natural phenomena

the museum of science and industry unleashes science storms

By Martin Palicki

Most attractions or museums have one icon, or centerpiece that draws people inside. For decades, the Museum of Science and Industry in Chicago arguably had its Coal Mine exhibit, placed toward the back of the museum's main hall, beckoning guests inward with its periodic whistle call.

As of March 18th, however, the Coal Mine has some competition. In the museum's new Science Storms permanent exhibit there isn't just one icon, however, there are SIX. And each one is more impressive than the previous one.

The exhibit focuses on basic science and replaces what was once the Grainger Hall of Science and a temporary exhibit space, which has relocated to other areas of the museum. Exhibit planners knew they needed to update the museum's collection of basic physics and chemistry exhibits, and had been working on the project for five years. Senior Exhibit Developer Olivia Castellini was brought on by the museum for the Science Storms project and helped guide the direction of the exhibit.

"Our goal from the beginning was to find elements of science that inspire wonder in people," explains Castellini. "We turned to natural phenomena that everyone is able to appreciate and understand." The exhibit then branches off from these natural phenomena and explains the scientific principles behind them in smaller exhibits, bringing in other examples. The effect is a sort of modular, free-flowing exhibit where one can wander in and out – the complete opposite of the linear start-to-finish style exhibit the Coal Mine offers.
Science Storms' six iconic exhibits include avalanche, tornado, sunlight, tsunami, fire and lightning. A seventh area, atoms in motion, includes some of the most interesting artifacts of the exhibit, but doesn't feature a predominant icon. Most of the exhibit fabrication was completed by Lexington Design + Fabrication, based in southern California.

"We have raised the bar in the museum fabrication field by creating these very complex interactives with fine details, and high end finishes that perform brilliantly day after day," said Howard Smith, Lexington's Project Manager for Science Storms. "The project required Lexington's team's to commit to an exhaustive, mock-up, prototyping and re- engineering process essential to proving the science."

With the avalanche disc in the foreground, tornado to the right and sunlight prisms in the middle, *the Science Storms exhibit has iconic demonstrations of science everywhere you look. Photo courtesy Museum of Science and Industry.*

AVALANCHE

Visitors approach Science Storms from the museum's main rotunda and ascend a small ramp. The entire first level of the exhibit is built on a raised platform, which was required in order to run data, electric, and water to the various elements of the exhibit. Immediately to the left is the exhibit's first icon, a slowly rotating disc, 20-feet in diameter. The giant disc, placed at an angle, is filled with garnet sand and glass beads. The different colored materials spin around inside the disc, depending on the speed of rotation, controlled by a steering wheel nearby.

As the disc's speed changes, the particles move, forming different types of motion within the disc, and exhibiting how granular materials can, en masse, behave like liquids. The effect is mesmerizing, as guests stop and stare in wonder.

Creating the 20-foot disc was a challenge in itself. Environmental artist Ned Kahn had created similar discs on a smaller scale in the past, mostly as art installations. The steel disc was manufactured in pieces and assembled onsite to allow it to fit through the museum's receiving doors. A polyurethane coating was required to create a single smooth surface on top of the steel plates. In order to keep the surface blemish-free, the museum constructed a temporary clean room around the disc in order to apply the polyurethane layer.

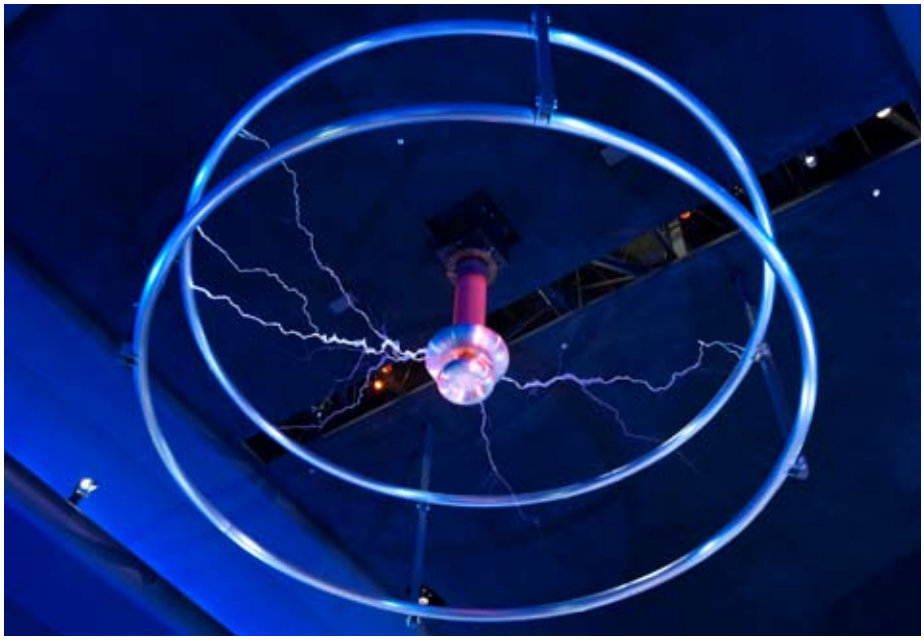
Surrounding the avalanche disc is an assortment of experiments and hands on exhibits that replicate lab experiments and teach guests about motion, including a giant Newton's cradle, and a tennis ball launcher that shoots balls from one side of the balcony to the other.

At a normal exhibit, a bottleneck at the avalanche disc might seriously clog the exhibit. But there's something bigger and even more eye-catching just beyond.

TORNADO

Standing 40 feet tall, a spinning tornado swirls from the floor all the way up to the ceiling, changing shape and moving around – controlled by museum guests. The tornado is created by 48 ultrasonic misting foggers and four giant fans (each the size of a VW bug) in the museum's ceiling that creates a swirling airflow and draws the fog up from the ground. Vents on the side open and close based on controls operated by visitors and change the tornado's shape and form.

It is the second piece from Ned Kahn, based on several smaller 8-foot versions he had created. According to Olivia Castellini, the museum staff wasn't really sure the tornado would form.



The giant Tesla coil, suspended from the museums ceiling, *creates an electrifying lightning show periodically throughout the day. Photo courtesy of Museum of Science and Industry.*

"With such a large scale, and in such a large space, it was hard to precisely know how the air currents in the museum would affect the formation of the tornado," said Castellini. "We all crossed our fingers when we turned the fans on for the first time, but within seconds, we had a tornado."

Surprisingly, the exhibit is extremely quiet. The fans are only running at 30-40% of capacity, so designed to increase their useful lifespan and minimize noise. The return air ducts, which run alongside the walls of the tornado space, feature acoustical treatment to reduce sound levels.

Once guests walk through the tornado, they can try their hand at building smaller ones, play the role of a storm chaser, learn about air pressure and hop into a wind tunnel booth to experience 80mph winds.

"We wanted to show people the exciting side of being a scientist," explained Castellini. "Each area features videos that highlight active scientists and asks them why they do what they do, what excites them and what they are planning on researching next. Each video is a human story that complements the science story around it."

The exhibit's media was produced by Cortina Productions, Inc. and the A/V systems were designed and integrated by MAD Systems.

Most areas have multiple touch screen stations, some on large monitors, that allow the guest to explore on a deeper level through video, interviews, and virtual experiments, the concepts being presented in each section.

"The A/V systems for Science Storms were created to be easily accessible by a wide audience, and to be intuitively understood," said Maris Ensing, MAD Systems Principal. Castellini agrees that a great deal of layering is available in the media content provided, and both 8-year olds and 80-year olds have been observed getting into the virtual content.

TSUNAMI

Behind the tornado, a 30-foot long plexiglass tank awaits guests' input for creating waves to crash upon a model shoreline. Typical ocean waves can be contrasted with a tsunami-style wave, and its effects are measured on two different types of shorelines. The tank, filled with mineral oil to avoid evaporation, also has a camera focused on it, shooting slow motion video of the waves crashing on the shoreline. The tank is one of the main icons fabricated by Lexington.

"Science Storms was one of those peak professional experiences and we couldn't have enjoyed more working with Kurt Hanfelner and the entire team at MSI," said Richard Bencivengo, President and CEO of Lexington. "Jack Pascarosa and Shari Berman of Evidence Design created an amazing experience and Lexington is proud to have been a member of this all star team and to have contributed to this ground breaking exhibition."

Surrounding the wave tank guests can explore waves in various ripple tanks and through a 20-foot tall oscillating wave form sculpture.

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Science Storms at the Museum of Science and Industry, Chicago

Collaborative Design/Build partners creating innovative exhibits, educational environments, and interactive experiences that engage, inform, and inspire.

Congratulations to our ***Science Storms*** *team!*

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The museum also acquired a tsunami-detecting buoy recently decommissioned by NOAA. According to Castellini, the museum was ready to have one fabricated, as NOAA did not have any available when one broke from its mooring and washed up on Kodiak Island in Alaska.

SUNLIGHT

The typically cavernous interior of the museum is pierced by direct sunlight at this station in the exhibit. A heliostat system on the museum's room directs sunlight down through a skylight where it intersects with four giant prisms. Each is 9 inches on a side and 40 inches long. The museum luckily found a source for the prisms that had some extra available. Should one of them break, it will take nearly two years to get the glass and form it into a replacement prism.

The prisms create rainbows that dance and move around the space. Below, the sunlight shines down on photovoltaic cells that power small electric cars on a racetrack. Nearby, exhibits explore the visible light spectrum, fiber optic technology, and a unique translucent color room allows guests the opportunity to add and subtract different wavelengths of blue, green and red light to create some surprising results.

LIGHTNING

No matter where you are in the Science Storms exhibit, or just about anywhere in the museum's main hall, you know exactly when the giant Tesla coil suspended from the ceiling is activated. If you can't see the bolts of lighting emanating from its center, you can certainly hear the giant shocking noise as it cycles on and off. It is set to discharge periodically, though a museum staffer can also control specific displays of lightning for use during an impromptu demonstration or a group presentation.

Beneath the coil a variety of experiments on static electricity and magnetism allow guests the opportunity to interact up close (and safely) with electricity.

FIRE

The exhibit's fire section is located close by the lightning exhibit. At the center is a fireproof chamber, similar to ones used by Underwriters Laboratories, that features a controllable flame and different sprinkler heads. Guests perform a live experiment to see which types of fire suppression systems are most effective. In doing so, flashing laser beams bisect the chamber and make clear the movement of water particles as they react to the heat, and vice versa.

The fireproof chamber is the only real fire in the exhibit. The remainder of the fire exhibits rely heavily on virtual experiments and simulated fire.

ATOMS IN MOTION

Hidden behind the fire exhibits, a compact area devoted to atoms and the elements contains some of the most interesting, and overlooked parts of Science Storms. A display of ferrofluid, which changes shape when exposed to magnets, is positively captivating, while a Periodic Table brings the elements to life.

Projected onto a flat surface, an image of the periodic table of elements invites guests to move small RFID pucks over various elements, in effect picking them up, and moving them to a virtual reaction chamber. As elements are brought together, reactions ensue. Create some table salt and a virtual pile of salt spills onto the table. And that's just on the tame side.

The table brings the elements to life and allows for exploration in ways that a traditional school lab isn't able to provide. "With more and more chemicals being banned from school science labs, students don't have the learning opportunities available to them that they can have here," said Castellini.

The exhibit space also allows for more in-depth exploration. Two classrooms near the atoms section give places for students (or teachers) to break out and focus more specifically on one topic. Museum educators are able to provide tracks for just about any group and level.

"Our main target for Science Storms is 10-14 year olds," said Castellini, "but the reality is they are not coming alone." That's why the exhibit offers so much to see and do for each of the main areas. If one of the big icons doesn't catch someone's interest, one of the smaller more intimate exhibits might. And the free-flowing nature of the exhibit encourages exploration at a personal level.

"Anyone can work the controls and move through the exhibit," explains Castellini. "But our goal at Science Storms is to inspire wonder. The best part of this whole project is coming out here and seeing the looks of fascination in people's faces. That's when I know Science Storms has been successful." **ipm**

BEHIND THE SCREENS

Mad Systems designed and built the media delivery and interactive systems for Science Storms, which had to take into consideration an extremely lively space with potentially many sound sources including the Tornado and the Tesla coil. Mad's Mad Dash server provides the media for all the media pieces, and in the case of Atoms and Avalanche also provides edge-blending, and its internal warp engine takes care of the Tornado primary media piece which is projected onto a concave surface.

Distributed speaker systems are used to deliver punchy special effects into the space, with specific listening stations providing the narrative for each of the media stations, which were set up to reduce sound bleed in the space as much as possible.

SolidDrive speakers are built into the benches of both the Lightning and the Atoms exhibits, and the Atoms exhibit uses the precedence effect to make visitors feel that the audio is delivered from speakers behind the screens, where the reality is that the main audio is actually provided by the benches which are fitted with SolidDrive transducers.

The AV system does not only provide media, but it also provides a control and diagnostics function. The control system turns the Science Storms gallery on in the morning, and it turns it off at night, removing power from every last single exhibit wherever possible. There are 14 exhibits that have Programmable Logic Controllers to take care of the detailed control and safety requirements of those individual exhibits, and the Mad control system controls their functionality and then if there are any fault messages, it collects those messages and sends an email to the maintenance staff. It also checks for projector status and lamp burning hours, and warns maintenance staff in case of projector issues or of lamps getting near the point where they need to be replaced, again by email.

The audio is DSP (Digital Signal Processing) based, and each audio channel was set up using a measurement microphone to ensure that the audio quality and speech intelligibility, a very important factor in venues such as this, is the best it can be. It also allows the overall sound levels to be controlled so that the museum has an easy method to change audio depending on how busy the gallery is - and again, changing the levels may be done from an iphone connected to the Science Storms system.