

Environmental Computing and Community Engagement in STEM education: Building Effective and Sustainable Relationships.

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Abstract

Xavier University of Louisiana, in collaboration with the Institute of Earth Science Research and Education (IESRE) run the ECoSTEM project. This project aims to improve the quality of undergraduate STEM education by introducing a computational, community-oriented component into STEM programs at Xavier University. Specifically, undergraduate students develop microcontroller-based systems for collecting airborne particulate data. They work with public school teachers (and their students) and Louisiana Department of Environmental Quality (LDEQ) officers to deploy the sensors at locations around New Orleans and to analyze the resulting data. Airborne particulates are often the pollutant of greatest concern in minority and other underserved communities. This project provide undergraduates at Xavier and the local teachers (and their students) with learning experiences that are relevant to them and their communities. ECoSTEM uses a tiered mentoring system in which the project team members mentor undergraduates, who in turn work with public school teachers and mentor their students. Research has shown positive effects from student involvement in such real-world, personally relevant STEM projects, including increases in student interest in STEM-related careers after graduation. As a result, the project has the potential to broaden student interest in STEM and increase pursuit of STEM-related majors.

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What is ECOSTEM?

- ❖ ECOSTEM is a three-year project funded by the National Science Foundation through its *IUSE* program and directed by Xavier University of Louisiana, starting in February 2021.

The Goals and objectives of ECOSTEM are:

- ❖ to develop microcontroller-based systems for collecting environmental data (primarily airborne particulates) and deploy the systems at locations around New Orleans
- ❖ to engage Xavier undergraduates in working with public school teachers and students, and government agencies to apply STEM methods to address environmental problems.
- ❖ to expand the meaning and implementation of a STEM education for Xavier's faculty and students.

A strong science focus is essential for such a program.

Science focus for ECOSTEM

- ❖ Air quality is one of the top environmental justice issues and airborne particulates present significant environmental and health issues.
- ❖ Air pollution is often worse in big cities and in minority and other underserved communities.
- ❖ Studying particulates provides many opportunities for developing and improving STEM+C education programs.
- ❖ Hence, this is an ideal focus for expanding STEM education at Xavier by encouraging community engagement by its students and broadening the range of possibilities for STEM-related careers.
- ❖ PM2.5 and PM10 are components of the EPA's Air Quality Index (AQI) and are often the pollutant that determines the AQI value.

The Arduino UNO microcontroller: an ideal tool for environmental monitoring by students

- ❖ Rugged and inexpensive (~\$20).
- ❖ A “real” programmable computer that
- ❖ interacts with hardware.
- ❖ Free project development software
- ❖ (but *not* for Chromebooks).
- ❖ Globally supported through open-source
- ❖ hardware and software.
- ❖ Hundreds of sensors, displays, and other
- ❖ accessories are available.
- ❖ Hundreds of online tutorials and books
- ❖ available, many of them free.



WHO ARE THE PARTNERS OF ECOSTEM?

- ❖ Xavier Faculty
- ❖ Louisiana Department of Environmental Quality
- ❖ Institute for Earth Science Research and Education
- ❖ Xavier Undergraduates Students
- ❖ Morris Jeff Teachers and Students



What do the partners do?

1. Xavier Faculty and LDEQ officers

- ❖ The PI (Dr. Gasseller from Physics Department) has overall responsibility for the ECOSTEM project and oversight for the undergraduate research students.
- ❖ The PI also teaches the IPSC4010 Advanced Earth Science course that was developed at Xavier as part of the ECOSTEM project.
- ❖ The Co-PI (Dr. Glaude from Department of Education and Counselling) coordinates training workshops for the participating teachers and serves as the liaison between the school district and the ECOSTEM team

What do the partners do?

2. IESRE

- ❖ IESRE serves as a consultant on this project
- ❖ IESRE builds the prototype PM sensor and other environmental monitoring instruments
- ❖ IESRE sources all the electronic components/equipment used for teaching and for building and maintaining the PM sensors
- ❖ Dr. Brooks acts as a resource person for both teachers and students

What do the partners do?

3. Xavier students

- ❖ Xavier Students build the PM sensors
- ❖ They deploy the sensors at various places in New Orleans
- ❖ They work with local teachers to deploy sensors at the respective schools
- ❖ They Collect and Analyze data from PM sensors
- ❖ They engage in various research projects using PM sensors



What do the partners do?

4. Teachers

- ❖ Each participating teacher has a PM sensor to use in their classrooms and to deploy outside
- ❖ Teachers have learned how to collect data from PM sensor
- ❖ Teachers have learned how to access LDEQ PM data
- ❖ Teachers incorporate environmental data collection into their classes in which ever way they see fit



Key to Building Effective and Sustainable Relationships.

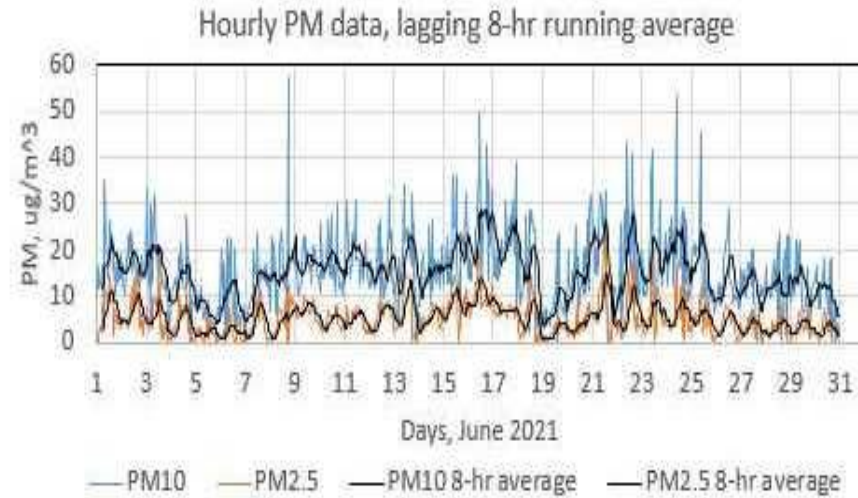
- ❖ Identify monitoring projects with student, community, and scientific interest.
- ❖ Identify partnerships early in any project.
- ❖ Encourage cross-disciplinary approach to project development and implementation.
- ❖ Make sure that project equipment is age-appropriate for students and maintainable by project personnel and partners.
- ❖ Develop incentives for participation and professional development (not just \$\$).
- ❖ Solicit and act on ongoing feedback from partners.

ECOSTEM MILESTONES



February 2021: prototype for ECoSTEM's particulate monitoring system completed by IESRE in preparation for summer 2021.

ECOSTEM MILESTONES



June 2021: Xavier students build and tested PM sensors. After training in electronics and soldering, Xavier students began building and testing the PM sensors.

ECOSTEM MILESTONES



June 28, 2021: ECoSTEM PM sensors were placed side by side with the Louisiana Department of Environmental Quality sensors at City Park site

ECOSTEM MILESTONES



July 12-16, 2021: First ECoSTEM professional development workshop

Five teachers from Morris Jeff Community School spent five days at Xavier, learning about programming Arduino microcontrollers, the importance of monitoring airborne particulates, and how to integrate ECoSTEM activities into comprehensive STEM education programs consistent with Louisiana science education standards.

ECOSTEM MILESTONES



July 30, 2021: Solar powered PM monitoring station installed

This image shows ECoSTEM's solar-powered PM monitoring station located at the northeast edge of Xavier's campus

ECOSTEM MILESTONES

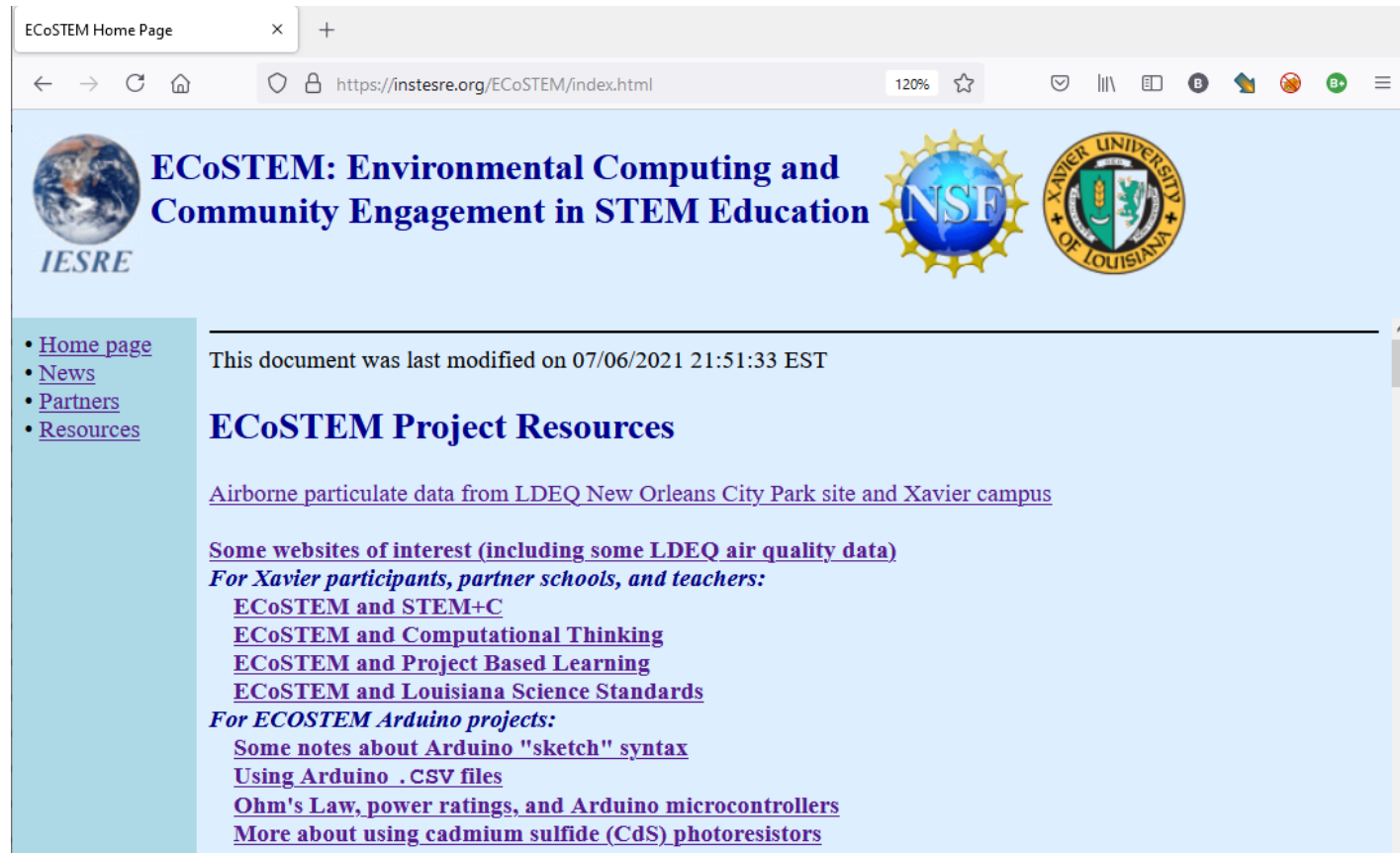


September 6, 2021: Stevenson screens for ECoSTEM schools!

ECoSTEM teacher partner Sarah Lubow has taken the lead in building Stevenson screens to hold ECoSTEM's particulate monitoring systems.

ECoSTEM information online

<https://instesre.org/ECoSTEM/>



Working with students

