



2018-19 Science Curriculum Report

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*If you truly love nature, you will find beauty everywhere.
-Vincent van Gogh*

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, we 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. We 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 two teachers in the science room this year; our Progressive Education Lab teaching fellow, Arielle Drisko, led third and fourth grade classes and co-taught other classes with Kate Shapero throughout the year.

Nursery

This year, students explored biology, ecology, and physics.

Framing questions included:

- How can we use our senses to learn about the world?
- How can we care for each other and the materials that we use?

The nursery approached these questions through playful observation and hands-on experimentation. Our investigations were also supported by reading children's literature, exploring nonfiction books, moving our bodies, and by sharing ideas during lively discussions. Nursery students met for science class once every other week for an hour.

Outdoor learning in the fall included looking for insects and worms, planting acorns, scat and track hikes, and tasting foods from the garden. We spent a few classes getting to know the worms in the worm bin and checking up on the progress of decaying food scraps. Children also explored simple machines by testing ramps and catapulting with levers. In December, we talked about the long nights of winter and learned different ways that animals stay warm during cold months. Children tested a variety of 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. After winter break, we explored eye anatomy to support questions about eyes raised in the home classroom. We also practiced using new tools like pipettes and magnifying glasses. In the spring, we were out and about as much as possible, checking for caddisfly larvae in the creek, pollinating flowers with pretend "bee's knees," and tasting fresh greens.

Kindergarten

This year, students explored biology, ecology, chemistry, physics, and gardening.

Framing questions included:

- How can we care for each other and the materials that we use?
- How can we use our senses and tools to learn about the world?
- 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 kindergarten approached these questions through playful observation and hands-on experimentation. Our investigations were also supported by reading children's literature, exploring nonfiction books, moving our bodies, and by sharing ideas during lively group discussions. Kindergarten students met for science class once per week for 45 minutes.

Outdoor learning included listening hikes, "scat tracking," and visiting the bird blind. Students

were excited to learn more about the different parts of plants that we eat. After reading the book “Plants Feed Me,” we had a few classes focused on preparing and comparing different vegetables. Massaged kale with olive oil and salt was a favorite, as well as parsnip strips and roasted cauliflower.

Our December study of balance used the books Just a Little Bit and Mirette on the Highwire to help students think about how weight and position affect balance. Children built and tested seesaws, designed fingertip balance toys, and learned how to compare mass in balance pans. In January, we briefly explored constellations and made our own planetarium. We also modeled why it’s hard to see stars during the day.

After winter break, the class investigated magnets to find out more about how they work, what materials they are attracted to, and what they can be used for. They also did experiments to understand more about chemicals and how materials can be changed by mixing them with other substances.

During the spring, we 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 faring. We also explored the campus on detective hikes looking for bird nests, harvesting garlic mustard, and making rubbings of tree bark.

First and Second Grade

This year, students explored biology, ecology, engineering, and woodworking,

Framing questions included:

- What happens to our waste?
- What does decomposition look like at Miquon?
- What is classification?
- How do adaptations help organisms survive in a specific habitat and pass on their traits?
- How can we use (woodworking) tools to create what we need and want?
- Why do teeth change so much when you are young?

Students approached these questions through playful observation and hands-on experimentation. Our investigations were also supported by reading children’s literature, exploring nonfiction books, moving our bodies, and by sharing ideas during lively group discussions. First and second graders met for science class once a week for forty-five minutes during the fall with an option for an hour-long Wednesday afternoon “workshop time.” After winter break, the workshop was paused and we began seeing each group for an additional 45 minute class every other week.

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 also practiced how to use available woodworking tools and other materials. Many students regularly took advantage of lunch choice time to build fun and functional creations.

Reducing Waste at Miquon

In October, we began our investigation of what happens to waste at Miquon. We started with the book “Joseph Had a Little Overcoat,” a charming story about a man who keeps reusing fabric from his worn coat until it turns into smaller and smaller items. The importance of conserving resources set the tone for our work observing, sorting, and learning about what happens to a variety of materials that we use at Miquon. After exploring what can be reused, composted, recycled, and what goes to a landfill or incinerator, we visited the dumpsters at the end of the driveway to see how much Miquon gets rid of on a weekly basis. Children were surprised at the quantity of waste and how much of it was improperly sorted. This was followed by making recommendations to improve our methods. Students also learned more about composting and observed our worm bin and the variety of organisms that help with decomposition. Marea and Sara’s group helped to maintain our school-wide compost system by preparing a new site and studying more about decomposers and their role in food webs and nutrient cycling.

Classification

During November and December, we learned about classification and the variety of ways that things can be sorted based on their observable traits. We practiced sorting objects into different types of categories (color, size, use) and elaborated on how humans have created categories to help them organize, learn about, and compare living things. We noted that this work is based on evidence but that living things do not always sort into clear categories (the platypus anyone?). This work was related back to identity studies in the home classroom through the lens of how humans describe and define what we see. Students learned about different animal groups like mammals, reptiles, and birds, and played games to practice classification. After browsing through field guides, students also created a “Guide to Me” that described their own characteristics, habitat, behaviors, and preferred foods.

Animal Adaptations

In January, our focus shifted to adaptations, a.k.a. “survival superpowers.” This exploration of adaptations was supported by curriculum from an online program called Mystery Science. Students watched short videos about the specific characteristics unique to different animals and then participated in hands-on activities to expand their understanding of how a particular trait might be advantageous. Our explorations included modeling how bird beaks work with different food sources, trying to create and find camouflaged moths that were hidden around the room, and simulating how archer fish capture their prey. This work also helped unpack questions that had been raised during discussions in the home classroom about how traits are passed down through generations.

Woodworking Workshop

Students were inspired to create after reading the whimsical picture book “Not a Box.” They learned the construction skills necessary to create basic wooden frames and then modified or assembled them into more complex and imaginative structures (“Not a Frame” creations). In the process, children learned how to use metric rulers, hand saws, jigs, c-clamps, and sandpaper. They jumped into the challenge with gusto and supported each other as they worked.

Teeth

Near the final weeks of school, students did many outdoor explorations and also delved into some common questions about why children lose their teeth and how teeth grow. They experimented with cleaning beverage stains from simulation teeth (eggshells) and learned more about how people take care of their teeth in different ways around the world.

Third and Fourth Grade

This year, students explored engineering, physics, ecology, and biology.

Framing questions included:

- Why is it important for scientists to work together?
- What does the process of inventing or innovating feel like?
- What are electric circuits? What can we build with them?
- What are states of matter?
- What is the water cycle?
- How does water connect us all?
- How do water and land interact?
- How is water used, cleaned, and reused?
- How does erosion affect Miquon?
- What lives at Miquon?

Students approached these questions through observation and hands-on experimentation. Our investigations were supported through reading, writing, videos, and by sharing ideas during lively group discussions. Third and fourth graders met for science class twice a week for forty-five minutes each.

Inventing From Nature

This fall, students focused on the concept that science and engineering involve trying out ideas, continual reflection, and revision. As a way to compliment their classroom studies on inventions and innovations, students had multiple opportunities to make and create in science. We began outdoors by using natural materials to create an object that was “fun or functional.” After sharing their creations, children learned how to make a paintbrush from materials on campus. We discussed how most of the objects we use on a daily basis are inventions and that throughout history people have tried to create what they need from available materials. We explored the idea that a need may lead to an invention or a material may inspire someone to create.

How Scientists Work Together

As the weather turned colder, we transitioned from being outside to indoor learning. We

discussed how scientists around the world work together in a variety of ways, do not always get to choose who they work with, and sometimes have not met their coworkers before they start working together. We intentionally practiced the skills of collaboration and making space for the ideas of others by having an extended class block of silly building challenges. Students were enthralled with this opportunity and embraced the larger goal of working together—a skill that applies to all aspects of life.

Rube Goldberg Machines

We continued exploring the theme of creating and refining inventions through Rube Goldberg machines. Students were asked to use a variety of materials to accomplish a simple task. Our goal was for students to experience the challenging process of creating something that works just the way you want it to. The task required problem solving and persistence as they adjusted and fine-tuned the details of their machines. Most children chose to create some kind of marble run; while marbles rolled across the classroom floor there was laughter and determination in the air. When students felt that they had completed their individual project, they practiced working together by “linking up” their machines with a classmate.

Circuitry

In December students developed engineering skills through an open-ended approach to learning about [electric circuits](#). Each class period began with a ten minute mini lesson about a new concept like making switches or identifying conductors and insulators. Students then had the rest of the period to practice and expand their growing skills by building things that interested them. They learned a lot through trial and error, helping each other along the way. We were really impressed by the way the group embraced a “[workshop mentality](#),” tackling challenges together and remaining optimistic when things didn’t go as planned.

Water

After winter break, we began studying water and land interactions through experimentation, modeling, and reading. Students explored the properties of water, conducted surface tension experiments, pretended to be water molecules, played a game simulating the water cycle, practiced using water cycle vocabulary in short stories, and learned about watersheds by building and spaying three dimensional models. We also examined a topographic map of the Miquon watershed and learned how everyone in a watershed is connected. This guided us into a water filtration project in which students designed and tested filters with the goal of removing contaminants like soil, dye, and soap. When it comes to clean water, students learned that slow filtration is the way to go. Later in the spring, we visited the Belmont Water Treatment Plant to see how water is cleaned on a larger scale.

Erosion

Our water studies led seamlessly into studying erosion. Students looked at images of amazing erosion (including the grand canyon), learned about different types of soil erosion through a matching style vocabulary game, and made models of splash erosion using pipettes and sand. We toured the Miquon campus looking for signs of erosion and concluded our studies by making signs to help people know where it is okay to walk to prevent further erosion.

Life at Miquon

The spring at Miquon was beautiful and a clear opportunity to learn about what lives and grows on campus. We started this process by practicing observation through listening. Students created “sound maps” by sitting outside in a quiet spot and writing or drawing all of the sounds that they heard around them. Next, we made a list of all of the animals that we knew were on campus, including mammals, insects, birds, reptiles, and amphibians. This led into our end of year project, creating a “Field Guide to Miquon.” This project allowed students to work independently while contributing to a greater goal. Each student chose an animal out of a hat to draw in art class and research during science. The end result was a beautiful student created book that holds information about many of the animals that can be found on campus.

Fifth and Sixth Grades

This year, students explored ecology, biology, physics, computer science, and experimental design.

Framing questions included:

- How do materials continually rearrange to create our diverse world?
- What is the relationship between living organisms and nonliving materials?
- What lives in the Miquon creek and what does this tell us about its health?
- What is computer programming? How can I use a code to give instructions?
- How do you use the scientific method to learn more about a question?

Students approached these questions through observation and hands-on experimentation. Our investigations were supported through reading, writing, videos, and by sharing ideas during lively group discussions. We began in the fall by collaborating with each classroom in different ways. Fifth and sixth graders met for science class twice a week for forty-five minutes periods.

Nutrient Cycling and Natural Materials

Students in Louis and Jeri’s group identified trees and collected leaves for natural dyeing processes that they practiced as part of their cultural study of Japan. We also harvested bamboo and learned how to split it using traditional Japanese tools. Students wove this bamboo into steamer baskets that were used as part of their work on shibori dyeing.

Students in Diane and Sarah’s class delved into decomposition and nutrient cycling to compliment their exploration of death. We created controlled experiments to study what types of variables might speed up, slow down, or stop the rate of decay. This process was described holistically as “studying the flow of nutrients” because we recognized that for something to decay, the materials must be rearranged into new life in the form of bacteria and fungi. The sealed experimental setups of rotting fish and lemons were interesting to observe and only started to really smell *after* families had a chance to help us record observations during Grandparents and Grandfriends Day. Both fifth and sixth grade groups explored the surprisingly complex concept of “aliveness” by closely observing specimens from the natural world. We recorded observations of fallen logs, debated whether an apple is alive using evidence and logic, and created our own working definitions of what it means to be “alive.” We also thought

about how nutrients move through a system and how it can be difficult to discern where one thing begins and another ends. Is the donut that you ate for breakfast now considered “you?” What about the water that you just released in the bathroom? How are living things continually constructed, deconstructed, and reconstructed from non-living materials?

Fire Skills and Safety

Nutrient cycle work was paused during a spell of dry weather in which we started Fire Skills 101. Our fire studies supported the broader concept of how materials change form. It also led into our study of digestion and how materials can release heat energy under specific circumstances. Arielle led the groups in classes on fire safety, scouting fire pit locations, and the necessary elements for a successful fire. Students had the opportunity to practice using different types of ignition sources like matches, bow drills, and fresnel lenses. They also learned how to successfully build a fire and maintain it. Finally, each student completed reflections to document what they had learned and what they were curious to know more about.

Food Energy and Digestion

We resumed our exploration of what it means to be alive and how materials change form by blending fire studies and digestion. Students learned that food literally provides the building blocks of our bodies and the vital heat energy that we release through the process of digestion. Children in both groups built homemade calorimeters that were used to burn foods and measure the calories they released. The comparative calorie content of different types of foods was calculated by measuring the change in temperature of water heated by the burning foods and the mass that was burned. We continued this work through a few mini-lessons on the anatomy of the digestive system and a lab to simulate how bile breaks up fats for easier absorption. Although it may seem obvious to adults, it was fascinating to watch students deeply process the concept of “you are what you eat.” The idea that bananas, cotton candy, and grilled cheese are taken apart and rearranged into hair, eyeballs, and bones was a revelation for many children. They were incredulous that a great deal of food becomes our body parts and not just the much disparaged “number two.”

Stream Health

In our annual tradition of learning about the Miquon environment through citizen science, both fifth and sixth grade classes learned about (or reviewed) the macroinvertebrates that live in local freshwater streams. They then conducted [leaf pack experiments](#) to find out what 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. To connect this work back to our study of nutrient flow we read a children’s book called “Trout are Made of Trees” that reinforces the idea of food webs and the interconnectedness of a variety of species.

Synthesizing Cycle Ideas

In the last weeks before winter break, we wanted to provide students with an opportunity to reflect on and reinforce the learning that happened throughout the fall. We created a “Never

Ending Story” about a molecule that is arranged and rearranged as part of different objects. The story was written in a “mad lib” format with multiple options for different endings (or continuations). Students completed and illustrated their stories through posters, comics, and small books. A few students continued to add to their story as the year progressed. My favorite moment during this project was when a student from Louis and Jeri’s class connected our work in science to their study of Japanese design principles; she looked up and exclaimed “This molecule keeps joining into new forms, it’s just like Mono No Aware, the idea that everything changes and nothing is permanent!”

Coding and Computer Science

After winter break, we shifted to computer science and programming. Students learned the basics of programming using a language called blockley through the online course at Code.org. The lessons allowed students to progress at their own pace, revisit areas of difficulty and feel accomplished as they moved to new levels. The work supported a variety of skills in logical thinking, mathematical concepts (especially estimating angles), problem solving, and spatial orientation. Some students then used this programming language to make their own projects in the online program SCRATCH.

The Scientific Method and Experimental Design

After spring break, we focused on testable questions and how to design an effective experiment. Children spent a few classes testing and improving experiments as a class; then each child chose and developed their own research question to investigate. This project was designed to give students a more formal experience with the challenge and glory of the scientific process. They worked hard to develop testable questions, write procedures, gather data at school and at the Art and Science Show, and analyze their results. Some investigations went smoothly and others experienced the aspects of science that can be delightfully surprising, deceptively tricky, and downright tedious. Each student created a slideshow to share their findings in our [online research journal](#).

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 new creations, extend explorations from class, practice woodworking, and just hang out. We really enjoyed getting to know students in this way and during our more personal minicourse times. In the fall, a group of fifth and sixth graders joined Louis and Kate to build picnic benches for the classrooms in a woodworking course. Arielle worked with Lisa and enjoyed playing lawn games while getting to know some of the older students better. In the winter, our maintenance director, Mike Batchelor, and Kate hosted a ukulele class for third through sixth graders while Arielle collaborated with Nicole on sewing and weaving in the art room. In the spring, Kate and Arielle partnered with Mariama Koroma and many dedicated children to reimagine the garden space in front of the library.

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