Student Contributions to Citizen Science Programs as a Foundation for Independent and Classroom-Based Undergraduate Research in Earth Science

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ABSTRACT

Environmental monitoring projects on the grounds of a campus can serve as data collection sites for undergraduate research. Penn State Brandywine has utilized students in independent study projects to establish two citizen science programs and to begin collecting data, with the data sets serving as a foundation for authentic inquiry-based exercises in introductory-level Earth science courses. The first citizen science program is The Smithsonian Institution’s Global Tree Banding Project, which contributes to research about tree biomass by tracking how trees respond to climate. We are going beyond the requirements of the Smithsonian project. Instead of only taking two measurements each in the spring and fall, undergraduate researchers are taking measurements every two weeks throughout the year. We started taking measurements of ten trees on campus in 2012 and will continue until each tree outgrows its tree band. The data are available for download in Google Spreadsheets for students to examine changes in tree diameter within one or between growing seasons, supplemented with temperature and precipitation data (see http://sites.psu.edu/treebanding/). A second citizen science program we have begun on campus is the NASA-funded Digital Earth Watch (DEW) Picture Post Project, allowing students to monitor the environment and share observations through digital photography. We established four Picture Post sites on campus, with students taking weekly photos to establish an environmental baseline of the campus landscape and to document future environmental changes pre- and post-construction. We started taking digital photos on campus in 2014 and will continue well past the completion of construction to continue to look for changes. The image database is less than a year old, but the images provide enough information for some early analyses, such as the variations in “greenness” over the seasons. We have created a website that shares the purpose of our participation in the Picture Post Project and links to our images (see http://sites.psu.edu/picturepost/). Having these citizen science programs on campus provides students a greater connection to their local environment, the opportunity to work with data collected by and for students, and the ability to contribute the data to a global database and research program.

What is Citizen Science?

- A program grounded in a scientific investigation where volunteers who are not scientists conduct surveys, take measurements, or record observations
- A collaborative process involving scientists and researchers working with the public (individuals and community-based groups) to generate ideas and seek advice, leadership, and program coordination
- Volunteers, amateur scientists, students, and educators may network and promote new ideas to advance understanding of systems/processes on Earth and in outer space

Organizations for citizen science

- Citizen Science Association - http://citizenscienceassociation.org/
- Citizen Science Alliance - http://www.citizensciencealliance.org/
- Citizen Scientists League - http://citizenscientistsleague.com/
- European Citizen Science Association - http://ecsa.biodiv.naturkundemuseum-berlin.de/

Why “tweak” existing projects?

- Provide additional data about the campus and data for students to work with over time
- Provides a detailed data set of the campus environment
- Provides additional opportunities for student researchers to practice research skills
- Collecting data in the field
- Organizing data
- Responsible for reporting/entering data to citizen science databases
- Allows students to document on resume regular/consistent participation and responsibility in collecting data on a weekly/bi-weekly basis

Why use Citizen Science Projects as a foundation for undergraduate research?

- Can keep the projects on campus (reduces transportation issues with the university’s Office of Risk Management, provides a field opportunity for students without cars)
- Engage students in learning about their own local environment
- Project is already set up and established, structure is in place
- Equipment costs are low, typically instruments already on campus (thermometers, pH meters, digital calipers, digital cameras, GPS receivers, etc.)

What are additional uses of data beyond the citizen science database?

- Classroom activities
  - Laboratory exercises where students work with authentic data collected by students on campus, helps develop quantitative skills of students
  - K-12 classroom activities
  - Inquiry-based classroom exercises with local K-12 teachers for their students to work with local data
- Outreach activities
  - Engage the general public to collect data during campus events, Boy Scout/ Girl Scout programs, summer camps for kids

One of four Picture Posts set up on the campus of Penn State Brandywine at a site under discussion for future construction. The photos at this site will not only contribute to the analysis of the greenness index (indicator of climate change) but establish a history and environmental baseline of the campus environment before human-environment interactions.
Recognition for Student Researchers

Jonathan Fridman
2014 GeoCUR Award for Excellence in Student Research

Kimberly Bowen
Selected for AGU 2015 Postcards from the Field calendar

To Learn More

Visit undergraduate researcher Kimberly Bowen when she presents the initial results of her work on Friday afternoon! ED53A-3464 Using the Citizen Science Picture Post Project as the Foundation for Campus Environmental Monitoring by Undergraduate Student Researchers (Poster)

Listen to Wednesday afternoon talks (1:40PM – 3:40PM, Moscone West 3002): U33A Is Global Citizen Science the Next Big Science?

Listen to Friday morning talks (8AM – 10AM, Moscone South 102): ED51E Era of Citizen Science: Intersection of Outreach, Crowd-Sourced Data, and Scientific Research I

Visit this Friday afternoon poster session: ED53A Era of Citizen Science: Intersection of Outreach, Crowd-Sourced Data, and Scientific Research II Posters

(And see Monday’s abstracts from S11A Citizen Seismology: Applications, Technologies, and Benefits Posters)

To download a PDF copy of this poster, scan this QR code

Future Project(s)

An unnamed stream runs through the length of the campus, providing the opportunity for:

- World Water Monitoring Challenge
  - Measurements not once-a-year but year-round of temperature, dissolved oxygen, pH, turbidity
  - Website: http://www.monitorwater.org/
- Additional projects that can be completed on campus grounds
  - Leaf Pack Network
  - Project BudBurst
  - CoCoRaHS (weather monitoring)
  - Snow Tweets (recording/geo-tagging snow measurements)

Common Concerns Across Projects

- Equipment over time
  - Trees outgrow the tree bands, new ones need to be installed
  - Trees damaged/removed because of construction activities
  - Picture Posts “in the way” of construction, cross country trail
- Student data collectors
  - Undergraduate researchers change semester to semester
  - Need access to digital calipers/digital camera (no lab tech on campus)
  - All are commuting students and face transportation challenges
  - Not available to collect data over school breaks (or while at AGU!)
- Authorship on publications
  - Takes several students over several semesters to collect enough data to publish the analysis and results
  - Which students get to be involved in writing as co-authors?
  - Losing contact with students once they transfer to other institutions

Picture Post Project

Purpose: A citizen science program that measures environmental change with digital photography

Methods: Place Picture Post in ground, take photos every two weeks and upload to Picture Post website

Our modifications: Take photos every week, track temperature and precipitation data

Involvement of students: Student researcher started the project, collect the data year-round as an independent study project during the semesters, paid in the summers

Above: Student researcher taking digital photographs on an octagonal platform

Right: Greenness index as calculated from analysis of the digital photos taken at each campus location

Smithsonian Institution’s Global Tree Banding Project

Purpose: A citizen science program that contributes to research about tree biomass tracks how trees respond to climate

Methods: Place dendrometer on a tree, use digital calipers to measure gap width twice in spring and twice in fall

Our modifications: Measure trees every two weeks, track temperature and precipitation data, place our data in Google Spreadsheets so it is downloadable/accessible to all audiences

Involvement of students: Student researchers started the project, collect the data year-round as an independent study project during the semesters, paid in the summers

One of the ten campus trees with the tree band (dendrometer) in place, approx. four feet above ground around tree trunk

Data collected by student researchers on campus trees, capturing trends that would have been missed with only 2-4 measurements per year

Map showing locations of campus Picture Posts

Map showing locations of campus trees part of our monitoring project

Stream that runs ~0.7 mi through campus

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