Engaging Engineering Experts

Programs hosted by Chicago Children's Museum (CCM)

Making Stringed Instruments. Dustin, head of Tinkering School Chicago, offered families the opportunity to design and build their own instruments. His personal narrative described making a stringed instrument from a large pole to make music that did not sound like anything he had heard before. Program iterations over five sessions included changes in how he told the personal narrative and whether the narratives was told to a whole group in a workshop program, or to individual families as they arrived for a drop-in program.

Making Swing Sets. Dan, a mechanical engineer, invited families to build swing sets for finger puppets out of every-day materials. Dan conveyed his experience making swing sets for a preschool, and the processes involved in creating a sturdy, functional design. Program iterations over six sessions focused on ways of introducing the narrative and using models and diagrams.

Making Fan-Powered Cars. This program was led by Jason, a mechanical engineer and co-founder of Project SYNCERE (*Supporting Youth's Needs with Core Engineering Research Experiments*). His oral narrative included a description of the engineering design process, together with his story of designing and redesigning remote controlled cars with his childhood friends. Program iterations over four sessions focused on connecting Jason's personal narrative to the project more explicitly, and trying new ways of inviting children's participation as the narrative unfolded.

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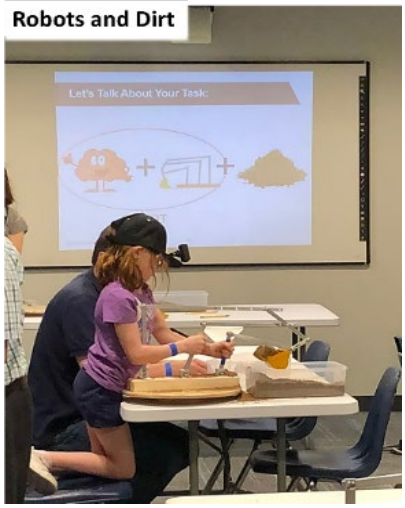
Making Wings. Anna, a costume engineer, facilitated a program for families to design, build, and test their own pair of "wearable" wings. Across four sessions, Anna modified her narrative about her efforts designing costumes to make it more understandable for young children. She also changed her narrative to make explicit comparisons between her personal experiences as an engineer and the challenges involved in making wings.

Wired Up. This program was led by Jason, a mechanical engineer and co-founder of Project SYNCERE (*Supporting Youth's Needs with Core Engineering Research Experiments*). His oral narrative included an introduction of himself as a mechanical engineer who encountered an electrical engineering problem at home. The activity involved understanding circuits that were built into a model home with the final goal of using circuits to make an alarm for the door. Program iterations of three sessions focused on narrative changes (connecting Jason's explanation of his engineering background to electrical engineering) and modifications to the materials.

Robots and Dirt. Anna, a Northwestern University geotechnical engineering graduate student from Australia, who creates robots to provide an efficient, quick way to move ground materials (e.g., dirt, sand) led this program. Her oral narrative included an explanation of her construction work, a presentation of the robot's design process, and a hands-on demonstration of the task. Program iterations over three sessions focused on changes to Anna's personal narrative to encourage children to keep trying in the face of failure, and the use of models to demonstrate the task.



Science of Slides. Adrienne, a structural engineer who spent part of her career working in city planning, led this program. Supplementing her oral narrative was a PowerPoint presentation that defined what engineers do and how they utilize the engineering design process. The Science of Slides program featured a story about animal characters that motivated the engineering design process for families. The first goal was to build a slide that could support small and large riders with certain constraints. Mid-way through the activity, Adrienne added a second, surprise challenge, asking families to redesign their slide in order to protect a monster habitat. Over her three sessions, Adrienne further drove home the need to use the engineering design process, showing how applicable it is in various situations. She also changed the way she introduced the second challenge.

Bicycle Engineering. This program was led by Alex, a bike shop owner. The connection with Alex was made by the Evanston Public Library (ELP), but the first iteration of the program was developed with Alex and practitioners at CCM. Alex opened this program by talking about his natural childhood curiosity about how object mechanisms worked. Using a bicycle, Alex demonstrated how gears work in relation to one another. He would rotate the small gear and point out how the large gear rotated in response. He asked the children how many times the wheel would move when he used the small and large gear. During the demonstration, the children counted the times the wheels rotated aloud, and were able to compare their predictions to the actual outcome. After watching this demonstration, children worked with their families to predict how many times a monster wheel would spin around depending on the size of gear they used. Families tracked their predictions and progress on a worksheet. After finishing the worksheet, families were then given a second challenge. The monster wheel was placed far away from the gear, and the family had to make the monster wheel turn using extra wooden pieces and rubber bands. Over his six sessions, Alex stressed the importance of making predictions and problem solving.

Programs hosted by Evanston Public Library (EPL)

Making Card Towers. Keren described how she came to pursue education and training in engineering, and her specific experiences designing a robotic arm for manufacturing equipment. Program iterations over three sessions included changes in the timing of the narrative (before or after building the first tower) and efforts to elicit information from children regarding their process and progress.

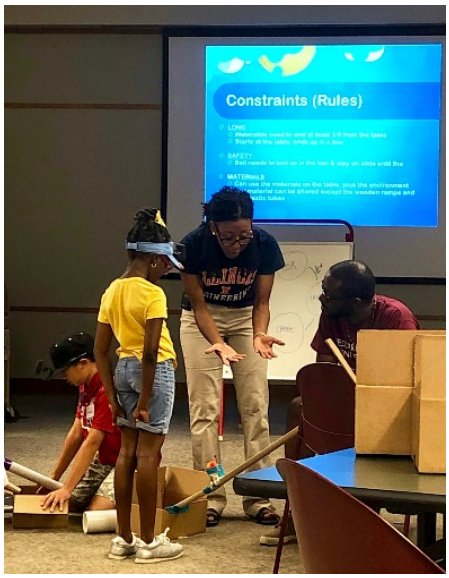
Making Balloon Powered Cars. Nic, an engineering graduate student, told about his experiences making robots to help people. Program iterations over three sessions included adding models and more communication about the connections between Nic's work in robotics and the engineering design process families would undertake to make balloon-powered cars.

Makeblock© mBot. Kim, a nuclear engineer, provided families with an introduction to engineering as a collaborative activity, such that engineers with different kinds of training all need to work together to complete projects. She encouraged children and their adult caregivers to bring their varied skills and expertise to the task of coding the movements of a robot using a tablet computer. Program iterations over three sessions included adding circle time, encouraging families to collaborate, and changing individual family challenges to group challenges.

Makey-Makey Electric Music. This program was led by Kaia and Melissa, two undergraduate engineering students at Northwestern University. Their oral narrative focused on differences in their personalities and on using programming to create music. Program iterations included balancing their interactions with families and simplifying complicated concepts during their narrative.

Wired Up. Jason's oral narrative included the same content to that which he used when hosting this program at the museum. It included an introduction of himself as an engineer, and explanations of what an engineer does and of the activity. Program iterations of three sessions focused on expanding the instructions for the activity. Families at these sessions had more time to engage in the activity in comparison to the museum sessions. The families were also invited to take the model house with them after the session for further exploration after the program.

Science of Slides. After this program was developed and used CCM it was then conducted at EPL with a few minor changes. Adrienne, the expert, is a structural engineer who spent part of her career working in city planning. Supplementing her oral narrative was a PowerPoint presentation defining what engineers do and how they utilize the engineering design process in their work. The "Science of Slides" program featured a story about monsters that motivated the engineering design process for families. The first goal was to build a slide that could support small and large riders with certain constraints. Mid-way through the activity, Adrienne added a second surprise challenge, asking families to redesign their slide in order to protect a monster habitat. Over her three sessions at EPL, Adrienne further elucidated why the engineering design process was useful and applicable to families' problem-solving process.



Bicycle Engineering. As he did when leading this program at CCM, Alex, a bike shop owner, opened this program by talking about his childhood curiosity about how things work. Because the library programs were longer sessions, Alex spent a bit more time in the EPL programs explaining to families how bicycles work. First, using a bicycle, Alex demonstrated how gears work in relation to each other. He asked the children how many times the wheel would move when he used the small and large gear. Then, adults and children did a walk-in-a-circle activity to see how these differences in gear sizes translated to a physical experience. Finally, he explained centrifuge using a small device. At EPL, children and their parents used a commercially available gear set for the hands-on activities, rather than the pegboard and gears materials CCM had created for the museum version of the program. Children were encouraged to count aloud the times the wheels went around and were able to compare their predictions to the actual outcome, but they could also iterate with other gears. Over three sessions at EPL, Alex stressed the importance of making predictions, exploring, and problem-solving.