



Rachel Carson and the Questions that Helped Save Bird Populations

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Introduction/Rationale:

As a little girl, I would go into our backyard and play under the old pine trees that were there when my parents bought our now 100-year-old house on the southwest side of Chicago. There were about seven of them, majestic and towering over our home. I could not tell you whether they were Eastern White Pines, Jack Pines, or any of the other types of pines that grow in the region where I live. I just know that they provided respite from the sometimes-chaotic life of a 6-year-old girl with three younger sisters. I played make-believe, pretending it was my own magical place. The forest floor was a floor plan for my kitchen, doll bedrooms, one-room schoolhouse, and whatever else occurred to me at the moment. It was quiet despite the hustle and bustle of the city streets. The heavy layering of the pine needles shielded the noise. The songbirds, mostly house sparrows, in the trees added to this fascinating scene with their chirpy melodies. They were my friends, my neighbors, and sometimes roommates in this make-believe haven of mine.

My parents were not scientists. With only a fourth-grade education, they were ordinary working-class people. Both immigrants from rural Mexico; my father was a construction worker, and my mother was a seamstress working in a factory. They provided the place. Nature did the rest. I would say that my fascination with the natural world began during this time under the pine trees. Botanist and author Robin Wall Kimmerer, in her book *Braiding Sweetgrass*, reminds us to learn the names of birds. She points out that when we do not know the name of a living being, we call it an "it". This makes us feel separated from nature. Instead, she invites us to view birds as living, breathing people.^[1] In her book, Kimmerer discusses the importance of developing a relationship with the Earth and all its living creatures. And although we may not know the names of birds, we can expose our students to them in simple, organic, but intentional ways. Yes, even in the city with its abundance of sparrows and robins. If we take an outdoor walk or simply stand still long enough, we will see red-winged blackbirds in their defensive fervor, woodpeckers pecking away, the ever-so-red male cardinals, and even an occasional bald eagle pair nesting on a light post just a few blocks from my city home.

Student Background and School Demographics:

Seward Communication Arts Academy is a pre-K through 8th-grade neighborhood school. Presently, we have 387 students. Ninety-six percent of our students are Latine, mostly of Mexican background, and 97 percent are low-income. Seventeen percent of our students have an Individualized Education Plan (IEP). The school is in the Back of the Yards neighborhood on Chicago's South Side. It has historically been an immigrant community, dating back to the era of the stockyards, for which it is famously known. It remains an immigrant community today, with 57% of students being English Language Learners.

Seward is an International Baccalaureate school, and this year our IBLT (International Baccalaureate Learning Team), composed of students, parents, and teachers, focused on Inquiry Teaching and Learning. The goal was to encourage students to ask questions, explore, and investigate the world around them. Through inquiry, students practiced critical thinking, problem-solving, and confidence as they expressed their ideas and took ownership of their learning, ensuring that they experienced inquiry, action, and reflection in every subject. This was done in hopes that our students will see learning as purposeful. Continuing this thought process, this unit will be written for about 40 brilliantly inquisitive 8th-grade students and will take about five weeks. It will encourage students to ask questions that will guide their learning. In addition to a regular classroom setting, this unit will include outdoor activities: field trips to the Nature Museum, neighborhood walks, and time at our nearby city park.

Rachel Carson and The Sense of Wonder:



Rachel Carson

Rachel Carson was a trailblazing ecologist who, in July 1956, wrote an article titled “Help Your Child to Wonder” in the Woman’s Home Companion magazine. This led to her now-famous essay, The Sense of

Wonder.^[3] In the article, Carson tells a story of when her nephew Roger visited her in Maine. They walked in the woods, and she made no conscious effort to name plants or animals nor to explain them to him, but she did express her own pleasure in what she saw, calling his attention to this or that. She shared that she made no conscious effort to name plants or animals because she wanted to encourage the mother figures reading the magazine to teach their children about the natural world by exposing them to it, even if they did not feel capable of providing the names. She goes on to say that “If I had influence with the good fairy who is supposed to preside over the christening of all children, I should ask that her gift to each child in the world be a sense of wonder so indestructible that it would last throughout life.”^[4]

In this unit, I intend to show my eighth-grade students how simple observations like these, everyday storytelling, and being in community with nature can lead to asking important questions about science and nature, and even serve as a form of advocacy for our natural world. I want them to learn that what may seem like simple observations are really gateways to asking questions that may lead to change. In *A More Beautiful Question*, Warren Berger defines a beautiful question as an ambitious yet actionable question that can begin to shift how we perceive or think about something and might serve as a catalyst for change.^[5]

Between the ages of two and four, children ask over 40,000 questions. A recent study found that the average four-year-old British girl asks her mother 390 questions a day, with boys that age not far behind. ^[6] Time magazine writes that by the time they are three, children have learned to ask questions, asking one every 2 minutes. They begin to ask questions about why and how things occur in the world around them. This type of questioning is called epistemic curiosity. It is a deep need for understanding and the desire to acquire new knowledge that only humans have developed.^[7] Unfortunately, our education system is partly at fault for suppressing children’s habit of asking questions, from one every two minutes to one every two hours by the time they start kindergarten.^[8] This natural inclination to ask questions continues to decline as children reach middle school and even more into high school. What can we as educators do?

In the book *Science Teaching for Social Justice by Rethinking Schools*, there is an article titled “I Just Can’t See How We’re Going to Learn Any Actual Biology Stuff Here.”^[9] The author, Lyle Dandridge, explains how he built his year-long syllabus on questions students asked during the first two weeks of school. Through community-building activities and conversations, and without the students knowing, he listened intently to their questions about what they wanted to learn in the upcoming school year. Finally, at the end of the first two weeks of school, he presented his students with a syllabus. Throughout those first two weeks, he had taken their questions, tied them to the biology standards he was responsible for teaching, and built objectives for a year-long syllabus.

Although this type of teaching may require more preparation time for the teacher, it helps maintain higher student engagement by transforming the classroom into a student-centered environment, while keeping high expectations in place. Dandridge goes on to say that, while he acknowledges that standardized testing is plagued by problems, his students’ scores were the best he has seen in comparison with previous years. ^[10] A decline in students’ willingness to ask questions as they get older stunts curiosity and, in turn, opportunities for learning. Methods such as this put students in the center of their learning and help combat this stunt in academic growth.

In the study titled *Children lose confidence in their potential to ‘be scientists’, but not in their capacity to ‘do science’*, the authors found that one reason why some children lose interest and confidence in science in middle childhood is that they begin to view the possibility of “being a scientist” as incompatible with their

identities. They quote various experimental and qualitative research studies that reveal pervasive cultural stereotypes about scientists. Some of these stereotypes entail particular social identities—for example, that scientists are male, white, and of relatively high socioeconomic status.^[11] Introducing students to a wide range of scientists throughout the school year is another way to help them see themselves in STEAM fields and to continue engaging willingly in scientific learning.

The study goes on to argue that when students see science as action rather than as identity-defining, interest and engagement grow. “Let’s do science” is a verb, whereas “being a scientist” is an adjective that describes the student. The researchers found that interest in science and self-efficacy shows fewer problematic trajectories when children are asked to think of science as action rather than as identity-defining.^[12] While the language we use with our students matters, there must be ample opportunities for students to practice the “Let’s do Science” mindset. This is something that, as educators, we must promote in order to change the trajectory of students' declining curiosity about learning and, therefore, their willingness to ask questions.

Rachel Carson and the Question That Started a Movement:

Rachel Carson, a marine biologist, wrote *The Sea Trilogy: Under the Sea-Wind, The Sea Around Us, and The Edge of the Sea*. Her first book, *Under the Sea-Wind*, was written in 1941, when she was a freelance writer for the U.S. Bureau of Fisheries and was asked to write an introduction to a brochure on marine life. Here, Carson wrote about the natural world in a relatable narrative, written from the perspectives of sea creatures (a sanderling, a mackerel, and an eel). Writing from this perspective allows the reader to build empathy towards these living creatures by reading about their experiences from their point of view. This book helped demonstrate the interconnectedness we share with sea creatures. *The Sea Around Us*, written in 1951, became a National Book Award Winner. It was turned into a documentary by film and television producer Irwin Allen and went on to win an Academy Award for Best Documentary Feature. Here, she explored oceanography, meteorology, and Earth's history. In the final book of the trilogy, *The Edge of the Sea* (1955), she explored the ecology of the Atlantic shoreline, rocky coasts, and tide pools.^[13]

In 1962, she warned the world about the dangers of pesticides in her most famous book, *Silent Spring*.^[14] In the book, she designed investigations, followed the evidence through food webs, and discovered the effects of DDT at each step of the food chain. It was this book that helped set the stage for the environmental movement. Carson had an ecological view of nature that connected all its living creatures through complex webs. This book questioned the effects of DDT on birds and other wildlife. Partly due to Carson’s detailed investigations and evidence, the United Farm Workers (UFW) protested the exposure to chemical pesticides suffered by laborers in the fields.^[15]

DDT

DDT (dichlorodiphenyltrichloroethane) is a synthetic chemical compound that was invented by Austrian chemist Othmar Zeidler in 1874 as part of his university work, and in 1939, chemist Paul Hermann Müller discovered that it could kill a wide variety of insects. Because of this discovery, DDT was used in WWII to protect U.S. soldiers from malaria and typhus by delousing them. Attacking the insect that causes malaria in the South Pacific Islands helped save millions of lives. During this time, DDT was the strongest chemical the world had ever seen, and it seemed to work. By 1942, DDT was available for civilian use. Farmers began using

it to protect their crops and livestock. Homeowners used it indoors and in their gardens, and trucks even drove around neighborhoods to kill mosquitoes as people watched.^[16]

Silent Spring documented the effects of DDT on the environment, particularly on birds, as the title alludes to the quietness of spring after songbird populations declined. DDT accumulated in the food chain, causing severe environmental damage. DDT interferes with how a bird's body metabolizes calcium, making the eggshell thin and fragile. This caused the eggs to crack under the parents' weight during incubation. Due to their toxicity, populations of apex predators such as bald eagles, ospreys, and peregrine falcons decreased sharply.^[17] As someone who was not afraid to ask questions, Carson's book was met with opposition from chemical companies. This opposition did not stop the message from reaching the masses. Eventually, DDT was banned.



Pelican eggshell affected by DDT

Eagles and Other Birds of Prey

Even before DDT, eagle populations were declining. Eagles were seen as a threat to livestock, and their decline began before civilian use of DDT. The killing of eagles was a common practice and even encouraged in the United States. In Alaska, the Alaska Territorial Legislature, a local government, paid bounties for their feet or heads. Farmers killed eagles to protect their livestock.^[19] As an attempt to save the declining population, in 1940, Congress passed the Bald Eagle Protection Act and banned the killing of eagles. Even with the Bald Eagle Protection Act in place, by the mid-1940s, when DDT was used extensively, their population decreased catastrophically. In 1963, the widespread use of DDT had decreased the bald eagle population to only 417 nesting pairs in the lower 48 states.^[20]

As with the eagles, DDT also nearly drove the peregrine falcon to extinction by disrupting calcium production during reproduction and causing thin eggshells. In the late 1960s, brown pelican colonies in Southern California declined by 90 percent. A chemical plant in Los Angeles had been discharging thousands of pounds of pesticides into the sewers. It was absorbed by the fish that the pelicans ate. Eventually, the environmental movement, which was partially influenced by her book, led to the creation of the U.S. Environmental Protection Agency (EPA). In 1972, the U.S. Environmental Protection Agency (EPA) issued a ban on DDT. Rachel Carson died while these birds of prey were disappearing and never saw the influence *Silent Spring* had on the environmental movement. As of 2009, there are now 316,700 individual bald eagles and 71,400

nesting pairs. [21] The peregrine falcon and brown pelican were eventually removed from the Endangered Species List.[22]

American Robins and other Songbirds

In the 1930s, Dutch Elm fungal disease was accidentally introduced into the United States by the transportation of elm logs. The disease was mainly transmitted by elm bark beetles (vectors-agents that carry spores that allow the fungus to pass from tree to tree) and killed millions of elm trees. For a time, it seemed that the use of DDT would stop the disease from spreading, but again, the devastating side effects were soon discovered. Our songbirds, specifically the American robin, were dying. The infestation of the fungus that was introduced in the 1930s reached its peak in the 1970s. Rachel Carson consistently argued that spraying chemicals was not the answer to Dutch elm disease, but the spraying continued until its ban in 1972.[23] Like the birds of prey, this ban helped stabilize small bird populations.

Citizen Science:

Going back to the beginning of this unit and the idea of kids ‘doing science’, some parents may think, well, I’m not a scientist; how do I teach my child about science when I do not know one bird from another? And the answer is that we can. In exposure and allowing our kids to wonder, Carson describes emotions developed during these observations as the fertile soil where the seeds of knowledge will grow.[24] When I look back at those moments under my pine trees, I think of the emotions I must have felt, not only the sense of wonder and curiosity, but also safety and peace, and most importantly, the reciprocity that Kimmerer writes about in *Braiding Sweetgrass*, citing the importance of the relationships that we share with the natural world.[25]

In recent years, Citizen Science has made an important contribution to the scientific world by encouraging everyday people to collaborate with professional scientists on research. Volunteers collect and enter data into websites such as Cornell Lab of Ornithology, eBird, and Merlin Bird ID. Although the term Citizen Science is relatively new, the idea has been around for some time. Wells Cooke, a member of the American Ornithologists' Union, began a program to study bird migration patterns in the late 1800s. It expanded into the North American Bird Phenology Program. A network of volunteers began collecting information about migratory bird patterns on information cards.[26] Those information cards are now heavily used by scientists.

Studying birds and the obstacles they overcome, as advocated by those who asked the tough questions, is a way to engage students in conservation efforts.

Migratory Birds in Chicago:

Why do birds migrate? It is almost always about finding food. Usually, changes in daylight initiate brain signals in birds. The German term *zugunruhe* means migratory restlessness; birds begin to get antsy. It is the need for them to begin moving. For example, red-winged blackbirds coming back to New York come back within a

two-week period. Typically, the males will migrate first. The adults leave first, then are followed by the juveniles. The bulk of migration happens at night because there are fewer predators. Since they cannot see much, they can detect the Earth's magnetic field. This is called magnetoreception. While it is still a mystery how magnetoreception works, scientists generally know that birds and other animals sense the Earth's magnetic field and use it to guide their paths. In the article "Unraveling the enigma of bird magnetoreception", the author cites cryptochrome, which is found in the eyes, is what allows birds to see electromagnetic fields.^[27]

Bird Banding to Keep Track of Bird Migration

Bird banding is a monitoring technique that has been used since the late 1500s.^[28] The earliest record of a metal band attached to a bird's leg was about 1595, when one of Henry IV's peregrine falcons was lost in France and then found in Malta about 1350 miles away only 24 hours later.^[29] In 1803, John James Audubon, a French-American artist and ornithologist, began tying silver cords to the legs of eastern phoebes and was able to identify them when they returned the following year. Birds are usually banded by mist netting. Mist nets are made of fine black nylon or polyester mesh netting and are about 12 feet long and 8-10 feet high. They are placed between two poles and become nearly invisible to the birds. Once the bird is captured, it is gently handled by a bander who loosely places a band around a bird's leg. Banding data are used in large-scale, long-term studies to track migratory movements and patterns, population size and demographics, morphology, and behavior, and to assess whether changes occur over time.^[30]



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Bird captured with mist netting for banding

Migration Route: The Mississippi Flyway

The Mississippi Flyway is a migration route along the Mississippi, Missouri, and lower Ohio rivers. It is one of the four flyways in the United States. The others are Central, Pacific, and Atlantic. As one can see in the following illustration, Chicago lies along one of the main bird migratory routes in North America, the Mississippi Flyway. This bird migration corridor follows the Mississippi and the Missouri rivers. It is used by about 325 species of birds, about half of all North American birds. Most birds from the northern plains will probably winter on the Gulf Coast, using the Mississippi River as a visual cue. Over half of the birds that migrate rely on wetland habitats as they travel.^[32]



The Mississippi Flyway in blue

The Endangered Piping Plover:



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Piping plover with bands for identification

One migratory bird in particular, the piping plover, has become Chicago's sweetheart. There are three populations of piping plovers. One population occurs along the shorelines of the Great Lakes, another on the rivers and lakes of the Northern Great Plains, and the third along the Atlantic Coast. The Great Lakes piping plover population likes sandy beaches and tidal flats. It nests on open beaches near the water. It usually lays one clutch of 2 to 5 eggs. The eggs are pale with black and brown spots. The incubation period averages about 26-28 days. Both males and females take turns incubating the eggs. Piping plovers form monogamous pairs during the breeding season but sometimes change mates the following year. The young may leave their nest a few hours after hatching and feed themselves by pecking at the sandy ground for insects. Marine worms, small crustaceans, flies, water beetles, snails, and roundworms, among others, are their preferred food. The chicks are precocial, meaning that once they hatch, they are completely mobile and can feed themselves.^[35] On December 11, 1985, the Great Lakes population was listed as endangered. By May 7, 2001, the U.S. Fish and Wildlife Service designated critical habitat for the Great Lakes breeding population of piping plovers.^[36]

Leslie Borns and the Questions that Revitalized Montrose Beach Dunes

In 2020, The Reader, a Chicago-based newspaper, published an article titled "How One Woman Revived the City's Most Impressive Natural Ecosystem." Leslie Borns, an avid birder and volunteer with the Bird Conservation Network, noticed lakeshore rush, *Schoenoplectus lacustris*, a grassy plant not seen in the area since 1946. Leslie convinced the Chicago Park District to allow it to grow. The Chicago Park District agreed.

Lakeshore rush is a rare plant that naturally grows on sand dunes and wet shorelines. Other plant species that are normally associated with dunes began growing there, too. Sandbar willow and cottonwood trees protect from waves and also serve as food for wetland birds, among other animals. Other plants on the Illinois threatened species list, such as sea rocket and dune grass, began to grow in the area too. Dune grass helps stabilize the sand, keeping it from blowing away. While this new growth may look messy to a casual beach sunbather, dunes provide a sanctuary for the tired migrating bird.^[37] This developing change in habitat provided a panne habitat, a rare wetland type that occurs only along the Great Lakes and is often found on sand dunes. This revitalization of the lakeshore rush, along with the other returning plants, later provided a hiding place for the piping plover. The fact that plovers are nesting there is basically a credit to all the volunteers who questioned authorities about the future of Montrose Beach Dunes.^[38]

Dunes start as bare sand, then become dunes with grass helping to hold them in place. When grass takes root on a beach, its roots will begin to trap sand, causing small dunes to form. This, in turn, sets the stage for additional plant and animal life to inhabit the dunes. Over time, shrubs and trees take root. As more time passes, a full forest, also called a climax forest, is able to grow at the back edge of a dune system. This change in ecosystems over time is called succession. During succession, a series of changes occur in the ecological community that inhabits a region. Succession occurs when the activities of living organisms and abiotic factors change a region's conditions, making it more habitable for a different group of organisms. In sand dunes, an example of the changing communities is beach, foredune, interdunal pond, and forested backdune.^[39]

Montrose Beach was originally formed by landfills and later shaped by natural processes and, more recently, by a whole lot of advocacies, as Leslie Borns demonstrated. Sand dunes were created at Montrose Beach by Lake Michigan and by the Chicago Park District, which stopped grooming the area in 2001 after Borns questioned what would happen if we let the plants grow.^[40] This helped create a rare habitat for rare plants. The dune is now about 6-8 feet tall in some parts. With its success as a migratory bird sanctuary and ample community volunteer advocacy, the Chicago Park District agreed to expand the Montrose Beach habitat. "We are thrilled to announce the expansion of the Montrose Natural Area," said Chicago Park District General Superintendent & CEO Michael Kelly. "This treasured space, which attracts native and migratory birds, including the endangered Piping Plover, and various plants, brings nature and people together in a unique way." 3.1 acres were added to the 12.8 acres that were originally there. It is the only place in the city that has a state-level designation as a protected area.^[41]

Monty and Rose: The Piping Plovers' Conservation Love Story

Monty and Rose first appeared on Montrose Beach in Chicago in May of 2019. That year they fledged 2 chicks. They were banded the previous year while nesting at Waukegan Beach, about 30 miles north of Chicago. When the plovers first arrived at Montrose Beach, birders were astonished. A bird-watching volunteer recognized them. This made big news because it was the first time that Chicago had nesting piping plovers since 1946. There was no enclosure, just a regular city beach. The pair was named Monty and Rose after Montrose Beach. Monty and Rose returned in 2020 and fledged 3 chicks, Nish, Hazel, and Esperanza. They came back again in 2021 and fledged Imani and Siewka before an eagerly waiting audience of volunteers and regular beach visitors, who were excited to take part in this rare natural event. Unfortunately, in 2022, Monty arrived in April, but Rose never arrived from her wintering site in Florida. Monty passed away a month later, on May 13, from a fungal infection. Imani, their chick from the previous year, returned to Montrose Beach but did not find a mate.

In 2023, Imani returned to Montrose Beach again but again did not find a mate. During that season in July, Sea Rocket, Prickly Pear, and Wild Indigo were released from the country's only plover incubation facility in northern Michigan from eggs that were captured in upstate New York.[42] Hoping one would return the following year and mate with Imani. The following year, in May of 2024, Sea Rocket returned and mated with Imani! They fledged Nagamo. The year after, in 2025, they returned and fledged Bean, El, and Ferris, honoring Chicago landmarks. Unfortunately, Ferris was eaten by a red-tailed hawk on 63rd Street Beach during its migration south. And this year, 2026, Imani and Sea Rocket returned once again to fledge four: Buddy, Frankie, Mavis, and Tweedy, honoring Chicago music legends Buddy Guy, Frankie Knuckles, Mavis Staples, and Jeff Tweedy.

Becoming familiar with the birds, naming them, and tracing their family tree forms a relationship with them that regular bird observations cannot match. Chicago bird watchers not only know them but also know their parents and offspring; their heartbreaks and triumphs. This heartwarming story has helped with piping plover conservation efforts. If anything happens to them during their migration, as in the case of Ferris, who was eaten by a brown-tailed hawk at 63rd Street Beach, the public is aware of it. I have had students ask me months after I introduced them to the Chicago piping plovers if I know their whereabouts. It is difficult not to care for someone that you have become familiar with, as in the case of Monty and Rose and their offspring. By the way, Monty's father, YOGI, and his mate, bLo, are still alive in Silver Lake State Park in Michigan.

Unfortunately, like many other animal species, the piping plover remains threatened by increased human activity. Beachgoers and off-leash dogs are a great threat.[43] The choice Monty and Rose made to nest on one of the most highly populated beaches in the Chicago area has not made it easy. Hence, the danger their offspring continue to face. Climate change is also a threat. The Audubon Survival by Degrees project is an interactive website that lets us choose a temperature scenario to see the threats facing the piping plover as the climate warms.[44] The 2025 State of the Birds report found that piping plovers have lost more than 50% of their population over the past 50 years.[45] The Great Lakes region has not yet reached its goal of 150 breeding pairs, but volunteers continue to fight for the comeback of this endearing bird. Volunteers now provide fencing around the nests, and night-vision cameras have been installed. One example of a large-scale effort to guard the nesting Montrose Beach pair was when Mamby on the Beach Music Festival, scheduled to take place on Montrose Beach and expected to draw 40,000 people over 2 days, was canceled due to the rapid mobilization of volunteers who had been monitoring the piping plovers.[46]

As one can see, it takes everyday people who ask important questions to aid in conservation efforts. I want my students to know that they can make positive changes, but first they need to understand and embrace the natural world around them. The most important thing we, as educators, can do is provide them with time and space.

Teaching Strategies:

All scientific studies start with a question. This question is then turned into a testable statement, the hypothesis. We have seen countless charts describing the scientific method in our science classrooms. As someone who has been teaching for over 25 years, I can say those charts have withstood the test of time. As early as 1000 AD, Arab mathematician, astronomer, and physicist Ibn al-Haitham acknowledged the importance of questions in science. "The duty of the man who investigates the writings of scientists, if

learning the truth is his goal, is to make himself an enemy of all that he reads, and attack it from every side.” He is known as the father of the scientific method and pioneered the modern approach by insisting that theories be tested and verified through systematic experiments, rather than relying on abstract philosophy. Many modern scientists continue to use the scientific method today.[47]

In my classroom, I have found that asking questions is an effective way to promote thinking during the scientific process. When students design their own scientific inquiry projects based on observations of the world around them, they not only answer their own questions but also ignite new curiosity. Through thoughtful guidance, the focus here will be on the types of questions that arise from their bird observations. Questions from their peers will ensure their projects are relevant and meaningful by guiding the next phase of their work. I find that students are less reluctant to ask their peers questions than they are to ask adults, such as their teacher. The expectation is that these questions will contribute to the formation of new hypotheses, further investigations, and so on. While many students’ curious engagement declines as they get older, it does not have to be this way. A classroom where students feel comfortable making mistakes is a classroom where students are actively learning. Creating a classroom environment where students put themselves in the vulnerable position of asking questions is powerful learning. The hope is that this engagement will lead students, especially students from marginalized communities, to pursue careers in STEM.

Activities

Using the Scientific Method: Design an Investigation:

In the activity section of this unit, I intend to explore the critical thinking and questioning skills that develop as students embark on student choice in their learning. Through an inquiry-based approach, students will guide their learning by working on independent projects using the scientific method. Students begin by asking an inquiry question about birds. Some examples are:

1. How does the variation in beak morphology within a single local bird population affect individual survival rates during food shortages?
2. To what extent does urban noise pollution alter the frequency and amplitude of bird songs, and how does this affect reproductive success?
3. In what ways do artificial light environments disrupt the circadian rhythms and migratory navigation of nocturnal flyers?

After, students continue with researching, developing a hypothesis, designing their activity, collecting data, and finally presenting their findings to their peers. As students ask their inquiry questions, I will meet with them to refine their questions and guide them in writing their hypotheses. While I may guide students through the process, ultimately, they decide the direction their project will take and the activities they will explore.

While students work on their independent inquiry projects, I will present the following activities for whole-class participation and gain more knowledge regarding birds:

Inquiry Beak Identification Activity:

Students will be given tools such as tweezers, spoons, and clothespins that mimic beaks and simulated food

such as rubber bands, small sponge bits, and sunflower seeds. Students will actively engage in deductive reasoning to match a bird's beak with its food. They will have a data sheet to log predictions, timed collection amounts, and reflections. This activity will encourage inquiry questions about birds and their habitats.

Celebrate Urban Birds Activity:

An activity that I have been doing the past few years is Celebrate Urban Birds, a citizen science project by Cornell Lab of Ornithology. Students will go out to the school playground or take a walk to the park to complete a bird-watching activity. Students will complete the activity for three days. This can be done consecutively or once a week. This is a 10-minute observation in a 50-ft-by-50-ft space focusing on 16 project focal species using an identification poster. Students will note which focal birds appear on their tally sheet. Although they are not needed for this activity, we are fortunate to have a class set of Peterson's First Guide to Birds of North America and binoculars, which we will take with us. After completing their bird observations, they will enter their data via a citizen science link on the Celebrate Urban Birds website to help researchers track urban bird habitats. This activity will help students familiarize themselves with the birds in our neighborhood.

Food Chain Activity:

Students will form a human food web. Each student will wear an animal card. The first student will toss a yarn from one organism to its food source. This creates a giant visible web that demonstrates ecosystem interdependence and energy flow. This activity demonstrates how DDT affected birds of prey, as it was passed to them through the food chain.

Appendix on Implementing District Standards

NGSS Standards:

MS-LS1-4

Use argument-based empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively.

MS-LS4-4

Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of survival and reproducing in a specific environment.

Throughout the unit, students will study migratory birds, specifically the endangered piping plovers. After learning about birds and the factors that threaten their survival, students look for solutions. They will do this by asking inquiry-based questions from the material presented to them or research they have done on their own. Along with teacher presentations, outdoor monitoring will enable students to collect empirical evidence of migration and other pertinent observations. They will analyze how piping plovers use dune habitats, how climate change will shift migration patterns, and how human activities, such as the use of DDT and other

pesticides, can alter ecosystems. They will examine how specific traits of the endangered piping plover benefit from local dune habitats. Through classroom activities, students will have ample opportunities to see how birds thrive in their environment and what adds to their success. Students will study how human recreation and development have altered the Montrose Beach ecosystem and how implemented management plans have helped conservation efforts for the piping plover. They will investigate how shifting climate and habitat loss at Montrose Beach can affect the bird populations. They will also explore how climate change can alter migration timelines and flight patterns. By participating in outdoor observations and citizen science, students collect, analyze, and graph raw field data. Students can build scientific arguments that show how changes to physical components (Montrose Beach) directly affect a biological component (piping plovers). Finally, and most importantly, throughout the unit, students will have opportunities to be guided and encouraged to ask questions that guide their learning.

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This article continues celebrating the offspring and family tree of Monty and Rose.

Bauer, Kelly. 2026. "4 Piping Plovers Hatch at Montrose Beach." Block Club Chicago

This article continues celebrating the offspring and family tree of Monty and Rose.

Berger, Warren. 2014. *A More Beautiful Question: The Power of Inquiry to Spark Breakthrough Ideas*. Bloomsbury.

This book highlights the importance of asking questions and how they can be a gateway to advocacy and innovation.

Carla Baricz and James Kessenides, curators, "*Silent Springs, Windswept Seas: Rachel Carson's Environmental Vision*," exhibition, Beinecke Rare Book and Manuscript Library, Yale University, May 18–October 4, 2026

This exhibit, which I viewed during the Intensive Session at YNI, was instrumental in writing this curriculum unit.

Carson, Rachel. 2021. *Rachel Carson: The Sea Trilogy* (LOA #352). Library of America.

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Chicago Park District. 2024. "Chicago's Very Own Native Son, Imani the Great Lakes Piping Plover, Returns to Montrose Beach Dunes' Monty & Rose Wildlife Habitat for the 2024 Season." April 25.

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This article helped me better understand the history of Dutch elm disease.

Gretchen, Kraig-Turner, Liza, Jana, and Jen. 2026. "Science Teaching for Social Justice." *Rethinking Schools*.

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Kimmerer, Robin Wall. 2013. *Braiding Sweetgrass*. In *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge and the Teachings of Plants*. Milkweed Editions.

This book talks about the reciprocity that exists between the natural world and goes hand in hand with Rachel Carson's life work.

Lei, Ryan F., Emily R. Green, Sarah Jane Leslie, and Marjorie Rhodes. 2019. "Children Lose Confidence in Their Potential to 'Be Scientists,' but Not in Their Capacity to 'Do Science.'" *Developmental Science* 22 (6).

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Student Reading List:

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*Chicago Park District 541 North Fairbanks Court, 7 Th Floor 312/742.4786 (Phone), 312/742.5391 (Fax) ****
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List of Materials for Classroom Use:

"Celebrate Urban Birds." n.d.-a. In *Celebrate Urban Birds*. Accessed August 14, 2026.

"National Parks in the History of Science: Plant Succession (Video) (U.S. National Park Service)." 2022. In *Nps.Gov*.

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