

## *The Cornell Summer Science Snapshot!*

### *Sounds & Waves are All Around*

Ever wonder what twenty-one rural middle school students and nine K-6 educators could possibly all have in common? At least three things come to mind; they all love eating ice-cream from the Cornell Dairy Bar, they all think the Mars Exploration Rover is the coolest robotic space mission ever, and they all had a great time at the Cornell Summer Science Sampler program learning about sound, waves and engineering.

If you were a visitor at Cornell's Laboratory of Ornithology during the morning of August 18th, you would have been greeted by a large group of students and teachers organized in a circle outside of the entrance to the laboratory. The only noise you would have heard, aside from the birdsongs emanating from the surrounding natural areas, would have been the voice of a tentative middle school student introducing herself; "Hi. My name is Amanda. The bird identification card I have is the Morning Dove which makes a sound like this: 'Oo-wah-hooo, hoo-hoo.'" After a few giggles from the crowd, all of the students, in turn, would introduce themselves and mimic the call of their assigned bird. This ice-breaker activity was just the beginning of a two-day team building and group learning experience for rural middle school students from Tully Central School District hosted by the outreach program at the Cornell Laboratory for Accelerator-based Sciences and Education (CLASSE).



In groups, students spent the morning at the Lab of O. rotating through a series of activity stations designed to encourage them to think, feel and visually represent sound. By listening to bird calls, whale songs and elephant

noises, students realized the important role sounds play in the animal world and how unique sounds convey different messages or emotions. Students delighted in the ability to alter pre-recorded animal sounds and their own voices by manipulating controls in the Lab of O's Sound Studio. After participating in a bird walk, listening to various recorded sounds from the Macaulay Library, and attempting to communicate with their peers without using words but only using sounds, students began to easily recognize differences in volume and pitch. As the two day workshop progressed, students learned more about how sound travels as a wave, the various properties of sound, and role of acoustical scientists and engineers in their everyday lives.



As the morning program concluded, students hurriedly boarded the bus and headed to campus to visit another laboratory at Cornell; the Wilson Synchrotron Laboratory. Wilson Lab is home to one of only a handful of particle accelerator facilities in the United States. Here, forty feet underground, tiny electrons and anti-electrons are accelerated to nearly the speed of light in a circular "racetrack" called the Synchrotron. Once the particles are accelerated, they are transferred to a second racetrack called the Cornell Electron Storage Ring (CESR), where they continue to whiz around the ring at over 99% the speed of light. Students munched on pizza as they listened to CLASSE staff explain some of the history, intricacies and importance of the research being conducted at Wilson Laboratory. Eyes began to wander and interest started waning until they were told they were going to actually walk through the underground racetrack as part of their visit to Wilson Lab! Enthusiasm peaked when they were informed that dessert would be waiting for them not far from the tunnel's end when they completed the tour. Armed with a dosimeter and plenty of curiosity, the group descended into

the tunnel and reveled at the spectacular array of equipment, electronics and technology that crowded the underground passage. Nervous laughter and occasional squeals of delight could be heard from the visitors as they ducked under the transfer lines, dodged puddles of tunnel juice, and climbed their way out of the facility using the cross-tunnel exit. Eyes squinting and mouths flapping as they emerged from the stair-well, the students talked about their underground journey most of the walk to central campus where they arrived for the afternoon portion of the programming at Floyd R. Newman Laboratory.



After consuming their fill of Oreos and chocolate chip cookies, the group was ready to focus on their afternoon projects. Students were split into two groups; each group assigned to a subset of educators to work collaboratively on project-based learning activities from the Engineering is Elementary (EiE) curriculum. This curriculum, developed at the Boston Museum of Science, integrates engineering and technology concepts and skills with elementary science topics. Through introductory lessons and a hands-on design challenge focused on either sound or solar energy, students worked in teams to apply their problem-solving skills and knowledge of science and mathematics to solve a problem. Together, students were guided through the process of designing, creating, and improving their own device. By the end of the afternoon, pairs of students developed and displayed either a tactile representation of a bird song or designed and built a functioning solar oven from sustainable materials.

Prior to leaving, students were provided with either a digital audio recorder or a mini digital camera in order to complete a homework assignment. Parents were told ahead of time that the students would need to allocate time at home to complete their photodocumentation or soundscape assignment. Students carefully examined their equipment and

diligently practiced using the device before leaving for the day. Students asked numerous questions about what images or sounds they were allowed to capture. Leaving the assignment as open-ended as possible, students were told they could capture any ten sights or sounds from home that they believe were examples of science, engineering or technology. The next morning, as the kids boarded the bus in Tully and headed towards Cornell, one could hear students rewinding and sharing their sounds with others. Later that afternoon, while sharing their sights and sounds with the workshop coordinators, it was apparent that these kids took great pride in the work they had done the night before. The familiar sights and sounds



that they brought from their houses, backyards, barns, garages and front porches were comforting to them and conveyed a sense of self; a small aspect of their own identity was wrapped-up in each image or noise they captured. Each student thoughtfully described their visual or audio selections and enjoyed explaining how the chosen technology worked. While their explanations were not entirely correct or comprehensive, the satisfaction the students experienced by carefully observing, capturing and communicating their personal knowledge was unmistakable.

After arriving on campus on the morning of August 19, everyone participated in a few more outdoor group activities that got the blood flowing and mind working. An echolocation game had one student volunteer ("predator") blindfolded and

surrounded by a circle of her peers, attempting to capture other student volunteers (“prey”) by listening to the sounds emanating from their movement in the grass. Afterward, the students imitated the movements of several teachers and collectively



mimicked the sounds generated by an approaching thunderstorm. By alternately rubbing their hands together, snapping their fingers, and stomping their feet the group was able to capture the sounds and essence of a real summer thunderstorm! Energy and enthusiasm were high as the kids made their way down the third floor hallway of Newman Laboratory, causing several physicists to peer out their doorways to investigate the source of such an unusual outburst of noise. Without missing a beat, the kids broke off into two groups to tackle the EiE project they had not completed the day before. In no time at all, students were outside testing the effectiveness of their solar ovens by melting chocolate atop marshmallow and other students were constructing three dimensional representations of bird calls using elbow noodles and pipe cleaners.

Students built up quite an appetite while thinking, designing and constructing their EiE projects in the morning. Everyone was more than ready to get a bite to eat on campus at the Trillium when it was lunchtime. The group quieted down when they entered the dining hall and were surrounded by an abundance of dining choices and a crowd of intimidating undergraduate students. As they ate, they glanced up and looked around, marveling at the foreign environment in which they found themselves immersed. Yet, even though several of them appeared timid, reflected in their eyes was a growing look of confidence that comes only with familiarity. This occasion was a milestone for many children whose parents had not attended college or whose family

had never set foot on a university campus.

During their time on Cornell’s campus the seeds of obtaining a higher education had been planted. With steadfast determination and guidance from the adults around them these students could reap the benefits of furthering their education.

Lunch was consumed and the satisfied group headed over to the Cornell Center for Radiophysics and Space Science. Students watched an animated video, from launch to landing, of the Mars Exploration Rover mission. They learned that scientists at Cornell had helped to build, launch and monitor the two rovers, aptly named Spirit and Opportunity, and that the scientific community had anticipated the rovers would run for only seven days before shutting down. A graduate student led the conversation as students brainstormed possible reasons why the mission was projected to end so abruptly. From their experience building solar-powered ovens, students were able to discuss the importance of the reflective solar paneling that adorns the rovers. From their own projects they were able to recognize the limitations of powering the rovers if the solar panels, used to recharge the batteries, were obstructed from the sun. After analyzing computer images, students learned that the dust from the Martian sky falls onto the rovers’ solar panels, impeding their ability to collect energy from the sun. Scientists speculate that dust devils are sweeping the solar panels clean. Improving the solar panels (an important step in the engineering design process) used in future rover missions to other planets could be a valuable technological contribution these budding engineers and scientists could make to society.



Before walking back to Newman Laboratory, the group visited the Cornell Dairy Bar at Kennedy Hall

and indulged in a flavorful scoop of ice-cream. The crowd then made its way back to the conference room to prepare for the culminating event of the program: the student project showcase. Parents, teachers, friends, family and laboratory scientists were all invited to the event which took place at Newman Lab from 5-6pm. The excitement was impossible to contain as students put the finishing touches on their projects and preparations for the Sampler Showcase began. The students were in charge of setting up their projects that would be on display throughout the third floor of the building. Various rooms and the hallway were lined with activity stations, props, signs and directions to follow. Munchies were delivered and arranged, a slideshow was created and displayed, and leaflets were folded in preparation for distribution as the youngsters waited for their guests to arrive. Once the audience of over sixty people settled into the packed conference room, introductions were made and the program started. Spectators were dazzled by the students' rendition of the rainstorm and amazed by the multitude of activities



and projects the children completed during their two days on campus. As students led their visitors throughout the third floor, various conversations could be overheard as students shared what they had learned with a captive audience; parents were instructed on how to use the two-can telephone, siblings were told to strike a tuning fork and listen to the vibrations, friends were shown how a solar oven was able to melt chocolate, and scientists were asked to match the characteristics of a bird call to a corresponding three-dimensional model. Nods of appreciation and smiles of satisfaction could be seen on the faces of every parent in the room as each participating student was recognized at the front of the room while receiving a congratulatory handshake and an official Cornell Summer Science Snapshot certificate of participation.



After the concluding words, the program ended and the crowd thinned but a sense of accomplishment filled the room. Rural school children deserve the opportunity to explore science and engineering beyond the confines of a traditional classroom. Programs such as the Cornell Summer Science Snapshot offer underserved students with a chance to level the playing field and be reassured that a college education is obtainable.



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