amplification
- Polishing and profiling equipment including - AlliedHitech Multiprep system for parallel polishing, angle polishing, and site-specific polishing, Buehler Ecomet 3 and Automet 3 power grinder and polisher for bulk and larger samples, and a Bruker DektakXT profilometer used for measuring thin films' thickness, stress, surface roughness, and form.
- Other analysis equipment – spectrophotometers, HPLC, Thermal gravimetric analysis, Nuclear magnetic resonance spectrometer, etc.

Hyper-Hornet High Performance Computing Center
- HPC system equipped with 8 × NVIDIA H100 80 GB PCIe GPUs, dual 96-core AMD EPYC 9654 CPUs, and 1.5 TB DDR5 RAM.

PAST PERFORMANCE

DSU's research expenditures since 2021 have averaged over $30 million/year. Between 2015 and 2025 DSU-affiliated faculty have published an average of 111 scientific publications each year, and over that same time period DSU-affiliated publications received an average of about 6400 citations/year. DSU currently has a patent portfolio of 10 active patents, with four additional full patent applications in process with the US Patent and Technology Office.