

Teaching Mathematics Through Garden-Based Education

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Overview

- Part I: Introduction and background
 - Introducing Rob, Logan, and Ellen
 - Reviewing garden-based education research
- Part II: REAL garden-based education teaching tools
- Part III: Garden-based math-focused PBL units
 - Building a garden-based PBL from the foundation up
 - Making strong instructional links to math TEKS
 - Displaying examples of student work
- Part IV: Q & A session

Part I: Introduction and Background

Introducing Rob Rouse

- Clinical assistant professor SMU
 - Former high school chemistry teacher
- Research and teaching interests focus on how to design innovative STEM learning environments
- Graduate courses taught at SMU
 - The science of learning in STEM education
 - Designing and making in STEM education
- Chair of the STEM Education Program Committee



Introducing Logan LeCompte

- Graduated with his M.A.T. from Tarleton State University and holds a Graduate Certificate in Global Education from Rice University
 - Former 5th grade Language Arts teacher in FWISD
- Instructional Coach for REAL School Gardens
 - Coached around 2,000 teachers, engaged close to 8,500 students, and currently serves nearly 100 school communities and garden-based education programs
- Presented at several state and local educational leadership conferences
- Certified Dallas County Master Gardener
- Published in *Green Teacher*

Introducing Ellen Pool

- Graduated with her B.S. in psychology and received her teaching certification from SMU
 - Currently teaches 2nd grade at Cannon Elementary (GCISD)
- Mickelson ExxonMobil Teachers Academy graduate
 - Professional development program focusing on STEM across multiple grade levels
- Presented at the American Horticulture Society's National Children and Youth Garden Symposium
- Accepted a position with UTD as the TexPREP Coordinator for the Texas STEM Coalition

Reviewing Garden-Based Education (GBE) Research

Nutritional and Health Outcomes

- GBE introduces children to sustainable food systems and improves nutritional awareness (Canaris, 1995)
- Reinforces lessons about nutrition and promotes children developing good eating habits (Morris et al., 2000)

Socio-Emotional and Community-Based Outcomes

- GBE increases parent and child enthusiasm and increases a sense of community (Alexander et al., 1995)
- Venue for children learning about culture, language, and environment (Cutter-Mackenzie, 2009)

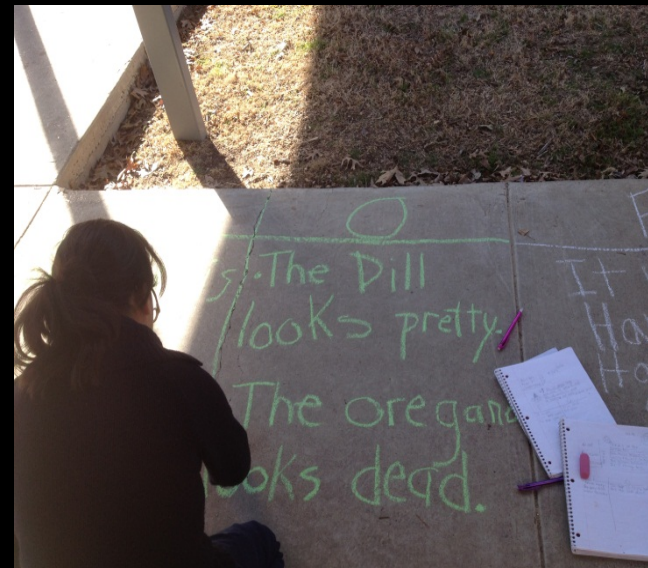
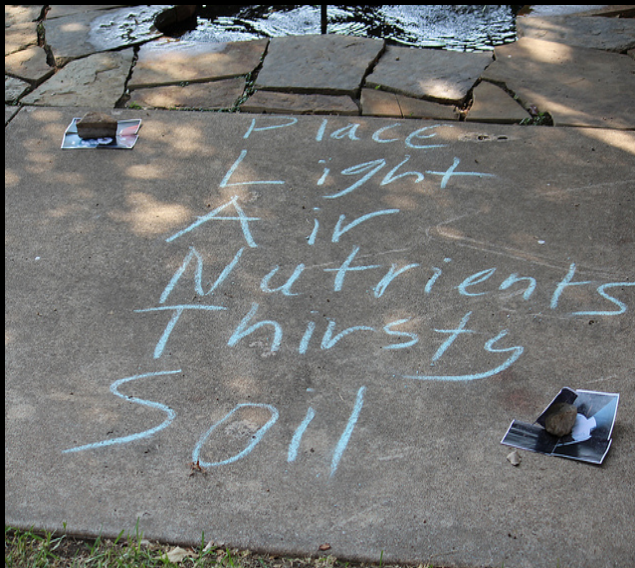
Academic Outcomes

- GBE increases children's positive attitudes towards science (Skelly & Bradley, 2007)
- GBE increases children's academic outcomes in mathematics (e.g., geometry, probability, and measurement) (Williams & Dixon, 2013)

Part II: REAL Garden-Based Education Teaching Tools

Tool 1: Sidewalk Chalk

- Sidewalk chalk is a quick and easy way to get kids engaged in an outdoor lesson
 - Use this tool to incentivize and deepen understanding of learning objectives
 - For example, in our fact/opinion lesson below, students used chalk to keep track of facts vs. opinions on the sidewalk



Tool 2: Measuring Tape

- Lower grade students can compare the lengths of real objects in the outdoor classroom (standard vs. non-standard)
- Upper grade students can master perimeter, area, and volume using this simple tool
- Experiencing concepts first-hand helps students remember them



Tool 3: Hand Lenses/Loops

- This tool helps teachers and students magnify animal characteristics, analyze plant parts, and compare soil samples from around the schoolyard
- Hand lenses make students feel like real scientists
- Giving students access to a microscopic point of view can transform their perspective about a subject



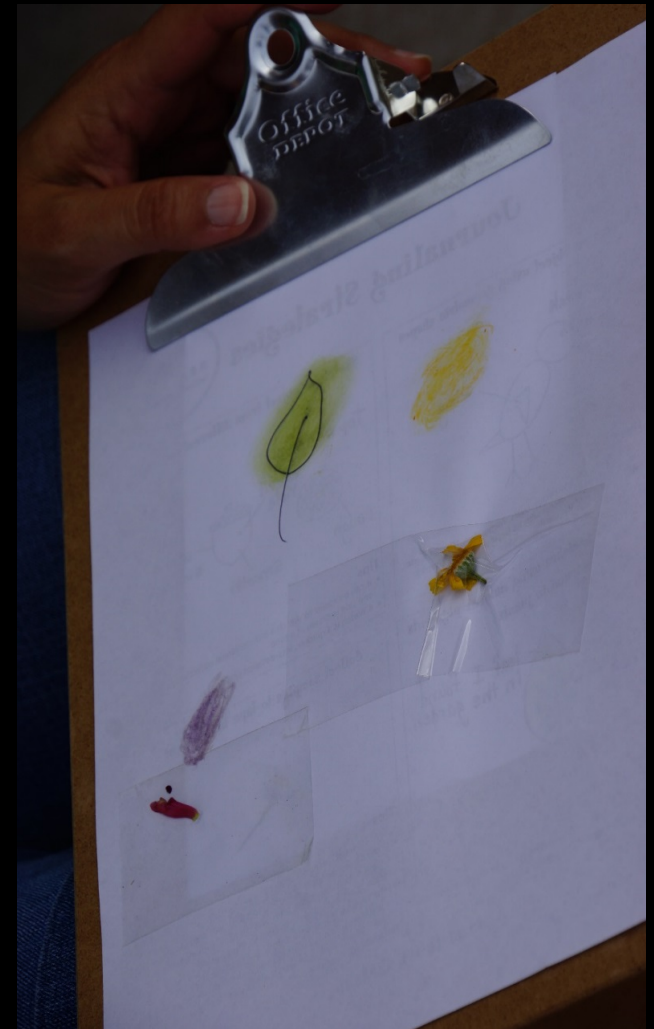
Tool 4: Weather Recorders

- Teaching weather objectives outside just makes sense
- Encourage students to use their five senses as tools for making weather observations before allowing them to interact with (a) thermometers, (b) cloud viewers, and (c) rain gauges
- Use these three tools to gather weather data as a regular practice before beginning your daily lesson



Tool 5: Tear-Able Tape

- Put down the scissors!
 - Tear-by-hand packaging tape is essential for your outdoor toolkit
- Teachers can help students apply their learning by asking them to tape concrete objects into their journals
- This hands-on manipulative helps students create powerful records of their schoolyard experiences



Other Useful Teaching Tools in the Outdoor Classroom

- Magnets
- Plastic baggies
- Melodic attention getter (harmonica)
- Journals and pencils
- Senses
- Compasses/GPS

Thought Experiment

Take a moment to think about how you could use the outdoor space at your school to integrate STEM objectives and facilitate hands-on experiences?

Discuss your ideas with a shoulder partner

Part III: Garden-Based Math- Focused PBL Units

Building a PBL Unit From the Foundation Up



Part 1: Content Standards

- Question: What do students need to know and do?
 - 2.1: Use mathematical processes to acquire and demonstrate mathematical understanding
 - a. Apply math to problems arising in everyday life, society, and the workplace
 - 2.3 Apply mathematical process standards to recognize and represent fractional units and communicate how they are used to name parts of a whole
 - a. Partition objects into equal parts and name the parts, including halves, fourths, and eighths, using words
 - 2.9: Apply mathematical process standards to select and use units to describe length, area, and time
 - a. Find the length of objects using concrete models for standard units of length

Developing an Entry Document

Purpose (STUDENTS)

- Engaging introduction to the project

Purpose (TEACHERS)

- Introduces learning objectives
- Sets the stage for entire project

Entry Document Example



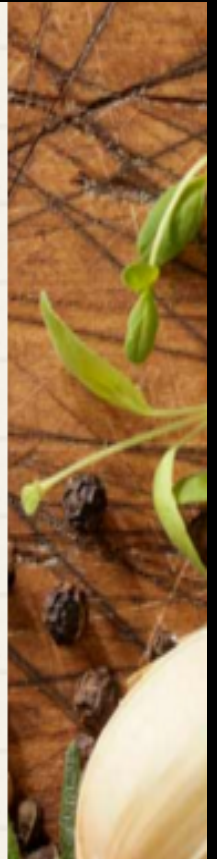
ATTENTION ALL PROBLEM SOLVERS

2.1

As a Potato Production Partnership (PPP) your company will be accountable for designing and creating a prototype garden extension that will allow for the space to yield the most potatoes.

Real School Gardens will be providing you with the support and resources needed in designing and creating an environment to produce a plethora of potatoes.

Submissions will be due Friday, February 5th.



Part 2: Criteria and Constraints

Purpose (STUDENTS)

- Informs students what to include in their final product
- Outlines limitations (e.g., obstacles/rules) that students may encounter during the project

Purpose (TEACHERS)

- Allows teachers to build in the necessary products for students to demonstrate understanding
- Allows teachers to guide student learning so that students experience each learning objective in a particular order (i.e., hidden learning path)

Criteria and Constraints Example

What Students See

Submission must include:

Criteria:

- Digital 2D and 3D blueprints of your prototype
- Prototype of your garden extension
- Digital Advertisement selling your garden based on the given criteria through Claims, Evidence, and Reasoning statements

Constraints:

- Designs must be in the form of a shape with more than 4 sides, 4 faces, and 4 vertices
- Designs must have an area of 20 square feet
- Claims, Evidence, and Reasoning Statements must defend your PPP's reasoning for choosing your gardens location, shape, size (area).

What Teachers See

Submission must include:

Criteria:

- 2.8 • Digital 2D and 3D blueprints of your prototype
- 2.4, 2.5 • Prototype of your garden extension
- 2.1, 2.2, 2.3 • Digital Advertisement selling your garden based on the given criteria through Claims, Evidence, and Reasoning statements

Constraints:

- 2.8 • Designs must be in the form of a shape with more than 4 sides, 4 faces, and 4 vertices
- 2.9 • Designs must have an area of 20 square feet
- 2.3 • Claims, Evidence, and Reasoning Statements must defend your PPP's reasoning for choosing your gardens location, shape, size (area).

Part 3: Knows and Need to Knows

Purpose (STUDENTS)

- Allows students to build on prior knowledge
- Allows students to generate a list of questions (content) they need answered
- Documents student learning throughout the unit

Purpose (TEACHERS)

- Pre-assessment identifies where teachers need to start and clarifies the focus of the content
- Ensures that students are learning the objectives
- Gives the teacher an idea of where to place mini-lessons throughout the unit

Knows and Need to Knows Example

Knows	Need to Knows
Potatoes grow in the ground	Can we go to Main Street Fest? <i>Yes with family</i>
We don't have room to grow our potatoes in the garden we have now	How do we get the materials for the garden extension? <i>RSG</i>
<i>Yield</i> means to make, grow, or have	What materials are we allowed to use? <i>Wood, clay, water, rocks</i>
We are partnering with Real School Gardens	How many potatoes will we begin with? <i>X potatoes RSG</i>
<i>Plethora</i> means a whole bunch	How do we get the potato seeds? <i>When you finish your 2D & 3D designs</i>
Submissions are due February 5th	When do we start building? <i>We will make a booth</i>
We are designing and creating a <i>prototype</i>	What shop will we sell them at?
We need to make a digital <i>advertisement</i>	Which company will sell the most potatoes?
Our extension has to be a shape with more than 4 <i>vertices</i> and 4 sides	How will we make the potatoes?
We have to add unto our garden	How is Real School Gardens going to help us? <i>support resources</i>
Potatoes are good to eat	How much dirt will we need to use? <i>however much you need</i>
We are working in Potato Production Partnership teams	What shapes will we use? <i>74 sides 74 vertices</i>
We need to make 2D and 3D shapes	What apps can we use?
We need to make 2D and 3D shapes	Where do we build it? <i>our classroom garden</i>
It can be no less than 100 square feet and no more than 200 square feet	Can we use the app My Garden 3D-free? <i>in negative space in the garden</i>
We need to extend our garden to make room to grow potatoes	How much room do we have? <i>No</i>
<i>Area</i> is the amount of space an object takes up	100-200 square feet <i>square feet</i>
We need a lot of potatoes to fry up for Main Street Fest!	Who will we be working with? <i>PPP's</i>
	How will we make our 2D and 3D digital drafts?
	How much time and money do we have? <i>1.5 weeks - we don't need money</i>

Making a Link to Your Own Outdoor Classroom

- Part I: Download the TEKS app on your smart device
- Part II: Pair up and take a few minutes to jot down some math TEKS that you could integrate into this activity *or* that you could use to extend this activity
 - Feel free to tailor the math content to your grade level
- Part III: Share out
 - What links did you make to the TEKS?
 - How would you extend this activity?

Digital Journal Assessment Examples



WHAT IS SEESAW?

Seesaw empowers students of any age to independently document what they are learning at school.

Students capture learning with photos and videos of their work, or by adding digital creations. Everything gets organized in one place and is accessible to teachers from any device.

Student work can be shared with classmates, parents, or published to a class blog. Seesaw gives students a real audience for their work and offers parents a personalized window into their child's learning.

[LEARN MORE](#)

Part IV: Q & A Session

Assessing Student Learning Using Digital Journals

Purpose (STUDENTS)

- The student is responsible for documenting when he or she has completed a part of a challenge
- Students provide individual responses to questions or come up with unique claims
- Reminds students where they left off and where to begin again
- Acts as a guide/transitional element for moving to next steps
- Allows opportunities for students to gain feedback from teachers, students, and parents

Purpose (TEACHERS)

- Teachers can assess groups and individuals as time allows (e.g., from home or from a conference when students have a sub!)
- Parents have access to quick daily feedback of what their child learns
- Allows for talking point (visuals and videos) for when students can't remember "what they learned in school today"
- Get students, parents, and teacher on the same page