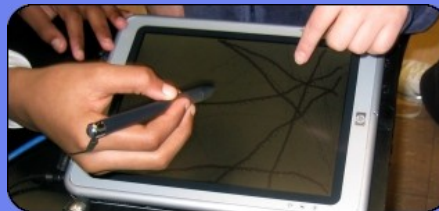
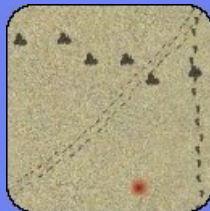


RoomBugs

Simulating Insect Infestations in Elementary School Classrooms Using an Embedded Phenomena Framework

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What are Embedded Phenomena?

- **Map science phenomena** to physical space of a classroom
- A **thin layer** of technology
 - *Lightweight technology*
 - *Minimal set-up*
- Designed to exist as **ambient media** in a given space
- Sole function is to **deliver the phenomenon**
 - *Does not (directly) handle data collection facilities, lesson plans, etc.*

Similar Studies

- Augmented Reality Simulations Klopfer, 2002
 - *Environmental Detectives* uses wireless devices (PDAs) to create parallel reality for investigation
- Participatory Simulations Colella, 2000
 - *Virus* uses custom “think tags” to track transmission of disease from student to student
- Mixed Reality Environments Rogers, 2001
 - *Hunting of the Snark* uses a heavily augmented environment and portable devices

Why Use Embedded Phenomena?

- **Facilitate inquiry learning** through easily accessible experiences
- Create **compelling** scientific phenomena
 - *Believable*
 - *Investigable*
 - *Teacher-controlled*
 - *Not limited by reality*
- Does **not** require heavy instrumentation

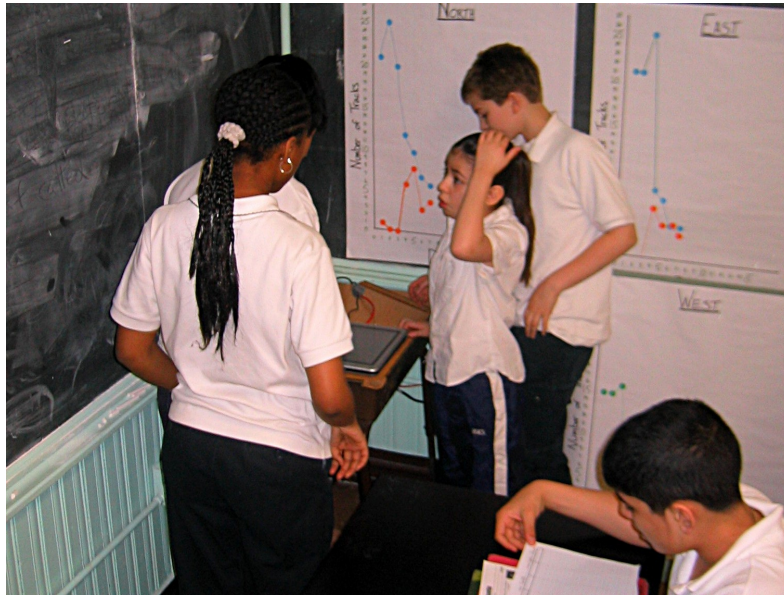
Embedded Phenomena Requirements

- **Commodity hardware**
- **A web browser**
- **An internet connection**

... and that's it!

Inquiry Learning in the Classroom

- Students need...
 - *New, interesting, and challenging activities*
 - *Environments they can investigate*



Inquiry Learning in the Classroom

- Teachers need (and want)...
 - **Engaging** activities for their students
 - Activities that are **easy to set-up & manage** on a classroom scale



Grab their Attention

**Thousands of
insects** are
running loose
in your
classroom



Student Scientist Activities

- **Observe** new bug tracks
- **Identify** species
- **Record** population data
- **Experiment** by changing variables
- **Predict** future populations
- **Justify predictions** based on sound reasoning and collected data

Deliver the Phenomenon

Stations, like **virtual sand traps**, capture foot prints of bugs as they walk around the room



Give them Control

Three variables students can control:

- *Pesticide Type*
- *Pesticide Amount*
- *Spraying the fields*

ENVIRONMENTAL ACTION FORM		GROUP:
		DATE:
Requested Environmental Conditions		
Pesticide Type <i>(check one box)</i> :		
<input type="checkbox"/> Red Reaper	<input type="checkbox"/> Green Eraser	<input type="checkbox"/> Blue Bomber
Pesticide Amount <i>(check one box)</i> :		
<input type="checkbox"/> 10 Metric Tons	<input type="checkbox"/> 100 Metric Tons	
Spray The Fields? <i>(check one box)</i> :		
<input type="checkbox"/> Yes, spray the fields <input type="checkbox"/> No, do not spray the fields		
Explanation		
Why are you making these changes? What is your goal? (for example "To increase X and decrease Y")		
Check the environmental variables that you think are most important for helping you accomplish your goal:		
<input type="checkbox"/> Pesticide Type		
<input type="checkbox"/> Pesticide Amount		
<input type="checkbox"/> Spraying		
<input type="checkbox"/> I don't know which variables are most important		
(Optional) Do you have any theories on the type of environment a bug species prefers?		

Give them Context

Field Guide and Newspapers

situate them in a town searching for a solution to their bug problems


NTA NEWS

All the News, All the Time

Monday, March 13th, 2006
0.25¢

PIQUENTACE STILL GOING STRONG IN NORTH AND SOUTH

PATIENT FARMER IS JUST WAITING FOR SCIENTIST'S SOLUTION



NORTH/SOUTH – Mr. Telios has resigned himself to just waiting, now that his entire crop has been destroyed.


“My crops have all been eaten... there is nothing left,” Farmer Telios said before cradling his head in his arms and sighing. “But I have been promised that those scientist groups in the Northern and Southern regions will be able to find out what I will need to do in the future to control the *Piquentace*. It brings me comfort to know that something this awful will never happen again!”

Mr. Telios was very interested to know if he could use spray on his fields and if the amount of pesticide mattered. “Spraying costs a lot of money and so does pesticide – I just want to make sure that it doesn't cost me an arm and a leg just to grow my crop. I want to make sure that I am only doing the things that I must do!”

CRONOS WORM NEEDS TO RETURN

GARDENS NEED WORMS TO COME BACK

EAST – “I just don't know what to do anymore,” exclaimed a flustered Mrs. Guttleworm as she dipped her glove into the dry soil. “These *Cronos Worms* are so important to my gardens, and now they are all almost gone.”



Across the Eastern area a lot of gardens are slowly wilting away. The worms, which used to flourish here in greater numbers, provide a nutrient rich soil that plants can thrive on. But it has been a while since those days of lush green gardens.


“Oh, I wish we had the worms back. It's bad enough that we're missing the *Red-Belly Beetle*,” Mrs. Guttleworm said as she tossed out some dried cabbage plants. “To make matters even worse, my grandson Jimmy was bitten badly by a nasty *Green Breen* swarm just last week in my garden. Can you believe that?”

Scientists from the East have reassured the area that they know what they are doing, and will in fact live up to their “All Stars” name. Mrs. Guttleworm isn't yet convinced, saying that “unless those scientists are able to find out exactly what is affecting each bug then I just don't see how we can get out of this mess.”

RED-BELLY BEETLE POPULATIONS DANGEROUSLY LOW

ENVIRONMENTAL WATCH GROUP SCARAB WANTS ANSWERS

WEST/EAST – The environmental watch group “Scientists Who Care About Beetles” (SCARAB) are upset. They have noticed a sharp decrease in the *Red-Belly Beetle* populations in the Western and Eastern areas. “We are very concerned that these very important insects are so scarce in some areas,” said Judy Mumbley, President of SCARAB.



Name: _____

Garguantoa

Name: _____

Dil Chata Hala

Name: _____

Red-Belly Beetle

Characteristics:

Distinctive bright red belly and dark green carapace. Scissor-like mandible is used for catching and eating unsuspecting insects. Very fast moving predator. In some isolated areas they have been rumored to grow as big as a child's fist.

Frequency:

Rare

QUADRANT CONDITIONS

NORTH	EAST
Cold	Warm
WEST	SOUTH
Warm	Cold

Encourage Collaboration

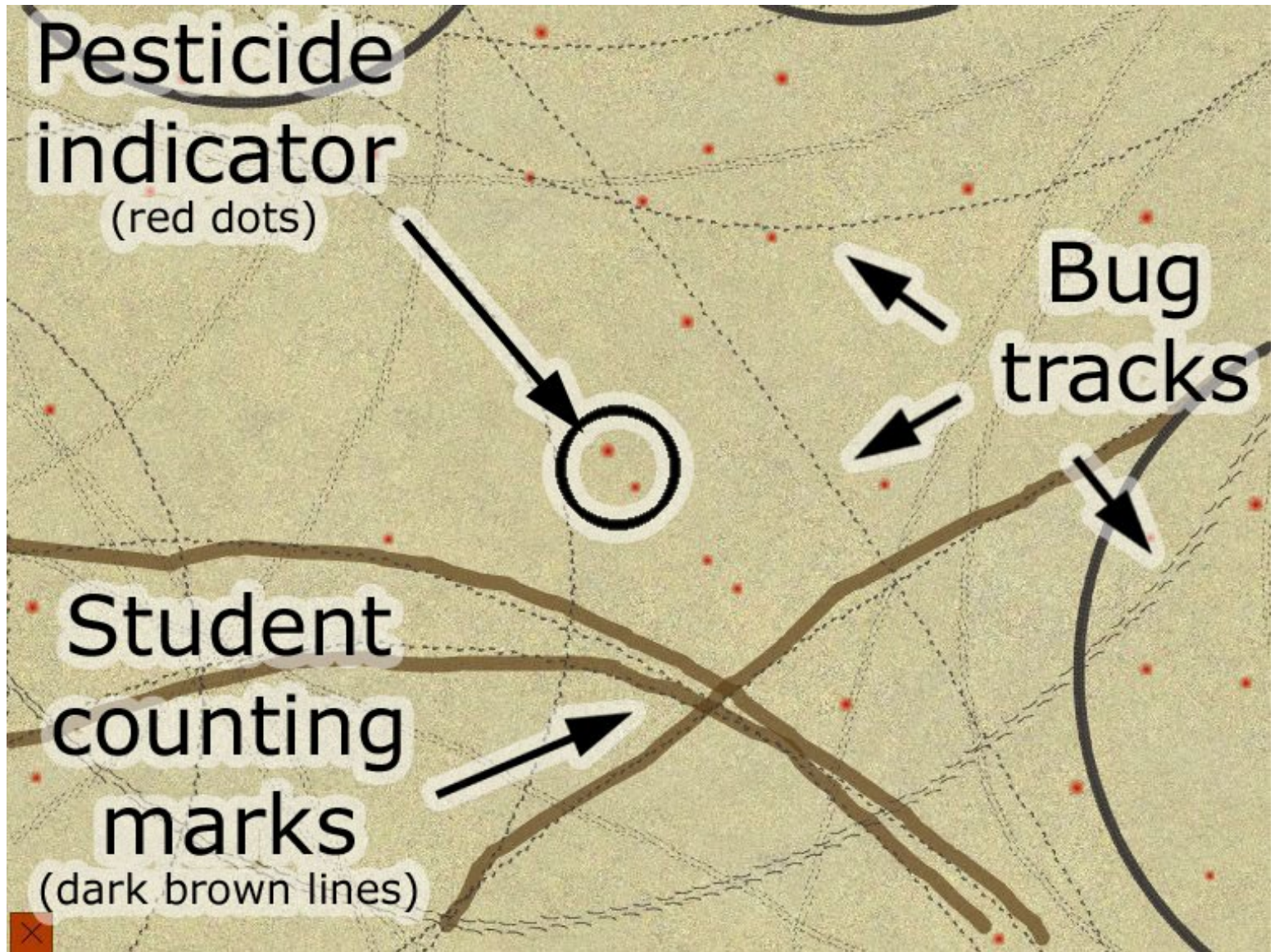
Group notes, charts, and posters augment activity by allowing collaborative data collection and analysis



Interface Design Goals

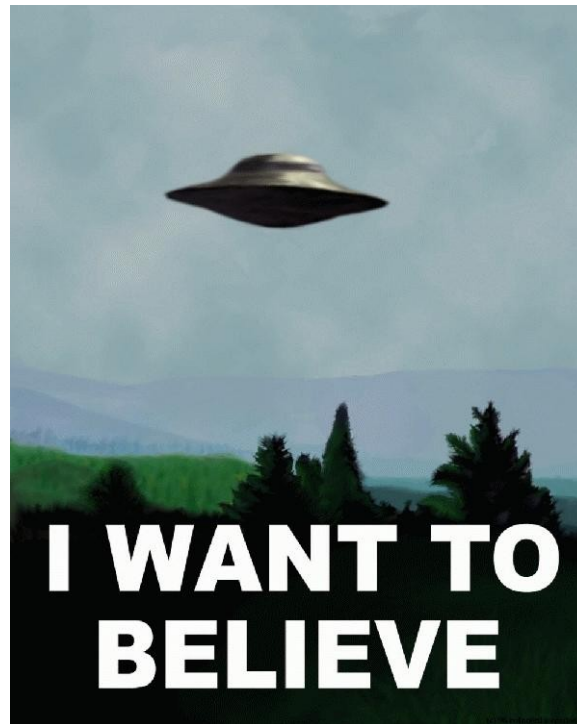
- Displays **avoid traditional windowing elements**
- The stylus behaves **just like a stick** that draws lines in the sand
- **No textual elements** are shown
- **Environmental conditions** are conveyed through appropriate visual cues

Interface (labelled)



Believe Enough To Engage

*Compelling phenomena
only really requires
A willing audience*



Accuracy and Engagement

- **Accurate date capture** was not trivial:
 - *Each track must be identified*
 - *Crowded & overlapping tracks were common*
 - *Novelty of experience decreases over time*
- **Students correctly identified and recorded 94% of the 1,524 tracks generated**
 - *Accuracy actually increased over the course of the activity*

Propensity to Experiment

- **18% decrease** in agreement with the statement: *“It is better to be told scientific facts than to find them out from experiments”*
- **13% increase** in agreement with the statement *“I would rather find out why something happens by doing an experiment than by being told”*

$p < 0.07$

$p < 0.01$

Control of Variables (COV) Strategy

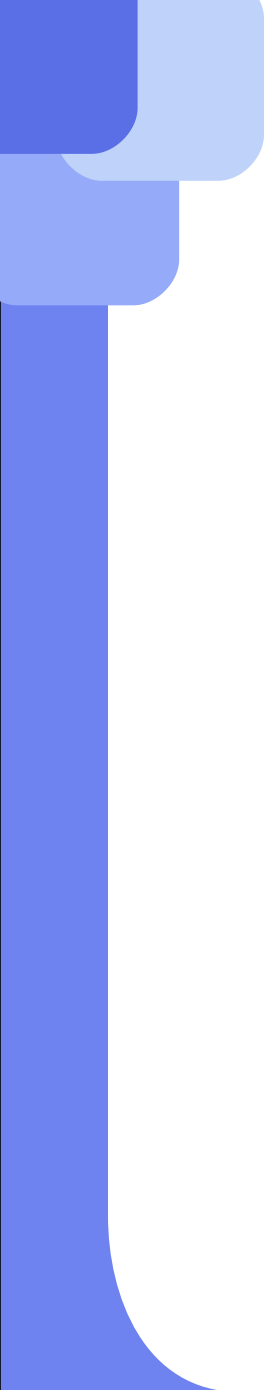
- Finding a solution **requires a strategy**
- Multivariate systems
 - *Manipulation of **only one variable** while others are held constant*
 - ***Difficult concept** even for college-aged students*
- Improvement seen, but **more investigation needed**

Acknowledgments

- **Galileo Academy of Math and Science**
 - *Students from Jeff's 6th grade science classes*
- **National Teacher's Academy**
 - *Mrs. Carol Fisher*
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- **University of Illinois at Chicago**
 - *Electronic Visualization Laboratory*
- **National Science Foundation**
 - *Grants DGE-0338328 and ANI-0225642*

End of Presentation

Thank you!



Spreading the Love

- **Distribute stations** around classroom
 - *Encourages physical movement*
 - *Enables classroom to better approximate a full room simulation*
- Students able to work in **small groups**

