Exploring the Exploratorium in San Francisco

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On three consecutive days in April 2014, two colleagues and I visited the Exploratorium in San Francisco, California. Founded in 1969, this "Museum for Science, Art and Human Perception" is highly acclaimed world-wide for its exhibits that allow visitors to engage in hands-on and self-guided explorations of science. The exhibits are meant to be educational, informative, engaging, fun and entertaining. Our intention was to fully participate in what the museum offers and to assess what we encountered. Here are some of my observations and reflections.

A visit to the Exploratorium is self-guided. No museum staff will prevent you from making your own choices nor will they help you make good choices. Walking into the large hall, you follow the path you choose and you meet, with only a few steps in between, exhibit after exhibit. Some of them have a quiet appeal, some of them are flashy. This creates an immediate hurdle to meaningful learning. Sue Allen, who conducted visitor research and evaluation as an Exploratorium employee for over a decade, described the problem this way:

> Science museums are actually very difficult environments to engineer for learning… On the exhibit floor there is no accountability, no curriculum, no teachers to enforce concentration, no experienced guide to interpret and give significance to the vast amounts of stimulus and information presented. Without restrictions, visitors have complete freedom to follow their interests and impulses as they move through a public space packed with exhibits all vying for attention. (Allen 2004)

Exploratorium visitors interact with exhibits.

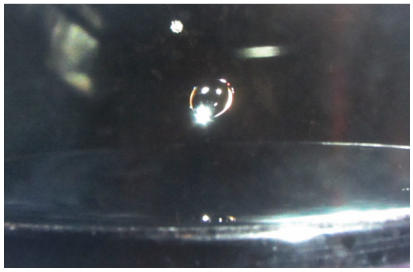
Staying focused

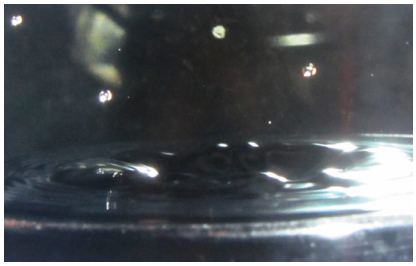
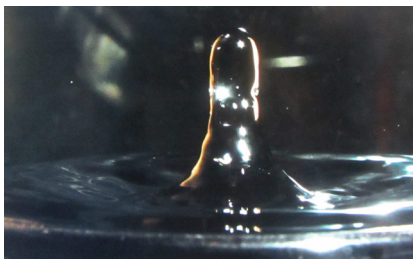
We found it important to voice and hold onto our own interests; without this we would get side-tracked, lose control over our explorations, and quickly tire. Over those three days, we consciously limited ourselves to certain parts of the museum. We stayed with exhibits on physics and human perception, and on the second and third day concentrated mainly on acoustics.

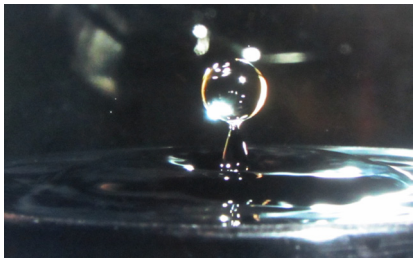
Even with a restricted focus it was easy to feel overwhelmed. This is known to be a frequent experience among visitors. As Allen observed:

> The effort it takes to negotiate a museum is apparent through the common phenomenon of "museum fatigue," in which the visitor can only engage deeply with exhibits for a limited period (typically about 30 minutes) before they lose their focused attention and begin to "cruise," looking for anything particularly compelling before moving on. Museum fatigue is an important factor that limits the degree to which visitors can effectively learn any form of science.

Each day we managed about four to five hours of wakeful activity at the museum. We engaged with exhibits, trying to understand what they demonstrated, how they were designed, and how they functioned. We observed other visitors engaging with exhibits. During breaks we shared and discussed our observations and our critiques. Our own motivation and intentional activity helped us to stay focused and resist "museum fatigue."





Those exhibits where I stayed for a longer time are the ones that I remember now and that fatigued me the least. When my long-held interests and questions were met or I came across novel aspects of topics that interest me, I was delighted and worked to gain a more thorough understanding. When, however, an exhibit related to things I had never concerned myself with, I did not always find an extended visit worthwhile.

In many cases it was helpful simply to ignore the interpretative texts accompanying exhibits. The explanations, I found, were rarely phenomenological. For instance, the caption next to the display of the brain of a deceased human being said "It is all in your brain." This dogma is reiterated at the Exploratorium over and over again in the exhibits relating to human perception. I sustained my interest in the phenomena on display by being aware of those theoretical constructs and not letting them guide and limit my own insights.

Interactions with exhibits can be fascinating

I was delighted to find in a quiet corner an exhibit that allowed me to photograph a falling drop of water and its impact on the surface of a cup brimful with water. The visitor sets the time when the photo is to be taken (in milliseconds after the drop release) and then releases the drop by pushing a button. Shortly after, the photo is displayed on a large screen. I took a series of photos: a drop falling, hitting the surface, and then a breathtaking unfolding of water movement — uprising, sinking, and uprising again — in intricate forms of great beauty. Behind me, other visitors watched patiently until I felt I had to move on.

This exhibit is one of many at the Exploratorium that allow a person to make observations that other teaching institutions (for instance high schools or colleges) cannot easily provide due to the exhibit's cost. In many cases I admired the ingenuity that went into the design of an exhibit, its elegance, durability, and professional craftsmanship. Exhibits here have to be robust in order to withstand misuse by children or adults. Most of the ones we engaged with functioned as they were intended, but some were broken and needed repair.

A simple exhibit awaits the visitor at the start of the acoustics area. A long sturdy rope hangs loosely under the high ceiling, fastened at both ends. A second rope is tied to this "giant guitar string", as it is called, and hangs down within reach of the visitor. By pulling this rope rhythmically you can set the "guitar string" into wavelike motions which will, with some skill on the user's part, result in a stationary wave. After practicing awhile, I managed a rather lopsided stationary wave.

The next exhibit in the acoustics section demonstrates air oscillation in relation to pitch: a metal pipe with a bore hole functions like a wind instrument. A constant stream of air is provided, and in a user-friendly way the visitor can adjust the pitch. Through an arrangement of a light beam and lens on the left and a screen on the right, the air movements above the bore hole are made visible on the screen as shadow-like, rhythmic, dancing oscillations. Their rhythm is faster when the pitch is higher and visibly slows down when you lower the pitch.

Further down the hall there are three Chladni plates. The first one is an impressively large thin square metal plate, about a yard in length. It is encased in a transparent box, connected to a microphone into which you can speak or sing. When I came across the exhibit, a young man was rapping into the microphone. Nothing happened on the plate. When he left I took the microphone and sang a single tone

over a longer period of time. In those areas where a thin layer of fine sand covered the plate, an intricate sand pattern began to form. When I changed the pitch, the pattern gradually reworked itself into a different form.

Next to this plate are two smaller Chladni plates, a round one and a square one. With these you can induce vibrations by forcefully pulling a bow alongside their edge. I sprinkled one lightly with sand, and then my continued bowing resulted in a sand pattern. Lowering my eyes to the level of the plate I saw the sand kernels bouncing off the plate in some places and coming to rest in others, thus forming the pattern. We showed a staff member how to work the plates and for the first time, as he admitted, he delighted in producing a sand pattern himself.

How does a child learn?

On Friday, the last day for us, we arrived at mid-morning and the museum hall was crowded with school children, from elementary through middle school. This obviously was the day for school field trips to the museum. The noise level was high.

A staff member had already told us "Nowadays children are often warned 'Don't touch this or that!' Here, at the museum, children are allowed to touch things." And this is what they did. "Plates are for pushing. Knobs are for turning. Slots are for inserting things into. … the user knows what to do just by looking: no picture, label, or instruction is required. Complex things may require explanation, but simple things should not" (Donald Norman, cognitive scientist, cited in Allen 2004). The children walked or rushed from exhibit to exhibit, excited to push, pull, or turn whatever they could put their hands on. Their teachers had an eye on them, but rarely gave guidance.

Most students seemed to have fun. But what did they learn that day about science, about the world? What memories did they form? What interest or motivation was sparked in them? What wonder was aroused?

On the Chladni plates that day, I repeatedly reworked a pattern so students would see it. Each time I returned, sand lay in thick layers on the plates, although the sign reads: "It works best with only a little sand." A child sang into the microphone. I told her and her mother about the secret of holding one tone. The girl was delighted when the magic worked and a sand pattern appeared.

I observed students at the "wind instrument" that I described earlier. They pushed the rod that regulates the pitch and then moved on. Like many adults on the previous day, they did not notice the screen to the right and missed the sophistication of this exhibit.

When I came to the water drop exhibit for a second exploration, I surprised two children who at that moment were attempting to shake the whole enclosure that protects the exhibit. They obviously were desperately looking for something they could put their hands on.

On my way back to the acoustics exhibition I passed by one of my favorite exhibits: heavy metal balls hang in one long row suspended from strings of varying lengths, the lengths getting shorter and shorter according to a mathematical law. Set simultaneously into motion through a simple mechanism, each pendulum swings at its own rhythm and together they show a wave form that metamorphoses. At that moment a boy was playing with the pendulums. I stopped and showed him what he could do. I called on his patience to watch the changing wave pattern closely. He enjoyed what he saw and continued when I walked on.

When I arrived at the "giant guitar string" exhibit, its function was being wholly transformed by two girls. The rope "for pulling" had changed into a rope "for climbing." They attempted to climb up that rope, with some success and no harm done.

At this point I saw clearly: This is not meaningful science learning. What these children need is the great outdoors or an adventure playground where they can engage hands-on with the elements; where they can play and experience, unhindered; where they can learn through their own activity, creativity and involvement; where they experience the world as young and fresh as they themselves are in their young lives; where their engagement with the world is free from and not constricted by the views of an already existing scientific establishment.

And later, from elementary into middle school and on, I wish for them a carefully thought-out, age-appropriate, and phenomenological science curriculum that can further their own curiosity—one that lets their interest in, and understanding of, the world grow in ever widening and deepening circles that can keep growing even when they get to be old and wise women and men.

Reference

Allen, Sue (2004). "Designs for Learning: Studying Science Museum Exhibits That Do More Than Entertain," *Science Education* vol. 88 (Suppl. 1) pages S17-S33. Available online: http://xa.yimg.com/kq/groups/28001072/1514719950/name/Allen_Exploratorium.pdf