

2017-18 Science Curriculum Report

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*Science is more than a body of knowledge.
It is a way of thinking; a way of skeptically interrogating the universe
with a fine understanding of human fallibility.
-Carl Sagan*

The main goal of the science program at Miquon is to develop interested and engaged scientific thinkers. Science at Miquon is taught through inquiry based, hands-on instruction. The program emphasizes critical thinking processes that give children the skills they need to explore their own questions. We want students to understand how scientific knowledge is developed and to give them the tools they need to be successful problem solvers. We also want them to enjoy this process and become more than a little enchanted by what they find. Emphasizing the importance of curiosity and careful thinking, students practice methods for noticing, asking questions, experimenting, evaluating information, and making connections to previous knowledge.

In designing curriculum for this year, I wanted to give all children real experiences with the scientific process and the Miquon environment. Science classes included time for observations, making predictions, gathering data, analyzing evidence, and decision-making. This was facilitated through hands-on activities, informational reading, discussions, and journal entries.

Miquon's campus greatly informed the orientation of the science program. The amazing resources at our fingertips provided students with the unique opportunity to directly learn the natural world. The curriculum was shaped to grow a knowledgeable love of the land and sense of environmental stewardship in each child.

We also spent a fair amount of time talking about what science does and doesn't do. The students continued their growth as they evaluated their previous knowledge through a scientific lens. I especially enjoyed talking with them about the relative truth of "facts" and the idea that scientific information is not set in stone, but rather that ideas are based on supportive evidence and open to revision.

We were also extremely lucky to have additional teachers in the science room this year; Miquon alumna, Gabi Isaac-Herzog, joined us as a volunteer in the fall and our Progressive Education Lab teaching fellows, Arielle Drisko and Sarah Nelson, co-taught science with me throughout the winter.



Nursery and Kindergarten

This year, nursery and kindergarten students explored biology, physics, and gardening.

Framing questions included:

- How can we use our senses to learn about the world?
- How can we use tools to learn about our surroundings?
- How can we affect objects to make them behave in a certain way?
- How can we use clues to make reasonable guesses about what has happened or what will happen?

The nursery and kindergarten approached these questions through observation and experimentation. Our investigations were supported by reading children's literature and nonfiction and by sharing ideas during lively group discussions. Classes were most exciting when students suggested ways of using materials that I had not anticipated. Their creativity and ability to see objects in a new light was inspiring.

Science included time to observe and take care of a variety of creatures including composting worms, Phoenix, the bearded dragon, and Ziggy, the ball python. Outdoor learning included hikes, gathering dried flowers for Thanksgiving bouquets, and tasting foods from the garden. Kindergarten outdoor learning also included listening hikes, scat tracking, and making dye from marigolds.

Nursery children explored simple machines by testing ramps, catapulting with levers, and using pulleys. Kindergarten explored physical science themes through the study of balance. The books, *Just a Little Bit* and *Mirette on the Highwire*, were used to help students think about how weight and position affect balance. Children then built and tested seesaws, designed fingertip balance toys, and learned how to compare mass in balance pans.

In January, both groups learned more about how animals stay warm in winter and tested different insulators to keep their hands warm in a bucket of ice water; they were surprised at the effectiveness of air as an insulator and loved feeling the squish of Crisco-filled "blubber gloves." The winter cold also offered opportunities to learn about changing temperatures, freezing and melting, and how to make maple syrup snow taffy.

During the spring, both classes shifted to an outdoor focus. We planted peas, sampled herbs, and made our own fertilizer from worm castings. (The cups of castings and water were affectionately dubbed "worm poop smoothies," just in case you were wondering.) Students also

prepared new bedding for the worm bin and regularly checked to see how our beloved decomposers were fairing.



First and Second Grade

This year, first and second grade students explored botany, biology, and engineering.

Framing questions included:

- How can we use tools to learn about our surroundings?
- How are most seeds alike? How are they different? How do they change into plants?
- How do people use seeds?
- How are we alike? How are we different? In what ways do we compare things?
- Can we see useful patterns in what we observe? How much information do you need to “trust” your ideas about what is happening?
- What are the main forces acting on bridges? Which bridge shapes are more stable?
- What are some of the major systems that support the human body?

Students approached these questions through playful observation and experimentation. Our investigations were supported by reading children’s literature, exploring nonfiction books, moving our bodies, and by sharing ideas during lively group discussions.

Five Senses and Seed Studies

We began the year with a focus on the five senses and how people describe objects. Students learned how to use and care for a microscope so that they could observe natural objects in greater detail. We then went on seed scavenger hunts throughout the campus and began learning more about the basic needs and life cycles of plants. Students germinated and transplanted bean seedlings, created descriptive drawings of plant parts in their science notebooks, and feasted at our seed celebration! (Marea and Rich’s group also had an opportunity for a more in-depth exploration of plant adaptations during the fall conference week when I partnered with Rich.)

Fingerprints

During the winter, we began examining identity through the lenses of anatomy and fingerprinting. Students learned about the three primary types of fingerprints, graphed the types of prints in our class, and made finger print art inspired by Ed Emberley. We also focused on practicing how to observe details closely, check findings with other researchers, and make reasonable predictions about larger patterns based on information from small samples.

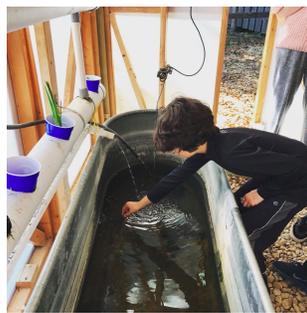
Inventions: Bridges

In the spring, students looked at bridges as inventions. We read the fictional story *Pop's Bridge* about the building of the Golden Gate Bridge and then surveyed the types of bridge designs on Miquon's campus. We looked at the differences between materials (wood, stone, metal), shapes (flat, arched) and anchoring (pillars, rocks). We made guesses about why specific bridges were built the way they were and which materials were most suitable in different circumstances.

We also examined how erosion on the creek banks affects bridge stability. Over the next few classes, we built our own bridges using gum drops and toothpicks. Students experimented with different shapes to identify strong supporting elements. We also learned about truss bridges, the variety of forces acting on bridges, weak spots and bridge failures. Students were very invested and showed steady progress in their understanding of how to approach three-dimensional designs as they practiced. A few students chose to display their final bridges at the Art and Science Show in March.

Human Body

After spring break, we began a study of the human body. The unit began with a brief overview of body structures and students were invited to share questions that would guide our investigations. We explored the nervous system first, learning the main components and then conducting two-point touch sensitivity tests to learn which areas had higher nerve density. This was followed by classes that included demonstrations, videos, games and read alouds to understand more about the function of the lungs and heart. Ben and Celia's group also had time to learn about the digestive system and model the digestion and elimination of veggie straws (yum!).



Third and Fourth Grade

This year, third and fourth grade students explored agriculture, physics, engineering, and biology.

Framing questions included:

- What do students need to know to work independently in the science room during lunch choice?
- Where does our food come from? How has this changed over time?
- How are growth and decomposition related? How can we affect the way a garden grows?
- How and why do we use controlled experiments?
- How are form and function related? How can we experiment to improve our designs?

- How do variables like hull shape and material type affect the capacity of boats?
- What are the main characteristics of amphibians and reptiles?

Students approached these questions through observation and experimentation. Our investigations were supported by reading literature and nonfiction books, writing, and by sharing ideas during lively group discussions. We began the year by getting acquainted and practicing how to use available tools and materials during lunch choice. Many students regularly took advantage of the workshop time to collaborate and build new creations.

Food Studies

To start our food studies, we collected stickers from fruits and vegetables to track where and when our food grows. This mapping activity led to investigations about the reasons for different seasons across the hemispheres, why much of our food comes from so far away, and what life was like before food could be transported over long distances. Children scouted the campus for local wild edibles and preserved food by drying herbs and pickling green tomatoes from the garden. This learning was further enhanced by a trip to Crefeld's permaculture site where we learned about compost, chickens, gardening, and aquaponics.

Nutrient cycling and decomposition were explored through build/unbuild/rebuild games using K'NEX, outdoor scavenger hunts for decomposers, videos on the work of George Washington Carver, and investigations with our worm bin. Students gently conducted primary research with our class worms to learn their preferences for different moisture levels and odors. We also talked about why food goes bad and carried out a controlled experiment to test whether bread would decay faster when handled by washed or unwashed hands.

Boat Building

After winter break, students began exploring the field of boat building to extend their classroom studies of Lenape and early colonist transportation. They worked to investigate why certain objects float, experiment with different hull shapes, and examine the relationship between form and function.

These investigations culminated in a boat building project that really took on a life of its own. After learning about a variety of water craft, children were asked to use engineering skills to plan, design, and build any type of model boat they wished to create. Students were extremely supportive of each other as they worked and the enthusiasm for building remained high over several weeks. I was very impressed with the creativity, trouble shooting prowess, and work ethic displayed by both classes. The kids seemed proud of their efforts as well. They joyfully shared their boats alongside reflective narratives about the building process at the science show in March.

Ecosystem Interactions: Reptiles and Amphibians

In the spring, students transitioned to learning about ecosystem interactions through the lens of reptiles and amphibians. In addition to read alouds, videos, and active games, students learned a great deal through simply spending time with tadpoles in the creek, Phoenix, our visiting bearded dragon, and Ziggy, our visiting ball python.



Fifth and Sixth Grade

This year, fifth and sixth grade students explored botany, woodworking, environmental health, and physics.

Framing questions included:

- How can we better know the trees at Miquon? How can trees help us learn about the history of a place?
- Why are trees a vital part of our ecosystem? How do people use trees?
- How can we use tools safely and enjoyably to modify materials?
- What lives in the Miquon creek and what does this tell us about its health?
- What is work? How are simple machines used to reduce the force necessary to do work?
- How is energy changed from one form to another? How is electricity generated?
- What are the major sources of energy today? What are their benefits and drawbacks?
- How can we evaluate our energy use and make positive changes?

Students approached these questions through observation and experimentation. Our investigations were supported by reading literature and nonfiction books, writing, and by sharing ideas during lively group discussions. We began the year by getting acquainted and practicing how to use available tools and materials during lunch choice.

Trees

Tree studies were rooted in the idea that trees are a key component of Miquon's identity. To get students thinking more deeply about the trees on campus, children closely observed and measured the circumferences of some of their favorites. Students also sawed dead branches and noticed how different trees grow at different rates. They then learned how to "read the rings" and uncover historical information hidden in growth ring patterns. Later, we practiced how to use a dichotomous key and field guide so that children could identify trees on their own. The final challenge was to identify many different types of trees and set up a scavenger hunt for younger students.

This field work was supported by in class studies of plant anatomy and photosynthesis. Students also learned more about the work of Wangari Maathai, a scientist-activist, who founded the Green Belt Movement and used trees to empower fellow Kenyans. As we continued to think about how people use trees, an interest in whittling surfaced. Wood carving classes emphasized creativity, safe handling of tools, focused engagement, and a willingness to try. Students demonstrated great persistence and attention to detail as they worked. They were encouraged and inspired by a visit from Jay Cox, a master woodworker, as he demonstrated how to carve basswood and steam-bend wood for custom furniture.

Classroom Connections

As part of their classroom sustainability studies, Louis and Jeri's group also had a visit from Kelly Cobb, a textile researcher at the University of Delaware. Kelly discussed the environmental impacts of the fashion industry and showed students how technology is being used to help designers make more sustainable choices.

Stream Health

After winter break, both fifth and sixth grade classes learned about the macroinvertebrates that live in freshwater streams and conducted [leaf pack experiments](#) to find out which species are common in the Miquon creek. The results were analyzed to help students understand how pollution-tolerant and pollution-sensitive populations provide information about stream health. We completed these studies by creating descriptive poems about individual macroinvertebrates in the style of passages from *The Important Book* by Margaret Wise Brown.

Simple Machines

Our simple machines unit began by messing about with mousetraps. The children were excited, scared and intensely motivated to figure out how to set a classic snap trap. We discussed how, in scientific terms, *work* is accomplished when an object is moved over a distance. After measuring the work required to do simple tasks, we watched a series of videos on simple machines. This led to a building challenge in which students created carnival rides or games that incorporated at least two simple machines. For the science show, students shared their creations along with a written reflection that communicated what they learned through the design and construction process.

Energy and Electricity

After spring break, we began an exploration of energy transfer and electricity generation. Students constructed waterwheels to transfer energy to a small generator. Partners experimented with the number of paddles on their waterwheel to find the configuration that would generate the highest voltage. This work was followed by classes that explored the relationship between motion and electromagnetism.

Next, we learned about the human quest to create machines that produce electricity by spinning wire coils and magnets. We also examined the benefits and drawbacks of the main energy sources used today. Students continued these studies by conducting a school-wide energy audit. After assessing energy use at school, the groups brainstormed recommendations for reducing our consumption. Later in the year, Louis and Jeri's group visited the Covanta Plymouth Renewable Energy waste-to-energy plant and debated the merits of this type of waste management and energy production.

Lunch Choice and Minicourses

In addition to scheduled classes, many children in first through sixth grade also enjoyed visiting the science room at lunch choice to build creations, extend explorations from class, practice woodworking, and just hang out. I really enjoyed getting to know students in this way and during our more personal minicourse times. In the fall, a group fifth and sixth graders joined me to watch and explore the conflicted roles of scientists in the original 1954 Japanese Godzilla film, *Gojira*. In the winter, our maintenance director Mike Batchelor, our librarian Amy Vaccarella, and

I hosted a ukulele class, and in the spring, I partnered with Rich to build race cars and airplanes in the “Things that Go!” minicourse.

Thank you for supporting your children’s interests and encouraging them to be curious, creative investigators. Their enthusiasm is what made our time together this year so much fun!