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## **MUSEUM OF DISCOVERY AND SCIENCE OUTDOOR SCIENCE PARK: SUMMARY NARRATIVE (DRAFT)**

### **INTRODUCTION**

The new Science Park exhibition at The Museum of Discovery and Science will build on the outstanding success of this well-known learning institution and further enhance the museum's capacity to provide experiential pathways to lifelong learning in science for children and adults through exhibits, programs and films.

This dynamic outdoor expansion of the museum's hands-on learning experiences will be a family-based zone of discovery targeted to older children aged 8-13 while welcoming visitors of all ages. Here, visitors will explore together to strengthen science understanding and science thinking skills through hands-on exploration in a beautiful outdoor setting. The exhibits will provide multiple, content-rich opportunities in which visitors can experiment with basic principles of the physical world and come to intuitive understandings about how they work.

The exciting, skill-based experiences and environment of the Science Park will increase the capacity of MODS by encouraging open-ended experimentation in the physical sciences and the development of science thinking skills. By creating a playful world where the mind, the senses and the emotions are all engaged in exciting and interconnected ways, the exhibits at the new Science Park will generate those surprising "a-ha" moments where true discovery, learning and skill-building take place.

### **THE DESIGN APPROACH**

The decision by The Museum of Discovery and Science to create a Science Park in the existing green space on the north side of the museum campus presents an exciting opportunity. The expanse of grass and lush stand of trees to the west provide an ideal canvas for designing a playful environment where visitors can exercise their minds and

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bodies while exploring the basic forces of nature.

The organizing strategy of the visitor experience starts with a strong sense of geometry. A diagonal promenade begins at the north building egress and extends to the northeast corner of the property. The various exhibit activities all connect at different points along this promenade, and the surfaces that define each exhibit's activity area make use of circles, rectangles and triangles to create a spirited play of shape and form. The park comes together as an energetic geometric composition that can be enjoyed by visitors at ground level, but also when seen above from the windows in the Beacon.

This abstract geometry is then balanced with a color palette that is derived from specific flora and fauna of South Florida, as well as from certain examples from the built environment. The geometric configuration of the exhibition and the palette of local colors combine to make the Science Park a space that is playful and sophisticated, surprising and original, and yet very much of the local environment.

The shade and lushness of the trees provides an ideal counterpoint to the open expanse of the rest of the park. The trees will remain exactly as they are, so the height and density of the trees is an important determinate in the location of exhibits. Many of the exhibits need open space around them in order to function properly, so these are located away from the trees. Smaller-scale exhibits are located among the trees, while others are positioned immediately next to them so that the trees can provide shade.

While the geometry of the Science Park creates a dynamic environment for the visitor, it also serves to orient them within the Park itself. The diagonal promenade is central to this organizing strategy, and with the introduction of benches and shade structures, it becomes a natural stage for social interaction and people-watching. Using the organizing elements described above, the Science Park will have a strong visual presence as well as a comfortable and playful atmosphere, all of which will serve to make it a destination for visitors that lives up to the goals of MODS.

## THE EXHIBIT EXPERIENCES

The exhibits included in the Science Park are designed to allow for open-ended, imaginative play that encourages intuitive concept building and problem solving, conversation and collaboration around a central "big idea":

"We can have fun outdoors exercising our minds and bodies by exploring the basic forces of nature."

The Science Park will be a social space where visitors of all ages are encouraged to talk and discuss what they're seeing, doing, feeling and thinking. This sharing completes the cycle of scientific thinking, in which discoveries are not only made, but also shared and built upon by others, leading to a desire for further exploration and discovery.

To accomplish this, visitors to the Science Park at MODS will have the opportunity to:

- Enjoy being outdoors, have fun and get physically active
- Connect physically, emotionally and mentally with the physical sciences
- Engage in open-ended experiments that lead to varied outcomes
- Construct a personal understanding of how the physical world works
- Interact cooperatively and competitively in a friendly, highly social environment
- Experiment with concepts that align with age-appropriate science learning goals for the State of Florida

The mix of open-ended exhibits at the Science Park will encourage a number of skills critical to the development and expression of scientific thinking, all of which support the "strands of science learning" as defined by the National Academy of Sciences in their 2009 report "Learning Science in Informal Environments: People, Places and Pursuits."

These include:

- Asking questions
- Making predictions
- Testing
- Making observations
- Analyzing, part/whole relationships, comparing, contrasting
- Relating causes and effects
- Drawing conclusions, giving reasons for conclusions
- Problem-solving, thinking up different solutions
- Planning
- Modeling
- Sequencing, ordering information

The open-ended nature of the exhibits also ensures that visitors of all ages, young and old, can successfully engage with the experiences in ways that change and grow in complexity as the visitors return from month to month, year after year—a critical factor

in building a long-lasting core audience that supports the museum's sustainability.

Following are descriptions of each experience included in the Science Park, including a listing of science topics that each exhibit explores and which could be further explored through staff-led programming or classroom-based activities and materials developed by MODS. Each description also notes any consumable needs, as well as staffing requirements particular to that exhibit. In general, Hands On! recommends that a staff member should always be present and in sight of the exhibits in the Science Park whenever visitors are present.

### **Tennis Ball Launcher**

With a satisfying "thunk," the Tennis Ball Launcher shoots high into the sky, delighting kids and adults alike with the power of air pressure. Using a pulley, visitors first lift a bowling ball by pulling on a rope. When the bowling ball is released, it compresses air in a cylinder, which travels to another, smaller tube holding a tennis ball. The concentrated compressed air becomes a propellant, forcing the tennis ball high into the air. A conical net funnels the falling tennis ball back into the tube for the next shot.

Science Connections:	Energy transfer, air pressure, mass, compression, force, volume, ratios, cause and effect
Number of Active Users:	1
Consumables:	The pulling rope will need to be replaced over time due to wear. The rate of replacement will depend on visitation and usage.
Staffing Requirements:	This exhibit does not require special staffing beyond general staff presence in the exhibition area.

### **Kid-Powered Fan**

This activity allows visitors to transform their own physical energy into wind power by pushing or pulling a large wheel round and round. The wheel powers overhead drive belts that connect the wheel to a large fan. The fan can blow in either direction—toward the people turning the wheel, cooling them as they work, or away from the exhibit toward onlookers. The faster the visitors push, the greater the breeze they generate. As an addition, a motion-activated misting system incorporated into the fan will create an additional cooling element on hot days.

Science Connections:	Energy transfer, mechanical advantage, pulleys, simple machines, force, cause and effect
Number of Active Users:	6
Consumables:	The water filter cartridges in the mister will need to be replaced. The rate

of replacement will depend on visitation and usage. The misting nozzles will also require occasional maintenance (the manufacturer is located nearby in Davie, Florida, if additional assistance with this process is required).

**Staffing Requirements:** This exhibit does not require special staffing beyond general staff presence in the exhibition area.

### **Ball Range**

At this exhibit, visitors are challenged to experiment with force and trajectory by aiming a nozzle and shooting balls at targets placed on the far side of a large circular enclosure. There will be five "shooting stations" around the perimeter of the circular Ball Range, all of which use air pressure to shoot the balls. Visitors first place a ball in the launcher at the shooting station, then aim the launcher at a target. The launcher is adjustable in both a left-right and up-down direction, allowing the visitor to experiment with different trajectories. Once the visitor has chosen a target and aimed the nozzle, they launch the ball and observe the results of the path they chose. Repeated experimentation will help visitors grasp the connection between force and trajectory in moving objects. The size of the Ball Range also encourages teamwork, with some visitors working the shooters and others serving as spotters to provide advice on adjustments.

The Ball Range itself will be enclosed with netting to contain the balls at the activity. The floor of the Ball Range slopes down from the center, funneling the balls into an accessible trough that runs around the perimeter of the activity area. Visitors can retrieve the balls from the trough and return them to the shooting stations to try again. Multiple targets will be placed inside the netting to provide goals for the visitors; the targets are moveable, so staff can change the positions to keep the experience challenging for returning visitors. An access door allows staff to enter the area as necessary.

**Science Connections:** Air pressure, force, trajectory, gravity, cause and effect, comparison/contrast

**Number of Active Users:** 5 to 10

**Consumables:** The balls used in this exhibit are inexpensive, commercially available rubber/plastic balls that will need to be replaced over time as they are lost. The rate of replacement will depend on visitation and usage.

**Staffing Requirements:** Staff should collect the balls at the end of the day and restock them each morning to ensure there is an adequate supply.

### **Pull Yourself Up**

Pulleys give kids the advantage when they pull themselves up in this energetic contest. Visitors hoist their own bodies with the help of pulley systems that increase their mechanical advantage. Configurations of two pulleys, three pulleys and four pulleys provide different amounts of mechanical advantage, varying the challenge at each of the three stations. By trying each, visitors can compare the efforts required to lift themselves up. Each pulley chair includes a seat belt and hydraulic damper that lowers the visitor safely.

Science Connections:	Pulleys, simple machines, mechanical advantage, energy transfer, cause and effect, comparison/contrast
Number of Active Users:	3
Consumables:	The pulling ropes and seatbelts will need to be replaced over time due to wear. The rate of replacement will depend on visitation and usage.
Staffing Requirements:	This exhibit does not require special staffing beyond general staff presence in the exhibition area.

### **Roller Coaster Ball Fall Build Area**

This open-ended activity invites visitors to construct a ball raceway and have fun experimenting with gravity, centripetal force and momentum. Visitors of all ages enjoy the challenge of constructing a course that a ball can roll through without stalling, dropping out or jumping the track. The exhibit includes base modules that provide the movable foundations on which visitors create their ball fall designs. Vertical pipes with sliding clamps drop into the foundations, providing an easily adjustable support system for the many different track sections from which the visitor may choose. The variety and flexibility of the construction system allows visitors to design a number of track configurations.

The large scale of the Roller Coaster Ball Fall encourages kids and parents to work together to design the biggest, coolest, fastest roller coaster possible. And, the adjustability of the pieces means a changing experience that can grow in complexity as visitors return again and again.

Science Connections:	Gravity, potential/kinetic energy, momentum, centripetal force, friction, inertia, cause and effect, mathematics (calculation of speeds, etc.)
Number of Active Users:	15 to 20
Consumables:	The balls used in this exhibit are inexpensive, commercially available rubber/plastic balls that will need to be replaced over time as they are lost. The rate of replacement will depend on visitation and usage.

**Staffing Requirements:** Staff should clear/reset the area from time to time throughout the day and ensure that balls are available to visitors.

### **Swiveling Kaleidoscopes**

This experiment in optics invites visitors to see the world in a very different way. Mirrors inside the barrel of a double-ended kaleidoscope produces an amazing, multi-faceted image that changes as visitors aim the kaleidoscope in different directions and look through both ends. The kaleidoscope can be rotated on its base, as well as moved up and down to allow for maximum viewing opportunities. Two kaleidoscopes will be provided, each with a different mirror configuration to provide different viewing effects.

**Science Connections:** Optics, light, reflection, refraction, angles, multiplication, observation  
**Number of Active Users:** 2 to 4 (for 2 double-ended kaleidoscopes)  
**Consumables:** This exhibit has no consumables.  
**Staffing Requirements:** This exhibit does not require special staffing beyond general staff presence in the exhibition area.

### **Distribution of Mass**

This experience features a pair of 10' long, gently inclined tracks and two wheels, each with three radially adjustable weights in slots. Visitors can redistribute the mass of each wheel by altering the position of the weights in the slots, thus changing the spinning speed of their wheels. Visitors release their wheels at the top of the tracks to see which one will reach the bottom first and win the race. A wheel with more mass near the axle will have less angular inertia and accelerate more quickly down the ramp than a wheel with its mass placed farther out. Each weight can be positioned individually, allowing an asymmetrical distribution of mass around the wheel that results in unusual patterns of acceleration and deceleration as the wheel makes its way down the incline. Repeated experimentation helps visitors make science connections through observable cause-and-effect results. To encourage experimentation, one pair of tracks is sloped at a smaller angle than the other, allowing for additional comparison, competition and observation.

**Science Connections:** Mass, speed, inertia, momentum, laws of motion, cause and effect, comparison/contrast  
**Number of Active Users:** 4 (for two pairs of tracks)  
**Consumables:** This exhibit does not have consumables.  
**Staffing Requirements:** This exhibit does not require special staffing beyond general staff presence in the exhibition area.



## **Bottle Rockets**

Here, kids launch a wire-guided rocket (a small water bottle) skyward approximately 30' using compressed air and water. First, the visitor activates the exhibit by choosing one of three combinations of water and compressed air they want to pump into the bottle. Once the rocket is filled with the chosen amount of water and compressed air, the visitor hits the "Launch!" button. Upon launch, the pressurized air forces the water out the bottom of the rocket, launching the rocket high into the air. When the rocket returns back down, it's ready for another flight. Visitors can experiment with the three different combinations of water and air and observe how it affects the force and height of the launch. Two launching stations will be included in this experience, so visitors can also do side-by-side comparisons as part of their experimentation.

Science Connections:	Energy transfer, potential/kinetic energy, pressure, force, laws of motion, cause and effect, comparison/contrast
Number of Active Users:	2 (for two launch stations)
Consumables:	The bottles will need to be replaced as they wear out from repeated use. The water filter cartridges will also need to be replaced. The rate of replacement will depend on visitation and usage. Additionally, the rubber landing pad for the rocket will require replacement over time (every 100,000 launches or so).
Staffing Requirements:	This exhibit does not require special staffing beyond general staff presence in the exhibition area.

## **Giant Levers**

This physics-based version of the classic "Tug of War" clearly demonstrates mechanical advantage in a fun, surprising way. One of the two Giant Levers creates a three-to-one advantage by having the two pull ropes attached at different distances from the fulcrum of the lever—one at two feet above the fulcrum and one at six feet above it. The difference in mechanical advantage allows a few visitors pulling on the six-foot side to overcome many visitors on the two-foot side, resulting in both wonder and a determination to figure out why. A second Giant Lever has pull ropes placed the same distance from the fulcrum, altering the visitors' experience of mechanical advantage there. Each lever has a bell to let visitors know when they have won. Designated "pull zones" on the ground help delineate the appropriate activity area, and hydraulic dampers and springs ensure that the lever returns itself to the starting position in a safe manner.

Science Connections:	Levers, mechanical advantage, simple machines, energy transfer, cause and effect, comparison/contrast
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Number of Active Users: 6 to 16 (for two levers)  
Consumables: The ropes may need to be replaced over time due to wear. The rate of replacement will depend on visitation and usage.  
Staffing Requirements: This exhibit does not require special staffing beyond general staff presence in the exhibition area.

### **Sun Spotter**

Visitors can view the sun and other solar activity at this user-friendly exhibit that utilizes optics to capture the sun's image. A lens projects an image of the sun onto a conveniently angled screen, permitting safe and easy viewing by visitors. Since the Science Park will have many trees, the Sun Spotter will be mounted in a location that will receive sun every day of the year. Each day, staff members will adjust the Sun Spotter's declination to the correct position; visitors can then turn the viewing screen wheel to find and observe the sun as it moves through the sky.

Science Connections: Astronomy, optics, reflection, magnification, observation  
Number of Active Users: 2  
Consumables: This exhibit does not have consumables.  
Staffing Requirements: Staff members will need to cover the Sun Spotter each night to provide protection for the optics and uncover it each morning. Staff will also need to adjust the declination mirror to align the Sun Spotter with the changing path of the sun. Depending on the time of year, this may need to be done a few times a day (at the equinoxes) or every other day or so (at the solstices).

### **Sound Station**

The Sound Station is made up of 13 musical instruments created by artists Bill and Mary Buchen. This enchanting arrangement of instruments invites multiple visitors to create music together in a collaborative experience rich with opportunities to explore the science of acoustics: the study of the ways in which sounds are made, changed and heard. Using the different instruments, visitors can experiment with tone, pitch, loudness, rhythm, mathematics, vibration and the connection between sound, shape and the properties of materials. The group consists of:

- **Children's Drums (6):** With names that mimic their tones, the quinto, tumba, conga, bata, atabaque and pow-wow drums comprise a world rhythm drum ensemble that is specially designed to develop smaller children's skills with percussive music making.
- **Turtle Drum:** This drum is based on the "ayotl," an Aztec instrument made from

a turtle shell. The steel hemisphere has vibrating tongues created by cut-outs that create different tones when struck with the hands.

- **Djembe Drums (3) with Seats and Earth Drum:** This drum circle centered on the Earth Drum, which is played with the feet, celebrates global rhythm traditions and invites communal music making. Each of the three djembe drums is tuned to a different pitch to encourage sound experiments.
- **Stone Xylophone:** This unusual take on a xylophone invites visitors to experiment with the sound properties of a natural material—stone. Each stone bar of this xylophone is tuned to a tone on the musical scale, allowing visitors to create their own songs.
- **Metal Xylophone:** The metal xylophone creates similar tones to the stone xylophone, but the material gives a strikingly different tonal quality to the sound, allowing visitors to compare the properties of materials and experiment with tone blending.

Science Connections: Sound, waves, vibration, tone, pitch, loudness, rhythm, harmonics, material properties, comparison/contrast

Number of Active Users: 13

Consumables: This exhibit does not have consumables.

Staffing Requirements: This exhibit does not require special staffing beyond general staff presence in the exhibition area.

## DESIGN DAY AND CAPACITY

Following this summary page is a chart showing the total number of active and vicarious visitors per exhibit in the MODS Science Park on a *design day*, or steady attendance day at MODS, as opposed to a *peak day*, in which your exhibition space is filled to extreme capacity.

If a visitor was to engage in all the activities, their predicted total attendance time, or "dwell time," in the exhibition area is 62 minutes. Based on this, the Science Park can accommodate five turns of attendance per day, assuming five to six hours of steady visitation on a design day such as a Saturday.

As noted in the following chart, the average turn can accommodate a total of 70 active visitors (those engaged directly in using the exhibit) and 59 vicarious visitors (those watching or waiting for a turn) at one time. At five turns per day, this results in a **total design day capacity of 645 visitors per day** in the Science Park, *not including visitors who are walking, sitting or otherwise engaged in this large outdoor area*. The following chart details these numbers on a per-exhibit basis.

Calculating out further, Hands On! estimates that the Science Park can accommodate a yearly attendance of more than 185,000 visitors, broken down as follows:

140 school days @ 320 people per day (half the design day capacity) =	44,800
220 other days @ 645 people per day (design day estimate) = (weekends, holidays, summer and other school vacation days)	<u>141,900</u>
<b>Total Approximate Annual Attendance Accommodated =</b>	<b><u>186,700</u></b>

Because the Science Park is an expansion and not a replacement of the current exhibition offerings of MODS, the Total Approximate Annual Attendance supported by this exhibition base represents a **potential expansion of at least 185,000 visitors, or 40% beyond MODS' current annual visitation of 450,000 visitors.**

*Note that these figures do not include visitor numbers from special programming or evening/special rentals.*

### Design Day Chart (Visitation and Dwell Time) Per Exhibit

	Active	Vicarious	Dwell Time (in mins)
Tennis Ball Launcher	1	2	2
Kid-Powered Fan	6	4	3
Ball Range	8	10	10
Lift Yourself Up Pulleys	3	3	6
Roller Coaster Ball Fall	15	10	15
Swiveling Kaleidoscope	4	0	2
Distribution of Mass	4	4	4
Bottle Rocket	2	6	4
Giant Levers	12	8	4
Solar Sun Spotter	2	2	2
Sound Station	13	10	10
<b>Total Per Turn</b>	<b>70</b>	<b>59</b>	<b>62</b>
<b>TOTAL PER DAY</b> (Total Turn x Five Turns)	<b>350</b>	<b>295</b>	
<b>TOTAL DESIGN DAY</b> (Total Active + Total Vicarious)	<b>645</b>		