Fostering Inquiry with i-Tree Tools: The Learning Streams International Model

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2021
I-Tree Academy

LEARNING STREAMS INTERNATIONAL

Case Western Reserve University

HIRAM COLLEGE
The Model: Learning Streams International (LSI) Active Student-Centered Investigations Modeled on Real Science Protocols Using:

- State of the Art Learning & Modeling Inquiry
- Ohio EPA Watershed/Wetland Assessment Tools
- Student Identified Problems
- Near-Peer Place-Based Mentoring
- Democratic Decision Making
- Data Driven Legacy Projects
HISTORICAL DEVELOPMENT
- 2007 Ohio Board of Regents Burning River Watersheds
  - Engage Students in Science
- 2014 Counterpart International – Dominican Republic
  - Coastal Community Resiliency Youth Program
- 2015 U.S. State Department – Pakistan
  - International Watershed Partnerships

TRANSFORMATIONAL OUTCOMES
- Participating High Schools
  56 American, 24 Pakistani, 8 Dominican
- Lasting Legacies
  New Courses, Parks, Sustainable Partnerships (DEEP)
2020 COVID REALITIES
- NO Face-2-Face Collaborations
- PROBLEMATIC Individual Students in Water
- NO International Travel – Pakistan, DR, Manaus Amazon

2021 SOLUTIONS 2021
- Develop Virtual Program
- Focus on Accessible Trees
- Branch out LSI Tree Curriculum
I-TREE CURRICULUM
Adapting TESTED METHODS

- Best Practices – LSI, Case Western, Hiram, Cleveland Metropolitan School District, ODNR
Tree Academy Commission, I-Tree Academy

NEW TREE CURRICULUM GOALS
- Adapt to Virtual, Blended, Face-2-Face Platforms
- Empower ALL Participants Through Mentors LIKE THEM (cooks, minorities, women, nerds, geeks, athletes)
- Speak to Rural, Suburban, Urban participants

IDEAL OUTCOMES
- Safe for all data collectors
- Easy to learn through Mentoring
- Inspirational and relevant science outcomes
- Transformational for students, teachers, schools & scientists
My Tree As a Point of Entry in Seeing an Invisible World

**STUDENTS:**
- Select a local tree
- Learn measurement of dbh
- Change size and species to see outcome
- Compare data on the Trillion Trees Map
- Discover what results interest students

<table>
<thead>
<tr>
<th>Date</th>
<th>Group</th>
<th>Planting Type</th>
<th>Species</th>
<th>Condition</th>
<th>Diameter (in.)</th>
<th>CO₂ Stored To Date (lbs)</th>
<th>CO₂ Sequestered (lbs)</th>
<th>Storms Water Runoff Avoided (gal)</th>
<th>Air Pollution Removed (lbs)</th>
<th>Avoided Energy Emissions (lbs)</th>
<th>Energy Usage Impacts (lbs)</th>
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<td>Black oak</td>
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<td>19.9</td>
<td>180.83</td>
<td>3526.78</td>
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<td>87.47</td>
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<td>1.14</td>
<td>0.51</td>
<td>3.31</td>
<td>175.43</td>
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</table>
KEYING TREES

• From observing differences between trees with My Tree to learning to identify tree species
  • In the Face-2-Face World: Learning to use a dichotomous tree key (left)
  • In the Virtual World: Picture This or another App (right)
• Tree identification makes I-Tree tools accessible
I-Tree Design

Goals
- To introduce students/teachers to I-Treetools using their school platform
- To allow students to find answers to questions using design (e.g. how does placement affect benefits?)
- To improve understanding of standards through tool use
- To have students use design to explore their own home or school
- To promote collaborative understanding through sharing results & questions

Rationale
- Mentors introduce using the same land area with all I-Tree tools
- Students practice steps in inquiry
I-Tree Canopy

- **Goals**
  - Determine and distinguish important components (e.g. trees, shrubs, ground covers vs. paved roads, buildings, stone surfaces)
  - Understand standard error, cover classes percentages on impacts
  - See Tree Benefits for Carbon, Air Pollution, Water

<table>
<thead>
<tr>
<th>Abbr.</th>
<th>Benefit</th>
<th>Amount (Kgal)</th>
<th>±SE</th>
<th>Value (USD)</th>
<th>±SE</th>
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<tr>
<td>AVRO</td>
<td>Avoided Runoff</td>
<td>8.68</td>
<td>±1.00</td>
<td>$78</td>
<td>±9</td>
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<td>E</td>
<td>Evaporation</td>
<td>235.86</td>
<td>±27.18</td>
<td>N/A</td>
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<tr>
<td>I</td>
<td>Interception</td>
<td>236.04</td>
<td>±27.20</td>
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<td>T</td>
<td>Transpiration</td>
<td>317.38</td>
<td>±36.57</td>
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<td>PE</td>
<td>Potential Evaporation</td>
<td>1,576.35</td>
<td>±181.63</td>
<td>N/A</td>
<td>N/A</td>
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<td>PET</td>
<td>Potential Evapotranspiration</td>
<td>1,147.85</td>
<td>±132.26</td>
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<td>N/A</td>
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</table>
# I-Tree Planting

## Goals
- Select trees
  - To improve and envision future
  - To anticipate climate change & build
  - Maximize ecosystem benefits

## Ecosystem Services

<table>
<thead>
<tr>
<th>Location</th>
<th>Tree Group Characteristics</th>
<th>Ecosystem Services</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Tree Biomass (short ton)</td>
<td>Rainfall Interception (gallons)</td>
<td>Avoided Runoff (gallons)</td>
<td>Avoided Runoff ($)</td>
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<tr>
<td>1</td>
<td>(7.0) Birch, Black (Betula lenta) at 1.5 inches DBH. Planted &gt;60 feet and north (0°) of buildings that were built pre-1950 with neither heat nor A/C. Trees are in excellent condition and planted in full sun.</td>
<td>4.6</td>
<td>176,340.4</td>
<td>13,271.2</td>
<td>$118.59</td>
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<tr>
<td>3</td>
<td>(5.0) Sweetgum (Liquidambar styraciflua) at 1.5 inches DBH. Planted &gt;60 feet and east (90°) of buildings that were built pre-1950 with neither heat nor A/C. Trees are in excellent condition and planted in full sun.</td>
<td>3.0</td>
<td>104,155.7</td>
<td>7,838.7</td>
<td>$70.05</td>
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<td>9</td>
<td>(3.0) Oak, Swamp white (Quercus bicolor) at 1.5 inches DBH. Planted &gt;60 feet and east (90°) of buildings that were built pre-1950 with heat and A/C. Trees are in excellent condition and planted in full sun.</td>
<td>3.4</td>
<td>86,672.9</td>
<td>6,522.9</td>
<td>$58.29</td>
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<td>10</td>
<td>(5.0) Tupelo, Black (Nyssa sylvatica) at 1.5 inches DBH. Planted &gt;60 feet and east (90°) of buildings that were built pre-1950 with heat and A/C. Trees are in excellent condition and planted in full sun.</td>
<td>2.7</td>
<td>113,586.2</td>
<td>8,548.4</td>
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<td>12</td>
<td>(4.0) Baldcypress (Taxodium distichum) at 1.5 inches DBH. Planted &gt;60 feet and east (90°) of buildings that were built pre-1950 with heat and A/C.</td>
<td>2.7</td>
<td>88,902.8</td>
<td>6,690.7</td>
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Finding Common Ground in a Polarized World

WHY INQUIRY
- Inquiry moves beyond risk perceptions influenced by deeply held religious/social values
- Higher numeracy skills can increase polarization
- Encouraging scientific curiosity (inquiry) improves ability to see evidence that may challenge personally held views (Kahan & Corbin)

OUTCOME OF INQUIRY
- Motivation to act correlated with increased knowledge
- Motivation to create lasting legacies through a legacy project (like the capstone projects here)
Social Justice & Learning Implications

- Learning to work with others with different perspectives
- Identifying and understanding social justice and equity implications using tree canopies and benefits
- Understanding what students know and feel – when, what, why through surveys and journaling (Mundorf)
Ways to Engage Students with I-Trees:
- MAKE LEARNING FUN

- Teachers who look like or were you in age, language, ethnicity
  - LSI Alumni (Students NPMs)
- Scientists Doing Exciting Work
  - Female Drone pilot capturing canopy shots of areas chosen by participants
- Platforms that promote interaction
  - design, canopy, planting
- Tools that promote seeing then learning about the invisible world around you
  - My Tree
- Tools that make you an expert
- Lessons that build and review
  - Sequencing itools
Figure 1. Transformative Learning, Partnership, and Systemic Change (HS = High School; NPM = Near Peer Mentors, which are pre-service teachers or STEM undergraduate majors)
Acknowledgements

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