

Practicing Science

Children Invent and Revise Models Of Local Ecosystems

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Disciplinary Disposition

- Disciplined ways of knowing
- Epistemic culture (Knorr-Cetina, 1999)
- Configuration of social, cognitive, and material mechanisms

Modeling

- “Model-based reasoning practices are the signature of research in the sciences.” (Nersessian, 2008)
- Students participate in forms of modeling practices to address questions about natural systems.
- What forms of modeling are accessible to youngsters?

Development of modeling

Analogy



Physical
Microcosms

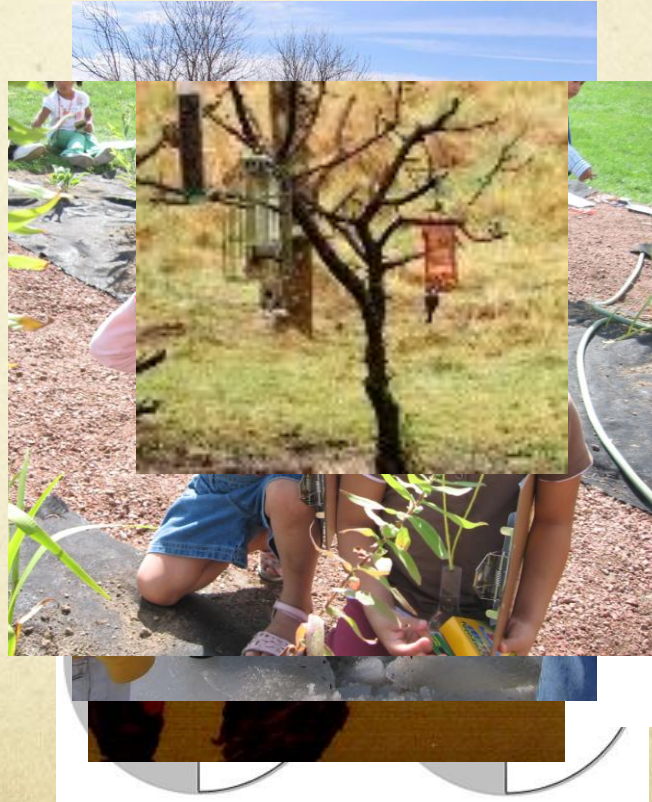
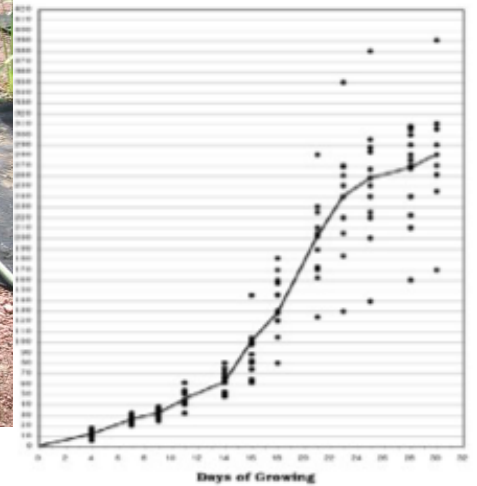
Representational
Re-Descriptions

Syntactic

Materiality



Height of Round Two Fast Plants
(6 pellets fertilizer)



Modeling means coordinating:

- Questions
- Measures
- Representations
- Materials, instruments, observation schedules, experiments
- Data and data structures
- Potential claims and argument

Long-term perspective

- Students at all grades involved in continuing ecosystems investigations
- Levels of modeling work, questions, conceptual tools
- Emphasis on building students' ecosystem knowledge and modeling capacity across grades

Teacher-Researcher Community

Lessons 6 and 7

Viewing Plant Life

Investigating Plant Life

Materials:

Pond Circle, by Betsy Franco and Stefano Vitale
Plant field guide slideshow
Plant field guide signs
Shovel
Small basins

Science journals
Pencils
Wet wipes
Trash bag
Student water bottles, if needed



"I see two hotdogs on that cattail."

This child identifies an attribute that distinguishes the plant as a Wide Leaf Cattail and not a Narrow Leaf Cattail.

Day 6

Viewing Plant Life

Read *Pond Circle*, by Betsy Franco and Stefano Vitale and notice the illustrations of plants in the pond.

View the plant field guide slide show. Encourage students to read the attributes and to "spy" them in the photos.

Day 7

Investigating Plant Life

Prior to visit: Place the plant field guide signs near matching specimens. Space the signs to surround the pond. Dig up a few of the plants to show root structure.

Establish rules for the pond visit.

Gather students near the Narrow Leaf Cattail sign to listen to a brief history of the pond.

At this time, students are given instruction on how to use the plant field guides: Look at the photo of the plant, read the attributes and play "I Spy" to find the real plant nearby.

The remaining time is spent with a free flow movement of students stopping at field guide signs, playing "I Spy" and sketching plants in their science journals. Students may copy the names of the plants from the field guide signs.

Wash hands and gather for a water break.

History of Pond on Whalen Road, 2010 As told by Cinda Quinn

About 10 years ago, there was no pond here. It was a flat field of grass and the houses behind us and to your left were not here. The farmer who lives in the rock house to your right let his horses run in the grassy field. One year he decided to move his horses to a different field so he could plant pumpkins here. He took down the fence and had a huge pumpkin patch and neighbors from across the street would walk here to pick their pumpkins for Halloween. After a few more years, he decided that he didn't want to plant pumpkins. He thought he could sell this land to a developer for a lot of money and beautiful houses could be built here.

The developer wanted to build these houses and he wanted to make sure that no water would seep into the basements, so he brought in big bulldozers to dig a hole for this pond. He had large dumptrucks carry the soil away so there would be enough space for the rainwater from the hillside and the street to run into the pond. If the pond gets too full, it lets the water run through the drain and below the street until it empties into the Mill Creek.

When the pond was built, grass seed was sown around the pond, but no other plants were put here. Over time, seeds were dropped here by the wind, and animals carried seeds on their fur to the pond. Eventually, all these plants started to grow and spread in the pond.

Construct Connections:

Notice attributes of plants for identification or comparison. Eco 3d

A slideshow will help students identify and compare attributes of plants.

On the third visit to the pond students will investigate plant life. They will match photos of plants to real specimens.

Drawings of the plants. Eco 2b

Students sit by plant field guide signs to spy the specimens and sketch them in their science journals. They may copy the names of the plant from the field guide signs.



Pedagogical Principles

- Learn in depth: “Big ideas”
- Generate fruitful questions
- Develop conditions for seeing
- Invent and critique measures
- Develop representational competence
- Participate collectively

Disciplinary themes

Variability

Difference → Distributed
Space
Time

Change

Organism

Population

System

Ecosystems

Association → Interaction

Constructs	Levels			
	Initial	Developing	Stabilizing	Emerging
Learning performance Individual Change	Select & represent relevant attributes of organism	Represent change as difference	Represent change as rate/changing rate	Describe covariation among two or more rates of change
Mediated by	Physical models, drawings, Venn diagrams	Remnant models (e.g., pressed plants), paper strips, measure	Tables, Cartesian system, linear function	Bivariate display, function (exponential, logistic)
Variability	Observe/inscribe difference	Construct measures of individual difference	Represent individual differences as distribution	Develop process models and evaluate model fit
	Drawings (e.g., morphology of soldier fly vs. beetle larvae), remnants	Tables, lists	Frequency displays, statistics	Chance models of distribution
Population Change	Identify attribute of a population	Produce qualitative description of change in attribute over time	Describe change over time for a single variable	Characterize population growth
	Measure	Counts, difference, table	Piece-wise linear change, distribution	Function
Ecosystem	Consider place and organism using analogy to humans	Relate place and organism by considering needs of organisms	Partition place and consider effects on survival and reproduction of organisms	Model interactions among organisms and place to predict stability and transition
	Narrative	Drawings, field guides (constructed by teachers, students)	Maps, sampling schemes, models of chance variation	Electronic tools for model construction

Level 4 of 7: Survival of organism in particular habitat

Consider how particular qualities or partitions of the environment affect the survival and reproduction of organisms.

	Learning Performances	Examples
4A	Pose question about how particular qualities of environment affect survival.	<ul style="list-style-type: none">• “How much sun does this plant need to flower? Will it get enough here?”• “Who lives near the shore and why do they live there and not somewhere else?”
4B	Use coordinates or related means to describe locations within a large-scale space.	<ul style="list-style-type: none">• “This map of the pond helps us find the same place in the fall and the winter, even though things look different in the fall.”• “This profile of the stream bottom shows how the bottom changes from the bank to the middle.”
4C	Identify and measure microscopic or invisible qualities of place, assisted by tools such as soil moisture meters, thermometers, and dissolved oxygen meters.	<ul style="list-style-type: none">• “When the pond freezes, the dissolved oxygen is 2mg/L near the bottom during the middle of the winter.”• “The speed of the water in the stream is changing with depth.”
4D	Consider how attributes or behaviors of an organism suit that organism to use the resources available in a partition of place or time.	<ul style="list-style-type: none">• “The water in the river near the bank is moving more slowly and that helps the clams stay there and eat. But in the middle where the current is fast, clams can’t get a grip.”
4E	Determine and apply partitions in order to predict or explain relative abundance of organisms.	<ul style="list-style-type: none">• “This side of the hill is on the north, and the way it slopes means that there is very little sunlight. That may be why we are finding fewer saplings on this side of the hill than on the top.”

Pedagogical principle: Generating fruitful questions

Questions about the Pond 3.14.09

Are there fish in the pond? Jonah

I wonder if they're are frogs in the pond?

Brooks

I wonder if there is anything living in or near the pond?

Bri

does that include plants? yeah

I wonder if some bugs burrow in the mud to keep warm in the winter?

There aren't escape places for the fish so I wonder how they survive. Isaac

Are there any cattails and do they have buds? Cece

Do you think you'll see any water striders on the top of the water?

Jake

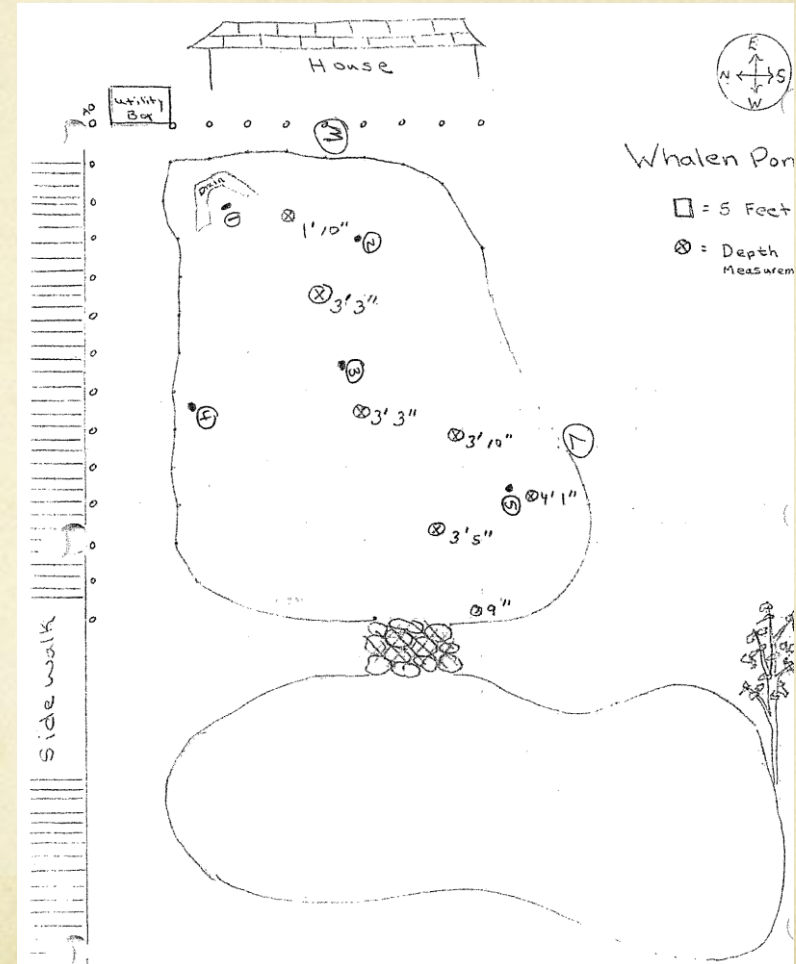
They'll be skater striders. Priya

I wonder if the bugs in the pond behave differently in the winter than in the spring. Kade

I wonder if some bugs changed their structures to help survive the winter Maya

I wonder if the bugs have different movements: move more in the winter like we do to get warm. Priya

Pedagogical principle: Developing conditions for seeing





Fifth, we found
the darker dirt.

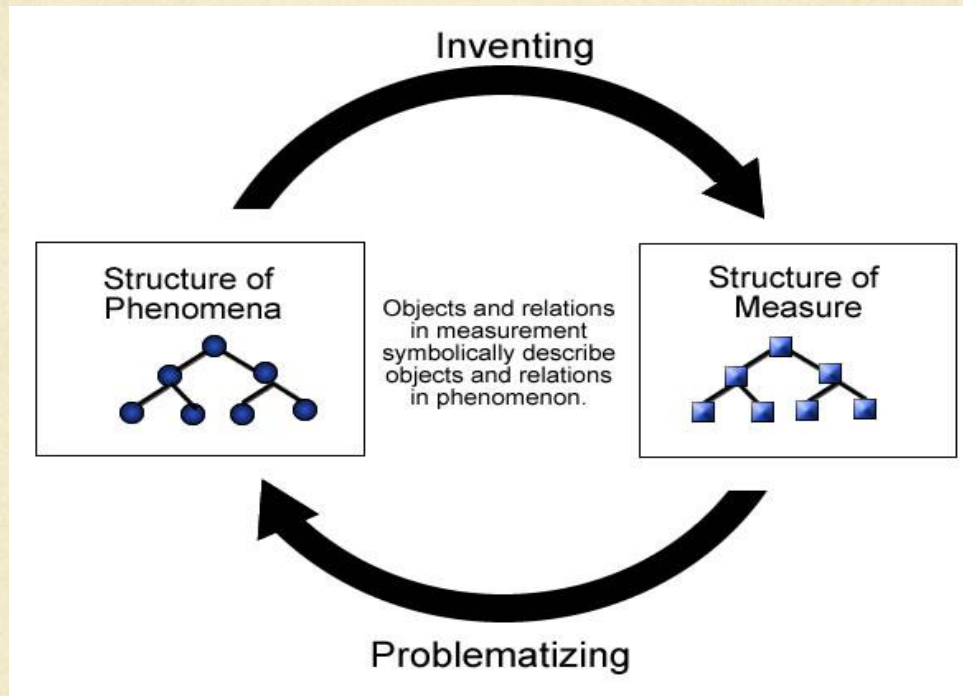
It looked darker
than the others
except for the
first bag of dirt.

It felt pebbly, sandy,
like it is still
needing to form,
and more loose than the ^{others}

It smelled disgusting,
like rotten hot dogs
and rath eggs.



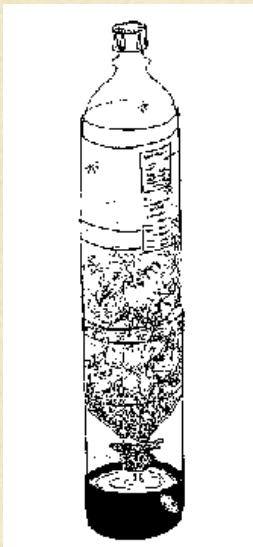
Pedagogical principle: Inventing measures



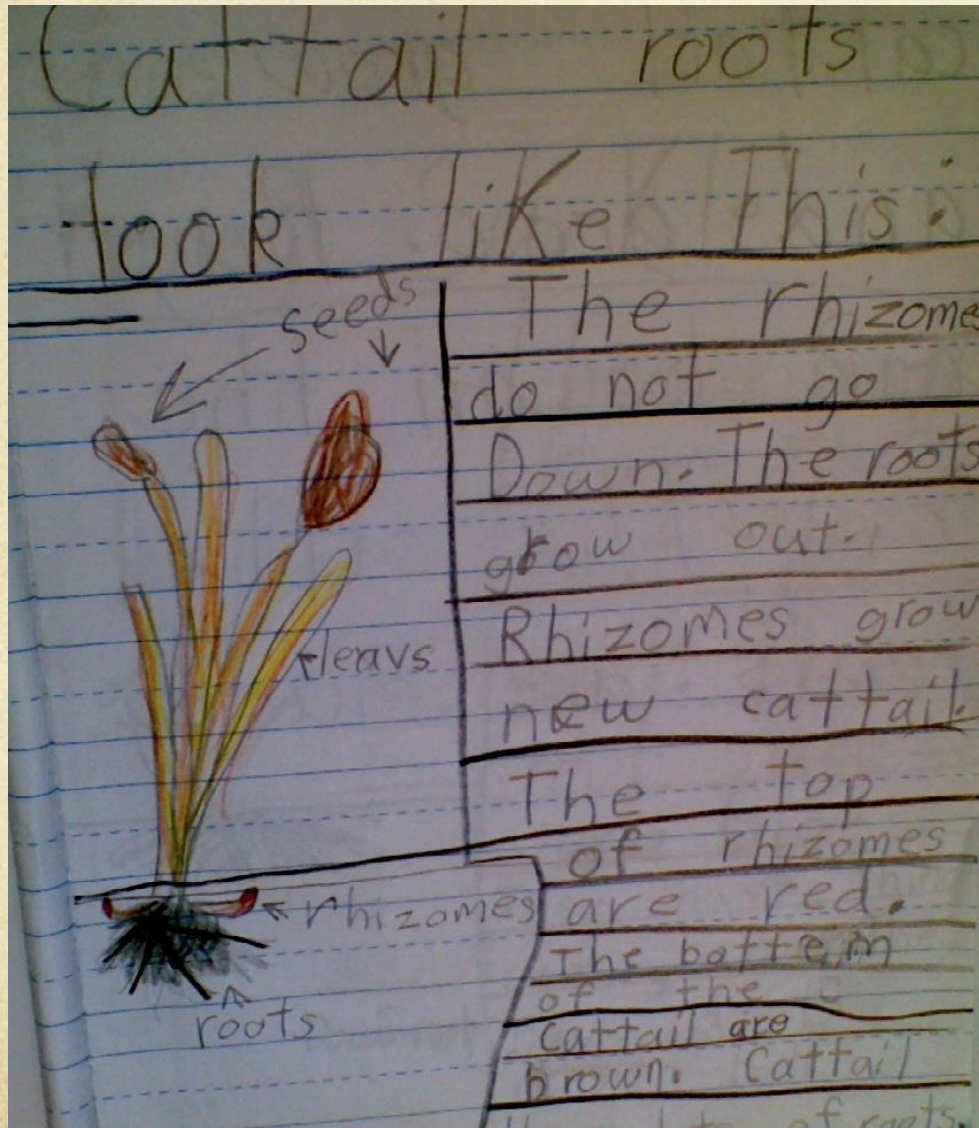
Inventing Measures

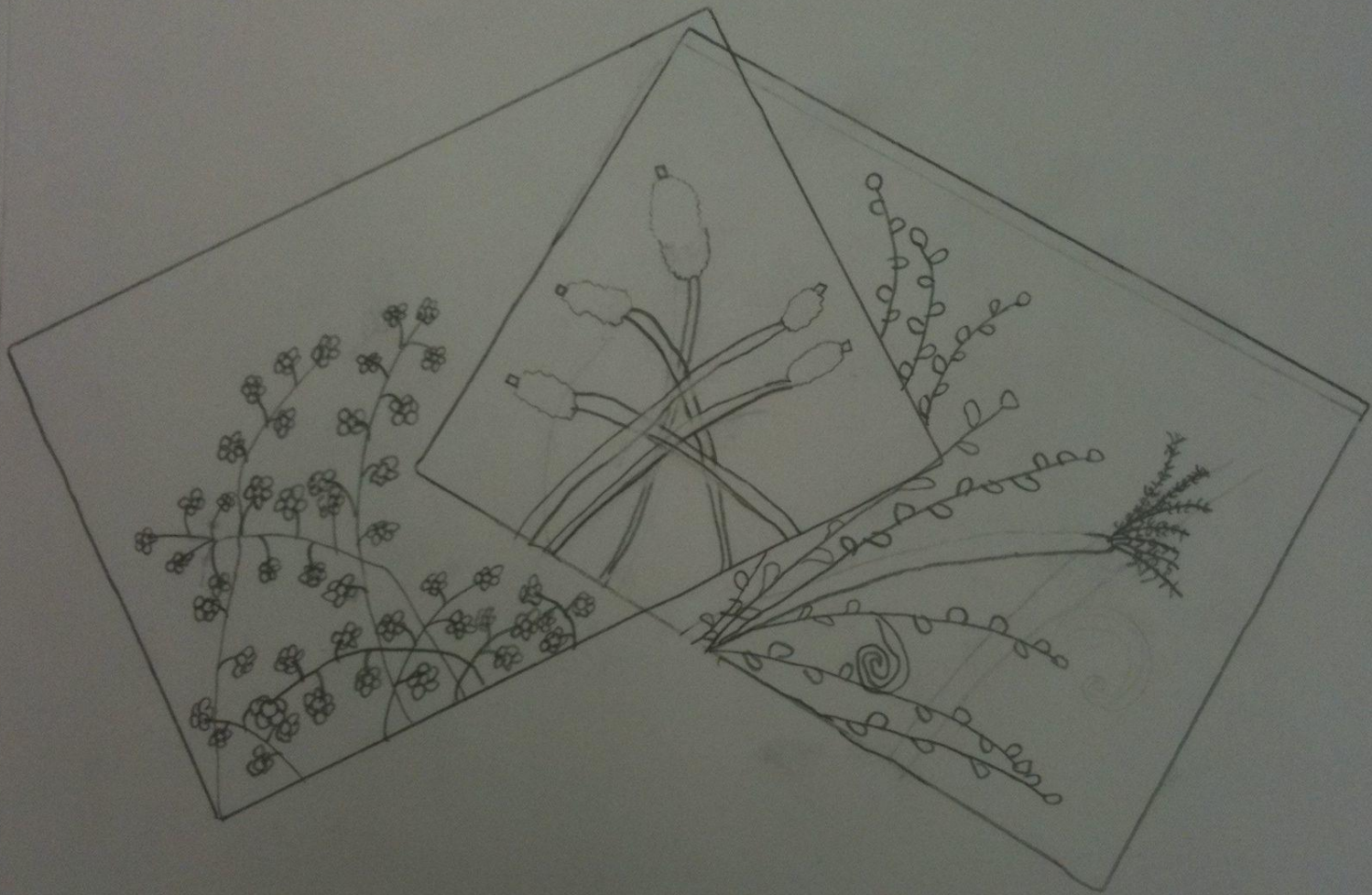
- Plant “Success”: Height? Canopy? Seeds?
- Soil “Moisture”: Dry, Moist, Wet (3 pushes of a paper towel dispenser is moist)
- Insect Abundance: Count (specify type of net)

Pedagogical principle: Representational competence



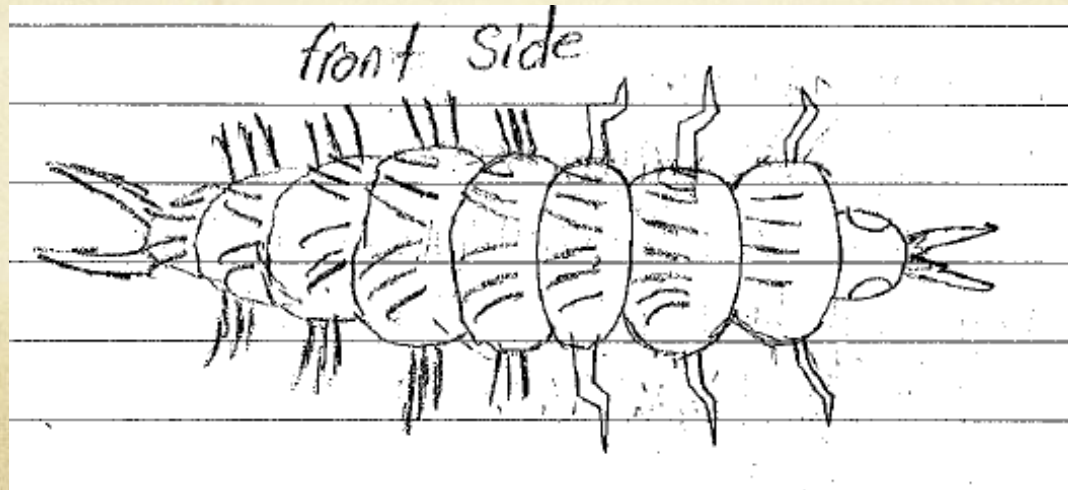
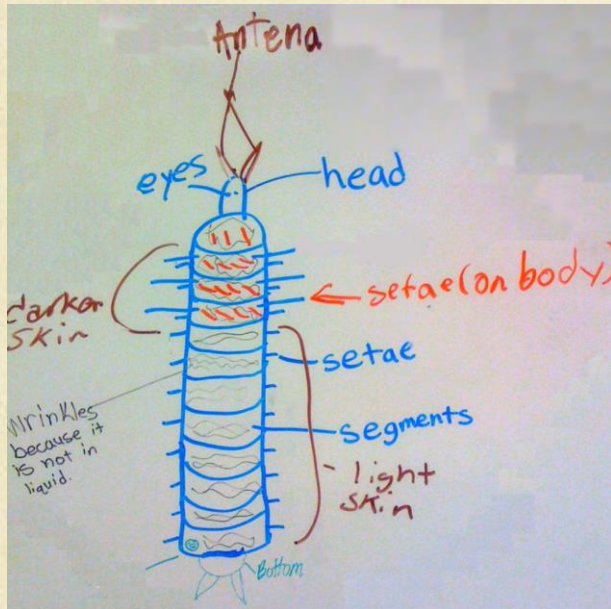
Representations amplify





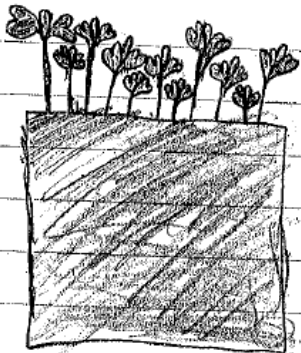
Hannah Sheedy

Representations also reduce



Circulating reference

Today Area 1, 2, 3, and 4 all have true leaves. They are very beautiful. On the stem they are hairy. There is something on area 4. What could it be? It is very small and it look like an egg. Could it be an egg? It has a white dot in the middle.



Fast Plant Growth



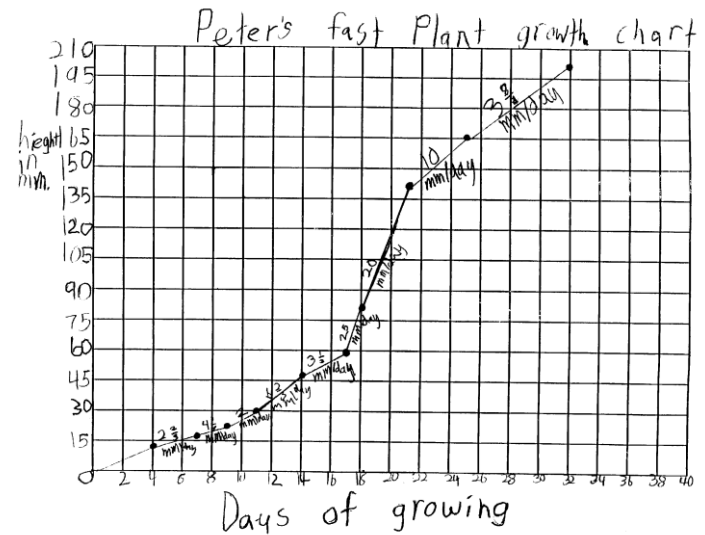
DAY 7
April 22



DAY 11
April 26



DAY 13
April 28



Pedagogical Principle: Participate Collectively

Whalen Pond Photo Plant Walk October 2011

"There were not many tall plants." Bri

"There were not many pokey thistles by the water." Seth



"I caught a cricket and a grasshopper in the grass." Annika



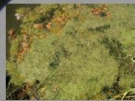
"There are lots of different kinds of plants at the pond." Owen



"Most of the plants are green." Bronwyn



"Many plants had small leaves."



"There were lots of tall grasses scattered around the pond." Bella

"We saw a fat orb weaver spider on a plant." Mathias

"There is duckweed by the edge of the pond. Not in the middle." Courtney

"Plants are not really in the pond. They are on the edges on land." Rachel



"There were lots of little daisies around the pond." Cecilia

"The brown tops we saw were smaller than what we saw at the HS." Bryn



"Maybe we are seeing less cattails because the grasses moved in." Bella



"There were less cattails from last year." Sydney

"More cattails are growing back." Cole

"Lots of the cattails did not have the brown tops." Joe

"Maybe the seed pods are not there yet because the cattails are kind of new and they are not ready yet." Gracie

Whalen Road Sidewalk

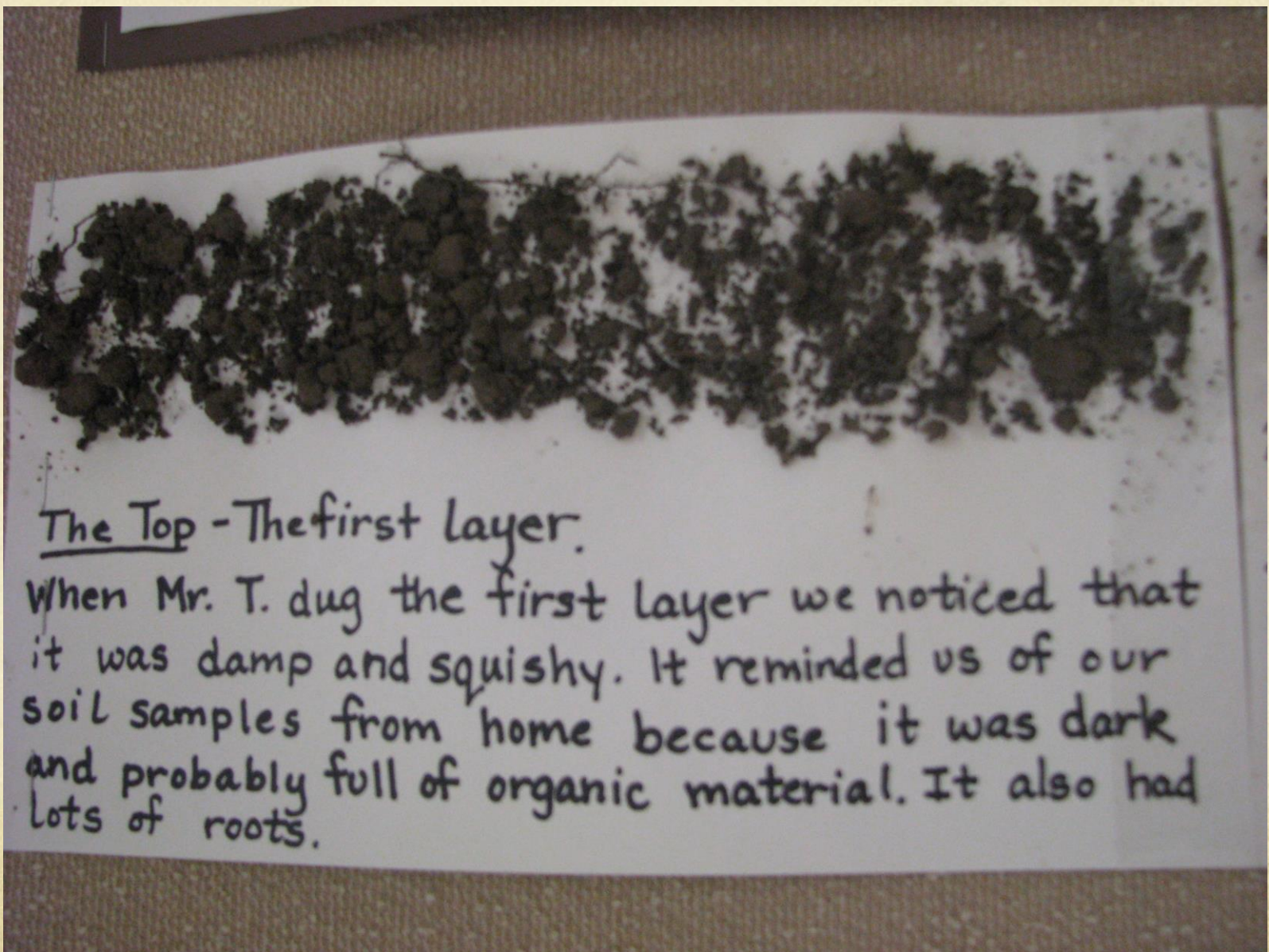
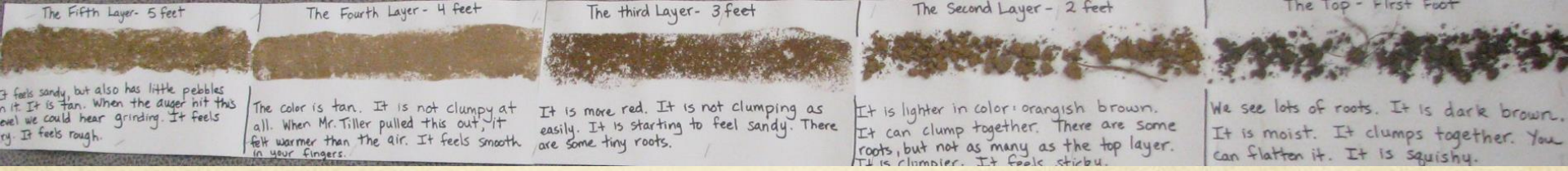
THE FOREST PRAIRIE AND WETLAND

What lives where?
Why?



Let Dig Down, Dig

A display board with soil samples and labels. The board is divided into several sections, each containing a soil sample and a label. The labels include: "The Forest Layer", "The Prairie Layer", "The Wetland Layer", "The Forest Layer", "The Prairie Layer", "The Wetland Layer", "The Forest Layer", "The Prairie Layer", "The Wetland Layer". Each sample is accompanied by a small photograph of the soil profile.

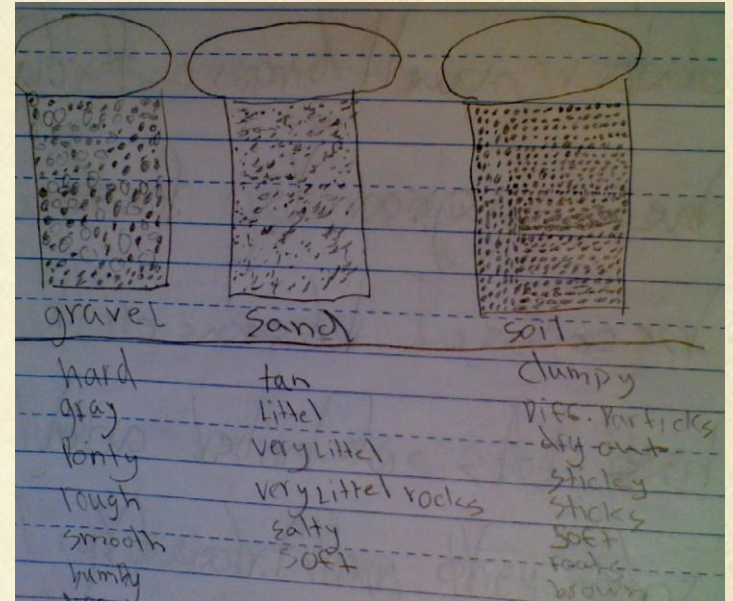


The third Layer - 3 feet

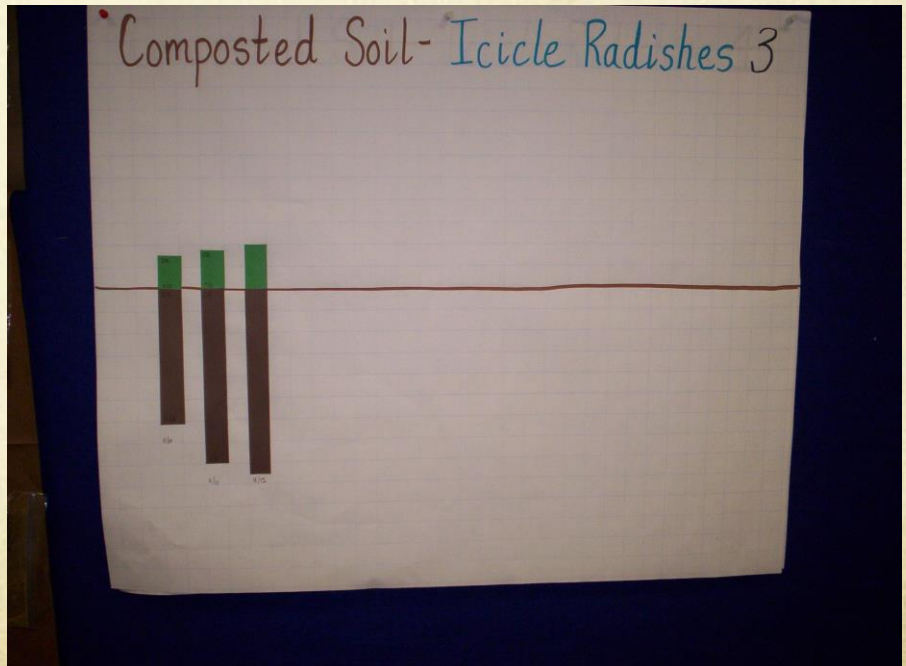


It is more red. It is not clumping as easily. It is starting to feel sandy. There are some tiny roots.

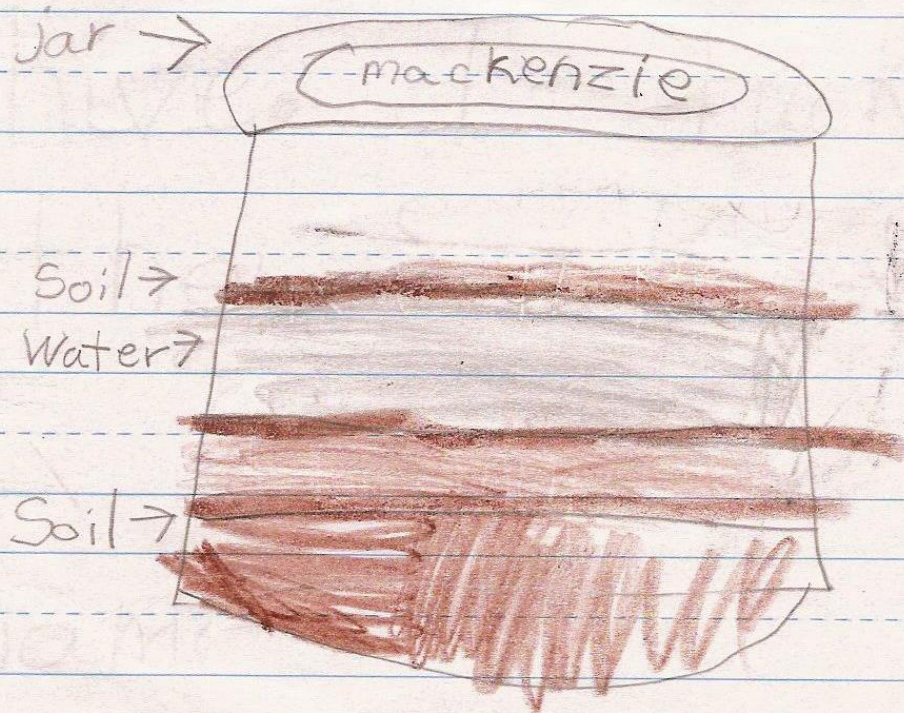
Properties of soils



Properties of soils

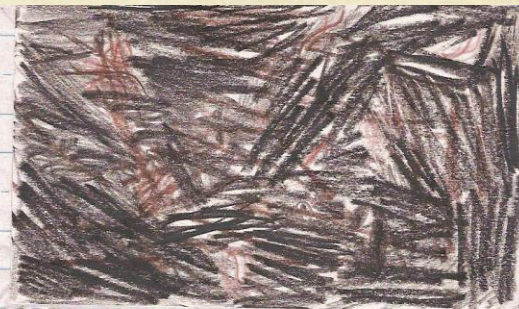


I saw my jar
with soil and it
looks like:



My Soil has 2
Laere of Soil and 1 Laere of
water.

Properties of soils



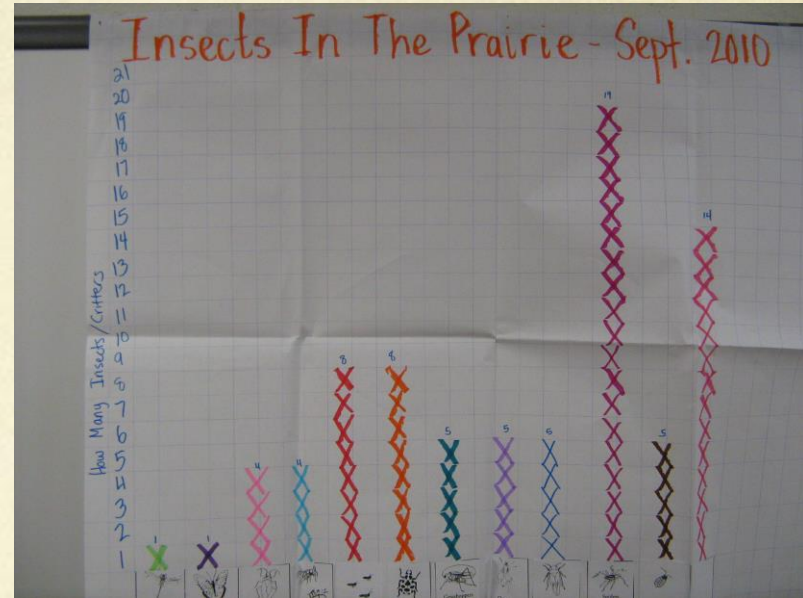
Soil is, brown and
black. It sometimes
has little clumps in
it. The clumps are made
out of moist soil.







Insects in the prairie



Mircocosm

Rain garden



Rain garden remnants





Capturing cross -grade change

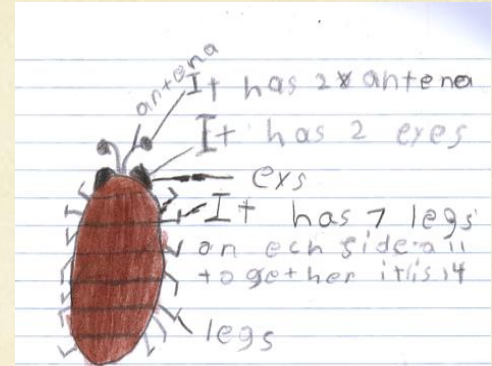
- Relationships between organisms and environments
- Variation, competition, change
- Design of investigations
- Constructing & interpreting samples
- Data display-based reasoning
- Purpose of models & model-fit

What is a sample?

- Samples represent, provide information about something beyond the collection
- Specific biological knowledge guides plans for sampling
- Chance or variability in sampling
- Randomization
- Multiple trials
- How many samples?

1st & 2nd Grade: Samples

- Idea of a sample as representing a population
- Comparison and control
- “When it’s equal
you can really compare.”



3rd Grade





Trial |
blue | green

Predictions
 5 times blue
 5 times green
 it spins in two ways
 6 green or
 4 blue or
 sort of popular
 5 and 5
 depends on
 which way
 how hard you
 spin
 depends on
 which way
 you spin

3rd Grade: samples

- Representational status of samples
- Part/whole notion of sample
- Plans for stratifying based on biological knowledge
- Purposeful samples intended to capture variability

“If you focus on one part and say that everything in that one spot is in the whole pond, it’s not fair.”

Continuing efforts....

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Verona Area School District



Photo by Seth Jovaag

Glacier Edge Elementary School teacher Liz Penner grabs a handful of solid waste from the bottom of the Whalen Road pond dredged up by parent volunteer Keith Zoromski on Tuesday as part of a lesson on ecology for her first- and second-grade students. A grant and some labor from the city are combining to build an observation deck across the middle of the pond that will add to its educational value.

A bridge to nature

Grant will further efforts to make pond a learning laboratory

SETH JOVAAG
United Newspaper Group

Big plans are in the works for a small pond on Verona's south side.

School and city officials last month landed a \$27,000 grant that will help pay for a new observation deck, walking paths, signs and native vegetation at the man-made Whalen Road Pond in the Hawthorne Hills neighborhood over the coming year or two.

The storm water detention pond, one of more than 50 in the city, has for years been an "outdoor lab" for nearby Glacier Edge Elementary School, where students regularly trek three blocks to study aquatic insects and plants as part of their science,

math and other classes. Students from other local schools and the University of Wisconsin-Madison have also studied the pond.

On April 20, the Madison Community Foundation awarded a \$27,000 grant for the project. Glacier Edge teacher Liz Penner, Verona Area High School science teacher Matt Tiller, and City of Verona assistant director of public works Marty Cieslik wrote the grant with Robert Bohanan, a biology educator with UW-Madison.

The grant — along with an estimated \$66,000 of donated "in-kind" labor by city crews — will help create a pleasant spot for residents to check out the pond, and it will bolster city

and school efforts to educate local citizens about what they can do to keep local ponds clean, Penner said. "We hope this initiative will really support learning in the whole community," she said.

Work on the observation deck, walking trails and signage will likely start this fall, Cieslik said. Plans also include planting native prairie grasses on a tenth-of-an-acre area east and south of the pond at a later date.

In addition, Cieslik and school leaders expect to continue talking to owners of the 55 homes in the neighborhood that send runoff into the pond. Cieslik wants to encourage the

Turn to **Pond**/Page 7

Town of For plan new

MARK IGNATI
United Newspa

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Recall

SETH JOVAAG
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Just we
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head back
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the June 5
Gov. Scott
The most
is between
— and one
candidate -
Democrat

