Advancing Environmental Justice Through Inclusive Design and Sustainable Materials

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As exhibit designers, we have the opportunity and responsibility to step up and modernize exhibit design practices so that our work, processes, and materials create greater environmental justice in our communities and less poisoning of our climate. By environmental justice, we mean the meaningful involvement of all people regardless of race, color, national origin, or income with respect to decisions about the environment and the same degree of protection for all from environmental health hazards. For myriad reasons, it is imperative that our field address these social and environmental justice issues through our design processes, find healthier alternatives for museum exhibit fabrication, and drastically reduce our carbon footprint at the same time. Through our exhibit design and fabrication, we can help break the cycle of harm that impacts all people, but especially those who have been historically marginalized.

For example, museums often use vinyl exhibit graphics because they are inexpensive and durable, but they contain toxic additives that can cause infertility, shorten life spans, and create a host of other health problems when used in exhibits which is problematic for all visitors.[1] Toxins from vinyl production have an even greater effect on communities that live near vinyl manufacturing sites. In Texas and Louisiana's "Cancer Alley," the toxic effects of PVC (polyvinyl chloride) used in vinyl emit cancer-causing chemicals into the air and water.[2] In the alley's predominantly Black neighborhood of Reserve, Louisiana, for example, the risk of cancer is 50 times the national average. Also, because vinyl is too toxic to burn and leaches toxic chemicals into landfills, there are no safe methods to dispose of it. Recycling vinyl is expensive and often hazardous.[3] This disposal problem also disproportionately affects BIPOC (Black, Indigenous, and People of Color) communities who most often live near our landfill and polluted sites.[4] In fact, income is not the biggest indicator of whether or not you live near pollution, it is race.[5] Years of racist or indifferent government policies created these racial disparities.[6]

Any actions taken to reduce our carbon footprint help to further environmental justice. Multiple studies have shown the disproportionate impact of climate change on BIPOC communities, who are responsible for a small percentage of carbon emissions.[7] For example, in American cities, urban heat islands' temperature increase can be as much as 22 degrees at night, with higher

temperatures in denser neighborhoods with more concrete and fewer trees.[8] People in these neighborhoods are less likely to be able to afford air conditioning or have the means to escape the city. In rural areas, the water quality on the land of Indigenous people is generally low due to pollution from landfills and incinerators often sited on their lands. Twenty percent of all drinking water advisories in Canada are for Indigenous communities, who only make up five percent of the population.[9] When reviewing products, processes, and supply chains, it becomes clear that embracing an environmental justice mindset will help motivate designers to choose materials that lessen negative impacts on museum visitors while also changing the outcome for those living in dense heat islands or in close proximity to material manufacturers and disposal sites.

Where to Begin?

This article offers practical steps that museum exhibit designers can take to include historically marginalized team members, to reduce the operational and embodied carbon footprint of museum exhibitions, and to choose reusable materials that do not emit toxic chemicals during production or use. We have selected examples from our own work in museums in the United States and hope that you will be inspired to go beyond what we have shared as you rethink your own processes. We also hope that you will join us in creating more inclusive practices that protect historically underrepresented people in the process. We approach our own learning with a growth mindset and recognize that within our larger collective work lies the true power of museums to educate and inspire change.

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Increase Diversity and Inclusion

Our journey to become more equitable in all aspects of exhibit design involves bringing diverse voices to the table in a challenging process that requires us to examine our own biases, blind spots, and fragility. Many exhibit designers approach projects from a place of privilege, where they have always been able to assume that their experience in a museum would reinforce their worldviews and feel comfortable and safe. Including additional voices in the design process allows us to welcome a wider range of visitors into our exhibits. CambridgeSeven recently worked with an exhibit design team at the RMSC

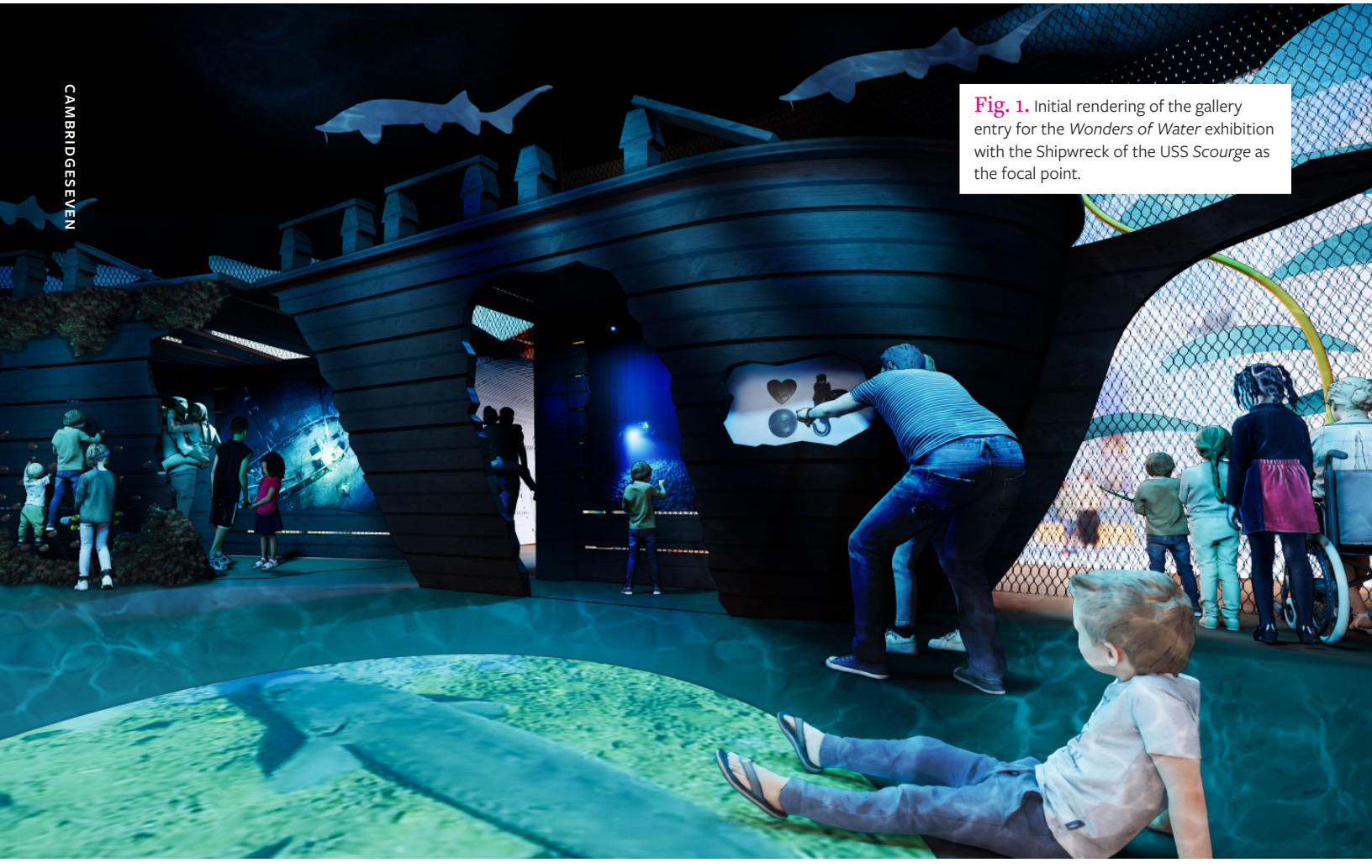

Fig. 1. Initial rendering of the gallery entry for the *Wonders of Water* exhibition with the Shipwreck of the USS *Scourge* as the focal point.

(Rochester Museum & Science Center) to design an exhibit about the power and importance of water. Black community leaders and activists involved in the process objected to a reconstruction of a large local shipwreck from the War of 1812, which was visible from the exhibit entryway. Minister Clifford Florence, Sr. noted that he would not enter the gallery because it resembled walking onto a ship used to carry enslaved Africans (fig. 1). The design team, which did not include any Black people, had not considered this. In the same way, many of us do not think about the production process of the materials used in exhibitions nor the people who may have been affected during their manufacture. We may not consider how much energy and carbon was used in the extraction, manufacture, and transportation of a given product nor about what effect that carbon has on those most vulnerable to a changing climate. Widening the perspective of our design teams allows us each to see our unexamined biases and blind spots, and to make our exhibits safe spaces on many levels.

Reduce Operational Carbon

A first step in reducing our carbon footprint is to reduce our operational carbon. Operational carbon is the carbon load created by the energy used in the operation of an exhibition. Reducing energy use in telling an exhibition's story can start with a simple spreadsheet to track each light fixture and its maximum watt usage in any given gallery. Multiplying these values by the hours and days used and the percentage

Lighting EUI

Jellies Gallery
Aquarium of the Aquariums

1-Apr-2022

Cambridge Seven

	QUANTITY	INPUT WATTS	HOURS/ DAY (1-24)	DAYS/ WEEK (1-7)	% DIMMED	LPD (w/sq. ft.)	ANNUAL kWh	EUI (annual kWh/sq. ft.)
Work Light Fixtures								
1'x2' LED Vapor Tight Fixture (BOH)	10	40.0	12	5	25%	0.11	939	1.6
1'x2' LED Vapor Tight Fixture (FOH)	13	40.0	4	7	25%	0.15	569	1.0
Subtotal	23					0.26	1,508	2.5
Architectural Fixtures								
B Rosco Pica Cube (Banner Lights)	60	2.2	9	7	25%	0.04	325	0.5
C LSI Track Light	37	14.0	9	7	25%	0.15	1,276	2.1
O ETC Pattern Projector	18	14.0	9	7	25%	0.07	621	1.0
Subtotal	115					0.25	2,222	3.7
Exhibit Fixtures								
Aquallumination Prime HD	2	55.0	16	7	50%	0.03	321	0.5
Aquallumination Hydra 26 HD	9	95.0	16	7	50%	0.24	2,497	4.2
Aquallumination Hydra 52 HD	1	135.0	16	7	50%	0.04	394	0.7
Acolyte Backlyte	71	14.8	9	7	60%	0.30	1,378	2.3
Lumascape - Jelly Tank 1	9	19.0	16	7	50%	0.05	499	0.8
Lumascape - Jelly Tank 2	3	27.0	16	7	50%	0.02	237	0.4
BK Fixture - Jelly Tank 3	3	7.0	16	7	25%	0.01	92	0.2
Light Box - Jelly Tank 4	160	7.0	16	7	75%	0.32	1,635	2.7
Overhead Lumenpulse - Jelly Tank 4	20	7.5	16	7	50%	0.04	438	0.7
Subtotal	278					1.04	7,491	12.6

LIGHTING TOTALS	LPD (w/sq. ft.)	Annual kWh	EUI (annual kWh/sq. ft.)
	1.55	11,221	18.8

Fig. 2. Use a spreadsheet like this to calculate the approximate annual energy usage for a particular lighting design. Museums can compare one gallery's energy use with others in the building. It incentivizes the use of motion and daylight sensors and the use of lower-power light fixtures.

of time dimmed provides an estimate of the exhibition's power use per year. Knowing the resulting number can help encourage the use of occupancy and light sensors to reduce unnecessary light use (fig. 2). Instead of blocking windows to provide a black-box experience, for example, we could optimize natural light instead, while protecting people and objects from harsh glare. In addition, by dividing the annual energy use by square feet you can obtain an Energy Use Intensity (EUI) measurement for lighting, which will indicate the efficiency of operations. A similar exercise can be done with audiovisual equipment or power-consuming exhibits. It is difficult to control what is not measured. After undergoing this exercise for two or three exhibits, it becomes easier to establish a not-to-exceed goal for power use per square foot.

Reduce Embodied Carbon

Embodied carbon refers to the greenhouse gas emissions produced from the manufacturing, transportation, installation, maintenance, and disposal of building materials. More manufacturers of products common in interior renovations are examining their embodied carbon and sharing this information on their websites in reports called Environmental Product Declarations (EPDs). Don't drive yourself crazy trying to track the carbon footprint of every screw and nail. Focus on the biggest drivers of greenhouse gas emissions. If you are spending more than $5,000 on a material, you should probably know its carbon footprint. Helpful websites for researching embodied carbon of building materials include Sustainable Minds' Transparency

Catalog (transparencycatalog.com) and the Embodied Carbon in Construction Calculator (EC3) tool (buildingtransparency.org). These free websites include databases showing the embodied carbon of products with EPDs. A carbon calculator on the Sustainability Tools in Cultural Heritage (STiCH) website (stich.culturalheritage.org) compares the carbon footprint of materials commonly used in museums. We have found that the more local and the more natural a product can be, the lower embodied carbon it tends to have. Metals, concrete made with Portland cement, and plastics tend to have remarkably high embodied carbon, and should be used sparingly if at all. Comparing options helps in the selection of products with the least negative global warming potential.

Use Natural, Sustainably Harvested, Local Materials

Using single-use manufactured products that cannot break down or be recycled – like plastics – means sending carbon resources to a landfill. Instead of using vinyl for lettering, select materials like thick cardstock or wood. Choose a mural made of natural fabric printed with water-based inks or paint work instead of a printed vinyl mural. Or consider using a paper mural adhered with natural wheat paste, like outdoor event posters that can be inexpensively composted and replaced as needed.

We also recommend designing with the material's full life cycle in mind, with each exhibit ending in a compost bin as a design goal. At the Madison Children's Museum in Madison, Wisconsin, for example, designers created huts for their *Wildernest* exhibition from wheat straw, wood, linseed oil, and soil – all fully compostable (fig. 3). Consider

“Metals, concrete made with Portland cement, and plastics tend to have remarkably high embodied carbon, and should be used sparingly if at all.”

MADISON CHILDREN'S MUSEUM

Fig. 3. These *Wildernest* play huts are made from wheat straw, soil, linseed oil, and wood.

BLUE RHINO DESIGN

Fig. 4. Prototypes for the Association of Children's Museums' Asian Culture Exhibit Series traveling exhibitions.

cork, wood, straw, wheat, bamboo, and earth for building materials, and select local sources if possible. Look up your closest wood mill to find local woods from your bioregion or go to a site like Woodfinder.com to locate nearby hardwood sources.[10] Bamboo flooring, which is considered a sustainable product, may be a less advantageous option than using local hardwoods, because of the environmental costs of shipping the material halfway across the world, thus increasing your carbon footprint. Madison Children's Museum's new *Wonderground* exhibition uses black locust, a local, invasive species, for its climbing structure. Removing this material from local forests helps to maintain native biodiversity while the material itself stores carbon even after it has been harvested. By using the naturally rot-resistant black locust instead of chemically treated wood for outdoor applications, toxic chemicals also stay out of the water supply.

Use Less Material

Less material means less embodied carbon. Much can be done to create big impact with less material, even when creating immersive environments. With traveling exhibitions, choose lightweight, recycled, and compostable materials to create environmental graphics that feel monumental but reduce weight, materials, and shipping costs. The Association of Children's Museums (ACM), with support from the Freeman Foundation, hired Toronto, Ontario's Blue Rhino Design to create a new set of small mobile exhibits about Asian cultures, with a sustainability goal of minimizing materials, plastics, and waste (fig. 4). The firm designed structural components made from 100-percent recyclable aluminum; minimized panel sizes to reduce materials; created a modular, flat-pack system with durable materials;

and used standard fasteners without glues. The modular, lightweight, flat-pack system means the exhibit is less expensive to ship, and standard fasteners used without glue allow the exhibit to be repurposed or recycled. Additionally, the team built separately from the structures, which made for easy replacement and adaptive reuse.

Plan for Disassembly, Material Reuse, and Durability

Most current exhibits eventually end their lives in a landfill. By designing with a modular design approach, when one exhibit is finished, the same basic building blocks can be used to create another exhibit with a different face. We recommend designing exhibits with a standard set of common, reusable hardware and mechanical fasteners. For example, metal channels used to hang graphic panels could be used repeatedly, especially if the museum uses standard dimensions for graphic panels and durable materials. Disassembling materials applied with glues or adhesives usually means they end up in the landfill and cannot be reused; using mechanical fasteners, such as clips and screws, can help ensure that you can reuse materials. At the Roundhouse Aquarium in Manhattan Beach, California, staff had always recognized annual donors on three large acrylic panels that they threw out and reprinted annually to keep the donor names current (fig. 5). During a renovation, the design team decided to instead create a school of updatable fish to display the names. Simple security screws doubling as fish eyes allow easy removal to update donors, and the use of reusable mounting hardware, instead of an adhesive, reduces waste (fig. 6).

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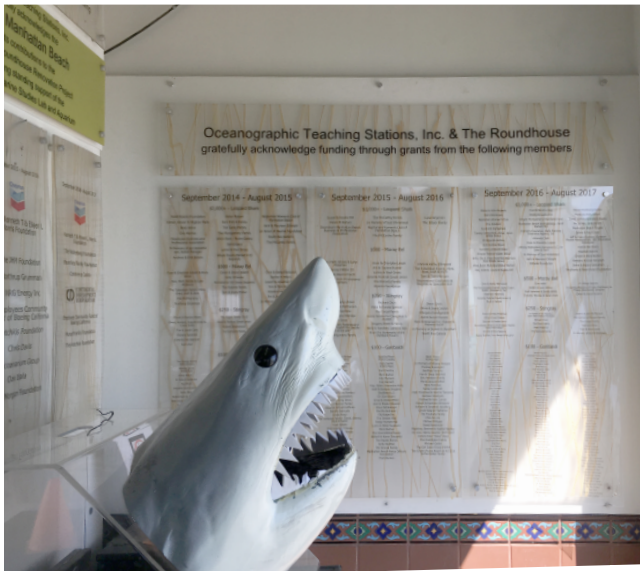

Fig. 5. Prior to the renovation, Roundhouse Aquarium replaced these donor panels annually to keep a current list of donors.

Fig. 6. Donor wall at the Roundhouse Aquarium with easily updatable donor names on a school of fish. Donors can be updated throughout the year with minimal waste.

MADISON CHILDREN'S MUSEUM

Fig. 7. The *Trash Lab* exterior in winter (all orange images on the trailer were things found in a local landfill.)

Tell Stories With Salvaged Materials

Madison Children's Museum recently created a mobile exhibition, *Trash Lab*, in partnership with Dane County Department of Waste & Renewables. It was built in a 27-foot-long repurposed cargo van to help citizens understand the immense problem with waste (fig. 7). Ninety percent of the materials used to create the exhibition came from Dane County's waste stream, helping reinforce the dual messages that we can all learn to create less trash in the first place, and that waste is not waste. Instead, waste is resources in the wrong places. The 10 interactive stations help visitors rethink their relationship with waste, understand the social inequities of waste, and learn about the ways landfills work to help keep the air, water, and soil healthy (fig. 8). The mobile exhibition's travel is fueled by renewable natural gas extracted from the landfill's methane emissions. This transferable practice of rethinking waste and considering an exhibition's end cycle is important to consider at the outset of every project. If it cannot be reused, recycled properly, taken apart, or composted, perhaps it has no business being used in an exhibition.

As *Trash Lab* encourages, buying and using less in our exhibition making is meaningful because nothing is really thrown "away." Everything goes somewhere and that somewhere is often a landfill or incinerator neighboring a BIPOC community. These communities have higher rates of environmental toxins and corresponding environmentally triggered negative health outcomes.[11] Design that considers the end-of-life or future life of exhibit components helps support environmental justice in our communities.

Look for innovative ways to reuse salvaged materials to tell your story. Ask museum visitors to bring in objects related to your story. The website All for Reuse (allforreuse.org) maintains a crowdsourced Reuse Ecosystem Map that may provide salvage resources in your area. Contact local theaters or film boards in your area to find out when productions plan to demolish their theatrical or movie sets. These can be a rich source of plywood and other commonly used exhibit construction materials. Reuse wood from packing crates to create museum benches or cabinets.

Avoid Toxic Chemicals

Building material manufacturers are providing more material transparency information than ever before, although sometimes it is hard to understand this

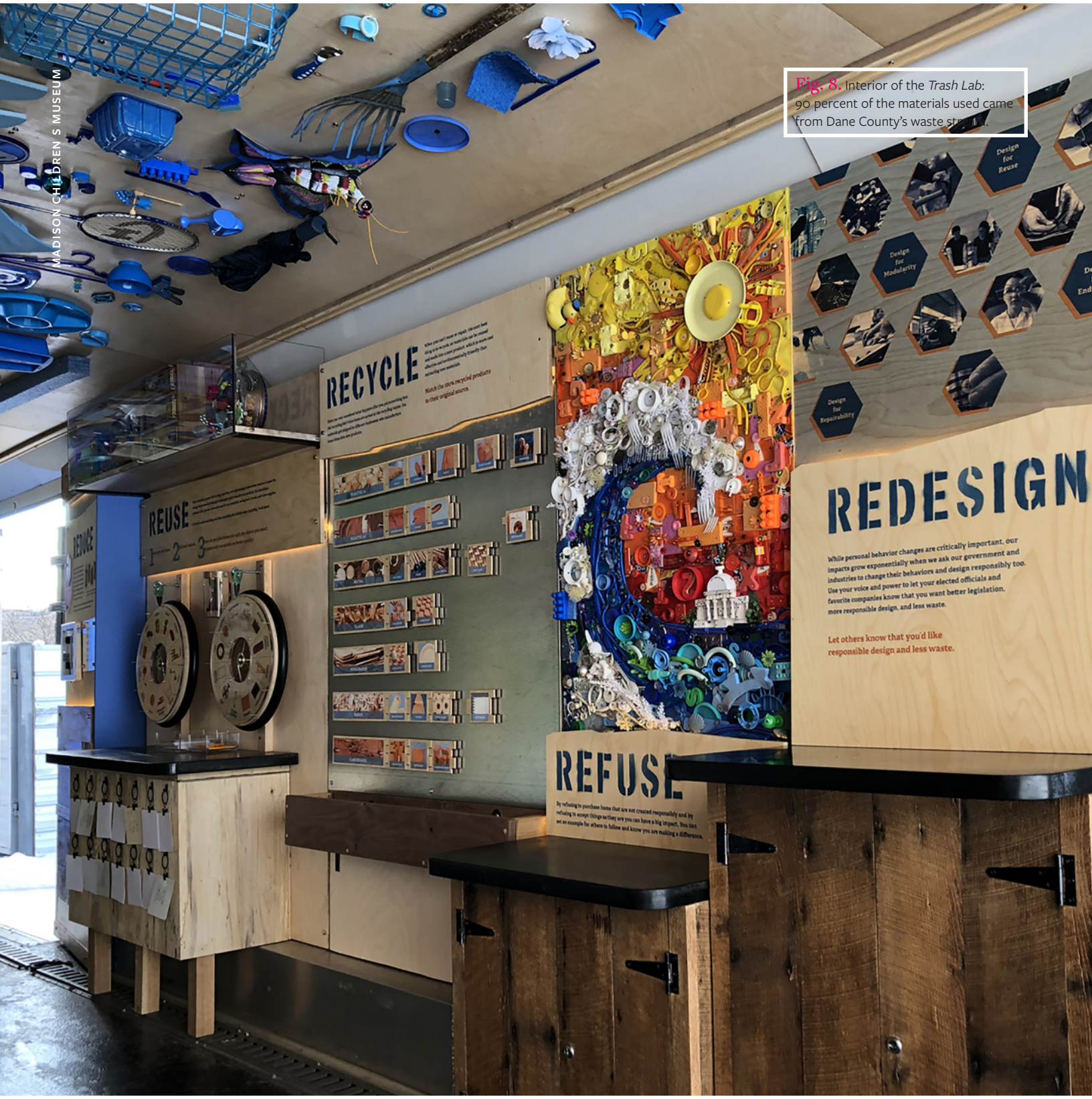

Fig. 8. Interior of the *Trash Lab*: 90 percent of the materials used came from Dane County's waste stream.

information and separate it from clever marketing. Health Product Declarations (HPDs) are reports that list the chemicals in products, but it can be a lot of work to find products free from toxic chemicals. For many products, third-party groups like the Cradle to Cradle Products Innovation Institute and the International Living Future Institute's "Declare" program have already done the work by reviewing products and listing chemicals of concern to human health in their "Red List." The Healthy Building Network's website, HomeFree Product Guidance, uses a red-to-green ranking system for building products based on their potential hazardous content.

Start by focusing on materials that visitors, and especially young children, touch the most. Look for companies with a history of providing transparency and sustainable products. They are often the best at providing truly healthy products and at treating their employees equitably.

Take Action

We believe that excellent design is always equitable design and equitable design is always sustainable design. By embracing a growth mindset, taking action, and getting started without worries of perfection, our field can experiment and instigate meaningful change. Give yourself plenty of opportunity to gain experience, grow, and fail. Try something new and reach out to others for help. Speak loudly about what you are trying to do in blog posts and exhibit panels to educate others. Join the American Alliance of Museum's Environment and Climate Network, a professional network that is "working to establish leaders in environmental stewardship, sustainability, and climate change."[12] One of its resources is the free and downloadable *Sustainable Exhibition Design & Construction Toolkit*.[13] Created by CambridgeSeven's Douglas Flandro and Rachel Moritz along with other collaborators, it can help you set goals and take actionable steps towards increased inclusion, diversity, and sustainability.

> **"Start by focusing on materials that visitors, and especially young children, touch the most."**

We hope this article and the toolkit serve as useful resources as you modernize your exhibition design and construction processes, reduce the environmental toxins in your materials, and include the voices and priorities of historically marginalized members of our communities. Within our collective work, we can model equitable, sustainable exhibit practices that inspire change and lift all our communities. ▮

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