Inquiry-Based Learning: Preparing Young Learners for the Demands of the 21st Century

SUMMARY

In this classroom early learners are challenged to explore a hands-on investigation in science. Using inquiry to inform the process, students are led through a carefully developed and exciting study on the life of worms. Across observations, rich discussions, and nature journals, a multi-sensory experience unfolds in one urban classroom.

Learning begins with a sense of wonder

— a sudden spark that ignites a curious mind and propels it into action. Children are born with this innate sense of wonder. They begin their lives already demonstrating the skills of a scientist, observing and questioning the environment in order to make sense of their place in the world. They totter to and fro, experimenting, fumbling, wondering and thereby creating their own understandings. Unfortunately, in this educational climate's push toward standardization and a one-size-fits-all curriculum, it is all too easy to lose sight of the natural curiosity piping from young children. As early childhood educators, it is our responsibility to nurture and defend the threads of curiosity and the wisps of wonder in order to best equip our youngest learners with the skills to become the future problem-solvers, researchers and critical thinkers of the 21st century.

The learners of the 21st century are poised to join a workforce that requires them to ask questions, problem-solve and think critically, pursue investigation and share and apply their findings through multisensory lenses. Many of today's jobs require workers to think outside of the box and problem-solve from different angles, always being ready to construct and defend a new way of thinking. In order to provide

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the learners of today with the tools to participate fully in this challenging workforce, the understandings of teaching methodology in the classroom must be altered.

Gone are the days of regurgitation of facts and figures or filling in bubbles on an examination. John Dewey in *Education and Experience* (1938) described this rote process of learning as "static," referring to traditional education as an "imposition from above and from outside" (p. 16). Instead of teachers filling young minds with isolated skills and required subject matter, Dewey advocated that children should be actively involved in their learning and help co-construct knowledge that has both interest and meaning to them. In order to facilitate this progressive branch of learning, he maintained that the image of the role of the teacher should change from that of an "external boss or dictator" to that of a "leader of group activities" (p. 45). It is essential that we take a cue from Dewey's research and begin to transform teaching and learning into two-way dialogues that prompt active participation for our 21st-century learners.

Inquiry-Based Learning

Our pedagogical method of choice is *inquiry-based learning*. This approach invites children to take center stage in their own learning. Children pose meaningful questions and are encouraged to solve problems by experimenting and evaluating possible solutions. Teachers guide children to apply this newly constructed knowledge to broaden, analyze, critique, and ultimately defend new hypotheses. The teacher's role within this framework is that of a facilitator, guiding learners to explore their questions and decide on a course of action. Teachers pose carefully crafted, open-ended questions that allow learners to deepen their thinking and investigate further, rather than respond with one correct or incorrect answer. These open-ended questions are a pairing of the teacher's goals and learning objectives but also follow the lead of the children's own thinking. Teachers actively listen and reflect upon the thoughts of children in order to provide resources and provocations to extend the learning. They document the process of learning and make it visible to others through such mediums as photography, narratives, transcripts, videos, or audio recordings.

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To channel this level of engagement in the classroom, our youngest students must be actively present and instrumental in their own learning.

The Benefits of Inquiry-Based Learning

Inquiry-based learning is a method of teaching and learning that extends across content areas. Inquiry, as characterized by the National Science Education Standards (1996), refers to the multifaceted process of gaining information through diverse levels of investigation. The standards compare the inquiry process in the classroom to the activities and thinking processes of real-life scientists. Inquiry in both realms requires all participants to make observations, pose questions, actively engage in the research process and share their findings. In order to channel this level of engagement in the classroom, our youngest students must be actively present and instrumental in their own learning. This inquiry model echoes the constructivist theories of Freire, suggesting that children must be active participants in their learning, as opposed to vacant minds waiting to be filled with preordained information (Freire, 1970).

From the preschool to university setting, research points to growing evidence that inquiry-based learning fosters problem-solving, critical-thinking, and meaningful ways to co-construct knowledge (Wells, 1992). Samarapungavan, Mantzicopoulos, and Patrick (2008) compared the learning outcomes from a kindergarten guided butterfly inquiry with those of a comparison kindergarten group lacking the inquiry component to the butterfly study. Results showed that learning outcomes were richer and the level of student engagement was higher when teachers allowed students to follow the leads of their own questions and engage in authentic exploration within the inquiry group. Students were encouraged to make predictions, observe, investigate, and share their findings through discourse, drawings, and book readings (Samarapungavan, Mantzicopoulos & Patrick, 2008).

Inquiry-based learning also enables children to find their individual voice (as opposed to that of their teacher) and critique their own thinking. Research conducted by Hamlin and Wisneski (2012) emphasized the powerful learning that preschoolers engaged in when simply responding to an open-ended "what if" question posed by their teachers (p. 82).

Conezio and French, designers of a preschool science-based inquiry curriculum, also noticed a correlation existed between inquiry and the strengthening of literacy and language in the classroom environment. When students were engaged in a rich discourse about their learning, both receptive and expressive language skills were exercised (Conezio & French, 2002). A discourse between children involves the ability to actively listen to others and take note of different

perspectives or opinions. Ellen Doris in *Doing What Scientists Do* (2010) emphasizes the importance of this exchange of information as children collaborate to deepen their knowledge and understandings.

The Beginnings of A Worm Inquiry

In our urban public school on the Upper East Side of Manhattan, an inquiry process unfolded within a worm and composting investigation done in collaboration with a kindergarten and first-grade classroom. Our classes began the year engaging in weekly nature walks to a nearby park, accompanied by teachers and family volunteers. The children were tasked with collecting samples, sketching interesting findings, and jotting down ideas and observations in their nature journals. Through the course of several outings and rich discussions about the children's questions and observations, we noticed a propelling interest surrounding worms and the mystery of their life underground.

We gathered the children's initial understandings about worms through conversations, drawings, and written facts. This dialogue served as a formative assessment of the children's original understandings about worms.

Sample facts from the classes included:

"Worms help trees."

"Worms eat in a compost."

"Worms eat mud sometimes."

"I know about worm's doo doo. This is soil."

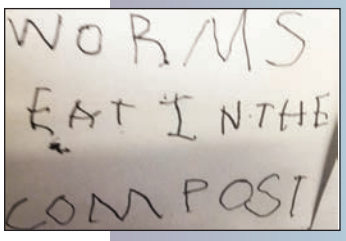
"Worms can grow a part of their body back if it gets cut."

"Worms eat dirt."

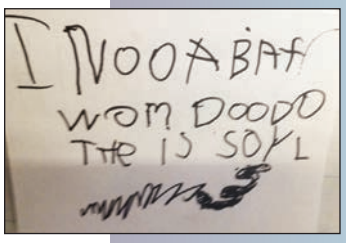
"Worms only live underground."

Both classes engaged in direct, hands-on exploration of a worm bin with Red Wiggler worms to allow children to further their observations and begin to pose wonders. The children took part in setting up the habitat and spent time observing and interacting with the worms.

Children examining worms during a nature walk to the park.

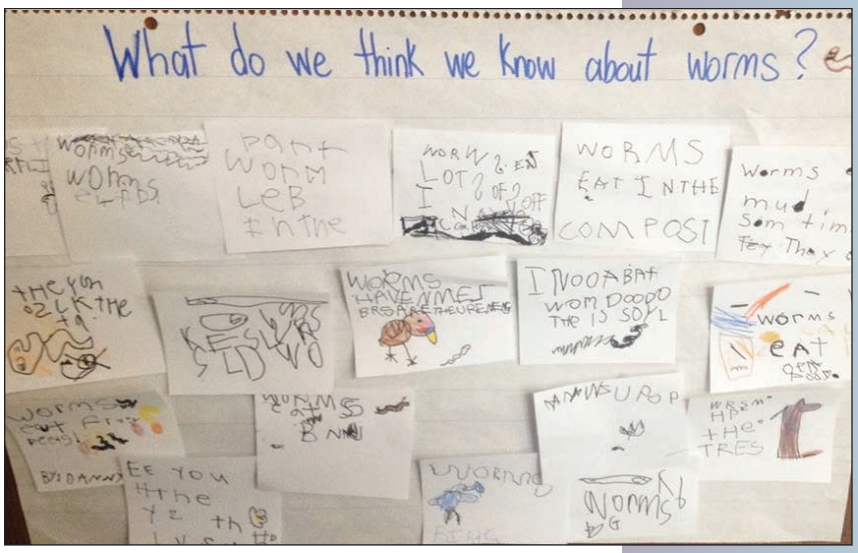


"Worms eat in the compost."



"I know about worm doo doo. This is soil."

Formative assessment interactive chart



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Children prepare the worm habitat by gathering strips of newspaper.

The strips of newspaper must be damp. The children are dipping the paper in water.

The worms are placed into the bin.

Kindergartner and first-grader exploring worms during buddy time.

During these observation times, we filled our notebooks with the thoughts and questions of the children.

"Do they like light or dark?"

"Do they like to be touched?"

"Can they hear?"

"How long will they get?"

"Why do they squirm?"

"Why do worms curl up?"

"Where are their eyes?"

"What is the ring around the body?"

"What do they like to eat when they go outside?"

"What do the babies look like?"

"Do worms have mothers?"

"Do they grow in their mother's belly?"

"Why are they wet?"

"Do worms have a heart?"

"Where are their teeth?"

Posing Questions and Seeking Answers

Through observation, experimentation, book research, interviews, and videos, the children began exploring and seeking answers to their many questions. An interview with an expert from the Lower East Side Ecology Center provided the children relevant information about the parts of the worm, their habitat, and how to feed them properly. Families from both classes contributed to our investigation by sending in food scraps for the new compost bins to help feed the worms. The pictures and captions in nonfiction books helped the children investigate the inner workings of worm bodies, including how they eat, reproduce, and survive in the wild. The acquisition and sharing of worm facts began to permeate the classroom on a daily basis, and we recorded conversations to document and reflect upon the learning process.

> "The worms in our worm bin have it easy!"
>
> "They don't have to worry about any predators and their food is delivered every week!"
>
> "I can't believe a worm has five hearts! Can you?"

Excitement filled the air as the worms acclimated to the bin and children explored and investigated. The children were eager to observe, dig, hold, measure, weigh, and prepare food for the worms.

Worm bin became a favorite activity in the classroom during choice time, and family members were encouraged to volunteer to help facilitate centers.

Children designed many contests to discover who could find the most babies or hold the most adults in one hand or prepare the new bedding the fastest. Boys and girls equally engaged in exploration and observation. One child enthusiastically noted, "Even though this is poop, it's not gross!" They had discovered that worms are, in fact, quite clean.

Sharing Learning Together

The children used photography, drawing, sculpting, and writing to share their findings with classmates. One group of students wrote the script for a puppet play and performed it in the class shadowbox theater, highlighting the day-to-day life of a worm in a worm bin.

> "I'm a Red Wiggler worm.
>
> I live in Classroom 205.
>
> I love to eat fruit and veggies but only after they are rotten.
>
> I squirm and dig and my poop is good for the Earth."

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Children prepare food to feed to the worms. The food comes from families and leftovers from the school's cafeteria.

Worm exploration at worm center.

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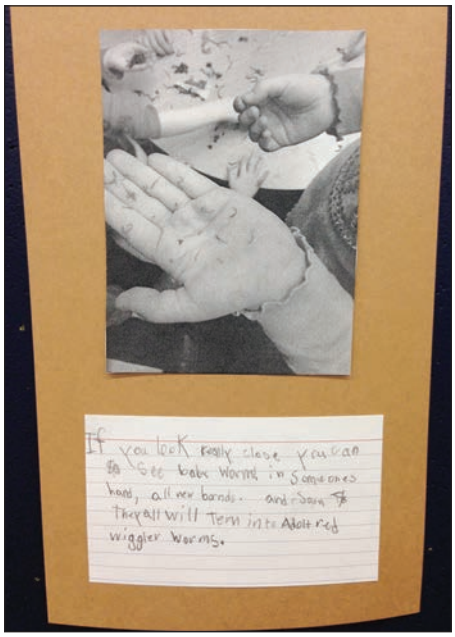
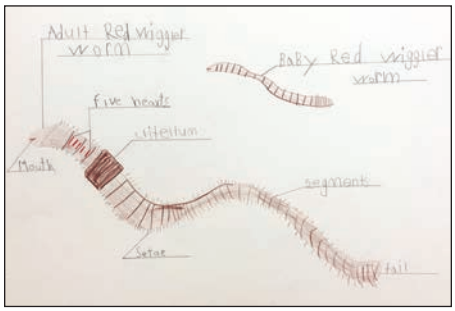
Another group crafted worm books in the "how-to" genre. Books with such titles as: *How to Care for Worms, How to Set up a Worm Bin, How to Get Rid of Fruit Flies,* and *What Worms Like to Eat* documented the learning children had acquired through observation and experimentation.

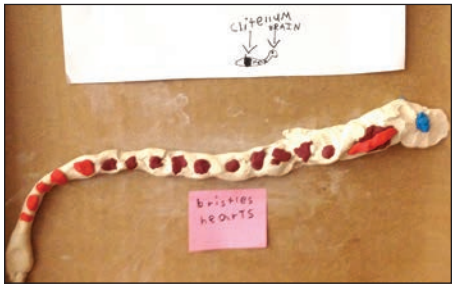
Posters and sculptures detailed the life cycle and labeled diagrams explained the body parts of worms, as well as their functions. Writing filled the rooms.



A student documents her observation of baby worms

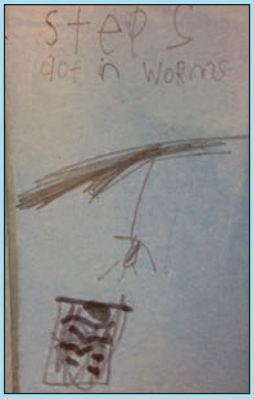


Student-created poster documenting the parts of a worm



Sculpture of the parts of a worm made with modeling clay

Excerpts from Student-Written Book: How To Care For Worms



Step 1
Get newspaper. Cut it. Soak it.

Step 2
Put in worms.

Step 3
Get vegetables, fruit or egg shell. No banana but peel OK. Make sure not a lot of water in it.

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Over the course of several months, the children hunted for cocoons and baby worms.

They sorted larger worms into categories such as adolescents and adults by looking for the clitellum (the ring around the head). Conversation began to revolve around questions and observations of the reproduction activity in the worm bin.

"What are the tiny yellow balls?"

"Look at the tiny newborn worms ... they look like strings!"

"What are we going to do with all these baby worms?"

"Will we ever see any dead worms?"

"When a lot of worms get close together it is hotter than when they are apart."

"Did you know that a worm can be a girl and a boy?"

Another research group became interested in exploring the food chain. The children marveled at the interdependence of animals for survival and imagined scenarios in which they might have eaten an animal that, at one time, ate a worm. As they learned about producers, consumers, and decomposers, children crafted their own plays documenting these life cycles.

"Worms eat plants.

Birds and frogs eat worms.

And even bigger animals eat those."

A Bend in the Road

Springtime brought new and exciting change to the worm bin. Children began to notice the worm castings (vermicast) filling up the bin.

"Sometimes the food gets eaten up fast and sometimes it stays in there for a long time."

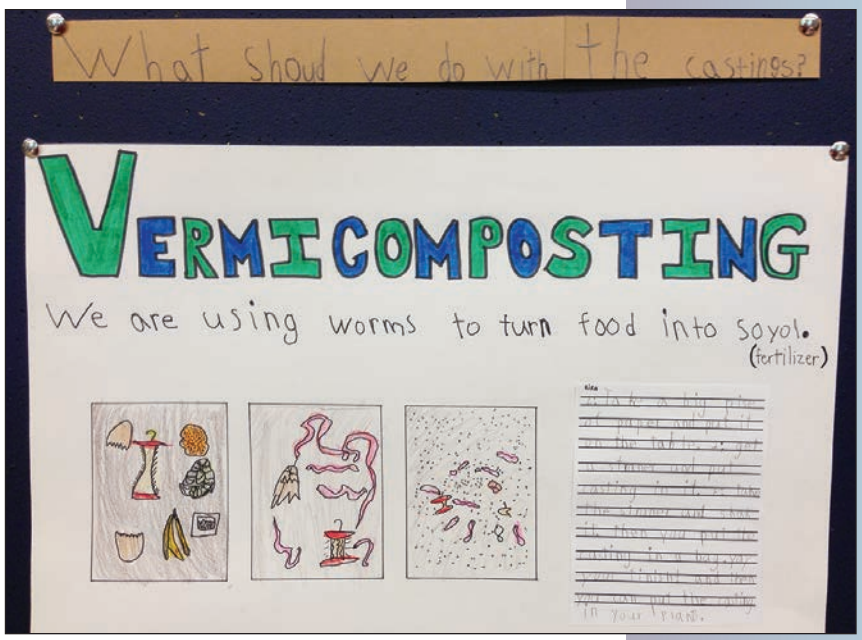
"Where is all the food going?"

"Why is it filling up with brown stuff?"

"It's starting to smell just like dirt in here!"

"Why is the worm bin getting so heavy?"

After reflecting on the content within questions such as these, it was clear that the children were curious about the process of *vermicomposting*.



Vermicomposting results from using worms to turn left-over food into soil.

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Students fertilize the soil of a young miniature daffodil plant with some vermicast compost.

We asked the children to determine what to do with these rich nutrients. By taking a vote it was decided that the vermicompost would be harvested and scattered in our local park to give back to the community. We would also use some of the vermicompost in the classroom to help our plants grow.

Giving Back to the Community

Plans dramatically shifted, however, when a third-grade teacher expressed interest in obtaining some of our vermicompost for her personal vegetable garden. Suddenly the learning constructed from our classroom inquiry was directly impacting a teacher in our school community, as well as her garden and all the animals and insects that called it home. Pride and purpose radiated from our classes as the children eagerly collected several gallons of vermicompost for the teacher. She brought in a fresh salad after the garden produced lettuce with our vermicompost. She later joined us for an interview to share how the vermicompost helped fertilize her garden and grow nutritious vegetables for others to enjoy.

Above: Children collect vermicast for a third-grade teacher's garden.

At right: The third-grade teacher shares a home grown salad with the class, completing the cycle of nature.

As the year and study came to a close, we reflected on the inquiry-based learning process in which our classes engaged. By allowing the children to pose their own questions, problem-solve and investigate, children became deeply invested in their learning and, as a result, formed and shared their own theories and findings with others.

A Student Shares His Findings With Classmates

An investigation into the life cycle of a worm had naturally evolved into a much deeper inquiry into food chains, decomposition, and environmentalism. In the process, our inquiry elicited exciting social action, research, writing, drawing, sculpture, puppetry, performance, and much more. Children portrayed a sense of compassion for the worms. Furthermore, the worm bin acted as an entry point into a deeper understanding of the worms' livelihood and environmental protection. Perhaps one child's thoughts best reflected the awareness to the connections within our natural world as well as a personal connection to the worm inquiry experience.

"Without these worms, lots of things would change."

Calling all 21st-Century Learners

The current workforce is demanding that we, as early child educators, guide children to cultivate the skills to become the future problem-solvers, critical thinkers and inventors of tomorrow. Traditional teaching practices that mirror a one-way line of communication and cater to one-size-fits-all curriculums are failing to prepare children for the road ahead. Our yearlong worm inquiry opened our eyes to the endless possibilities that arise when teachers provide children with the tools, time, and trust to become key players in their own learning. It is time to start building the foundation for teacher practices, such as inquiry-based learning, that will promote the skills needed for 21st-century thinkers. The time to begin this journey starts today.

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