Embedding citizen science into K-12 curricula: Empowering youth to help manage the urban forest ecosystem

Samuel Severance & Tamara Sumner

*University of Colorado Boulder*

This work was supported by a grant from the National Science Foundation (Award #1147590). The opinions expressed herein are those of the authors and do not necessarily reflect those of the NSF.
Problem: Providing meaningful learning
Approach: Co-design with differing expertise
Illustration: Citizen Science in formal settings
Preliminary Findings: Evidence of impact

Call to Action
We seek to offer all youth the chance to become informed stewards of their urban ecosystems. How can your organization help support this vision?
Lack of Meaningful Learning

Traditional forms of science education often deny students the opportunity to investigate real-world phenomena of interest or solve consequential problems using science and engineering practices (National Research Council, 2012).
Empowerment as a Solution

One potential solution involves empowering future generations of students to become informed stewards of their local urban ecosystem.
Potential of Citizen Science

Citizen science can offer students opportunities to address issues seen as meaningful to their community (Roth & Lee, 2004). Yet citizen science projects fail to reach all potential students as most lack supports for their integration into formal science classrooms (Trautman et al., 2012). Many citizen science projects seem less like citizen science than “using citizens to do science” (Lakshminarayanan, 2007).
How can a citizen science curriculum be deeply embedded within a formal school setting to promote meaningful and empowering forms of science learning that support the management of the urban forest ecosystem?
What is the iHub?

A long-term partnership of Denver Public Schools, UCAR, CU-Boulder, and other local organizations

Seeks to solve problems of practice facing school districts
How the Curriculum Came About

The advent of the Next Generation Science Standards (NGSS) provided an opportunity to develop new science curriculum.

Denver Public Schools asked for the Inquiry Hub to help develop a new Ecosystems unit aligned to the NGSS.
Ecosystems Unit Components

Anchoring Phenomenon
Humans actively manage and change urban ecosystems

Driving Question
What species of trees should we plant and where to increase biodiversity and maximize benefits to human beings and other organisms?

Sub-Phenomena
Trees grow in some areas but not others
Trees are dying in large numbers
Our Design Approach

We engaged in cycles of **co-design**
Groups with differing expertise working collectively on a common design

Key participants included:
- Teachers from Denver Public Schools
- Researchers and computer scientists from CU-Boulder and UCAR
- Urban forestry experts from Denver Parks & Rec
## Ecosystems Lessons Overview

<table>
<thead>
<tr>
<th>Lessons</th>
<th>Highlights</th>
<th>Big Ideas</th>
<th>Tech Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Students explore <strong>anchoring phenomenon</strong> of humans managing ecosystems and receive tree <strong>challenge</strong></td>
<td>Services</td>
<td></td>
</tr>
<tr>
<td>2-3</td>
<td>Students explore <strong>sub-phenomenon</strong> of why trees grow only in certain areas and survey potential planting sites</td>
<td>Abiotic Factors</td>
<td></td>
</tr>
<tr>
<td>4-6</td>
<td>Students explore loss of tree services and biodiversity via <strong>sub-phenomenon</strong> of trees dying from Emerald Ash Borer (EAB)</td>
<td>Interactions Services Biodiversity</td>
<td><strong>NetLogo</strong> (6 only)</td>
</tr>
<tr>
<td>8-10</td>
<td>Students survey local ecosystem to explore potential of <strong>sub-phenomenon</strong> of trees dying en masse from EAB occurring here and create model of local ecosystem</td>
<td>Resilience</td>
<td><strong>EcoSurvey</strong></td>
</tr>
<tr>
<td>11-12</td>
<td>Students argue for which tree best meets <strong>challenge</strong> (via EcoGuide) and <strong>tree order is placed with DPR</strong></td>
<td>Resilience Services</td>
<td></td>
</tr>
</tbody>
</table>
EcoSurvey

EcoSurvey "Card"

Relationship graph
Interactive computer simulations

Allow for the observation of phenomena that might otherwise be impossible to see in real life

Example of NetLogo simulation:

*tinyurl.com/ecosystem-eab*
Data Collected During Pilot

Interviews with randomly selected students three times over the course of the unit

Weekly observations of classroom teachers enacting the unit

Examination of student-created artifacts (e.g. final presentation reports to DPR)
The challenge and sub-phenomena (e.g. EAB) helped create a meaningful experience for students.

Students felt what they learned is useful to the community.

Students effectively applied their understanding of ecosystems concepts.
Preliminary Claims & Findings

Students found what they did in the unit as empowering.

On sharing their work with the community:
“…they’re going to show it to like the community and see like this is what students think about it, this is what students have – yes…I think it’s pretty cool because they get to see like instead of having seen like adults point of view they’re getting to see student’s point of view and how we took in the information yes.” (Interview)
Presenters Contact Info

**Dr. Tamara Sumner**
sumner@colorado.edu

**Samuel Severance**
severans@colorado.edu

Our project website: inquiryhub.dls.ucar.edu