Innovation in Interdisciplinary Research and Education: Virginia Tech

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ICTAS: Institute for Critical Technology and Applied Science
ICTAS

An investment institute with a mission to tackle grand challenges though interdisciplinary research at the intersection of the physical, life, and social sciences.
Interdisciplinary labs: ICTAS

**Kelly Hall**
- Bio-engineered devices
- Bio-based materials
- Injury biomechanics
- Cognitive radio
- LEWAS lab

**ICTAS CRC**
- Nanoscale characterization and fabrication
- UAS research
- National security
- Sustainable nanotechnology

**ICTAS II**
- Sustainable water
- Bioinspired engineering
- Macromolecules and materials

**VTRC-A**
- Cybersecurity
- Data analytics
ICTAS Doctoral Scholars

• 95 scholars have participated since 2007
Department of Engineering Education

- [www.enge.vt.edu](http://www.enge.vt.edu)
- Established in 2004; one of first such two departments in the United States
- Always looking for PhD students – students admitted are fully funded.
- My LEWAS (Learning Enhanced Watershed Assessment System) lab is an example of research in this department.
Key Motivation to Establish the LEWAS lab

To Provide Hands-on Learning Experiences to Students using an On-campus Water Quality Problem
Interdisciplinary LEWAS Lab Team

LEWAS Lab Team Members’ Backgrounds:
• Civil & Environmental Engineering
• Electrical Engineering
• Engineering Education
• Mechanical Engineering
• Biological Systems Engineering
• Computer Science
• Business Analytics
• Chemical Engineering
• Industrial Systems Engineering
The LEWAS Field Site

- Webb Branch Subwatershed:
  - 2.78 km²
  - 95% Urban

- Stroubles Creek Watershed

- Roanoke River Watershed
- Atlantic Ocean
- Chesapeake Bay Watershed
- Ohio River Watershed
Undergraduate Students’ Contribution to LEWAS

1) INPUTS
- Solar Panel
- AC/DC Converter with Automatic Transfer Switch
- Grid Power
- Weather Station
- Live Stream Camera
- Ultrasonic Level Sensor
- Flow Meter
- Water Quality Sonde
- Rain Gage with internal battery

2) PROCESSING
- Database
- Raspberry Pi

3) STORAGE
- HTML
- Live data streaming web

4) OUTPUTS
- Power flow
- Data flow
- Proposed data flow

EDUCATION AND OUTREACH

LEWAS LAB
LEARNING ENHANCED WATERSHED ASSESSMENT SYSTEM
Public Interface of LEWAS: Online Watershed Learning System (OWLS)

**Online Watershed Learning System (OWLS)**

The Learning Enhanced Watershed Assessment System (LEWAS) is a unique real-time water and weather monitoring system that has been developed to enhance watershed monitoring education and research at Virginia Tech, where it is installed near the outlet of Webb Branch next to West Campus Dr.

The Online Watershed Learning System (OWLS) is an open-ended guided learning environment using LEWAS data. By programming in only HTML5, CSS & Javascript, the OWLS is able to interactively deliver integrated live and/or historical environmental system data to end users from anywhere and at any time that they have internet access.

The development and classroom implementation of the OWLS is part of an ongoing PhD dissertation in the Department of Engineering Education at Virginia Tech. [Related References]

Please review the following before using this system: LEWAS Intro, Watershed Summary and Key Components.

**Case Studies:**
- Chloride Toxicity
- High Flow (2015)
- Sedimentation
- Water Main Break
- Water Main Break & Rain Event (2015)
- Weir

**NEW: Live LEWAS Data (Doppler Radar)**

**NEW: Live Camera (Photo Index)**

http://www.lewas.centers.vt.edu/dataviewer/
OWLS Used By World-Wide Students

Motivation for Personalized Learning

Advancing Personalized Learning

Assessment with technology
Paths taken through the OWLS by 15 students to complete an environmental monitoring task.
Virtual Environments (VE) for Learning

• Experiential Learning
  – Virtual and Online Learning
• Situate the Learner in the Lab
  – ‘Magic’ Techniques
• Emphasize Personalized Learning
  – Individual Curricula
  – Comfortable Pace
• Re-invigorate Distance Learning
  – Very High Presence and Immersion
Citizen Science and K-12 Outreach
NSF/Research Experiences for Undergraduates (REU) Site

• 95 REU Scholars; 62 women, 33 men;
• Mentorship team: 22 faculty and 80+ graduate students from 5 different colleges at VT
Water ECubeG (Engineering, Ecology, Environment, Geosciences) 2016-2019

Goal: To provide teachers (grades 9-12 & community college) with an interdisciplinary water research experience that integrates water research perspectives from engineering, ecology, environmental science, and geosciences.
What is I-Corps?
“The primary goal of NSF I-Corps is to foster entrepreneurship that will lead to the commercialization of technology that has been supported previously by NSF-funded research.”
(https://www.nsf.gov/news/special_reports/i-corps/about.jsp)

Highlight:
First I-Corps for Learning at VT

Training:
2 months of intensive training about business startup principles

Funding:
$50,000 during 6 months to explore the feasibility of commercializing the LEWAS/OWLS