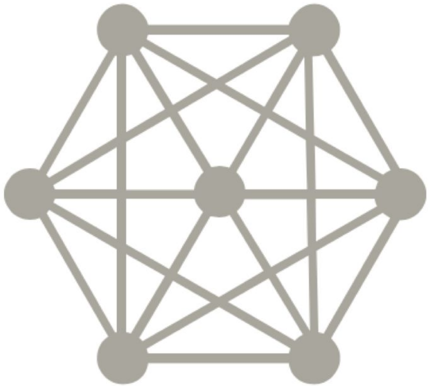
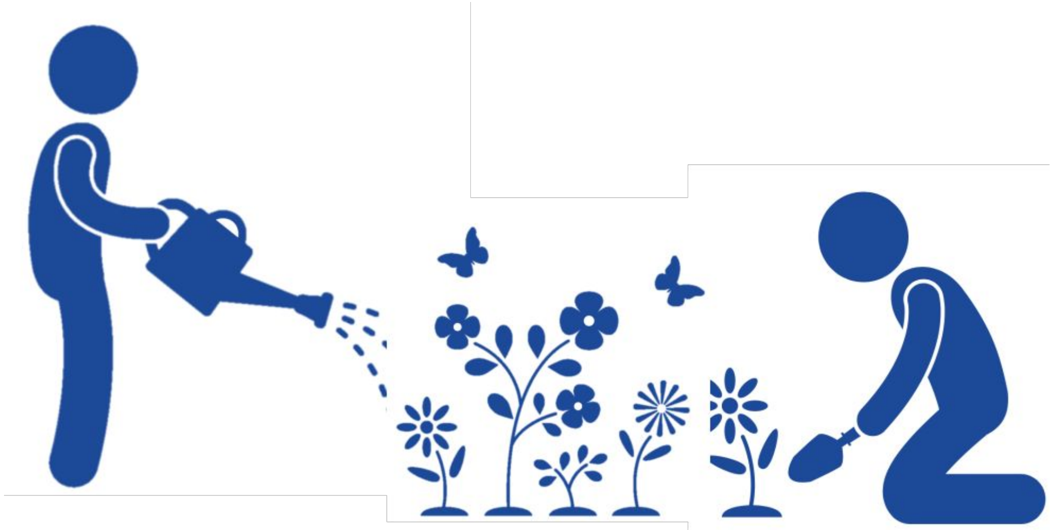
# Using School-Gardens as a Physical and Virtual Modeling Environment

Becca Shareff
UC Berkeley
Summer 2017

# Vision



Students will engage in a multi-week garden unit with their science class where they tend to the ecosystem and make detailed observations of biotic - abiotic relationships.



They will test and model their ideas about the relationships in the virtual space, using others' ideas to help them revise and refine their own.

# Motivation

## Engagement

Outdoor experiential learning offers the chance to personally connect to science content through multi-sensory activities, particularly students typically excluded from traditional STEM fields.

Bell et al. (2009); Ozer (2007); Ralston (2011)

## Complexity

Students can develop both domain and complex systems knowledge by conjecturing about and programming their garden observations into an agent-based behavioral language.

Eilam (2012); Harel & Papert (1990); Manz (2012)

## Collective Inquiry

Sharing models and iterating on ideas within a whole-class network can develop students' understandings of both the physical ecosystem and its virtual representation.

Jacobson & Wilensky (2006); Lehrer & Schauble (2004); Wilkerson et al. (2015)

# Research Questions

## Learning through Design

**What design-oriented scientific practices are occurring?**

The garden model is collectively built with students. How can the design process itself be a productive learning opportunity?

## Stakeholder Diversity

**What needs and skills do they express?**

Do students and teachers envision the same end-goal? To what degree are teachers' concerns for students' capabilities reflected in initial interviews?

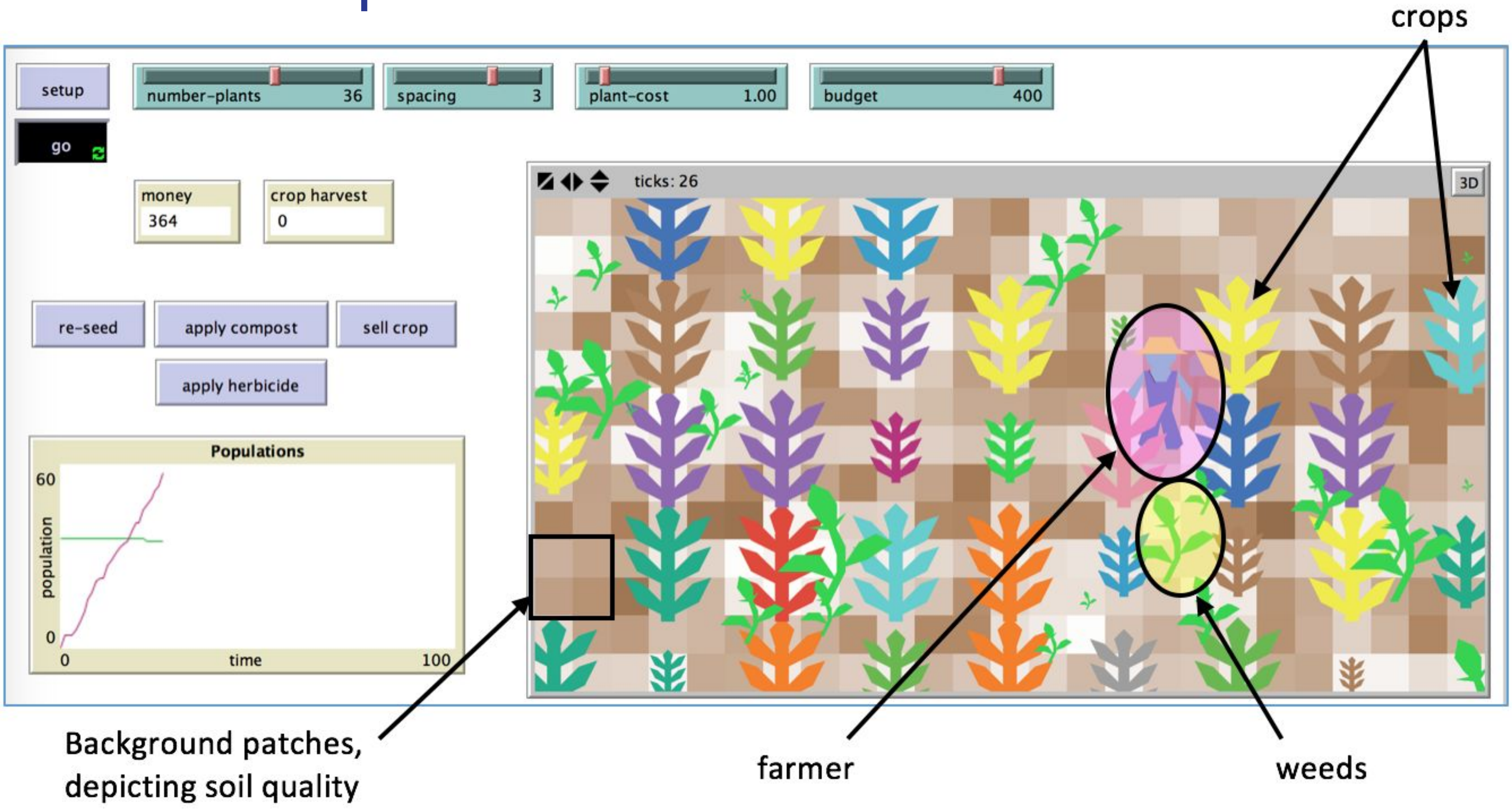
## Tools & Connections

**How can they best support learning?**

What supporting instructional materials can best contribute to the implementation of the activity sequence? How should they work?

# Design Sketches/ Vision

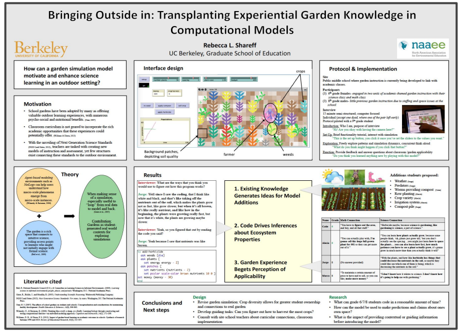
# Model 1 Components



# Project timeline

**Fall 2015**: Idea conception and first model build, pilot student data collection

**Spring 2016**: Data collection with graduate students




**Fall 2016**: First round of analysis complete; presentation to environmental educators

**Spring 2017**: Data collection with middle-school teachers

**Next Steps**: Model revision; second-round student data collection; identify teacher-collaborator

# Methodology

# Participatory design-based research

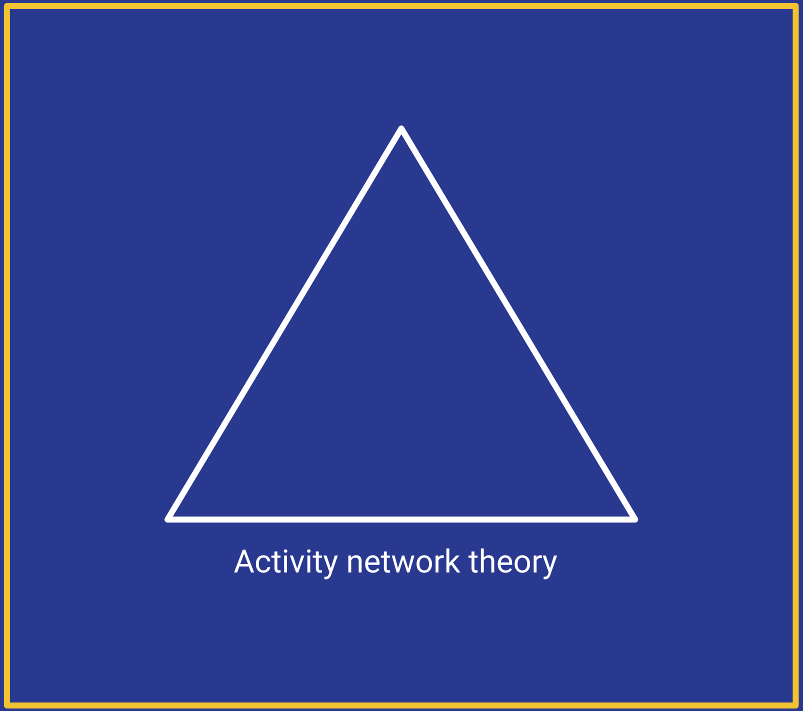
- Middle-school with existing garden-academic project-based curriculum
- Longstanding relationship with district curriculum team, teachers, and principal

Analytical Constructs:

- Current education standards (science content and practices)
- Design heuristics and principles
- Application of external knowledge and contexts
- *Social- emotional learning, affect, and scientific identity*

# Theoretical Frameworks

- Social
  - Stakeholder roles
  - Rules
  - Division of labor
- Environmental
  - Resource systems
  - Instruments
- Conceptual Development
  - Modeling Proficiency (Manz 2012)
  - Ecological Complexity (Hmelo-Silver et al., 2007)




Krasny & Roth (2010)
Engeström (1987)

# Preliminary findings

# When Kids Co-Design and Offer Feedback

*Shaded regions indicate at least one occurrence of expressed learning by that student.*
**The dark color of J's model-based reasoning cell indicates advanced reasoning, to be explicated below.*

| *Student* | Disciplinary Content Learning | | | Scientific Practices | | | Design Attributes | | Application of outside experience |
|---|---|---|---|---|---|---|---|---|---|
| | Herbicide | Plant Nutrition | Abiotic/ Biotic Interactions | Making predictions/ Constructing Explanations | Experimentation | Model based reasoning | User control and navigation | Information accessibility | |
| M | | | | | | | | | |
| J | | | | | | | | | |
| A | | | | | | | | | |
| C | | | | | | | | | |

# Possible impact/ Contribution

" Typically middle school students haven't ever been asked to *develop* the model itself... I can see that the garden gives them something really tangible to work with, that they can observe phenomena in nature and apply it to this model, [which] could give them some experience for...something that's more abstract like a chemical reaction."

-Science Teacher, Grade 8

*Meeting standards, cognitive challenge, and stepping stone to abstract systems & simulations.*

"You can learn how plants actually grow"

-Amelia, Grade 6

*Science learning can be enriched when hands-on experiences couple with virtual representations*

# Thank you!

Becca Shareff

rlshareff@berkeley.edu

[All images from thenounproject.org]

Round 1

- Existing knowledge generates ideas for model additions
- Code drives inferences about ecosystem properties
- Garden experience begets perception of applicability

Round 2

- Teachers view broad subject appeal (history, math, science)
- Different handles on the flexibility for student use