PROJECT-ORIENTED GEOSCIENCE
SERVICE LEARNING: TANNERY BROOK AS
URBAN LABORATORY AND SCIENCE-TEAM BUILDER

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Outline

- What is service learning (SL)?
- My SL project—the “nuts & bolts”
  - The Search for Partners
  - Project-based/embedded themes
  - Scaffolding—the key to engagement
    - Question-asking
    - Field-work training
    - Presentation skills
    - Cooperative-learning
- Embedding SL entails making choices.
- What students learned/shared.
- Conclusions
What is service learning?

- "Service-learning is an experiential teaching method that combines community service with academic instruction as it focuses on critical, reflective thinking and civic responsibility. Service-learning programs involve students in organized community service that addresses local needs, while developing their academic skills, sense of civic responsibility and commitment to the community."
The elements of excellent geoscience service learning

• “100% science/100% service-learning”
• Project-oriented, embedded in the curriculum.
• Runs throughout the semester—not tacked on as a one- or two-time event disconnected from the themes of the course.
• Deep learning that is highly reflective.

How to imbed science-service learning into a project-oriented pedagogy is the subject of my presentation.
ESC 120: Introduction to Geology & Earth Processes

- Described as a general, first-year introduction to physical geology
- No prerequisites—most students liberal arts & science majors
- A “lab science”—general-education requirement needed for graduation & transfer
- Enrollment ~25; two labs of ~12 students each
HCC demographics (fall 2013)

- **Enrollment**
  - Headcount 6740
  - FTE 4560

- **Gender**
  - Female 60%
  - Male 40%

- **Race/ethnicity**
  - White 66%
  - Hispanic or Latino(a), any race  22%
  - African American 7%
  - Asian 2%
HCC demographics (fall 2013)

- **Age**
  - <20, 30%
  - 20-24, 36%
  - 25-29, 13%
  - 30-44, 15%
  - 45+, 6%
  - Median/mean: 21/25
ESC 120 majors (fall 2013)

- Liberal Arts, 50%
- Criminal Justice, 20%
- Business Admin., Education, ~2%
How ESC 120 embeds SL

- Made it inquiry-/problem-based around a major theme of the course.
- Added undergrad research components (my students are generally not science majors).
- Partnered early with community organizations around common interests.
- Constructed elaborate scaffolding with deadlines throughout the semester.
- Organized an end-of-semester student research conference. Serve food!
Down-sides to embedding

- Takes time away from other Earth science topics
  - Requires shuffling your schedule
- “Fit” may not be precise
  - Often no coverage of SL curricula in textbook(s)
  - Hard to explain “uneven” science coverage to students
- Season-/weather-permitting
The Search for Partners

- Partnering organizations **must** have a common interest in the Earth science/geology curricula.
- My “Science Partner Infiltration” process
- Four partners available from the Holyoke community:
  - Connecticut River Watershed Council
  - The City of Holyoke
  - The Trustees of Reservations, “Land of Providence”
  - Sisters of St. Joseph/Sisters of Providence charities
SL curricula/partner common interests

- Urban hydrology
- Greenway/open-space vision/design
- Stream & Connecticut River pollution (total coliforms)
Embedded research themes that serve partners

- Tannery & Refuge Brooks as urban hydrology laboratories
  - “Tale of Two Watersheds”
  - Urban impacts, especially run-off & erosion
  - CSOs (combined sewer overflows) draining to the Connecticut River
- “Greenway Vision for Tannery Brook”
  - An exercise in creative urban planning
Scaffolding—the key to engagement

- Question-asking
  - Proposal
  - Outline
- Field-work training/data collection
  - On-campus (two lab sessions [per lab])
  - Off-campus (one lab session [per lab])
  - Off-campus all-day field trip (whole class)
- Cooperative learning teams
- Presentation skills
  - Dry-run & rubric of expectations
  - Final “whole-school” science conference
Framing the questions

- Tale of two watersheds
- Urban impacts
- CSOs
- Greenway vision for Tannery Brook
Drafting an outline

1. Introduction
2. Method
3. Data & analysis
4. Conclusions
5. References
Collecting data

- Many protocols were constructed:
  - Field observations data forms (right)
  - Stream discharge (Q)
  - Riparian conditions
  - Chemical data (pH; specific conductance/temp.)
  - Total coliforms
- All data were pooled.
Our stream discharge (Q) method

\[ Q = v \cdot A \text{ [m}^3\text{/s}] \]
Sample Q calculation

- Average stream velocity (m/s) is multiplied by cross-sectional area estimate (m):

  $$Q = v \cdot A \ [m^3/s]$$
Planning field work

- Models their own work
- Check lists for on- & off-campus field work
- Itineraries
- All-day Saturday field session was “extra-credit,” & very well attended!
Easy-to-make base maps are critical.

- When possible, Google Earth/Google Maps & other public-access mapping software were used.
- I provided map templates to get them started.
- iPad GPS mapping particularly helpful.
Office of Geographic Information (MassGIS)

Through the Office of Geographic Information (MassGIS), the Commonwealth has created a comprehensive, statewide database of spatial information for mapping and analysis supporting emergency response, environmental planning and management, transportation planning, economic development, and transparency in state government operations.
Cooperative-learning teams

- Randomly selected teams maintained throughout semester. We were lucky!
- Goal: Make team-building training/skills intentional not hap-hazard.
- Cooperative assignments were progressively more complicated.
- Team tasks facilitate team work:
  - Communicator/leader
  - Equipment manager
  - Data manager
Cooperative-learning skills

- Three cooperative learning techniques (CoLTs*) were used in one of two lab sections (a pilot study):
  1. “Think-pair-share”
  2. “Fish Bowl”
  3. “Pass the Problem On”
  4. “Graph-Your-Progress”

- Each CoLT was progressively more reflective.

- Pre- & post-testing
  - Friday lab was my “control.”
  - Monday lab was my “treatment.”

Planning & practicing the final presentation

- Rubric of expectations (distribute early)
- Practice “dry-runs”
The Mini-Conference Invitation

- College-wide, including administrators
- All partners
- Serve food!
Embedding SL entails making choices
- Significant rearrangement of traditional material/sequence
  - Hydrology lecture coverage ~2 weeks; stream labs & field exercise ranged over ~3 weeks.
  - Some later labs sacrificed so students could work on research projects.

Five weeks devoted to hydrology lecture & labs/field work.
• Significant rearrangement of traditional material/sequence
• Hydrology lecture coverage ~2 weeks; stream labs & field exercise ranged over ~3 weeks.
• Some later labs sacrificed so students could work on research projects.

Three weeks devoted to data analysis & presentation prep.
What students learned/shared

- Watershed characteristics
  - Background & setting
- Field work
  - Stream velocity
  - Discharge
  - Riparian conditions
  - Reconnaissance water-quality
  - Total coliforms
  - Significant erosion/mass wasting
Our study watersheds (a student map)

- **Refuge Brook Watershed** (~2 mi²)
- **Tannery Brook Watershed** (~.2.2 mi²)
- **HCC campus**

[Map diagram with labeled watersheds and distances]
Study watersheds summary statistics

- **Tannery Brook**
  - Intensely developed/urbanized
  - Drains ~10% of the City of Holyoke
  - Headwaters on campus
  - Area ~2.2 mi²
  - ~3.5 mi long; drains to the Connecticut River

- **Refuge Brook**
  - Undeveloped/wooded back-up water supply for the City of Holyoke
  - Headwaters in protected “refuge” adjacent to campus
  - Area ~2 mi²
  - ~2.4 mi long; drains to an impoundment
A big plus: student easy-access
The blue line marks iPad/GIS track along nature trail in the Refuge Brook watershed & along Tannery Brook on campus.
Tannery Brook—on-campus

Adjacent to the parking lot

Head-waters
Tannery Brook—off-campus
Tannery Brook—off-campus
Refuge Brook—on- & off-campus
Field work

- Maps, maps, & more maps (from itineraries)
  - Google Maps/Earth
- Student findings & trends
On-campus field sites (four sessions)

HCC campus base map

- Proposed sampling locations

- Refuge Brook
- B (retention basin)
- C-C'
- D-D'
- E-E'
- A-A'

1000 ft = ~0.2 mile

TANNERY BROOK – 10-25- & 10-28-13
SITES – base map

NOTES

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1) **SITE 1** -- Homestead Ave. Fire Station #6, 667 Homestead Ave. (2a, 8, 9, 10)

2) **SITE 2** -- Upland Rd. City of Holyoke Maintenance Garage (2a, 8, 9, 10)

Off campus field sites (two sessions)
Off campus field sites (two sessions)

2) **SITE 2** -- Upland Rd.  
   City of Holyoke  
   Maintenance Garage  
   (2a, 8, 9, 10)

3) **SITE 3** (tributary to TB) -- Sears  
   Auto/Brightside Mall  
   (2a, 8 [one team only], 9, 10)
TANNERY BROOK – 11-2-13 SITES – base map

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SITE 4 – Sisters of Saint Joseph
Pick one of the SUB-SITES a-d and do protocols 2a, 8, 9, 10 (Figure 2) – include sub-site name on data sheets!

SITE 5 – Jones Ferry (protocol 9) & lunch

SITE 6 – Sisters of Providence
Pick two of the eight SUB-SITES (a-h) and do protocols 2a, 8, 9, & 10 (Figure 3) – include sub-site name on data sheets!

Off campus field sites (one Saturday extra-credit session)
Some data trends—discharge

Q, m³/sec

location avg. ,Q

SITE 4 = Sr. of St. Joe.

On-campus sites
City of Holyoke sites
Some data trends—specific conductance

On-campus sites

City of Holyoke sites

SITE 4 = Sr. of St. Joe.
Some data trends—total coliforms

BASE MAP

Split your team's duties.

All teams must
1) monitor **THREE** of six campus locations (A through F) using Protocol 2a (visual & qualitative observations of stream conditions); across the channel & up and down banks; use data codes
2) estimate stream discharge (Q) at either transect C-C' or E-E' using Protocol 8a.

**Friday lab** turn in data/calculations on following Monday; **Monday lab** turn in data/calculations on following Wednesday. All data will be pooled/shared.


*Too Numerous To Count*
FIGURE 1

NOTES

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*Too Few To Count

**To Numerous To Count
Some data trends—total coliforms

• Despite seeing large concentrations of total coliforms on campus, urban sites down-gradient of campus were less contaminated.

• The exception: Total coliforms colonies in the Connecticut River were TNTC (Too Numerous To Count).
  • CSOs? Yes, but we sampled on a dry day.
Erosion issues near the Sisters

- Erosion has been documented the #1 problem associated with Tannery Brook (An Assessment of Urban Stream Restoration—Tannery Brook, Nov. 1999)
- Sisters’ Properties down-gradient of the shopping mall are the most impacted—the focus of my students service research.
Our study watersheds (a student map)

- Refuge Brook Watershed (~2 mi²)
- Tannery Brook Watershed (~0.22 mi²)
- Sisters’ Properties
- HCC campus

Map showing locations of study watersheds relative to the HCC campus and Sisters’ Properties.
Erosion issues near the Sisters

SITE 4 – Sisters of Saint Joseph

SITE 6 – Sisters of Providence
Erosion issues near the Sisters

SITE 4 – Sisters of Saint Joseph

SITE 6 – Sisters of Providence
Holyoke Mall & the Sisters of St. Joseph

SITE 4 – Sisters of Saint Joseph

SITE 6 – Sisters of Providence

Tannery Brook RR culvert

Connecticut River
Holyoke Mall & the Sisters of St. Joseph

SITE 4 – Sisters of Saint Joseph

SITE 6 – Sisters of Providence

Rip-rap cages (west bank)

Connecticut River

MOUTH
Holyoke Mall & the Sisters of St. Joseph

- SITE 4 – Sisters of Saint Joseph
- SITE 6 – Sisters of Providence

Parking-lot drainage
Severe erosion at Sisters of Providence 2013 (near mouth of Tannery Brook)

SITE 4 – Sisters of Saint Joseph

SITE 6 – Sisters of Providence

Connecticut River
Some background ... from MassGIS

SITE 4 – Sisters of Saint Joseph

SITE 6 – Sisters of Providence

Connecticut River
Tannery Brook (or a tributary) historically ran under the mall & now exits (via pipe) just upstream of “the elbow”!

“THE ELBOW”

SITE 6 – Sisters of Providence

MALL
Tannery Brook (or a tributary) historically ran under the mall & now exits (via pipe) just upstream of “the elbow”!
Tannery Brook (or a tributary) historically ran under the mall & now exits (via pipe) just upstream of “the elbow”!
Severe erosion at Sisters of Providence 2013 (near mouth of Tannery Brook)
Significant—even dangerous—erosion/mass wasting at “the elbow”
Severe erosion at Sisters of Providence 2013 (near mouth of Tannery Brook)

“The Elbow”
“THE ELBOW”

~800 lb. drainage tile moved ~300 ft.
End-of-semester HCC SL Program survey/feedback results

Gained a lot (18 or 24%)—gain closely related to embedded geoscience curriculum

- Capacity & commitment to work collectively with diverse others to address common problems (24%)
- Desire to work in a diverse society & world to improve the quality of people's lives & the sustainability of the planet (18%)
- Find & examine research related to a social issue (18%)
- Read, write, speak, listen, or communicate effectively (18%)
- Responsibility that I contribute to solutions of social problems (18%)
- See a situation from other viewpoints (18%)
- Use critical inquiry (such as evaluating assumptions, multiple points of view, & evidence) to identify a problem, research solutions, analyze results, & make decisions (18%)
- Use quantitative reasoning to identify a problem, research solutions, analyze results, evaluate choices, & make decisions (18%)
Cooperative-learning pilot study conclusions

• I saw no obvious differences between my “control” & “treatment” groups.
• Both groups seemed to learn as much with or without targeted CoLTs.
• Further studies with CoLTs:
  • Start earlier; raise expectations; use in every lab/field session.
  • Reward more reflection.
  • Use focus groups/interviewing?
Overall conclusions

- Real-world science focused on benefits to local partners is always engaging to students & reinforces geoscience learning.
- Finding the right partner can be time-consuming.
- Embedding service learning into curriculum means making choices.
- Scaffolding is critical. Do more of it.
- Focus on cooperative learning plus reflection.
- Follow-up studies of “the elbow” may be of interest to not just the Sisters but the City of Holyoke.
  - How can students visualize/quantify this hazard?
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