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

Lucy Chamberlain
Dennis Taylor

2021
I-Tree Academy

LEARNING STREAMS INTERNATIONAL

CASE WESTERN RESERVE UNIVERSITY EST. 1826

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

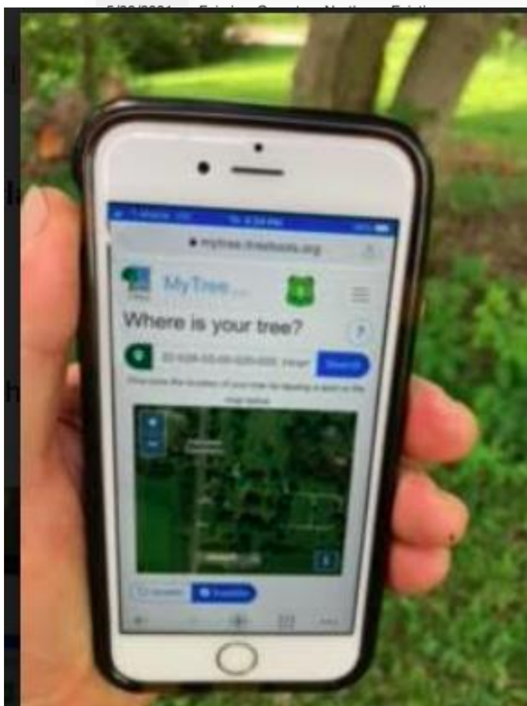
IDEAL OUTCOMES

- 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

Date	Group	Planting Type	Species	Condition	Diameter (in.)	CO_2 Stored To Date[1,2]		CO_2 Sequestered[2]		Storm Water Runoff Avoided		Air Pollution Removed[3]		Avoided Energy Emissions[4]		Energy Usage Impacts[5]
						$	lbs	$	lbs	$	Gal	$	Oz	$	Oz	$
5/30/2021	Fairview Cemetery North	Existing	Sugar maple	Fair	8.3	19.77	385.62	20.5	20.5	0.12	0.27	0.14	0.86	174.39	9.01	18.43
5/30/2021	Fairview Cemetery North	Existing	Green mountain sugar maple	Fair	8.3	38.12	743.53	49.54	49.54	0.14	0.33	0.15	0.81	86.86	4.49	9.19
5/30/2021	Fairview Cemetery North	Existing	Sugar maple	Fair	4.9	5.74	111.91	10.17	10.17	0.07	0.17	0.07	0.38	86.89	4.49	9.19
5/30/2021	Fairview Cemetery North	Existing	Sugar maple	Poor	9.8	29.23	570.02	19.33	19.33	0.1	0.24	0.15	0.86	172.8	8.93	18.2
5/30/2021	Fairview Cemetery North	Existing	Crimson king norway maple	Poor	10	58.24	1135.9	24.88	24.88	0.13	0.31	0.17	0.9	87.38	4.52	9.28
5/30/2021	Fairview Cemetery North	Not provided	Sugar maple	Good	8.6	21.49	419.2	24.97	24.97	0.14	0.33	0.15	1.02	175.43	9.07	18.57
5/30/2021	Fairview Cemetery North	Not provided	Sugar maple	Good	1	0.11	2.22	1.5	1.5	< 0.01	0.02	< 0.01	0.02	29.65	1.53	3.09
5/30/2021	Fairview Cemetery North	Existing	Sugar maple	Good	9.7	28.53	556.42	29.36	29.36	0.15	0.36	0.17	1.2	175.43	9.07	18.57
5/30/2021	Fairview Cemetery North	Existing	Sugar maple	Fair	9.3	25.84	503.92	23.9	23.9	0.13	0.3	0.16	1	174.39	9.01	18.43
5/30/2021	Fairview Cemetery North	Existing	Sugar maple	Good	1	0.11	2.22	1.5	1.5	< 0.01	0.02	< 0.01	0.02	29.65	1.53	3.09
			Sugar maple	Poor	11	38.36	748.25	22.6	22.6	0.11	0.26	0.17	1	172.8	8.93	18.2
			Black oak	Good	19.9	180.83	3526.78	87.47	87.47	0.51	1.19	0.47	2.66	175.43	9.07	18.57
			oak spp	Good	19.9	146.82	2863.52	28.21	28.21	0.48	1.14	0.51	3.31	175.43	9.07	18.57
			oak spp	Good	19.9	146.82	2863.52	28.21	28.21	0.48	1.14	0.51	3.31	175.43	9.07	18.57

Previous 1 Next

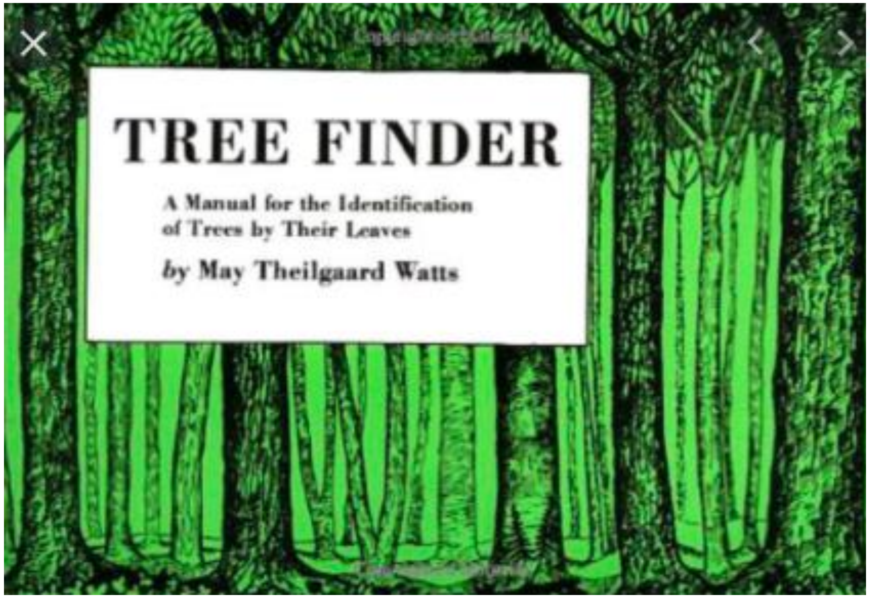


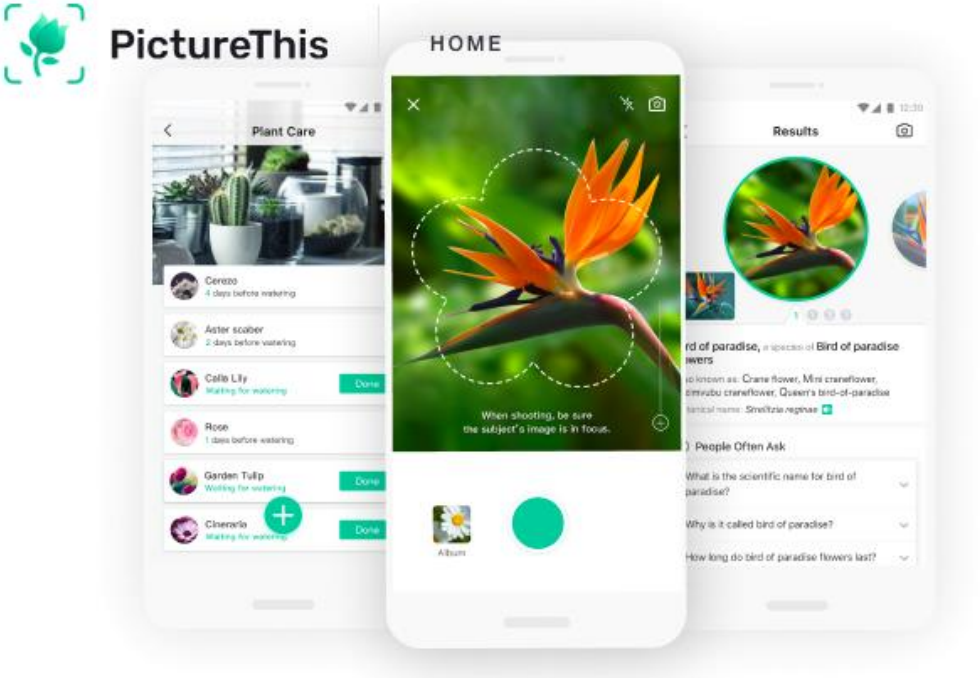
STUDENTS:

- 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

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

Fairview Cemetery Hiram

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

Tree Benefit Estimates: Hydrological (English units)

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

Hydrological Benefits Fairview Cemetery

I-Tree Planting

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

Copy | Export | CO_2 | Energy | Eco | Air Pollution

Search:

Location		Ecosystem Services			
Group Identifier	Tree Group Characteristics	Tree Biomass (short ton)	Rainfall Interception (gallons)	Avoided Runoff (gallons)	Avoided Runoff ($)
1	• (7.0) Birch, Black (Betula lenta) at 1.5 inches DBH. • Planted >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.	4.6	176,340.4	13,271.2	$118.59
3	• (5.0) Sweetgum (Liquidambar styraciflua) at 1.5 inches DBH. • Planted >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.	3.0	104,155.7	7,838.7	$70.05
9	• (3.0) Oak, Swamp white (Quercus bicolor) at 1.5 inches DBH. • Planted >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.	3.4	86,672.9	6,522.9	$58.29
10	• (5.0) Tupelo, Black (Nyssa sylvatica) at 1.5 inches DBH. • Planted >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.	2.7	113,586.2	8,548.4	$76.39
12	• (4.0) Baldcypress (Taxodium distichum) at 1.5 inches DBH. • Planted >60 feet and east (90°) of buildings that were built pre-1950 with heat and A/C.	2.7	88,902.8	6,690.7	$59.79

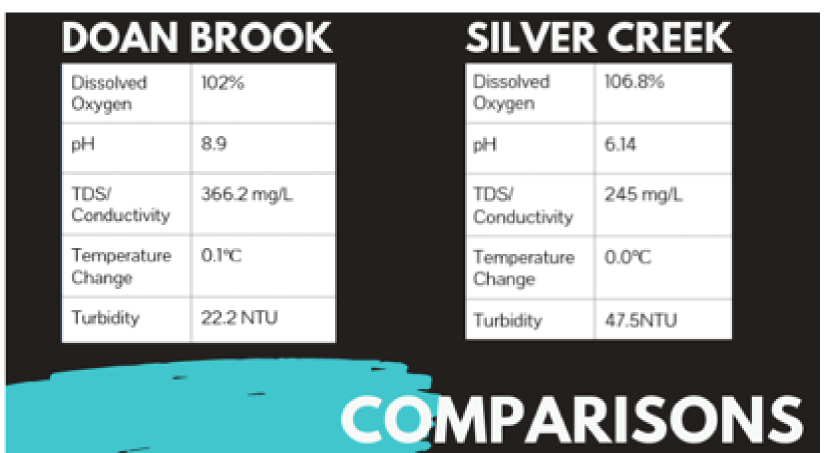
Finding Common Ground in a Polarized World

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)



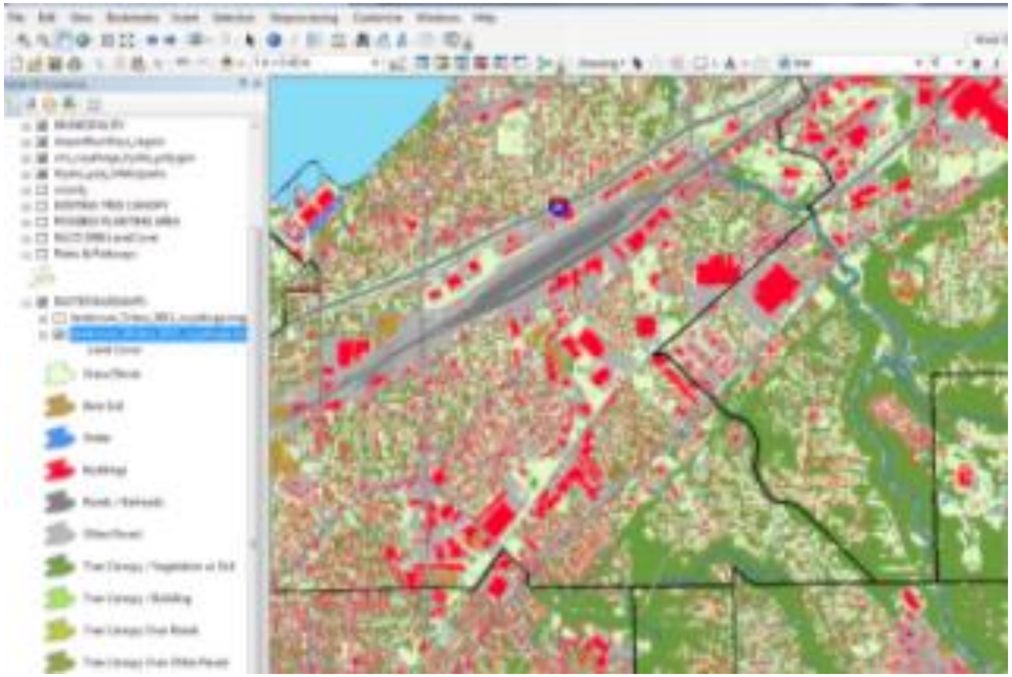
DOAN BROOK

Dissolved Oxygen	102%
pH	8.9
TDS/ Conductivity	366.2 mg/L
Temperature Change	0.1°C
Turbidity	22.2 NTU

SILVER CREEK

Dissolved Oxygen	106.8%
pH	6.14
TDS/ Conductivity	245 mg/L
Temperature Change	0.0°C
Turbidity	47.5NTU

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

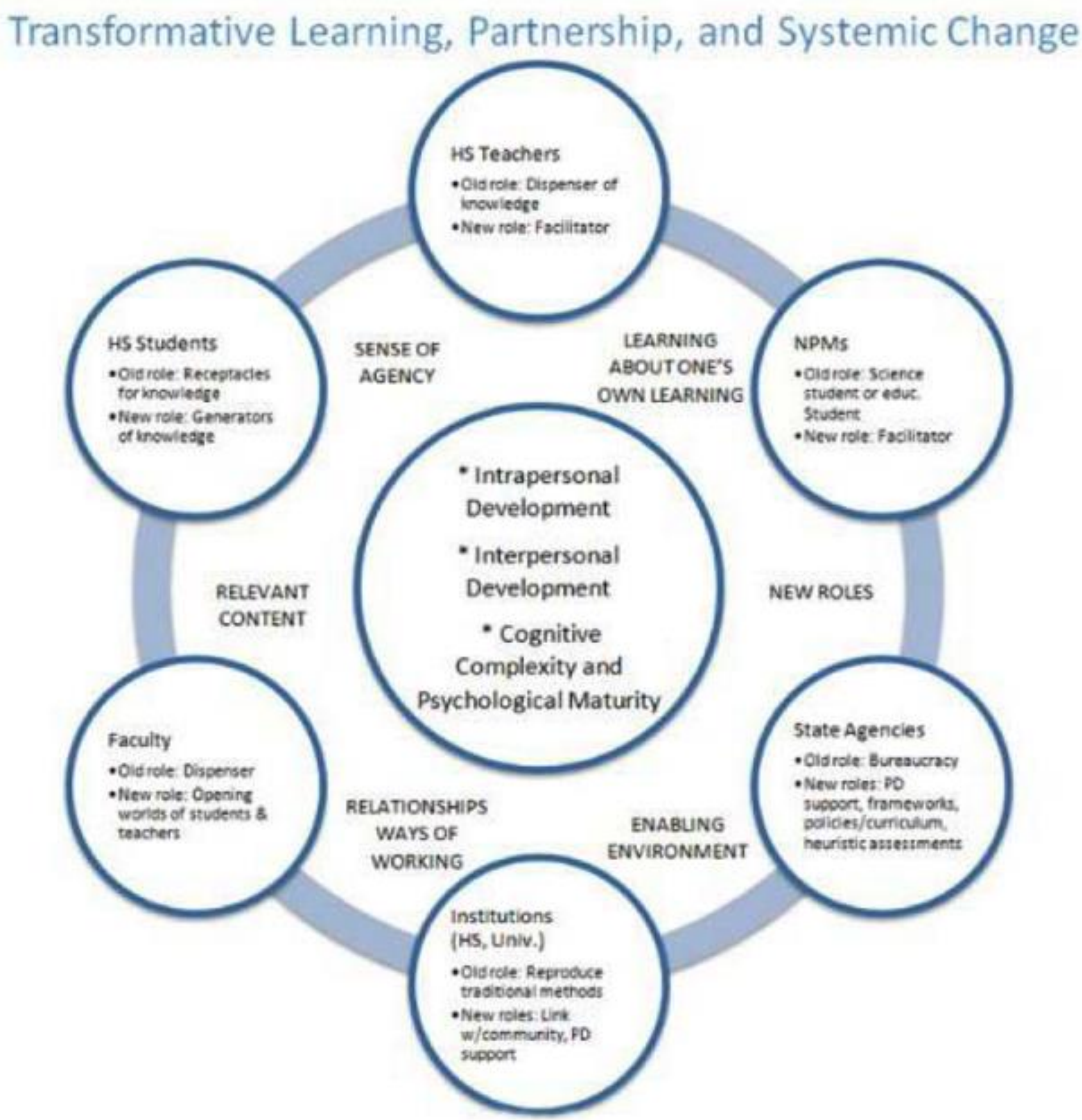


Figure 1. Transformative Learning, Partnership, and Systemic Change (HS = High School; NPM = Near Peer Mentors, which are pre-service teachers or STEM undergraduate majors

Acknowledgements

- Funding for LSI programs and program development provided by the Paul and Maxine Frohring Foundation, the United States Department of State, Counterpart International; Hiram College; and the Leonard Gelfand Center at Case Western Reserve University