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OREGON MUSEUM OF SCIENCE AND INDUSTRY

Tripping Over Science

Taking STEM Exhibits Outside of the Museum

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In addition to the authors, this guide represents the efforts and insights of the whole OMSI Science on the Move team: Mark Patel, Kevin Kearns, Kate Sams, Chad Jacobsen, Scott Pattison, Kari Jensen, Tim Hecox, David Redburn, Mark Keppinger, Leah Rutz, and Anna Sky. We are indebted to our partners at TriMet, Lamar, Bent Image Lab, and the Urban Farm Store, who offered support, creativity, and expertise in myriad ways throughout the project. We are also grateful to our advisors, Troy Livingston, Darrell Porcello, John Falk, Saul Rockman, Michael Buonocore, David Lustick, and Kevin Crowley, for sharing their ideas, experience, and feedback with us throughout the process.

The project team developed the ideas in this document over the last two years while thinking, researching, and reflecting on experiences with the Science on the Move (SOTM) project (NSF DRL #1222659) — a National Science Foundation Pathways project awarded to the Oregon Museum of Science and Industry (OMSI) to prototype exhibits at transit centers (i.e., busy bus and light rail stops) in the Portland area.

Any opinions, findings, and conclusions or recommendations expressed in this report are those of the authors and do not necessarily reflect the views of the Foundation.

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Introduction

What do you remember about your day? Your commute? Your neighborhood? For many of us, the experiences that stand out in our minds are the things that seemed out of place, strange, novel, or amusing. The stories we share with friends and family are of the experiences that caught us by surprise. And then, these memories re-emerge when we visit the places where they happened.

This document is a “think piece” about why and how informal science, technology, engineering, and math (STEM) education institutions could be placing amusing, novel experiences in people’s paths to create memorable STEM experiences embedded in their everyday lives.

This report focuses on what we learned about creating interactive STEM exhibits in public spaces outside of a science center. That said, the content can inform hands-on learning experiences on other topics, as well, within the limits outlined.

Why did OMSI create STEM exhibits for transit centers?

We felt that experimenting with exhibits in novel public spaces, especially transit centers, might allow us to extend the benefits of informal science education (ISE) to a broader audience. The benefits we focused on included building a more informed citizenry, raising interest in STEM careers, and engaging people with enriching STEM concepts (National Research Council 2009).

About 75% of adults in the United States do not regularly visit science centers (National Science Board 2010) and those who do are more likely to be college educated with more formal and informal experiences in STEM topics than the general public (National Science Board 2010). Similarly, when OMSI conducted preliminary research at transit centers in Portland, the majority (67%) of the adult public transportation riders surveyed reported they had not been to OMSI recently, with many reporting they had not visited in decades (OMSI 2011).

In contrast, our anecdotal experience and research suggested that even though the large majority of adults are not visiting OMSI and science centers in general, science centers are widely respected and enjoyed by the majority of the population (Chung and Wilkening 2008). Therefore, the low attendance rates likely reflect a variety of reasons for people choosing not to visit other than lack of interest such as cost, time, a belief that science centers are just for children, or that a science center is not top of mind as a destination. In contrast, a vast majority (78%) of adults in the Portland area ride transit at least once per year, and 41% use TriMet at least a couple of times per month. Additionally, riders reflect the general population and come from all economic, educational, and ethnic backgrounds (TriMet 2014). So, OMSI decided that rather than wait for adults from all walks of life to come to us, we should take our exhibits to them.

If taking science to the community has so many benefits, why have more science centers not done it? In some ways, they have. There is a lot of experience and knowledge in the ISE field on how to reach audiences outside the science center through educator facilitated programs such as outreach classes, camps, science cafés, community events, and festivals. Though most existing programs still require that participants seek out the experience (e.g., attend a science café or book a school-based program), our goal was to reach people who do not seek out these experiences, and we found that there was a general lack of experience and knowledge in the field about how to develop strong, non-facilitated, unanticipated experiences away from a science center.

Why? We speculate that science centers have been limited by the following challenges:

- Most science centers rely on ticket sales for financial viability. Investing in free experiences outside of the science center does not necessarily support that model and may feel like a drain on limited resources.
- It can be a challenge to acquire permission to design, install, and maintain exhibits on public spaces that science centers do not control.

- The public does not expect interactive STEM exhibits outside the science center so getting people to participate in and associate the experience with STEM is difficult.

- Exhibits outside the science center can blur the lines between marketing and education that necessitates a different combination of internal decision makers and processes.

- It can be difficult to create durable, weatherproof, and vandalism-proof exhibits for non-science center public spaces.

Of course, many science centers, parks, zoos, and other informal education institutions host interactive, outdoor STEM exhibits. Most of these examples, however, are in or directly adjacent to areas explicitly dedicated to interpreting science topics. Such a setting provides for a very different contextual environment than would an unexpected encounter with a science exhibit while going about one's everyday life. There are relatively few examples of interactive STEM exhibits in unexpected, free, public spaces but a few organizations that have recently experimented with these include the Exploratorium (San Francisco, CA, USA), Science World (Vancouver, BC, Canada), and Sciencenter (Ithaca, NY, USA).

As a field, very little critical thinking, research, and dialog has emerged from the existing projects about if, why, or how we should create these types of experiences. Similarly, there is very little written about the tangible or theoretical basis for understanding how unexpected, public STEM exhibits could fit into the larger ecosystem of free-choice learning experiences. In this think piece, we hope to build on existing work in

Exploratorium Studio for Public Spaces

THE EXPLORATORIUM has created multiple outdoor exhibits in novel public spaces including permanent interactives along a popular walking/jogging path at Fort Mason and a "portable parklet" on the science of skateboarding that can be moved around the city (Richards and Rockwell 2010). (More information about their projects can be found at http://www.exploratorium.edu/publicspaces).

Rethink

SCIENCE WORLD created several witty, eye-catching advertisements that included an interactive "Sneeze" touchscreen placed in a bus shelter. When touched, the screen triggers a startling mist of water and one of approximately a dozen facts about sneezes (Clark 2010).

Gary Hodges / Sciencenter

SCIENCENTER created a scale model of the solar system from the city center to its doors in honor of Carl Sagan (Weinstien 2014).

relevant fields and share the research that OMSI conducted through our SOTM project while focusing on the following issues:

- What we learned about engaging people with these exhibits
- Why we feel that OMSI and other ISE institutions should experiment with public exhibits outside of science centers
- How to get the necessary stakeholders and partners to participate

Science on the Move

This section is meant to give readers a basic overview of the SOTM project, how we implemented it, and what we learned from it. If you would like to know more, please contact us. You can also find a copy of our front-end research report on the OMSI website: https://www.omsi.edu/evaluationreports.

The SOTM project was supported by a Pathways Grant from the National Science Foundation (NSF). The purpose was to use design based research (Brown 1992, Cobb et al. 2003, Cobb and Gravemeijer 2008, Kelly et al. 2008) to investigate how to engage adults (especially those without college degrees, a demographic which is less likely to visit science centers) in public, non-science center settings using interactive STEM exhibits.

As part of this project, OMSI also looked for new ways to establish relationships with local for-profit and non-profit organizations. The hope was for these partnerships to 1) help OMSI identify timely, locally-relevant stories to highlight in the exhibits and 2) explore potential funding models for exhibits outside of the science center.

The OMSI team worked with a variety of community partners to create and conduct research on two prototype exhibit experiences. The core project partners were TriMet (Portland's public transit agency) and Lamar (the advertising agency that oversees ad space on TriMet properties). OMSI also worked with the Urban Farm Store (a local supplier of garden and animal-keeping supplies) and Bent Image Lab (the second largest animation company in the Portland area) to identify relevant, locally-specific STEM content.

LOCATION

Why did we choose to conduct research on exhibits in public transportation transit centers? As mentioned above, existing literature and data collected during front-end research suggested that bus and train stops would be good places to experiment with these exhibits for several reasons. First, those using public transportation in the Portland area include a large number of our target audience of adults without college degrees (TriMet 2013). Second, people waiting for the bus often have time to kill and welcome an opportunity to do something fun while they wait (Ohmori, Hirano, Harata, and Ohta 2004). Third, in OMSI's front-end research, some bus riders reported that most bus stations are "pretty bleak" suggesting that interesting activities at transit stops could attract attention by standing out in an otherwise stark environment (OMSI 2011).

THE PROTOTYPES

The transit shelter exhibits were meant to be prototypes rather than permanent, durable exhibits. There was always an OMSI staff person nearby conducting the research study and ensuring that nothing was damaged or stolen. The prototypes were created in a way to allow for easy installation, transportation, and updating between each research cycle.

Chicken Scene Investigation was a multi-component, diorama-style exhibit which invited audience to explore a "crime scene" to analyze evidence and determine which urban predator was responsible

Chicken Scene Investigation set up at the Rose Quarter Transit Center during the second research cycle.

View of the **Make Me a Monster** kiosk from the ticket booth or bus stops at the Gresham Transit Center during the first research cycle for this prototype.

View of the **Make Me a Monster** kiosk from a popular bus stop at the Rose Quarter Transit Center during the second research cycle for this prototype.

for a recent "chicken-napping." Participants could then share their conclusions on a large chalkboard or by texting OMSI. The educational objectives of this exhibit were to learn about urban predators, make observations, and practice critical thinking.

Make Me a Monster was an interactive touch screen exhibit which invited participants to take a picture of themselves with a digital "monster mask" on their face. They were then introduced to animators and technology experts at Bent Image Lab, the animation company that creates animation for the Portland-based shows Grimm and Portlandia. The educational objectives of this exhibit were to introduce the technology used in the entertainment industry as well as local career options for people who do this type of work.

PROCESS

Step 1: Front-end research

We started with a review of existing research and conducted our own front-end research study with the local intended audience. We conducted secondary research on relevant behavior and learning theory, our intended audience, exhibit design, marketing, and similar projects. For our project, that meant collecting and synthesizing information about situational interest, how people behave in bus stops, best practices for interactive design, marketing research on "conversion rates," and other interactive bus stop advertising and public art. We also conducted original research with people at local bus shelters to identify which topics or themes they found interesting and personally relevant.

(For detailed findings on these topics, read the Science on the Move: Front-End Evaluation Report.[1])

Step 2: First "best guess" theory of action (TOA)

To learn more from prototyping, the SOTM project used a design based research model for creating and refining a localized theory of action (TOA). A TOA is a written or visual document that captures the following (Cobb and Gravemeijer 2008):

- Desired impacts, objectives, and outcomes for the project
- Potential inputs and support structures that influence the target impacts
- Indicators of the desired outcomes
- Contextual factors that may influence the outcomes

We based the first iteration of the SOTM TOA on the front-end research conducted by OMSI regarding topical interests, our secondary research, and the intuition and experience of the team.

Step 3: Prototype exhibits

With the desired impacts, objectives, and outcomes of the TOA in mind, the team focused on exhibit ideas that related to popular topics identified in the front-end survey (e.g., animals) and the inclusion of potential local businesses. We also attempted to design the interfaces to be intuitive but engaging, with little extraneous internal or external text. Ease of use and brevity of the text was especially important because people waiting for trains or busses often have little time to engage with an exhibit.

Step 4: Progressive refinement of the TOA

In this phase of the project, OMSI progressively refined the TOA by conducted three "mini-cycles" of data collection and progressive refinement for each prototype. Researchers focused on what encouraged people to notice, attend to, and engage with the prototypes at the transit center. Research methods included conducting naturalistic observations, timing and tracking studies, post-use interviews with participants, and intercept surveys with people who noticed the exhibits but did not engage further.

Step 5: Update TOA based on findings

After each round of research and progressive refinement the team 1) revised the TOA to reflect the data and observations the team had collected and 2) revised the prototypes with the hopes of improving engagement based on research collected from the "mini-cycles." This allowed us to develop learning

THE CASE FOR A TOA

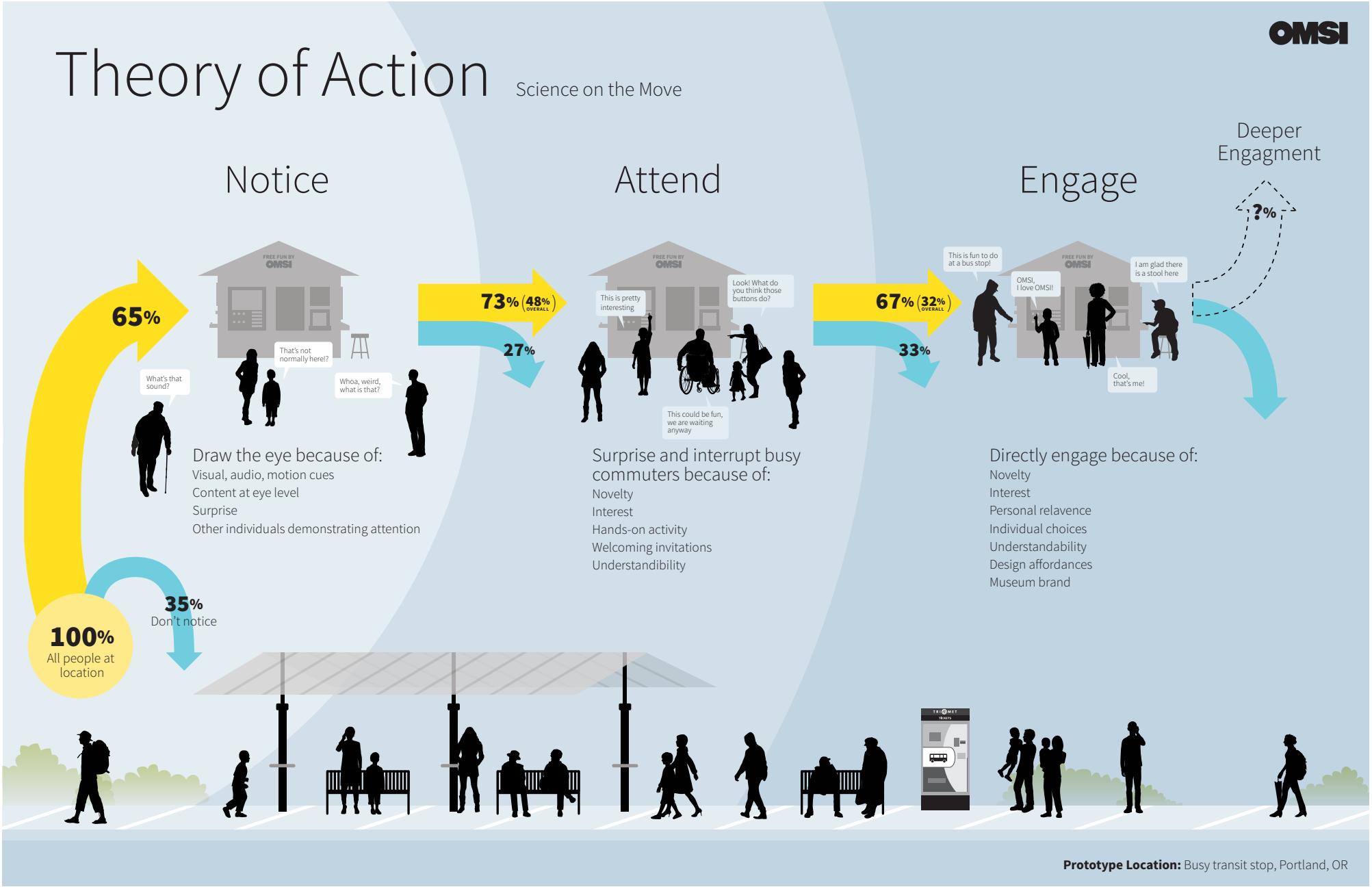
Not everyone on the OMSI team initially saw value in the TOA, but many "came around" once they saw that it could be used to:

- Allow the team to combine and represent the group's intuition, creativity, and data in one document.
- Provide the team a place to capture its findings over time and through several iterations of research and progressive refinement—the TOA was a living, constantly evolving record of what we changed and why.
- Allow the team to efficiently share its findings with a variety of stakeholders.
- Provide a framework from which to start when transitioning to new exhibit ideas.

1 https://www.omsi.edu/sites/all/FTP/files/evaluation/CardielPattison2014_ScienceOnTheMoveFrontEndFINAL_14%2005%2002.pdf

Theory of Action

Science on the Move



http://programs.omsi.edu/sites/default/files/Science_on_the_Move.pdf

Science on the Move: Make Me a Monster

Theory of Action "Current Best Guess"

Version: 10 Date: 10/19/14

Environment & Context Considerations:

Setting: Bus shelters/transit centers, possibly open to the elements
Social/cultural norms: Different expectations in public than in museum
Weather: Temperature, precipitation, shelter from elements, etc.
Group dynamics: Friends, children, etc.
Participant characteristics: Prior knowledge, interest, experiences, etc.

Target audience:

Adults without college degrees

Notes:

Notice

Draw the eye because of:

Visual cues
- *Monster cutout affixed to top of cabinet*

Audio cues
- *Creepy haunted house music (when loud enough to cut through aural "clutter")*

Motion cues
- *Images on screen morphing between humans and monsters*

Text or other content at eye level
- *Follow universal design principles for monitor height*

NEW **Other individuals demonstrating attention**
- *Presence of a crowd indicates potentially salient environmental characteristic*

Surprise
- *Monster hands holding sign*
- *Images on screen morphing between humans and monsters*
- *Shape of cabinet itself—picture frame, bright red coloration, etc.*
- *Monster cutout affixed to top of cabinet*

Expected Conversion Rate: Not notice → Notice: ***60%***

☐ *Eyes on the exhibit for 2 seconds*

Attend

Surprise and interrupt busy commuters because of:

Novelty
- *Unusual or incongruous presence at a transit center*

Personal relevance
- *Visitors can make themselves monsters*

Hands-on activities
- *Touchscreen interface is interactive and generally intuitive*

Welcoming/inviting experience
- *Visitors feel they are allowed/encouraged to approach and explore*
- *No environmental or contextual cues which make the experience seem "not for them"*
- *Audio component, particularly music, may contribute to a welcoming/inviting atmosphere*

Understandability
- *Minimal copy or instructional text—use icons or graphics to guide visitor into and through experience*

NEW **Other individuals demonstrating attention**
- *Presence of a crowd indicates potentially salient environmental characteristic*

Computers
- *Provide clear indication that this is a computer touchscreen, not just a television monitor*

Multi-outcome
- *Visitors can choose between wolf and snake*

Expected Conversion Rate: Notice → Attend: ***66%*** *Overall:* ***40%***

☐ *Eyes on the exhibit for 5 seconds*
☐ *Eyes on the exhibit for 10 seconds,* ***if no other indicators are also apparent***
☐ *Pointing at prototype*
☐ *Approaching prototype*

Engage

Directly engage because of:

Understandability
- *Clear "story" piques visitors' curiosity*
- *Orienting markers (e.g. copy panels and signage) guide visitors into and through the experience*
- *Icon- or graphics-based directions, familiar/intuitive touchscreen interface*

Novelty
- *Offers visibly new/different experiences across multiple visits*

Interest / personal relevance
- *Animals perceived as interesting and relevant based on front-end evaluation*
- *Presents STEM/STEAM jobs in the local community*

Familiarity
- *OMSI brand tells visitors what to expect (i.e. fun, accessible science content)*

NEW **Clear differentiation from similar structures or experiences**
- *Should not be able to be confused with others which already exist*

Individual choice
- *Visitors can choose which monster to "become"*

NEW **Alignment with individual preference for/against exhibitionism**
- *Presence of a crowd may attract some and dissuade others*

Design affordances
- *Physically accessible interface, including multiple (removable) seating options*
- *Exhibit design accounts for existing social and cultural norms which might preclude engagement*

Indirectly engage because of:

Design affordances
- *Screen is visible to others besides current user*

Personal relevance
- *Observers can see that a real person is on the screen*

Average Conversion Rate: Attend → Engage: ***50%*** *Overall:* ***20%***

☐ *Eyes on the exhibit for 10 seconds,* ***if other indicators are also apparent***
☐ *Eyes on for 10 seconds,* ***when others are using the exhibit*** *(indirect engagement)*
☐ *Reading Informed Consent*
☐ *Looking at façade / reading signage*
☐ *Touching the touchscreen*
☐ *Taking pictures*
☐ *Talking to others about the exhibit*
☐ *Collaborative use with others*

Impacts

Impact 1: Participants will be observably engaged by the prototype experience which they encounter during their day-to-day activities (i.e., at transit centers)

Impact 2: Participants will be excited by, be interested in, and have fun with the prototype-specific science (or STEM) content related to a topic which is part of their everyday lives and experiences.

Ideas and precipitants for deeper engagement:

- Offer the option of exploring the "story" more deeply after morphing is complete
- Provide one or more QR code(s) to scan and learn more about "monstrous" animals and/or STEM jobs in Portland
- Possible tracking of Facebook image uploads and/or hashtag use
- Tangibility of reward seems to be important—allow visitors to print their monster photo rather than go online to find it
- The experience must be **fun** (in addition to novel and understandable)

This document is intended to provide guidance in exhibit development and testing by drawing attention to relevant concepts, exhibit characteristics, and audience actions and suggesting possible relationships between them; revisions are made and new document iterations are created as appropriate.

http://programs.omsi.edu/sites/default/files/Science_on_the_Move.pdf

experiences grounded in localized theory and localized theories based on empirical evidence.

We also experimented with communication styles within the TOA and included words, diagrams, images, and stories to better share it with key stakeholders. Attached are the original TOA, a "final" written TOA, and a pictorial version of the TOA. (Final is in quotation marks here to indicate that a TOA is always a work in progress and that this is simply the most recent iteration.)

It is important to note that the attached "final" TOA articulates a localized "small" theory tied to specific context and is not necessarily generalizable on a broad scale. That said, we could use our existing TOAs to strongly inform the "first best guess" TOAs for future projects in similar settings. We have also begun identifying and charting possible connections between this localized "small" theory and the models and findings posited by other researchers to explain individual engagement patterns.

RELEVANT FINDINGS

Many of the findings are represented in the attached TOA, but here are a few of the team's most important big picture insights. Many of these insights seem painfully obvious now, but it took time and experimentation for us to recognize them. We were accustomed to designing exhibits for the science center, not transit stops, and this meant that we had not fully recognized how much our science center context influenced our choices.

Capturing Attention and Inviting Participation in Different Environments

We quickly realized that we had to take into consideration how people behaved at a transit stop, what they were or were not expecting, and the types of interactions they were used to having in that space. First, people were not expecting to find STEM exhibits at the transit center, so the first big challenge was to get people to notice the exhibit. Bright colors, strange sounds (e.g., squawking chickens, creepy clown music), the OMSI logo, and generally unexpected things (e.g., a chicken coop, monster cut out) helped to grab people's attention.

Second, potential users had to recognize what the exhibit was and that they were allowed to participate. To do this, the exhibit had to give explicit and implicit cues that the exhibit was safe, free, fun, and that they were invited to participate.

Location, Location, Location

We also learned that we needed to carefully consider behavior patterns and safety when determining where to place the exhibit in the transit center. The exhibit needed to be located right next to a

WHAT MADE YOU NOTICE THE EXHIBIT?

"Probably the monster and the seat, it meant that I could sit down."

"Well, I did notice the sounds, but that was the second thing… The first thing was just the oddity of a chicken coop at the bus stop."

BEWARE OF EXHIBIT DOPPELGANGERS

The Make Me a Monster kiosk was bright red (like the OMSI logo) with images from old Wolfman movies on it. Because of these design elements, many people assumed it was a Redbox DVD rental kiosk.

heavily used stop (not an area of the transit center primarily used for walking from one stop to another) so that people could engage with it without feeling like they might miss their bus or train. TriMet also has strict safety rules that prohibit placing the exhibit anywhere people could get hurt or that positioned people with their backs to the train tracks. We also had to rule out locations where people might feel unsafe for reasons such as poor lighting or distance from the main waiting areas.

Promoting STEM Recognition and Learning

A lot of what and how people learn depends on the context. In a science center, people know that the exhibits in that space are 1) about STEM topics and 2) they are meant to be educational. None of these assumptions are in people's minds at a bus stop. If we want people to think in terms of STEM and learning, we need to provide that information explicitly and in many ways.

Case study: What STEM?

The Make Me a Monster prototype was very popular—it was good at getting people's attention and encouraging people to engage with it. Without prompting, though, almost no one expressed the STEM themes embedded in the experience.

Finding and Testing Technology for Outdoor Environments

The science center environment is usually consistent and controllable, but outdoor environments are not. Lighting, weather, and infrastructure can pose major challenges that would be nonexistent or easily resolved inside a science center. We had to design our exhibits carefully for the outdoors and, even then, lighting, rain, and wind occasionally curtailed plans. It was also a challenge to find electric outlets at the bus shelters and they are prohibitively expensive to install.

Case study: Lighting and Contrast Issues

One of the most frustrating and unexpected challenges involved setting up the camera and software for Make Me a Monster outside. When we tried the prototype inside with a variety of people, it worked well. The strong ambient lighting at the transit center, however, prevented the exhibit from reliably mapping the monster mask to the faces of visitors with darker skin tones. We tried many different things to fix the problem, but we never found

PLAY IT SAFE

For the Chicken Scene Investigation prototype, we thought that it would help set the scene and attract attention to put yellow police tape around the chicken coop.

In the science center, this would have seemed fun and exciting, yet totally approachable, like when used in the Mythbusters exhibit.

At a transit center under a freeway bridge, people were more likely to assume that it was a real crime scene, so most people avoided the exhibit or only approached it after asking permission from the evaluators.

a solution that allowed everyone to use the prototype reliably outside without adding a backdrop or facing the camera and screen towards a wall. Unfortunately, the backdrop significantly reduced the number of people who participated in the exhibit as it blocked the view of the screen and stool, and positioning the screen towards a wall meant the exhibit interactive was not facing the bus or train waiting area.

Adjusting for Frequency of Visitation

People who use bus stops and transit centers often use them regularly, perhaps multiple times a day, whereas people might only visit a science center once a year or less. Higher frequency of visitation can be a benefit and a challenge for creating successful exhibits in these spaces. People who visit a place often are likely to notice something new, which is advantageous to projects like ours as novelty creates interest. It also means that people will stop noticing a new thing if that thing does not change regularly.

Case Study: Been There, Done That

After the first few days of setting up Chicken Scene Investigation at the transit center, several people said that they did not interact with the exhibit because they had seen it previously. When we changed the headline during the second round of data collection from "Chicken missing!" to "Another chicken GONE!" participation ticked up again. When we did not change the headline for the third round of data collection, but changed the story and clues, which were less visible from a distance, the exit interviews indicated that some people assumed it was the same as before and did not approach.

The challenge of constantly changing the content of an exhibit is countered by the opportunity to engage with people on a very regular basis, possibly even daily—something we can rarely do at a science center. This is an area that needs more thought and experimentation. Advertising, media, and others who deal with the need to update content regularly will likely provide valuable information on this subject.

Reinforcing Branding and Mission

Even though we were reaching a more diverse audience than we would usually find in the science center, people recognized and trusted the OMSI brand. Multiple people reported that they noticed and approached the exhibits because they saw the OMSI logo. In fact, this was the single most common reason for choosing to approach the exhibits once they were noticed. Even though many people had not been to OMSI recently, in some cases for decades, they had fond memories and feelings of OMSI. They were also very appreciative and excited to get to participate in a free, fun, interactive exhibit at the bus stop.

WHAT MADE YOU APPROACH THE EXHIBIT?

"The thing said 'free fun.' My friend and I were laughing about that, like 'Really? Free fun? Since when?' No one offers free fun anymore!"

Engaging the Right Stakeholders

In addition to researching what influenced the success of transit shelter exhibits, the team explored the reasons and processes for creating this type of experience. A key part of this process was thinking about how to engage the right stakeholders in our institution and community.

WHO NEEDS TO BE AT THE TABLE AND HOW DO YOU GET THEM THERE?

In many ways, making outdoor exhibits was like making indoor exhibits. In other ways, the issues OMSI designers, content developers, builders, and evaluators faced in public spaces posed different challenges. First, even during the prototype phase, we were promoting the institution, so the experience had to be designed with both marketing and learning in mind. Therefore, OMSI's marketing team, an entirely different department than this team, needed to be involved. Second, TriMet, which owns and manages the land we used to stage the exhibits, was heavily involved in the process, from the proposal writing, to selecting test sites, and reviewing prototypes. Third, because OMSI would need to be able to fund the project if it extended beyond the period of the NSF funding, our development and exhibit sales teams would need to see the benefits of these exhibits and know how to "sell" the project differently than an exhibit in our museum. We needed to make a case for exhibits that might not directly increase ticket sales or other revenue-generating aspects for OMSI. Fourth, other people in the community, such as urban planners, public arts organizations, and others looking to integrate dynamic, engaging learning experiences into public spaces, could be valuable partners.

Below we demonstrate how we articulated to these internal and external stakeholders that this project was worth OMSI's effort as would potential future free exhibits is novel public places.

EDUCATIONAL VALUE

For us, the fundamental purpose of free exhibits in public spaces is to reach audiences that do not visit OMSI. By researching where such audiences go and creating experiences that meet their interests, we can bring meaningful STEM experiences to them.

Working in new environments also allows us to also take advantage of a whole new set of places to interpret, as well as the opportunity to link these environments to learning experiences in people's minds. We hypothesize that the creation of STEM experiences in everyday places, especially places that people frequent regularly (e.g., transit centers and walking paths), will result in mental triggers for people to think about STEM in their everyday lives. That the STEM exhibits are novel in these places will make the connections burn brighter in people's minds. Of course, this hypothesis needs validation from research.

INTERNAL MARKETING AND DEVELOPMENT VALUE

As mentioned earlier, if we are to continue this work at OMSI, more departments would need to be convinced of the value to the institution.

In addition to the educational value, we identified the following reasons why exhibits that afford opportunities for our community to "trip over science" in public spaces are valuable to OMSI.

First, our research suggests that these experiences may have a greater impact than traditional advertising. Creating unexpected, fun, interactive experiences at transit centers provides a mechanism to capture more attention and engagement than many traditional advertising mechanisms. In fact, people noticed the exhibits and approached them the most when they did not look like advertising. To track how many people noticed, attended to, and engaged with the exhibits, we used the marketing concept of "conversion rate" or "the percentage of visitors who take a desired action" (Marketing Terms). Combining data from all six research cycles, the prototypes had the following overall conversion rates: 65.1% of the people walking past noticed them, 47.7% attended to them (73.3% of the people who "noticed"), and 31.9% engaged with them (66.9% of those who "attended"). In addition to the users and on-lookers in the immediate vicinity of the exhibit, people were also excited to share their experience afterwards by talking with others and taking pictures to share on social media. We do not have comparable statistics to include here, but when we share our statistics with people in the marketing world, the general response is, "wow, how did you do that?"

Second, we found that placing OMSI-identified exhibits in bus shelters brought to mind prior OMSI experiences. Even people who had not visited OMSI recently (or even possibly since they were children) usually had positive associations with OMSI, and experiencing an OMSI exhibit reminded them of these warm feelings. While we did not explicitly look for these outcomes in our research, there is the possibility that these types of experiences could lead more people to visit the science center, support it financially or politically, or just talk about it in positive ways to their friends and family, thereby building the brand and brand loyalty.

Third, we are still exploring ways that OMSI could "sell" these novel experiences to businesses, organizations, and foundations. For example, local business funding could, theoretically, fund co-branded exhibits in public spaces about STEM content related to their business (like with our prototypes) partially because the OMSI brand makes the exhibit more approachable and compelling than traditional advertising. (This topic is explored more below.)

VALUE FOR COMMUNITY PARTNERS

Why would a transit agency or similar organization that oversees public spaces (e.g., urban planners, shopping mall managers, city parks departments) want to partner with a science center to create public exhibits? OMSI's partner TriMet had the following reasons for working with us and allowing us to use their spaces:

- **Improving the rider experience:** TriMet believes that infusing learning opportunities and public art installations along light rail and transit lines would enhance the ridership experience for customers. These installations positioned TriMet as an essential resource and partner in community well-being.

- **Supporting positive public relations:** The press often focuses on mishaps or problems when reporting on public transportation. Therefore, TriMet was interested in providing opportunities to share positive stories about the organization and its transportation services.

- **Positioning the transit agency as a national leader:** TriMet felt that the SOTM concept was innovative for Portland and the nation as a whole. TriMet believed there would be strong interest from other regions and transit organizations in adopting a similar outreach model, thereby positioning them as a national leader in the public transportation sector.

Potential community partners could also be interested in working with science centers in order to share relevant content with key audiences, such as the human or natural history of the area, local industries, or scientific stories related to critical policy decisions (e.g., how and why the city wants to reduce carbon emissions).

POTENTIAL VALUE FOR FUNDERS

Long term funding considerations pushed us to think beyond government and foundation grantors. That meant thinking about why a business or organization might want to fund public science exhibits. For corporate funders, supporting a public, outdoor exhibit can support the same goals as an in-science center exhibit while providing the additional benefits of:

- Being novel and engaging, thereby attracting more attention than traditional advertising and standing out in people's experience and memory

- Adding more to the "halo effect" by being associated with the science center and allowing people to engage with it for free in an accessible place

- Reaching a larger array of potential audiences

- Reaching people in a larger variety of locations, including locations that might be particularly well suited to the exhibit's content (e.g., at the bus stop near a corporate headquarters or place where people might use the business' product like a running shoe company supporting an exhibit near a public running track)

In addition to businesses, the team discussed how regional governments, urban planners, developers, and community groups might be interested in funding these projects in order to create family-friendly public spaces that foster learning and public engagement.

Finding and Starting Necessary Partnerships

For OMSI, identifying potential partners took thought, research, and relationship building. Even then, we did not know if would work. As we move forward, these are a few of the important lessons we learned regarding the partnerships needed to locate, fund, and create new public, outdoor exhibits.

DEFINING GOALS

OMSI struggled at the beginning of SOTM because there were many different strategic and content-related directions that we could take with this project. Therefore, we created a project charter that included a variety of topics usually included in a typical exhibit process. These are some of the questions we asked ourselves while creating the charter:

- What were the learning objectives and measures of success for the project considering the unexpected nature of the exhibit (the "tripping over science" aspect) and the limited amount of time visitors would have to engage with the exhibits?
- What business and community relationships did OMSI want to explore?
- What capacities or expertise did OMSI want to build?
- What was the purpose of the exhibits beyond the learning outcomes? Were they also meant to be marketing tools? If so, were we explicitly trying to drive traffic to the science center?
- How durable and reproducible did we want the exhibits?
- Did we have explicit expectations for the exhibits to use or not use certain technology or approaches?

DIGITAL VS. PHYSICAL

Within the team there were different opinions about whether we should create all digital interfaces using large touchscreens or more physical experiences.

The thought was that the touchscreens would be more easily updated, but the physical experiences would catch more attention and draw on the strengths we have creating hands-on, interactive exhibits. In the end, we decided to explicitly try both.

LOCATION PARTNERS

For SOTM, we built on existing relationships to identify a community partner to host the prototypes. OMSI already had a relationship with TriMet and Lamar because we buy a lot of their ad space for our traveling exhibitions. As a result, our Vice President of Marketing had a positive, reciprocal relationship to leverage to start conversations. As mentioned above, TriMet was also interested in participating because they were committed to creating positive, innovative experiences for riders.

Once the basic partnership with TriMet and Lamar was agreed to, we spent a lot of time discussing concrete details about what was possible. This included logistical, safety, and user information that impacted the types and placement of exhibits. Some of the key issues included:

- **Safety:** What safety restrictions were in place at transit stops?
- **Logistics:** Where were the electrical outlets? Which areas were protected from rain and snow? Were there areas that were off limits or owned by other agencies/businesses? How could we pick up and drop off the exhibits? How could we protect exhibits from vandalism and theft?
- **User Information:** Which transit stops were used the most by our target audiences? Where are people most likely to be waiting rather than in a hurry to get elsewhere?

Through this process, we also learned that the development, installation, and research process called for additional time when working with external partners than if OMSI was locating exhibits on its own property. We needed time for initial and ongoing consultations, approving plans, and sharing research findings. This extra time and effort was an investment rather than a deterrent. Having a more intimate understanding of our partners, and the opportunity to meet with them regularly, strengthened our relationships and allowed for the possibility of additional collaborations.

WORKING WITH BUSINESSES

We quickly learned that most businesses had a hard time imagining what type of exhibits would relate to their work, so we decided to come to potential partners with possible exhibit ideas that related to their businesses. If they were interested, we met to discuss how to improve the idea and connect it directly to their work and expertise.

For example, we originally wanted to work with an animation company to create a "make me cute" kiosk that would take photos of people then manipulate the proportions of their features to make them look "cuter." When we floated this idea to Bent Image Lab, they suggested the "make me a monster" idea instead to fit with the work they do animating the monster morphing scenes for the TV show Grimm.

FUNDING AND CONTENT PARTNERS

With the SOTM project, OMSI already had funding from NSF to pay for exhibit development, so we mainly looked to businesses as "content partners." The goal was to try out new ideas and processes related to working with for-profit businesses. We specifically wanted to find businesses headquartered in our area with content links of interest to our target audiences.

During this project, because the businesses were not paying for the exhibits, the relationship was much less formal (i.e., requiring a memorandum of understanding instead of a contract), and OMSI clearly retained the creative control of the project. We are currently investigating how to work with businesses to better understand how we might fund similar projects and how to carefully include partner businesses in the STEM content. Based on our experiences with this project, as well as similar projects at OMSI, in the future we would use the following guidelines in our work with business partners:

- **Be proud of OMSI's brand—it is a very powerful thing!**

Many people noticed our exhibits in the transit shelter and were willing to engage because they recognized the OMSI logo and

had positive associations with it. Once they realized that it was not an advertisement, they were excited to participate.

• **Protect our brand.** We feel strongly that we need to clearly communicate to the partner and the exhibit users that the museum is not creating the exhibit to promote a specific business. Instead, the desire is to articulate a clear, mission-driven project goal that the partner is excited to support related to STEM experiences. As part of this process, OMSI will need to articulate the goals and parameters clearly.

• **Integrate partners in an authentic way.** Instead of "promoting" the partner, we would collaborate with the partner to highlight the STEM related research, professionals, or stories embedded in their work. This is especially interesting if the business is local or doing work locally that the target audience would find interesting. If the work is related to something in or near the exhibit, even better.

• **Have one key contact person.** While it was important for us to hold relationships with more than one person in an organization, it was helpful to have one point person at OMSI work with one point person at the partner organization to help us find and collect the relevant information, materials, or connections.

• **Have the partner's role in the exhibit be obvious.** We learned that if there is only a subtle topical tie to the partner, the public might not make the connection to the business. When we explicitly shared stories related to partner staff or projects, connections were clearer for the public.

• **Get to know each other's processes and jargon.** There was some confusion and consternation with some of our partners and contractors because we did not understand each other's expectations or work flow. In the future, we would take more time at the beginning of the relationship to talk about timelines, assumptions, desires, expectations, organizational hierarchies, communication styles, intended outcomes, benefits and risks, etc. before launching into the work.

SHOWCASING PARTNERS EFFECTIVELY

Many people noticed Bent Image Lab in the Make Me a Monster kiosk because there was a photo of the Bent staff person who created the monster masks and bios of other staff highlighting tech careers related to animation.

Far fewer visitors noticed the Urban Farm Store's involvement because the topic was more generically "chickens and their predators." Reference to the staff's expertise on the behavior and prevalence of chicken predators was not included the exhibit, so very few people noticed that they were involved.

Next Steps

As OMSI and our advisors reflected on what we learned, we identified several areas where we feel we should or could learn more. Here are some of the key questions that emerged for the team as we think about next steps for OMSI and the field.

What types of exhibits work best in free, non-science center spaces?

- What exhibits work better in public spaces versus science centers? Why?
- Do digital or physical interactions engage more users? Which are more practical in these spaces?
- Is it better to make the exhibits "bombproof" or disposable? What are the trade-offs?
- Is it better to do non-facilitated exhibit experiences or facilitated activities? What are the trade-offs?
- Do people have to recognize and articulate the STEM in the exhibits? Do we care? Does it matter in terms of the goals, topic, and audience?

Where should these exhibits go?

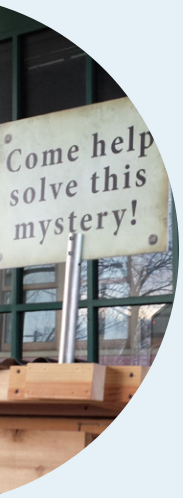
- What locations work better: adjacent to the science center (i.e., right outside) or nearby (i.e., location within walking distance but unrelated to the science center) or far away?
- Are there certain types of gathering places (e.g., parks, malls, bus stops) that work well or poorly?
- What are the trade-offs of each location? For example, do some do better at reaching diverse or underserved audiences while others drive traffic to the science center?

How do we fund these types of projects?

- Are there new funding models that science centers or other organizations can use to create these types of exhibits?
- What could we do that would be less expensive with comparable outcomes?

Do free, public exhibits function as marketing? If so, how?

- What are the costs and benefits to an institution for doing this? How do you balance the costs and benefits?
- What, if anything, is the role of social media? How can it be incorporated in a meaningful way that actually gets used?
- Do these exhibits drive traffic to the science center? If not, do we care?



Concluding Thoughts

The questions and thoughts presented here by OMSI's SOTM team are intended as prompts for further exploration. ISE has only started to experiment with unexpected exhibits in free, public, non-science center spaces, but we believe that these types of exhibits create the possibility for engaging people with STEM as they literally move through their lives and communities. These novel approaches will also need innovative partnerships and funding models to make them possible, but that is part of where the opportunity lies. It is not possible to know what out-of-the-science center thinking could lead to, but based on our experience, there are a lot of potential directions to explore.

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