

Exhibit Designs for Girls' Engagement

A Guide to the EDGE Design Attributes



EDGE

visitor research
& evaluation

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As a child, Alice’s family encouraged her to engage with science. But her visits to science museums were less than positive. She remembers, “I would stand there, trying to figure out what was so interesting, and usually fail at doing so” and “I thought that I had to be able to ‘figure out’ each exhibit to be ‘using the museum’ optimally. When we finally left, I was exhausted and frustrated. My parents sensed that and decided that in the future, I shouldn’t go to science museums with my brother, because I’d just rush things and make it so that they can’t enjoy the experience either.”¹

Science museums have a unique potential to help engage young people in STEM.² They are excellent places to spark interest and excitement about the sciences, they help visitors develop identities as science learners and doers, and they provide hands-on experience with many of the skills required in scientific pursuits.³

Unfortunately, science museums aren’t always working as well for girls as for boys, and many girls’ experiences may be similar to Alice’s. Some research has shown that girls visit science museums less frequently than boys.⁴ And once inside, girls often have different experiences at exhibits than boys. For example, certain exhibits tend to attract girls less and engage them for less time—particularly exhibits in physics and engineering.^{5,6}

There is a need for science museum staffs to better understand how to meet girls’ needs. While a few museums have begun this work, none have explored the relative impacts of a variety of potential exhibit designs on girls’ experiences.⁷ Here, we describe the Exploratorium’s endeavor to identify the best approaches to designing exhibits to better engage girls.

The EDGE project

The purpose of the EDGE project is to identify the most important design attributes for engaging girls at STEM exhibits.* Below we describe the steps we took to do this work.

Create a list of potential girl-engaging design attributes

To help us design for various girls with diverse interests, and because there has been so little work on designing exhibits with girls in mind, we had to scour a broad range of literature. We drew on prior research and trends from various fields—museums, education, psychology, web design, and gaming—to learn about girls' experiences in STEM. We used this guiding literature to identify key areas to explore when considering what exhibit designs might support girls' engagement:⁸

1. Create experiences that enable social interaction and collaboration⁹
2. Ensure low-pressure experiences¹⁰
3. Provide meaningful connections¹¹
4. Represent girls and their interests¹²

*We realize some museums use the word *exhibit* to refer to an entire collection; however, we refer to the individual elements or components of an exhibition as *exhibits*.

These key areas identified in the literature, along with information gathered from interviews with practitioners, and input from advisors (including experts in the fields of gender, equity, museum learning, and an advisory group of girls in the target age range), were used to identify 100 design attributes that had the potential to engage girls at exhibits.**

Assess exhibits

To test those 100 attributes and their relationship to girls' engagement, we studied more than 300 physics, engineering, math, and perception exhibits at the Exploratorium (EXP), the Science Museum of Minnesota (SMM), and the Arizona Science Center (ASC). We chose these institutions to ensure that the findings could apply more broadly. We assessed each exhibit to identify its design attributes by answering questions, such as: Does this exhibit have seating for two or more people? Does the exhibit or label have bright, prominent color?

**We tested nearly 100 design attributes, and over 100 if you consider variants and combinations. You can find a subset of tested attributes listed in Appendix B (pp. 58–61).

Measure engagement

Next, Exploratorium researchers studied nearly 1,000 randomly selected family group boys and girls ages 8–13 as they used the 300+ exhibits. We looked at four measures of engagement: which exhibits visitors used; which exhibits they returned to; how much time they spent at each exhibit; and whether they repeated, varied, or talked about their experience while using an exhibit (high-level engagement).

Identify the most important design attributes for engaging girls

The purpose of the EDGE research was to winnow the list of 100 potential design attributes to those most important for engaging girls. To that end, we identified which design attributes were highly related to girls' engagement—mostly present at the exhibits where girls were more engaged and mostly absent at exhibits where girls were less engaged.*** And we found that none of the attributes that best engaged girls were harmful to boys' engagement; in fact, many were positively related to boys' engagement as well.

***Note that we statistically controlled for crowding and institutional differences.

Limitations to the research

We employed an exploratory research approach because there were a great variety of attributes that might work in museums and we wanted to explore which worked best for girls rather than starting with a narrower set of attributes and specific predictions. For this study, we did not test the direct impact of adding and removing each design attribute. However, we do know that there is a strong relationship between the EDGE Design Attributes and girls' engagement, and we have worked diligently with practitioners to rule out any alternative explanations (such as location on the museum floor, or gender of the developer). This study lays the groundwork for future experimental research that can further test specific hypotheses about the top design attributes, and their causal impacts on girls' engagement.

In an attempt to broaden the applicability of the results, we included different kinds of science museums in the study. However, we don't yet know what the EDGE Design Attributes will look like at other kinds of institutions (such as children's, history, or art museums). We look forward to learning about how the findings apply in other types of museums. The most important EDGE Design Attributes, nine in all, are described next.

The EDGE Design Attributes

Following are the nine EDGE Design Attributes, those that emerged strongly from the large-scale research study as **the most important for engaging girls at STEM exhibits**. Across the 300+ exhibits and 100+ design attributes we studied, girls were much more engaged when any of these nine attributes were present, and much less engaged when they were missing. The order in which we present these attributes does not signify their level of importance.

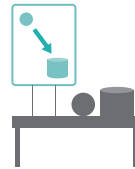
Not every exhibit can or should include all nine attributes, but including several of them when they make sense for a given exhibit should help your museum better engage girl visitors. We hope people working on exhibit design will explore which attributes are synergistic with each exhibit's content and consider adding or enhancing as many of them as makes sense.



EXHIBIT DESIGNS FOR GIRLS' ENGAGEMENT

The EDGE Design Attributes

EXHIBIT LABELS



Use drawing



Image of a person

EXHIBIT LOOK-AND-FEEL



Familiar object



Homey, personal, homemade, or delicate



Playful, whimsical, or humorous

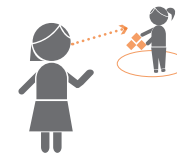
EXHIBIT INTERACTIONS



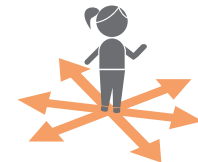
Multiple stations or sides



Space to accommodate three or more people

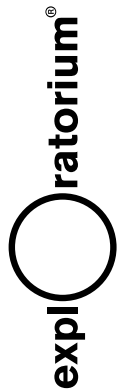


Visitors can watch others to preview



Open-ended

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I wouldn't really want to read [the label], but I could see someone in the picture doing it.

—Bianca, EDGE Girl Advisory Committee

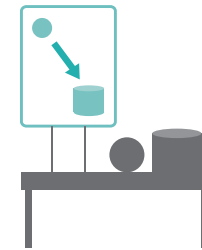
Some people are visual learners Pictures can help them know how to do the exhibit.

—Mariel, EDGE Girl Advisory Committee



EXHIBIT LABELS

The exhibit label includes a use drawing, giving visitors an idea of how to use the exhibit.



A use drawing should be designed to help visitors understand what actions to take at the exhibit. These drawings often show a person doing an action, or how to use an interactive element (e.g., a crank with an arrow). Ideally, the use drawing should be visible and understandable even from 5–10 feet away.

slow-motion camera

- Press **reset** to begin.
- Center yourself on the screen.
- Press **capture** and then do something.
- Your video will play back in super slow motion.

Watch your video in super slow motion, $\frac{1}{50}$ actual speed.

Fast forward to find the best parts. (push and hold)

Things to try:



blow a raspberry



clap your hands



shake your hair



snap your fingers

Some motions are more complex than you'd imagine. Slow them way down to see surprising details.

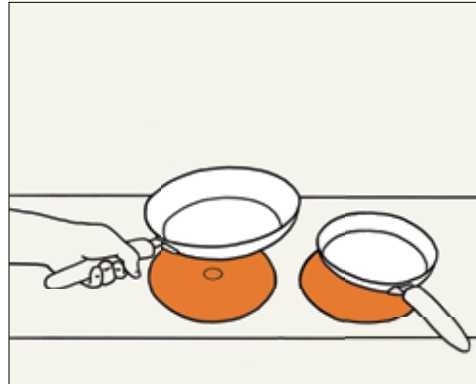
Slow-Motion Camera's label includes use drawings to suggest different activities to try. (EXP)

Add the motion of two pendulums and create a work of art.

Try this . . .

- 1 Position your papers.**
Slide a piece of paper under the pen, all the way up to the metal rod. Pull the letter toward you to lock the paper in place.
- 2 Make some swinging art!**
Once pull the pendulums to one side and let them go. Hold the red plunger down to start drawing.
- 3 Experiment!**
 - To make the pendulums swing at the same rate, set the weights to the same height.
 - To make the pendulums swing at different rates, move the adjustable weights to a different height.
 - Let one pendulum go, then the other one a moment later.

Use diagrams on the Harmonograph label help visitors understand the process of swinging and adjusting the pendulums. (SMM)



Orange highlights on the Skillets use drawing help visitors understand where to place the pans. (EXP)

Pluck it.

Bow it.
(Straight up and down works best.)

These use diagrams on the Waves on a String label show how to play the cello. (SMM)

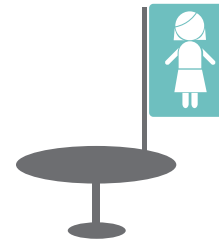


If it's a picture of someone actually doing something, you might be curious to come over and look at what they're doing. After you see that, if you think it's interesting, then maybe you think the exhibit might be somewhat similar to that. It's gonna make you want to play with it.

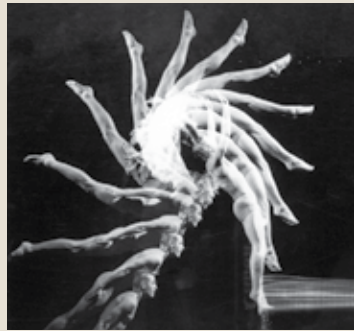
—Jasmine, EDGE Girl Advisory Committee

EXHIBIT LABELS

The exhibit label includes at least one image of a person.



An exhibit label might include an image of a person to add real-world context, show prior visitors' reactions, or help visitors use it. The label might show an entire person, a face, a hand, or even just an eyeball. And the image could be a photo, illustration, use drawing, 3-D model, video, or something else.



In the 1900s, Harold Edgerton used a long exposure (as we have here) and lit the moving subject with a series of bright strobe flashes.

The photos on the label at Strobe-O-Scope show real-world examples of strobe photography of humans—just like those you can make using the exhibit. (EXP)

perspective drawing window

This sixteenth-century drawing by Albrecht Dürer shows one way of transferring the three dimensions of nature onto a flat surface. The artist saw the model from a fixed point, through an aperture. Then, by viewing the image through a grid, the artist could trace the model square by square. The resulting drawing would be an accurate representation of the artist's point of view.

Architects use perspective to give their drawings the illusion of space and volume. Notice that the figures seem to recede toward one point and the doors to another. This is called two-point perspective.

Photographic images capture the same way we see things, so the images of objects get smaller as they get further away.

European artists began to use perspective in their work in the fifteenth and sixteenth centuries.

Perspective Drawing Window features sample artwork with a variety of people. (EXP)

- Place one face on each tabletop. Look through the viewer and adjust the faces until the eyes of both faces overlap. You'll see a new face that combines the two.

Sweep your hand across one of the faces and you'll see mostly that face.

Two as One uses two faces to illustrate how when each eye sees a different image, the brain combines them into one. (EXP)



The label outside of Shadow Box adds context by showing shadows of people out in the real world. (EXP)



It's like you're playing with something like a regular toy . . . but just at a museum.

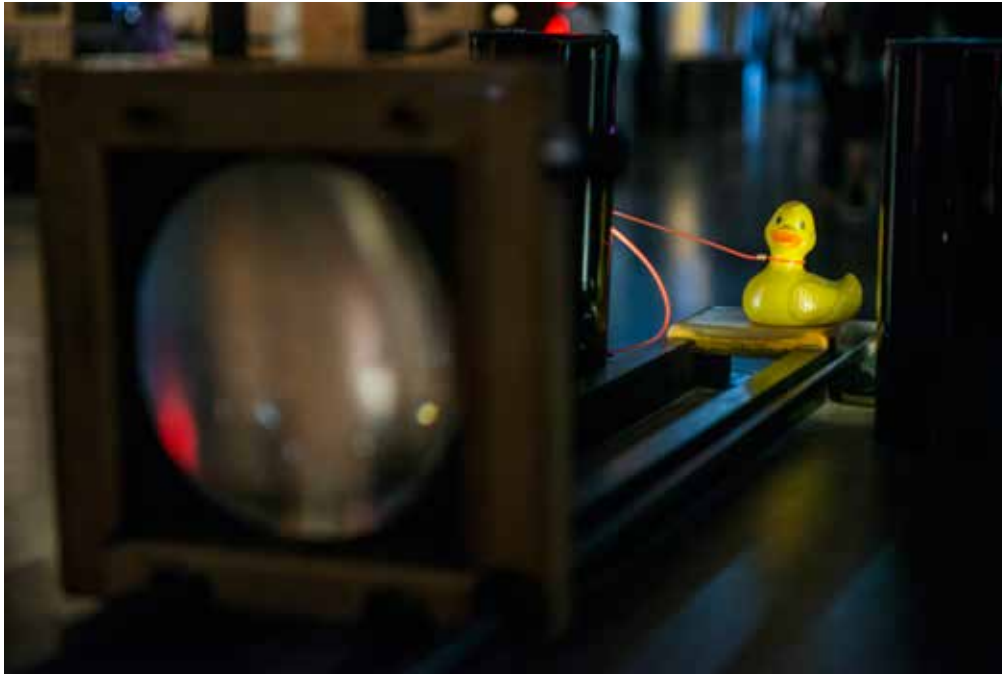
—Anahi, EDGE Girl Advisory Committee

EXHIBIT LOOK-AND-FEEL

The exhibit includes at least one familiar object that most people have seen before.



Including everyday things such as kitchen items, basic household tools, musical instruments, or stuffed animals may offer visitors a familiar entry point or help show how an exhibit idea is applied in the real world. When there's a choice of objects, designers should select things that can be easily found at home, school, or a department store, and should emphasize the objects' commonplace shape and form. A regular flashlight would be more recognizable than a custom tube with an LED in it; a round hand mirror or compact would be more familiar than a custom-cut piece of mirrored plexiglass.



Designers included a rubber duck as part of the exploration of lenses and optics at Image Relay. (EXP)



Does it Conduct? lets visitors test the conductivity of pennies, marbles, rubber bands, and other household objects. (ASC)



At Bike Generator, visitors use an exercise bike to power glowing lightbulbs and a household fan. (SMM)



Everyday stop signs are among the objects to investigate at Reflection Angles. (SMM)



It feels like you're at home, like you can just relax.

—Anahi, EDGE Girl Advisory Committee



The pans: I actually want to go to them since I like to cook, I wanted to check it out.

—Kayla, EDGE Girl Advisory Committee

EXHIBIT LOOK-AND-FEEL

The exhibit's look-and-feel is homey, personal, homemade, or delicate.



This attribute applies to the overall “vibe” of the exhibit. When thinking about homey design aesthetics, consider elements such as materials and scale. Soft fabrics, wood cabinetry, pliable cardboard, or similar materials may contribute to a homemade impression or delicate texture; a small, intimate scale may give a more personal feeling. Another way of creating a homey experience might be to incorporate a common home activity—cooking, playing with toys, or sitting on a cozy couch.



Bernoulli Blower has kitchen sinks to catch the lightweight plastic toy balls. (ASC)



The colorful wrapping paper at Binocular Rivalry gives visitors something homey to look at as they explore how their eyes work. (EXP)



Skillets, an exhibit about temperature, uses pans visitors might have at home. (EXP)



The seating at Nerve Journey is cozy and inviting. (EXP)



In silly things, there's not very many rules, so you don't have to worry about much. You can have fun without worrying about anything.

—Jasmine, EDGE Girl Advisory Committee

There's a lot of moments in my life that are serious, where you have to take things seriously, like school and stuff. It's fun to just relax, play a little, so life's not so serious. Being goofy, expressing yourself, being silly . . . it's a relief.

—Mariel, EDGE Girl Advisory Committee



EXHIBIT LOOK-AND-FEEL

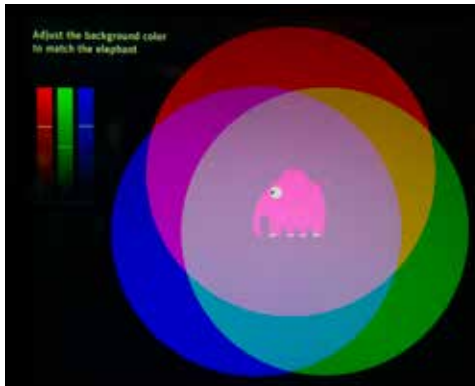
The exhibit's look-and-feel is playful, whimsical, or humorous.



This attribute applies to the overall “vibe” of the exhibit. The central experience or overall aesthetic should foster a feeling of playfulness rather than a need to “be serious” or “get it right.” Ideally, the whimsy and humor should be integrated with the phenomenon in a meaningful way, rather than added as an afterthought.



The playful shapes of animals, trees, and houses add a whimsical feeling to Shadow Fractions. (SMM)



At Mix and Match, the goal is to make the elephant disappear, which adds playfulness to the activity, yet the key concept—mixing colors of light—remains front and center. (EXP)



Monochromatic Room playfully demonstrates what happens to color under a sodium light. (EXP)



The house shape of this exhibit makes mixing Countless Colors into a playful experience. (EXP)



With someone else, they have the same problems as you. You figure it out with them. You don't feel alone; you have help.

—Eliseana, EDGE Girl Advisory Committee

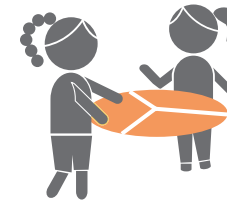


Some people get mad when someone interferes! If you can both play, it's a huge difference.

—Kayla, EDGE Girl Advisory Committee

EXHIBIT INTERACTIONS

The exhibit has multiple stations or sides, allowing more than one person to experience the phenomenon.



Exhibits with multiple stations give each visitor ownership of a personal space to experience the phenomenon or do the activity. Each station or side may offer the same activity or different but related activities.

Exhibits with multiple sides allow visitors to experience the phenomenon or do the activity from more than one side, making it easier to work together.



Each of the different chair stations offers a different experience at Pulley Power. (ASC)



Pentaphone offers five stations, and invites visitors to “play alone, play together.” (EXP)



Light Island’s multiple light sources and free-floating lenses allow visitors to experiment from any side of the table. The exhibit’s wiggly shape helps create individual stations for visitors. (EXP)



At Sand Graph, visitors work from many sides—scooping up sand from the end of the table, or moving the pendulum while standing on either side. (EXP)



I came with ALL my friends. There were five of us Some of us were left out. I wanted to see [the museum] WITH them.

—Mariel, EDGE Girl Advisory Committee

EXHIBIT INTERACTIONS

The exhibit has been designed with space to accommodate three or more people.



A large room, spacious floor, or large table surface create physical space, or “elbow room” at the exhibit, making it easier for a group to interact or work together. For this design attribute to be present, everyone in a group should be able to fit, but not everyone has to be having an active, hands-on experience. The design could support some group members in watching, listening, or commenting, while one person is in the “drivers’ seat.”



Colored Shadows features a large wall screen and a large floor space that can fit many visitors at once. (EXP)



Many people can experiment at Heat Camera, working alone or together. The bench fits at least three people, and the back of the bench offers additional activities for those who are awaiting their turn. (EXP)



Wave Machine has only one station for controlling waves, but the large tanks allow many visitors to gather and watch the moving water. (SMM)



Dancing Iron Dust has a fairly small footprint, but the square shape and transparent plexiglass top make it easy for many people to watch the magnetic particles move. (ASC)



You see the demo of how people play [with it]. It's exciting.

—Anahi, EDGE Girl Advisory Committee

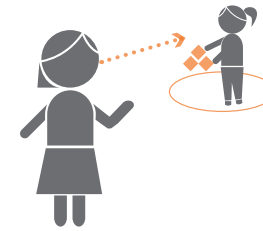


If you don't know what you're gonna do, you might feel like you're making a fool of yourself if you do it wrong.

—Eliseana, EDGE Girl Advisory Committee

EXHIBIT INTERACTIONS

The exhibit is designed so visitors can watch others to preview what to do.



When visitors can see the actions or reactions of another using an exhibit, it may orient them to the activity. The presence of this attribute requires seeing a visitor's actions but does not require seeing or understanding the phenomenon. Exhibits with this design attribute may have open tabletops, large screens, or other ways to view what others are doing. Exhibits would likely not have this attribute if they feature things such as enclosed kiosks or small controls.



Visitors can easily observe each other moving, dancing, and laughing at Giant Mirror. (EXP)



When visitors use the binoculars at Double Vision it's easy to see what to do before you approach because the movement of lifting the tubes to the eyes is big and observable. (EXP)



It's easy to watch visitors playing in the windy conditions at Bernoulli Blower. (SMM)



Visitors climbing the Weight Wall offer a dramatic preview of what to do. (ASC)

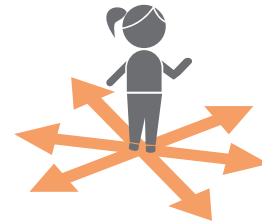


Some people are embarrassed to get the answer wrong. If there's no way to get it wrong, you can just have fun with it.

—Kayla, EDGE Girl Advisory Committee

EXHIBIT INTERACTIONS

The exhibit is open-ended, providing multiple outcomes, activities, or ways to interact.



There are many ways an exhibit might be open-ended. We consider an exhibit open-ended if it meets one or more of these criteria:

- visitors do not follow a series of predetermined steps
- it provides three or more distinct activities
- many interactions are “right”
- the outcome of using it is different every time
- it is designed for a multitude of iterations with an assortment of variables, encouraging visitors to keep using it for extended play



Showing Double suggests various activities to explore fractions. For example, you could try to make your shadow eight squares high, the same height as the “shadow man,” or half as tall as someone else’s. (SMM)



Build a meandering path or a high-speed jump—anything you do at Magnetic Ball Wall is “right.” (ASC)



There is no series of steps to follow at Waves on a String; visitors can play any notes they want to explore the relationship between sound and sine waves. (SMM)



At this praxinoscope (mirror-based zoetrope), there are endless ways to make a Robot Dance. (EXP)

These case studies are meant to show you how the EDGE Design Attributes play out at exhibits that are highly engaging or not very engaging for girls. They also highlight the fact that not all design attributes will be used for all exhibits, and that when designing exhibits for better engaging girls, it is best to incorporate multiple attributes that make sense given the exhibit's content and experience.

Distorted Room: An exhibit where girls were highly engaged

Distorted Room uses a life-size optical illusion to illustrate features of human perception. It was among the top 25% of Exploratorium exhibits for the four engagement measures: girls' use, time spent, returns, and engagement behavior scale scores. It has many of the EDGE Design Attributes.





- The label includes a use drawing that can be understood from a distance.



- The label has images of people showing the effect of the illusion.



- It includes a familiar object—the window looking into the room is styled just like windows in a real house.



- Distorted Room offers a homey feeling; it looks much like a typical room, including the linoleum tile floor.



- Small children can transform into giants, while adults look tiny. The experience of Distorted Room is whimsical and humorous.



- There are multiple stations and sides—visitors can play inside the room, or stand outside and look in the windows to see the distortion effect.



- The large room, with additional activities outside, creates space to easily fit three or more people.



- Although Distorted Room has narrow windows and a door to look into, it's not easy for visitors to watch others to preview what to do before they approach.



- It's open-ended—many interactions are “right.” Visitors might move to different areas in the room, look in the windows, or even slide down the sloping floor, and all of these activities are part of exploring the phenomenon.

Giant Lever: An exhibit where girls were highly engaged

Giant Lever is a tug-of-war exhibit designed to let visitors explore force, friction, and motion. It was among the top 25% of Arizona Science Center exhibits for three of the engagement measures: girls' use, time spent, and returns; and it was in the top 33% for the fourth engagement measure: girls' engagement behavior scale scores. There are many EDGE Design Attributes present at this exhibit.





- It has a use drawing that's visible from a distance.



- It has an image of a person.



- The familiar objects here are a playground-style rope and a classic carnival bell that rings to announce a “winner.”



- This exhibit is not especially homey or personal.



- The experience of “tug of war” gives a playful feeling to the exploration of the phenomenon.



- It has multiple stations and sides (two), since the “tug-of-war” activity involves creating two teams. Each side has a different experience.



- It's designed not only with space to accommodate three or more people, but actively encourages large groups to use it.



- The spacious, open floor plan, as well as the large force meter, allow visitors to watch others to preview what to do.



- It's open-ended—many interactions are “right.” For example, visitors can pull the rope from either side with a different experience; they can pull alone or with others, or they can try pulling from up close or further back.

Tapered Wind Tube: An exhibit where girls were highly engaged

Tapered Wind Tube lets visitors build “wind riders” that hover and spin in a column of air. It was among the top 25% of Science Museum of Minnesota exhibits for three of the engagement measures: girls’ use, time spent, and returns. It includes the following EDGE Design Attributes.





⚡ No use drawing is visible from a distance.



⚡ There is no image of a person.



- The materials include familiar objects such as pipe cleaners and paper cups.



- The materials—simple paper cups and soft pipe cleaners—give a delicate, homey feeling, and the experience of crafting with these supplies may be a comfortable, familiar home activity.



- The bobbing, spinning objects floating in air offer a humorous, whimsical experience.



- Multiple stations and sides—the cylindrical tubes can be used from any side, and there are several tubes to try out. There's also a separate table full of materials for building.



- There are enough stations, and therefore space, for three or more people.



- The clear tubes and open table allow observers to preview what to do before approaching.



- It's open ended—the variety of materials and tubes encourage multiple iterations and extended play.

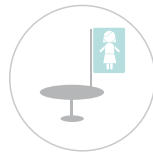
Look Into Infinity: An exhibit where girls had low engagement

Look Into Infinity lets visitors look into a set of eyeholes to see a set of mirrors configured to create infinite reflections. It was in the bottom 25% for three of the engagement measures: girls' use, time spent, and returns. For this exhibit, boys had significantly higher engagement than girls in two engagement measures: time spent and returns. Look Into Infinity has only one of the EDGE Design Attributes.





∅ There's no use drawing here.



∅ The exhibit has no image of a person on the label (your own reflection doesn't count here).



∅ Although this exhibit features a mirror, it's displayed in an unusual shape and frame. We would not consider this kind of mirror to be a familiar object.



∅ With its large metal frame and plain black panels, the design is not homey or delicate.



∅ The experience is not designed to make whimsy or playfulness central to the experience (though a creative visitor might certainly invent a playful way to use it).



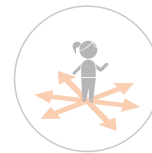
∅ Although there are multiple eyeholes which might seem like "stations," since they're stacked vertically, only one person at a time can use this exhibit, so the exhibit is not considered to have multiple stations. Further, it can only be used from one side.



∅ The narrow vertical shape suggests this exhibit is not designed with space to accommodate three or more people.



∅ Observers can preview what to do by watching others peer into the eyeholes.



∅ This exhibit is not open-ended. Because the mirrors and eyehole positions are fixed in place, there are few possible interactions, and the outcome is more or less the same every time.

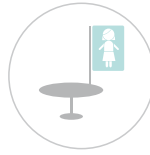
Disagreeing About Color: An exhibit where girls had low engagement

Disagreeing About Color shows a circle of colorful dots, and asks visitors to discuss which dot best matches the one in the center. Due to variances in individual perception, not everyone will agree on which dot is the match. It was among the bottom 33% of Exploratorium exhibits for two of the engagement measures: girls' use and time spent; and in the bottom 25% for the other measures: returns and engagement behavior scale scores. It has only one of the EDGE Design Attributes.





It has no use drawing.



There is no image of a person.



The colorful glowing lights in this exhibit are not familiar objects, since they are arrayed in an unusual format and hidden behind a panel.



The texture of the wood cabinet adds a small amount of homeyness, but it's offset by the dark, flat panel and metal stand. There's not enough to call it especially homey.



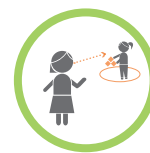
There's nothing particularly whimsical about this exhibit. The title, Disagreeing About Color, might even suggest conflict rather than playfulness.



It has only one station, and can only be used from one side.



It is too small to be easily used by three or more people.



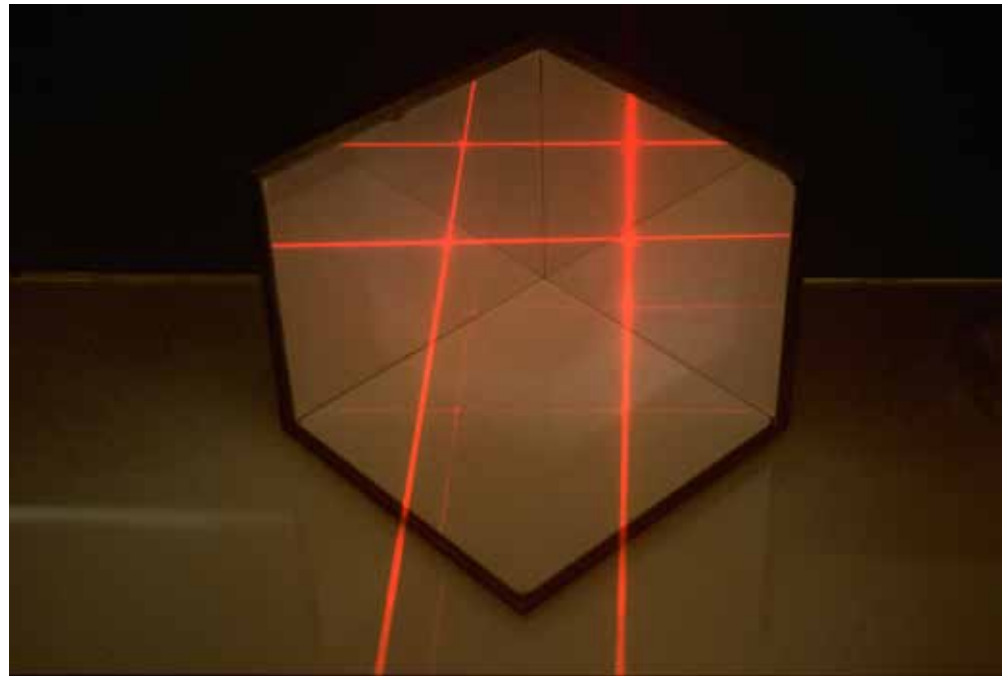
Using this exhibit requires looking at the lights; visitors can easily observe others to preview what to do before approaching.



Although visitors may disagree about what dot matches, the overall exhibit outcomes are more or less the same every time, and there are few activities to try. It's not open-ended.

Corner Reflector: An exhibit where girls had low engagement

Corner Reflector demonstrates how mirrors aligned at 90° reflect light back to its source. It was among the bottom 25% of Exploratorium exhibits for all four engagement measures: girls' use, time spent, returns, and engagement behavior scale scores. It has none of the EDGE Design Attributes.





∅ There's no use drawing.



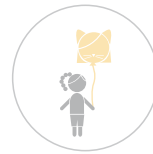
∅ This exhibit doesn't have an image of a person.



∅ The mirrors in this exhibit are not considered familiar objects, since they are in an unfamiliar format and configuration.



∅ While the design is small and possibly intimate, the large black label and industrial looking mirrors don't feel especially homey or delicate.



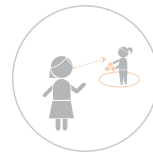
∅ The experience of looking in the mirror to find a small focal point feels serious and matter of fact, rather than whimsical or playful.



∅ Corner Reflector has only one station, and can only be used from one side.



∅ It's so small that only one person can fit in front of the table.



∅ The small size of the mirrors also makes it difficult to watch others to preview what to do from afar—a visitor's body would block their actions from view.



∅ This exhibit is not open-ended. There are few interactions possible with this design, and the outcome is the same every time.

Appendix A: Assessing Exhibits

Assessing exhibits for the EDGE Design Attributes

The following questions should help you determine whether your exhibits have the girl-engaging EDGE Design Attributes. In an effort to make it easier for all institutions to assess their exhibits, all attributes are based on the exhibit design rather than the visitor experience. Answers in green indicate the girl-engaging criteria.

When using this manual:

- Evaluate each exhibit based on what it is designed to do, rather than what users could do. Think about whether the exhibit has been designed to easily or obviously meet the criteria.
- Look at each exhibit twice—once from a distance and then again from up close. Visitors may decide whether or not to use an exhibit based on what they can see from far away, so it's important to look for design attributes that are evident from afar, as well as up close. The manual tells you which questions to answer from a distance.
- Have at least two people look at the exhibit on their own and answer the questions. Then, have them come together, discuss their answers, and agree on a final answer. It is helpful if at least one person is not familiar with the exhibit.
- If you find yourself unsure of the best answer, or in disagreement with your partner, it's likely that the exhibit does not have the design attribute, or perhaps it could be improved to more strongly incorporate that attribute.



Assess from a distance

Answer the questions that follow according to this protocol:

- Make sure no one is using the exhibit.
- Stand at a distance (about 5 feet away for small exhibits; about 10 feet away for large exhibits. This is where you might stand if you were watching a stranger using the exhibit).
- Observe carefully and thoroughly to get an overview of the exhibit.



The exhibit has multiple stations or sides, allowing more than one person to experience the phenomenon.

When an exhibit has this attribute, it helps multiple people experience and access the activity or phenomenon. To have this design attribute, the exhibit should meet at least one of the following criteria.



This exhibit doesn't have stations, but it's designed so that **it can be used from any side.**



This exhibit is designed to be experienced from **multiple sides, and each window is a station.**

Assess from a distance

The exhibit is designed to allow people to experience the phenomenon or do the activity from more than one side:

- Yes
- No

The exhibit includes more than one station:

- Yes
- No



Here, phenomenon is designed to be experienced from one side (the front). There are **three stations.**



The exhibit has been designed with space to accommodate three or more people.

This design attribute is about physical space, or “elbow room.” Often, an exhibit might fit a group via a large room, a spacious floor, or a large table surface, but there are other ways, too. Note that people should be able to see the exhibit, activity, or phenomenon, but not everyone in the group has to be actively using the exhibit.



The **spacious floorplan** fits more than three people.

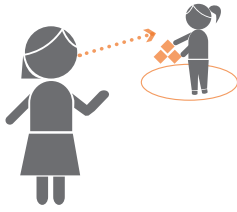


This interactive wall in a **large room fits many** people.

Assess from a distance

The exhibit is designed to accommodate three or more people:

- Yes
- No



The exhibit is designed so visitors can watch others to preview what to do.

Exhibits with this design attribute may have open tabletops, large screens, or other ways to view what others are doing. Here, the important consideration is whether one might see the actions and reactions of a user; seeing or understanding the phenomenon is not required for an exhibit to have this attribute. Enclosed kiosks, exhibits with small controls, or exhibits where a user's body blocks the view of his or her activities would not have this attribute.



Big arm movements are **obvious to observers** when visitors spin the wheel.

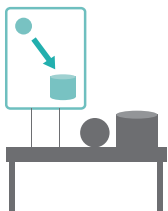


The open table **allows visitors to see** what others are doing.

Assess from a distance

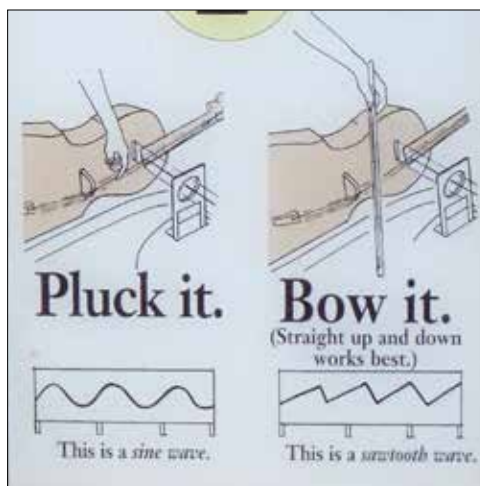
The exhibit is designed so that from a distance, visitors can watch others to learn how to use it:

- Yes
- No



The exhibit label includes a use drawing, giving visitors an idea of how to use the exhibit.

A use drawing should be designed to help visitors understand what actions to take at the exhibit. It often shows a person doing an action, or how to use an interactive element (e.g., a crank with an arrow). However, there are other possibilities, too. Note that a use drawing is not a diagram or illustration designed to explain the content or phenomenon.



These use drawings **indicate different ways to play** with the cello.



This use drawing hints **where visitors should look**—in the eyepiece.

Assess from a distance

The exhibit is designed so that a use drawing is visible and can be understood from a distance:

- Yes
- No



Assess from up close

Answer the questions that follow according to this protocol:

- Make sure no one is using the exhibit.
- Move up close to the exhibit.
- Read the label carefully and thoroughly and follow all instructions.
- Use the exhibit thoroughly.
- Be sure to investigate all sides/stations.
- Try two to three challenges or suggestions, if appropriate.
- Try a few ideas of your own, if appropriate.



The exhibit label includes at least one image of a person.

The images of people could be a photo, illustration, use drawing, 3-D model, video, or something else. The image could be an entire person, a face, a hand, or even an eyeball.



- The countdown clock will let you know when the light's about to flash.

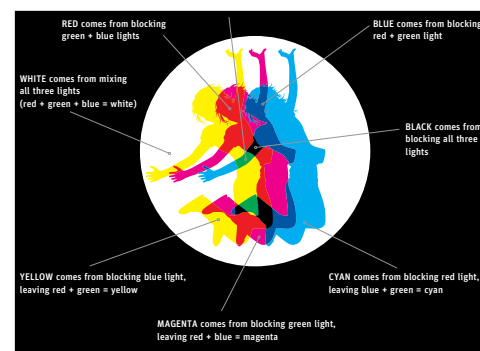
What's going on?
 Motion is fleeting. We're surrounded by events that happen too fast for us to see. But with a flash of light and a way to record the illuminated moment, you can seem to stop time.

In 1940, these images were extraordinary—no one had ever frozen motion like this. Photographer Harold Edgerton invented the strobe-flash technique to capture moments like the leap of a dancer, or a daughter.

Assess from up close

The label has one or more images of people; visible from up close (includes hands or other body parts):

- Yes
- No





The exhibits' look-and-feel is homey, personal, homemade, or delicate.

This question is a holistic one that looks at the overall “vibe” of the exhibit. It does not need to be ALL of these things. Here we use a scale from “Not at all” to “Very” that includes three sections with three bubbles each. Choose a bubble within the most appropriate section. You and your partner agree if you both choose within the same section, even if you choose different bubbles.

Assess from up close

The overall look-and-feel of this exhibit could be described as homey, personal, homemade, delicate:



The materials—cardboard tiles with sewn-on Velcro edges—feel **homemade**.



Toothpicks are small and **delicate**; this exhibit looks **hand-made**.



The exhibit includes at least one familiar object that most people have seen before.

A familiar object should be something chosen by the designer for its familiarity. For example, there are many kinds of lightbulbs; a designer could deliberately choose to use and make visible a standard household bulb rather than a string of LEDs. A computer screen that’s part of a media kiosk is something most likely chosen for its utility, and is often hidden within cabinetry, and so is not considered a “familiar object.”

A familiar object should be something where the form factor matches what visitors would see at home, school, or in a department store. A typical flashlight would count; a custom-built one would not. One common question is about mirrors—many exhibits have mirrors, but to be included in this category they should look just like mirrors people use in their daily lives—with a similar shape or frame.

Assess from up close

An element of the exhibit includes an object or objects most people have seen before, that can be seen from up close:

- **Yes:** the exhibit has stuff like kitchen items, basic household tools, musical instruments, stuffed animals
- **No:** the exhibit has stuff like pulleys, lab equipment, shop equipment



This guitar is upside down, but its overall **form is familiar**.



This sculpture is made of **household** toothpicks.



This exhibit lets visitors power **common household objects**, such as a fan or light-bulbs.



The exhibit's look-and-feel is playful, whimsical, or humorous.

This question is a holistic one that looks at the overall “vibe” of the exhibit. It does not need to be ALL of these things. Here we use a scale from “Serious, matter-of-fact, straightforward” to “Whimsical, playful, humorous” that includes three sections with three bubbles each. Choose a bubble within the most appropriate section. You and your partner agree if you both choose within the same section, even if you choose different bubbles. The examples reflect each end of the scale.

Assess from up close

The overall look and feel of this exhibit could be described as:

Serious,
matter-of-fact,
straightforward

Whimsical,
playful, or
humorous





The metal DNA sculptures and black specimen viewers suggest a **serious and straightforward** experience.



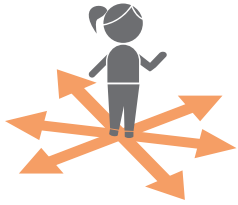
The experience of observing plants and insects feels **matter-of-fact**; the shape and materials also communicate **seriousness**.



The shapes and materials, as well as the ping-pong balls that roll through, all make this exhibit feel **playful and whimsical**.



The humorous example video and **playful** materials (colorful shapes and toy parts) add **whimsy** to the heart of this experience.



The exhibit is open-ended, providing multiple outcomes, activities, or ways to interact.

There are five questions in this section, because there are many ways an exhibit might be “open-ended.” If an exhibit meets at least one of these criteria, it has this design attribute; if it meets several, it is likely strongly open-ended. These examples reflect exhibits that do and do not meet one or more of these criteria.

Assess from up close

The exhibit is designed to provide three or more distinct activities:

- Yes:** it is more like 3-D shapes (*Make a house, Make a beehive, Make a snowflake*)
- No:** it is more like Square Wheel

The exhibit is designed so that many interactions are “right”:

- Yes:** it is more like Turbulent Orb
- No:** it is more like Water Freezer (*Too much water and it won't freeze.*)

The outcome of using the exhibit is designed to be more or less the same every time:

- Yes:** it is more like Square Wheel
- No:** it is more like Turntable

The exhibit is designed for visitors to follow a series of predetermined steps:

- Yes:** it is more like Water Freezer (*Slide the door... flip the switch... push the button... etc.*)
- No:** it is more like Turntable

The exhibit is designed for a multitude of iterations with a variety of variables, encouraging visitors to keep using the exhibit for extended play:

- Yes:** it is more like Turntable
- No:** it is more like Water Freezer



Turntable features a **multitude of objects** to spin, often with surprising outcomes.



3-D Shapes offers **multiple activities**, such as make a house, make a beehive, and make a snowflake.



Turbulent Orb can be spun fast, slow, or not at all, so **anything you do is right**.



Square Wheel rolls **predictably** over the track; there are **no variables** to tweak.

- Slide the door of the chamber closed.
- Flip the switch to **vacuum**. This will pump air out of the chamber.
- There should be a little water in the **vacuum chamber**. If not, push the **button** to add some—just a dribble! (Too much and it won't freeze.)
- Watch for about 30 seconds. What happens to the water?
- Flip the switch to **release vacuum**. In a few seconds you can open the door and remove the ice.

Water Freezer has a series of **predetermined steps**, and if the steps aren't followed, visitors can't experience the phenomenon.

Appendix B: Tested Design Attributes

List of tested design attributes

Here is a selected list of the design attributes we tested. The full set of attributes included subtle variations and selected combinations of many of the following.

Design Attribute	Final standing
Has multiple stations	EDGE Design Attribute (part of a combination)
Can be used from multiple sides	EDGE Design Attribute (part of a combination)
Space to accommodate three or more people	EDGE Design Attribute
Visitors can watch others to preview what to do	EDGE Design Attribute
Exhibit provides three or more distinct activities	EDGE Design Attribute (part of a combination)
Many interactions are right	EDGE Design Attribute (part of a combination)
Outcome is different every time	EDGE Design Attribute (part of a combination)
Exhibit does NOT have a series of predetermined steps	EDGE Design Attribute (part of a combination)
Exhibit allows for a multitude of iterations with a variety of variables	EDGE Design Attribute (part of a combination)
Exhibit includes at least one image of a person	EDGE Design Attribute
Exhibit includes a use drawing	EDGE Design Attribute
Exhibit includes at least one familiar object	EDGE Design Attribute
The exhibits' look-and-feel is homey, personal, homemade, or delicate	EDGE Design Attribute
The exhibits' look-and-feel is playful, whimsical, or humorous	EDGE Design Attribute

Design Attribute	Final standing
Exhibit includes any image of a female	Not enough to test
Exhibit involves self-expression or authorship	Not enough to test
The exhibit is designed to reflect a visitor's self-image	Not enough to test
Prior visitors' work is visible from afar	Not enough to test
Exhibit has embedded story or narrative	Not enough to test
Includes two or more required roles	Not enough to test
Exhibit does NOT have a competitive feel	Not enough to test
Exhibit includes competition between teams	Not enough to test
Title suggests what to do at the exhibit	Not enough to test
Label recommends telling or showing others	Not enough to test
Label describes how the exhibit phenomenon is related to social issues for humans, animals, or the environment	Not enough to test
Exhibit includes any text about a female STEM professional	Not enough to test
Exhibit uses a familiar object in an unfamiliar way	Not enough to test
Exhibit topic has been related to shared male and female interests via prior research or evaluation	Not enough to test
Label text offers a challenge to try	Not enough to test

Design Attribute	Final standing
Seating for two or more	Not in the final set
Phenomenon can be experienced by two or more people at the same time	Not in the final set
Allows for more than one set of hands or bodies	Not in the final set
Designed for multiple players to use without interfering with each other	Not in the final set
Label asks at least one open-ended question	Not in the final set
Title suggests what the exhibit does	Not in the final set
Label provides history of the exhibit or the phenomenon	Not in the final set
Label describes how the exhibit phenomenon is used in the real world	Not in the final set
All interviewed girls (n=3) report that there is something at the exhibit they have seen before	Not in the final set
Exhibit has bright, prominent color in the phenomenon or interactive elements	Not in the final set
Exhibit content has been related to male interests via prior research or evaluation	Not in the final set
Exhibit content has been related to female interests via prior research or evaluation	Not in the final set
All interviewed girls (n=3) report that the exhibit relates to their lives or interests	Not in the final set

← Not in the final set, because either:

- NOT SIGNIFICANT across the three institutions
- NEGATIVE RELATIONSHIP for at least one engagement measure at one institution
- REDUNDANT to another attribute or combination sub-attribute*

*The specifics for each attribute will be discussed in more detail in forthcoming journal articles.

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