hand to hand
ASSOCIATION OF CHILDREN'S MUSEUMS

The data tells us the planet is warming; the science is clear that humans are responsible; the impacts we're seeing today are already serious; and our future is in our hands.

—Katharine Hayhoe

Talk, Act, Hope: Pushing Together to Save Us from the Effects of Climate Change

A Conversation with Katharine Hayhoe, PhD, along with Jonathan Patz, MD

Led by Brenda Baker, Madison Children's Museum

Noted atmospheric scientist, writer, teacher, communicator, and researcher Katharine Hayhoe studies climate change. She is the chief scientist for The Nature Conservancy and a Horn Distinguished Professor and the Political Science Endowed Chair in Public Policy and Public Law in the Department of Political Science at Texas Tech University.

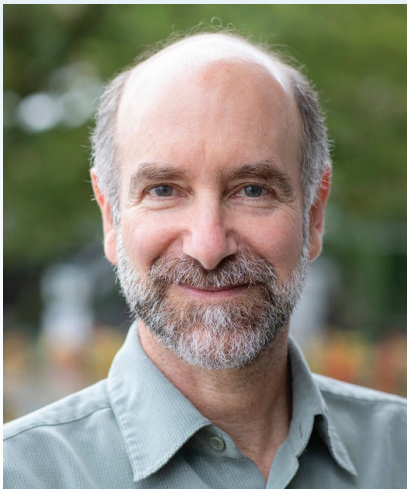
As an undergraduate, Katharine studied physics and astronomy at the University of Toronto and later earned both master's and PhD degrees in atmospheric science from the University of Illinois at Urbana-Champaign.

In 1997, she founded ATMOS Research to bridge the gap between scientists and stakeholders and provide relevant, state-of-the-art information on how climate change will affect our lives to a broad range of nonprofit, industry, and government clients.

She frequently gives public talks and interviews on climate science, impacts, communication, and faith. Her TED Talk has close to 4 million views. Her book, *Saving Us: A Climate Scientist's Case for Hope and Healing in a Divided World,* was released in September 2021. With her local PBS station, KTTZ, she writes and produces a PBS Digital Studios short series, "Global Weirding: Climate, Politics and Religion."

Katharine's list of publications, affiliations, appearances, and honors is lengthy. Why does she do it all? "When just one person tells me sincerely that they had never cared about climate change before, or even thought it was real: but now, because of something they heard me say, they've changed their mind. That's what makes it all worthwhile."

Ashley Rodgers, Texas Tech University



Jonathan Patz, MD, MPH, is director of the Global Health Institute at the University of Wisconsin-Madison. He is the Tony McMichael Professor and the John P. Holton Chair of Health and the Environment with appointments in the Nelson Institute for Environmental Studies and the Department of Population Health Sciences. For fifteen years, Jonathan served as a lead author for the United Nations Intergovernmental Panel on Climate Change (IPCC)—the organization that shared the 2007 Nobel Peace Prize with Al Gore.

Patz is committed to connecting colleagues around the world to improve health for all. He is continually striving to integrate his research into teaching for students and communicating to policymakers and the public.

He has written more than 200 scientific papers, a textbook addressing the health effects of global environmental change, and co-edited both the five-volume *Encyclopedia of Environmental Health* (2011), and, most recently, *Climate Change and Public Health* (2015, Oxford University Press).

Jonathan has served on scientific committees of the National Academy of Sciences and was the Founding President of the International Association for Ecology and Health. He is double board-certified, earning medical degrees in both Occupational/Environmental Medicine and Family Medicine from Case Western Reserve University (1987) and his Master of Public Health degree (1992) from Johns Hopkins University.

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Editor & Designer
Mary Maher
Mary.Maher@ChildrensMuseums.org

Association of Children's Museums
Email acm@ChildrensMuseums.org
Website www.ChildrensMuseums.org

Brenda Baker is an artist and and vice president of exhibits, facilities and strategic initiatives at Madison Children's Museum, where she has worked for more than thirty years.

BRENDA: Katharine and Jonathan, thank you very much for joining us. I've known Jonathan for a couple of decades and have been following your work, Katharine, for as long as I can remember. You've both been inspirations to me. Katharine, your new book, *Saving Us: A Climate Scientist's Case for Hope and Healing in a Divided World*, is all about hope and healing. What are the main challenges that keep people from acting on climate change? What makes them feel overwhelmed or less than hopeful in the first place?

KATHARINE: When it seems like people aren't worried about climate change or aren't doing anything about it, we often assume they lack information, so we just dump more scary scientific facts on them. But that just makes the problem worse. Because the vast majority of us are already worried: 70 percent of all people in the US are worried; 83 percent of moms are worried; and 84 percent of young people are worried. So, why are we not acting? Because we don't know what to do. Fifty percent of us feel helpless, hopeless, and don't know where to start. What we lack is something that social scientists call "efficacy"—a belief that what we do will make a difference. We have this global crisis that could spell the end of civilization as we know it, and most of us think we can't make a difference. But it's not about saving the planet—the planet will be orbiting the sun long after we're gone—it's about saving us. That's why I called my book *Saving Us.*

We're told we need to do things like change your lightbulbs and eat less meat—don't get me wrong, those are good things to do—but we know they are not sufficient to fix a global crisis. Jonathan knows this; that's why, for so long, he's spoken at venues from Davos to TED about why climate change matters and what we can do to fix it.

Using our voice to talk about what we can do at our schools, where we work, in our buildings, or in whatever organization or church we might be part of, to advocate for climate action, is the single most powerful thing we can do. My book is full of stories of ordinary people who have made a profound difference by talking from the heart about why climate change matters and what we could do about it. Today, that's exactly what the young people of the world are doing. If they can use their voice, why can't we? As one of my students said, "You know, the biggest thing I've learned in this class is that the most important thing we can do to help fix climate change is to use our voice—and it's free!" Installing solar panels costs a lot of money. But every single one of us has a voice and it's free.

BRENDA: Jonathan, what scares you the most about what you see in the data?

JONATHAN: The fact that there are multiple exposure pathways through which climate change affects human health really scares me. It is not just one toxic agent or a few infectious agents to avoid. There are multiple insults from many different factors that affect our health. And it's no longer in the future. It is already happening, faster than we expected; the acceleration of change is alarming.

I am also scared about the disregard for science that we have seen during the pandemic. The science is clear on climate change and its current and future impacts. There is no question about what is happening and what we need to do as a society. Given the current misrepresentation of facts and the conspiracy theories that abound, even though we have the best scientific information, we still have difficulty coming together and changing behaviors. In the face of overwhelming evidence, there is an alarming lack of response. This is where we need to bring in social science and other experts to help.

BRENDA: Do either of you have any stories about someone who was unconvinced that climate change mattered? What did it take to change their mind?

KATHARINE: There's a simple formula for engaging with people on climate change: begin with something they already care about. Don't begin with what you care about and try to convince them to care about it, too. Begin with something they care about, and then connect the dots to how climate change affects it, bringing in positive, constructive solutions that they can get on board with. Although not a Rotarian myself, a number of years ago I was asked to speak at our local Rotary Club. I wondered where to begin. What did we have in common? Well, we all live in West Texas, so I'm going to start by talking about what

we can see happening right here: our heat waves are getting stronger, and our summers are getting longer, and how that affects our home energy bills and how it affects our local farming community.

When I walked into the hotel ballroom where they were meeting, I saw this giant screen showing the Four-Way Test, which Rotarians use to evaluate all of the decisions that they make. 1) "Is it the truth?" Is climate change the truth? Absolutely. 2) "Is it fair?" Absolutely not. It disproportionately affects the poorest and most vulnerable people, primarily through their health. 3) "Would it build goodwill and better friendships?" Yes, fixing climate change definitely does that. Finally, 4) "Would it be beneficial to all?" Yes, climate solutions help us all.

So, while everyone else was eating their lunch, I sat in the corner of the ballroom and rearranged my whole talk around the Four-Way Test. As I began my presentation, I could see people who were not paying attention, or had their arms folded like, "Who invited the climate scientist here? This isn't what we normally have." But as I started to go through the Four-Way Test, I saw people's arms unfolding, people leaning forward, and heads starting to nod. They saw their values reflected in what I was saying. I was showing them how they were the perfect people to care about climate change because of who they already are—Rotarians. Caring about and acting on climate change would allow them to have an even more genuine expression of the Rotarian values they already held. In the book, I talk about a local banker, who I had met a few times and who had always been cordial but distant. He came up to me afterwards with the most bemused look on his face and said, "You know, I never thought too much of this whole climate change thing," which of course is a polite Texas way of saying "I thought it was a load of crap." "But it passed the Four-Way Test, so I have to agree.

JONATHAN: Katharine, I have a similar story with the Madison Rotarians. Except the first time I spoke to them, a member already very familiar with climate science told me, "You can talk about your stuff, but don't say the words 'climate change'." Well, that's easy, I'll just talk about extremes, like flooding, and resulting sewage backup and how they affected people's health. Six months later, the same guy said, "You know what? Now you can talk about climate change."

BRENDA: Many children's museum professionals feel that they can't use the words climate change in their board rooms or with donors because it's become so politically charged. How might we reframe the conversation so that it's first and foremost about health and well-being of children?

katharine

Using our voice to talk about what we can do at our schools, where we work, in our buildings, or in whatever organization or church we might be part of, to advocate for climate action, is the single most powerful thing we can do.

KATHARINE: Begin the conversation from the heart with something people already care about—and what is closer to the heart of any parent than the physical, mental, and emotional wellbeing of their child? We would move mountains to save our children from anything that threatens or harms them. Today, climate change is firmly in that category.

Climate change exacerbates air pollution, which contributes to childhood asthma. It increases our high temperatures to the point where one of my colleagues, a fellow "Science Mom" who lives in Arizona, had to wake up her children before dark this summer so they could go play outside before it got too hot. Children's sporting events and practices are rescheduled to avoid the hottest parts of the day. Another colleague puts monitors on children playing outside in playgrounds to see how much energy from the sun and heat they're exposed to and whether they're getting dehydrated. Another colleague in Nevada couldn't let their children outside to play for three weeks this past summer because of the terrible wildfire smoke. We have to worry about our children's health today in ways that we never had to before. Climate change is no longer a distant threat. It is right here, right now, and it is affecting the health of those most precious beings, our children.

JONATHAN: According to the World Health Organization, 88 to 90 percent of the effects from climate change affect children.

Multiple physical health threats currently affect children in the US due to hot temperatures and extreme hydrologic cycles. Behind the elderly, infants are second most vulnerable to overheating, which can cause all sorts of problems. Warm temperatures also exacerbate pre-term labor. Climate change is affecting air quality, with stagnant air masses and increased air pollution, resulting in higher incidences of asthma in children, greater aeroallergens, and higher counts of ragweed pollen, along with a longer pollen season. Mold also greatly exacerbates childhood asthma. With more extreme weather events, flooding in the basements of homes and apartment buildings results in a perfect environment for mold growth, which has become a real problem, especially for disadvantaged communities that were formerly redlined; these neighborhoods are more prone to flooding and are at higher risk.

Hot temperatures also mean bigger and more intense wildfires. The Journal of Pediatrics recently reported that the particulates from forest fires like we've seen out West this past year are ten times more harmful to children ages zero to five than other particulates.

We have also seen a strong relationship between gastrointestinal issues in children and heavy rainfall, which results in more combined sewage overflow events, especially in areas reliant on well water. There are increased risks of recreational exposure for children swimming at a beach after an extreme rainfall event, for example, which increases bacterial loads for e coli.

Aside from physical threats, climate change also inflicts mental health impacts, which we are seeing now, on children, including young children. Known as "eco-anxiety" or "climate anxiety," these crippling worries about the future, or the post-traumatic stress experienced after disasters like recent hurricanes, forest fires, and floods, disrupt children's lives. Many more people are taking a serious look at these issues. It is so important for children to avoid hopelessness, because it is so paralyzing. We need children to have hope that inspires them to act.

BRENDA: Children's museums' primary audience are kids eight and under. Many of us in the field hold closely to the principles put forth by environmental educator/activist David Sobel, who basically says no tragedies before fourth grade. Instead of frightening, doom-and-gloom warnings, we should instead focus on providing opportunities for young children to be delighted by—and not worry about—the natural world. How can we best support very young children and their caregivers in understanding their role in creating sustainable com-

munities?

KATHARINE: With young people it is even more important to emphasize how they can make a difference. Awareness of the issue wakes us up, but if we don't know what to do about it, fear and anxiety set in. Many young people today already suffer from anxiety and stress because of the threat of climate change and the perception that people aren't doing enough to fix it. I started to hear this so often that a few years ago in my YouTube series "Global Weirding," I decided to make an episode called, "I'm just one kid, what can I do?" I found so many kids doing so many amazing things. Kids are creating $5 inventions that charge people's cellphones using solar and wind energy. One girl created an algae biofuel lab under her bed until her mom found it and made her move it into the garage—and she won a national science fair prize for it. Children are leading the Children's Climate Strike and suing their federal governments, not just the US, but Canada, Germany, and other countries, for the right to a better future. Children and young people are engaging with cities and corporations. When I was at COP26 (the 2021 United Nations climate change conference) in Glasgow, I was really encouraged to hear from entities as disparate as the United Arab Emirates government, IKEA, and Nestle that they were forming youth advisory councils and it was mandatory to consider their advice when making major decisions on climate.

Kids are using their voice to make a difference in their school, with their classmates, in their neighborhoods, and online, where many children are engaging these days. I don't think we should shelter our children, saying "everything's fine" until they get to a certain age and they find out it's not. Age-appropriate awareness and conversations that acknowledge the fact that yes, there is a problem, but here are examples of people who are working on it in our city, state, or country, or maybe in our own family, are the way to go.

jonathan

My own soapbox pitch is that the more we talk about climate change through a human health framework, the better. Because it is both a human health crisis and a human health opportunity at the same time.

BRENDA: As climate scientist parents, did you talk about climate change with your own children when they were young, or did you just encourage them to get out and get excited about the natural world around them?

KATHARINE: When my son was in third grade, I forgot to give him his lunch one morning. So, I ran over to school to put it in his locker. As I was walking down the hallway on this January morning, right after Martin Luther King, Jr. Day, looking to see which one was his locker, I noticed that all of the kids had posted an "I have a dream"-themed essay on their locker doors. I knew I got to the right one when I spotted the "I have a dream that we'll fix climate change" essay. It started with "I have a dream that we'll fix climate change because here's what it's doing to the world," but very quickly moved to solutions: here's what people can do about it, and here's what's already happening, and here's why it's a good idea to fix it. Although my son has listened to some of my talks and interviews, I've never sat him down and lectured him on climate change. It melted my heart that he got that it was important, but he also got that there were solutions. He was concerned but hopeful—and that's what we want for all of us.

JONATHAN: We did lots of camping, just being outside and appreciating nature. We had a unique opportunity to build a log cabin in Montana that happened to be very close to the cabin of Charles D. Keeling, the famous climate scientist who discovered the effects of the carbon cycle on climate (the controversial Keeling Curve of CO2, "a standard icon symbolizing the impact of humans on the planet"). I remember having drinks with him on the porch and later telling my then eight-year-old son, "This is the guy that discovered climate change." But mostly, I'm just leading by example. Riding my bike to work (luckily, I live in Madison), composting, recycling, installing solar panels on my roof, etc.

BRENDA: Traditionally, museums have been considered neutral ground. Numerous studies have shown that people trust them. Now, many museums are doing more advocacy work and taking a stand on issues like social justice and climate change. Katharine, as a member of the Smithsonian's National Museum of Natural History's Advisory Board, you are well aware of this changing dynamic. How can museums remain trusted institutions while also taking a bolder stance on climate change and action?

KATHARINE: Well, a thermometer is not Democrat or Republican. Telling people that the climate is changing, that humans are responsible, that the impacts are very serious, and that the faster we act the better off we'll all be, are not political statements. They are neutral scientific facts, which over the last twenty years have been deliberately politically polarized by those who don't want us to act. But if we tacitly agree with that politicization, we're agreeing that a thermometer somehow gives different answers to different people. It does not.

The reason we care about climate change is not because we come from the left, the right, or the center of the political spectrum, it's not because we live in the north or the south or the central part of the country. It is because we are all human beings living on this planet, which we depend on for everything we need: the air we breathe, the water we drink, the food we eat, the resources we use to make everything we have. It all comes from this planet. I didn't call my book Saving the Planet, because it is not about saving planet, it is quite literally about saving us. Climate information matters to every single person on the planet. If we believe we have a duty to inform people of facts that are directly relevant to their lives and pose an immediate threat to their wellbeing, then climate change today is at the very top of the list of what museums need to be informing people about, because this science has direct implications for people's lives, for our future, and for our children.

BRENDA: In our recent experiences with COVID, despite sound medical advice, many people have rejected scientific data that showed that vaccinations would help not only themselves, but the larger community. How might we revive a sense of the common good in the climate change fight where we need everyone on board to win?

KATHARINE: The biggest challenge with climate change—similar to our country's approach to COVID—is not that we aren't aware of and worried about the problem, but the majority of us still don't think

that it matters to us here and now in relevant ways. When you ask people across the United States, "Is climate change real?", three-quarters of them say yes. When you ask, "Is it going to affect people in the future?" everybody says yes. "Is it going to affect people who live in developing countries?" Yes. "Is it going to affect plants and animals?" Yes. "Is it going to affect me personally?" The numbers plummet. That's called psychological distance. Humans are very prone to seeing risks as distant in time, space, or relevance. So, climate change is an issue for the future, not now. Or it's an issue for people who live over there, but not here. All of these aspects of psychological distance come into play with climate change. That's why when we talk about climate change, it is so important to bring it here, to bring it now, and to show that climate change is not an isolated, localized issue.

We also tend to think of climate change as a separate issue, competing for our interest. People may be worried about their child's health, or their job, or the safety of their home, or poverty or justice. Life is a set of buckets and we only have so much time, effort, and attention to put into each one. Along comes this new bucket of climate change and we just don't have much left over for it. Well, climate change is not a separate bucket—it is the hole in every single other bucket: our children's health, the safety of our home, the health our local economy, and issues like justice and poverty. When we can show someone how much they already care about the other buckets, and how those buckets are all being affected, they can see that they are already the perfect person to care about climate change. Then they can make the connection to understanding why climate action matters to all of us—because it affects every single one of us.

BRENDA: How do you keep yourselves inspired, and, as professors, how do you keep your students inspired to make their own life changes and find new solutions?

JONATHAN: I tell my students, okay, this is serious, but look at all the things that can be done. They have to know and understand the problems in order to begin to address them. In my classes, we spend 30 percent of our time focusing on the dire impacts of climate change on global health and the other 70 percent learning about solutions. Like Katharine, I like to focus on the fact that we already have most of the solutions we need. We just need to scale up. Today we are lucky that we don't have to wait for new technology. Even though our politicians are not moving quickly, the private sector is moving faster. Everyone is realizing that fossil fuel is yesterday. People all over the world are stepping up and making changes.

On a personal level, there are many things you can do to contribute to a collective impact. Change your diet. Ride a bike for transportation. Most importantly vote. Speak up. Join others to fight for policy change. As author Bill McKibben says, and Katharine mentions in *Saving Us,* the best thing you can do as an individual, is to be less of an individual. Joins groups, talk to others, engage people in conversation and action. My own soapbox pitch is that the more we talk about climate change through a human health framework, the better. Because it is both a human health crisis and a human health opportunity at the same time.

KATHARINE: I take on two new personal sustainability habits each year, and I keep the old ones, too, because that gives me more to talk about. About two years ago I realized how much indoor air pollution gas stoves produce, creating indoor air pollution levels that are many times over the EPA recommended level. In fact, children are much more likely to develop asthma if they live in homes with gas stoves. In the interest of good cooking, I had a gas stove, but this year I swapped it for an inductive cooktop. I also decided to take plastics out of the bathroom, switching all of our shampoos and soaps to bars instead. We tried out a few to see which ones we liked best and then I shared the ones we liked best on social media.

The year before I decided to reduce food waste, a big source of heat-trapping gas emissions. I changed the way I shop and got rid of the freezer. (As a win-win, I used the space for clothes drying racks.) We eat a lot more fresh vegetables and seafood and a lot less meat. Every little action counts. But again, when we use our voice to talk about what we can do together and why it matters, that's the biggest thing we can do.

BRENDA: In terms of climate change, what gives you the most hope?

KATHARINE: Over the past five years, no matter where I am or who I'm speaking to, that's the biggest question I get and why I wrote my book. Action gives us hope—our own action and seeing others act. We often picture the giant boulder of climate action sitting at the bottom of a steep hill with only a few hands on it trying to push and it isn't even budging. If we add our hand, we think it won't make a difference. But when we realize that boulder is already at the top of the hill, and we see millions of hands—children, young people, parents, grandparents, students, businesspeople, people who work for government—on it, already pushing it down the hill in the right direction, that gives us a very different picture. Adding our hands makes a little bit of a difference, but using our voice to encourage others to add their hands, too, will make an even bigger difference. What gives me hope is recognizing how many hands are on that boulder.

I engage in a practice called active hope where I consciously look for good news stories—stories of people who are making a difference, who are changing minds or inventing new technology, or helping cities be more resilient or working with poor communities to expand their ability to grow food—and then I share them on social media because I know other people want to hear them, too. Recognizing that the boulder is rolling downhill in the right direction gives us hope. It just needs to go faster. And to make it go faster, every single one of us needs to act, beginning with using our voice. To quote Greta Thunberg, "There's one thing we need more than hope and that's action. Because when we act, hope is all around us."

katharine

If we believe we have a duty to inform people of facts that are directly relevant to their lives and pose an immediate threat to their wellbeing, then climate change today is at the very top of the list of what museums need to be informing people about, because this science has direct implications for people's lives, for our future, and for our children.

Amelia Carter © NHMU

One key idea that emerged from our initial dive into the rich body of climate communication research was the importance of "side doors." When tackling a polarized issue like climate change, side doors frame the issue in ways that aren't clearly marked as belonging to one partisan group. They focus on shared values that resonate across groups with diverse perspectives and create a space for taking action together.

Building a Climate of Hope

Lisa Thompson
Natural History Museum of Utah | University of Utah

A *Climate of Hope* is the working title we've adopted for a new exhibit on climate change under development at the Natural History Museum of Utah (NHMU). Like our colleagues at natural history and science museums around the world, NHMU is shifting away from an older, more data-driven approach to climate change exhibits (also known as the "doom and gloom" approach—largely focused on the dire nature of the crisis). As our working title suggests, our goal is to create an exhibit that inspires hope and empowers visitors to take meaningful climate action in their communities.

This article highlights a few of the "guiding principles" shaping the content and design of our exhibit that we have learned from research on effective climate communication, consultation with wonderful advisors, front-end evaluation with visitors, and evaluation of a full-scale cardboard prototype of the exhibit. Although our exhibit is not aimed specifically at young children, we hope some of these ideas will be useful in exploring how children's museums can create hopeful, empowering experiences that support children and families.

Welcome Visitors through the Side Doors

Some inherent challenges come with tackling climate change in an exhibit. Even a title mentioning climate change could turn away visitors whose political identity tells them, "This exhibit isn't for me," as well as people who are worried the exhibit will add to the anxiety and stress they already feel about climate. In contrast, other audiences may not have strong feelings about climate change or perceive its personal relevance because it seems remote in time and distance, a problem for other people far away in the future.

One key idea that emerged from our initial dive into the rich body of climate communication research was the importance of "side doors." When tackling a polarized issue like climate change, side doors frame the issue in ways that aren't clearly marked as belonging to one partisan group. They focus on shared values that resonate across groups with diverse perspectives and create a space for taking action together. Talking with local organizations working on climate solutions and our visitors in a front-end evaluation helped us identify some of the side doors that resonate with Utah audiences.

At the top of the list is Utahn's deep concern about the impact of the poor air quality in many parts of the state on their health. While the greenhouse gases that cause climate change and the particulates and ozone that damage our health are distinct, they are often emitted by the same sources. For example, focusing on how measures that improve Utah's air quality can also reduce greenhouse emissions offers a side door to climate action. Other side doors that resonate with our audiences include concern about the decline of Utah's famous snow that supports our ski industry, a strong tradition of emergency preparedness that could carry over into creating climate resilient communities, and the opportunities for Utah to benefit economically from developing and implementing climate solutions.

Keep It Local

The local nature of these side doors reflects another key idea that emerged from our research—the power of telling local stories to make climate change immediate and relevant for our audiences. While melting glaciers and rising sea levels seem remote to many Utahns, stories that demonstrate local climate impacts in relatable ways made a big impression on visitors in our prototype exhibit. For example, one story in the prototype that visitors often discussed illustrated Utah's warmer, shorter winters with a historic photo of ice skaters on a well-known park pond that rarely freezes today. The prototype also offered visitors a chance to share their own observations of local climate impacts and what they mean for them at a talk-back station.

Stories about the many existing, feasible climate solutions already being implemented in communities around Utah also connected with prototype participants. They expressed excitement, surprise, and pride upon discovering the numerous efforts underway in Utah along with some of the innovative ideas in development. Focusing on solutions is another key principle of effective climate communication. Solutions, after all, offer hope and inspiration. Stories about people implementing effective solutions also serve to counter common misperceptions

our visitors expressed in our front-end evaluation—"Nobody is doing anything" and "Solutions don't exist yet"—which serve to discourage and disempower.

Don't Ignore Emotions

Our front-end evaluation with visitors provided important context for developing our exhibit. When we asked participants how thinking about climate change made them feel, they predominantly expressed discouragement, fear, anger, confusion, and other negative emotions. Their responses reflect the growing number of people who report experiencing climate anxiety or climate grief. However, according to research in psychology, fear and uncertainty can shut down our ability to act.

A growing number of climate communication researchers emphasize the importance of acknowledging the powerful emotions climate change evokes, helping people understand how their emotions impact their ability to act, and emphasizing that taking action can lead to feeling more hopeful. This approach presents hope as a practice to be cultivated, not something you can obtain simply by wishing for it. As Dr. Katharine Hayhoe explains: "Hope doesn't come to me if I just sit there waiting for it to show up."

In *A Climate of Hope,* we are seeking ways to explicitly address the emotional component of climate change and give visitors a chance to share their feelings through an interactive, which will have a therapeutic or cathartic quality. The exhibit will also introduce visitors to the idea of hope as an outcome of action. One idea we are considering is a set of short "TikTok" style videos of community members responding to the prompt, "What gives me hope…" with a description of the action they are taking.

Reimagine the Future

Both the front-end evaluation and exhibit prototype showed that visitors were extremely interested in knowing what actions they could take to reduce climate change. In fact, in the prototype it was clear that visitors expected—almost demanded—to learn about what individual actions they could take in their daily lives in an exhibit about climate change. While individual actions can be a good start, climate science indicates that they aren't sufficient for addressing a problem that requires systemic change. Plus, placing the onus of addressing climate change on individuals—especially through their consumer choices—fosters "climate guilt" and is inequitable to those who can't afford those choices.

A Climate of Hope will seek to provide visitors with a different set of tools for taking meaningful action. We envision opening the exhibit with an immersive interactive that engages visitors in imagining a future where humans and nature thrive in a changing world. Many visions of the future related to climate change in our culture are dystopian if not apocalyptic. Several climate communication scholars are emphasizing the need for new cultural stories that help us know what we're aiming for and envision paths to getting there. Even the very low-tech version of the interactive we created for the prototype was compelling for visitors, and many reflected on the content of the videos during their wrap-up discussion.

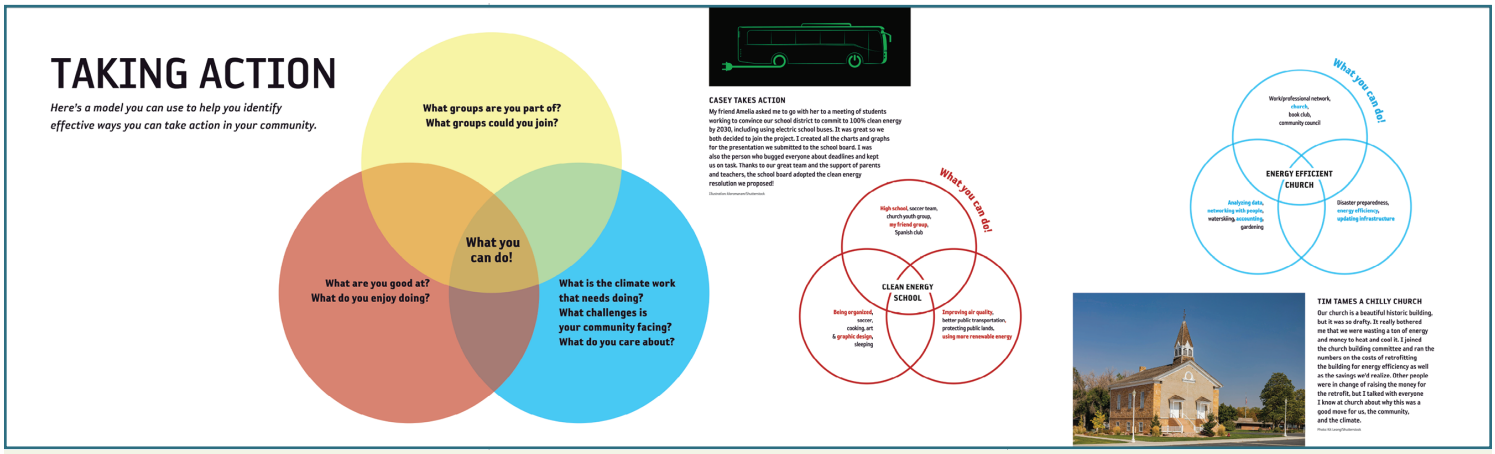
The prototype also included a Venn diagram that provided visitors a framework for thinking about how they could take action at the community level—a level at which actions have more possibility of affecting systems change. Our goal is to encourage visitors to take the next step beyond individual actions to actions in their networks that still feel personally relevant and achievable. The three circles of the Venn diagram contained a set of questions visitors could answer to identify ways they could act:

- What groups are you part of? What groups could you join?
- What are you good at? What do you enjoy doing?
- What is the climate work that needs doing? What challenges is your community facing? What do you care about?

We realized that this framework would be a significant shift from the messages focused on individual actions most visitors are accustomed to receiving. We were pleasantly surprised that many prototype participants called others over to the Venn diagram to discuss it and mentioned it in their conversation with evaluators.

Big Changes Start with Small Talk

One individual-level action the exhibit will highlight is talking about climate change with family and friends—not to persuade or debate, but to listen and share. Surveys from the Yale Program on Climate Change Communication indicate that more than 70 percent of Americans are worried about climate change, but only 35 percent talk about climate change even occasionally. Talking about climate change is critical for processing our emotions, imagining and telling new stories about our future, and finding and building networks for commu-



Dawn Renee Farkas Prasad

The prototype also included a Venn diagram that provided visitors a framework for thinking about how they could take action at the community level—a level at which actions have more possibility of affecting systems change. Our goal is to encourage visitors to take the next step beyond individual actions to actions in their networks that still feel personally relevant and achievable.

Amelia Carter © NHMU

The final section of the prototype encouraged visitors to connect with others around climate change. It included a "climate conversation quiz" focused on skills for discovering shared values.

NHMU currently has a small climate change exhibit, *Sky Gallery,* that focuses on data about temperature and precipitation.

nity action. Climate communicators have developed great resources outlining how to have a constructive climate conversation.

While visiting the prototype, several parents asked for resources on talking with their children about climate change. We are just beginning the process of developing family resources for the exhibit. We are considering the approach of encouraging families to focus on building the social and emotional skills we all need for being resilient, such as empathy, talking about our feelings (especially when we're worried), and working together to tackle big problems. Because children's museums excel at creating experiences that foster the development the social and emotional skills for resiliency, they are already doing important climate solutions work.

Other climate communication approaches align well with the strengths of children's museums and could even be worked into existing exhibits and programs. For example, stories about local people and organizations working to implement climate solutions fit naturally with exhibits about the people who make our communities safer, healthier, and stronger. Activities that invite children and their caregivers to imagine the future of their community could include challenges for designing new kinds of climate adaptations. And children's museum could host activities or partner with other organizations to connect families with opportunities to take action in their community, such as planting trees or community gardening.

Children's museums are well-situated to play an important role in building a climate of hope that empowers children and their caregivers to take meaningful climate action and develop the resilience and empathy we'll need to navigate climate change. We're excited to see how you do it.

Lisa Thompson has worked as an exhibit developer at the Natural History Museum of Utah at the University of Utah in Salt Lake City since 2013. Prior to this, she managed Public Programs teams at NHMU and Discovery Gateway Children's Museum in Salt Lake City, Utah.

Building a Climate of Hope Resource List

A short and by-no-means-comprehensive list of climate communication resources to get you started.

Organizations with great research and tools:

ecoAmerica
https://ecoamerica.org/

National Network for Ocean and Climate Change Interpretation (NNOCCI)
https://climateinterpreter.org/

Yale Program on Climate Change Communication
https://climatecommunication.yale.edu/

Voices for hope:

Dr. Katharine Hayhoe,
Climate Scientist, Texas Tech and The Nature Conservancy
http://www.katharinehayhoe.com/

Emma Marris, Environmental Writer
https://www.emmamarris.com/writing
"How to Stop Freaking out and Tackle Climate Change,"
New York Times, 1/10/2020
https://www.nytimes.com/2020/01/10/opinion/sunday/how-to-help-climate-change.html

"Why we'll succeed in saving the planet from climate change,"
National Geographic, 3/25/2020
https://www.nationalgeographic.com/magazine/article/why-we-will-succeed-in-saving-the-planet-from-climate-change-feature?loggedin=true

Rebecca Solnit,
Writer, Historian, Activist
http://rebeccasolnit.net/essays/
"Ten ways to confront the climate crisis without losing hope,"
The Guardian, 11/18/2021
https://www.theguardian.com/environment/2021/nov/18/ten-ways-confront-climate-crisis-without-losing-hope-rebecca-solnit-reconstruction-after-covid

Climate Communication in action:

Climate Adam
https://www.climateadam.co.uk/climateadam

Global Weirding with Katharine Hayhoe
https://www.youtube.com/channel/UCi6RkdaEqgRVKi3AzidF4ow

Science Moms
https://sciencemoms.com/
The Secret to Talking about Climate Change
https://ourclimateourfuture.org/video/secret-talking-climate-change/

Science from the Past and for the Future

Learning from Indigenous Knowledge for Climate Change Adaptation

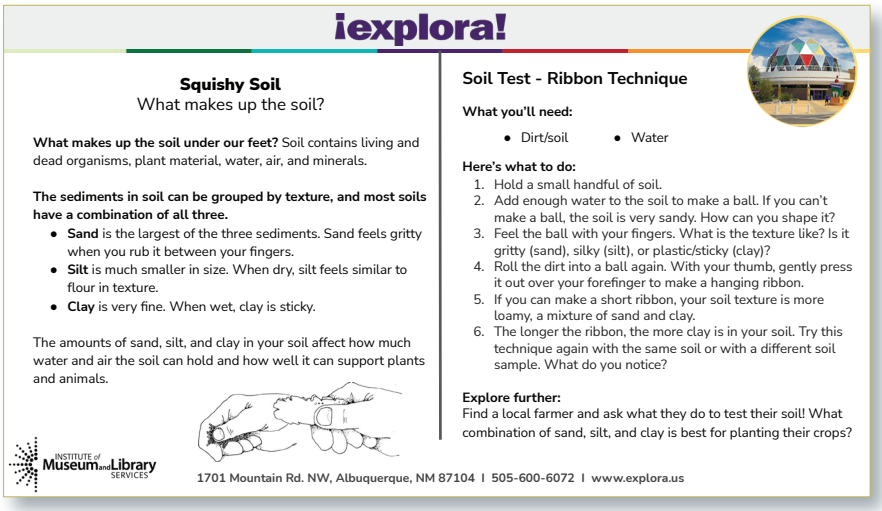
Lauren Butcher and Rachel Zollinger
Explora Science Center and Children's Museum

One exemplar STEM activity card focuses on waffle bed gardening (below). This water conservation technique arose independently in cultures living in arid lands around the world, including in the Southwest, where Diné (Navajo), A:shiwi (Zuni), Zia, and Laguna peoples use waffle bed gardening to grow corn, beans, squash, and other crops.

How can we equip our children for climate change? One way is to look to long-established knowledge of climate and place. Since time immemorial, Indigenous peoples have made their homes in New Mexico's arid lands, experiencing climate events such as extreme drought and devastating wildfires. At Explora Science Center and Children's Museum, we are developing at-home STEM activity cards that highlight local Indigenous peoples Traditional Eco-logical Knowledge (TEK) around water conservation, forest management, and living within arid conditions. The cards showcase how traditional practices have effectively utilized science and engineering principles—and continue to do so.

One exemplar STEM activity card focuses on waffle bed gardening. This water conservation technique arose independently in cultures living in arid lands around the world, including in the Southwest, where Diné (Navajo), A:shiwi (Zuni), Zia, and Laguna peoples use waffle bed gardening to grow corn, beans, squash, and other crops. The card provides instructions on how to construct a simple waffle bed by digging out a small square of earth and building walls around the edges. The bottom of the square is filled with gravel, sand, or mulch to prevent evaporation. Water is poured directly inside the square. The activity fosters science and engineering practices by asking children to meet challenges and test different variables: what would happen to the damp soil in the square if the walls were taller or the square was deeper? How might more gravel, sand, or mulch affect the evaporation? What soil composition makes the strongest wall?

STEM activity cards are a way to share education resources on a range of topics for at-home learning, a pathway Explora has utilized for reaching individuals and communities outside the museum. Climate-focused cards invite young children to play with ever-fascinating water, soil, and rocks in the new context of positive climate change solutions. They provide an arena for family conversations by promoting an interactive play experience. The cards encourage children and their families to expand their conversations to include local knowledge holders such as traditional gardeners, farmers, and elders. Climate change is a community concern, and the cards prompt families to look to community assets to address it. The Southwest is projected to experience more intense drought and storms as a result of climate change. Proven agricultural and land management techniques developed in response to extreme natural weather patterns are especially effective for adapting to the region's future.



iexplora!

Squishy Soil
What makes up the soil?

What makes up the soil under our feet? Soil contains living and dead organisms, plant material, water, air, and minerals.

The sediments in soil can be grouped by texture, and most soils have a combination of all three.

- **Sand** is the largest of the three sediments. Sand feels gritty when you rub it between your fingers.
- **Silt** is much smaller in size. When dry, silt feels similar to flour in texture.
- **Clay** is very fine. When wet, clay is sticky.

The amounts of sand, silt, and clay in your soil affect how much water and air the soil can hold and how well it can support plants and animals.

Soil Test - Ribbon Technique

What you'll need:

- Dirt/soil
- Water

Here's what to do:

1. Hold a small handful of soil.
2. Add enough water to the soil to make a ball. If you can't make a ball, the soil is very sandy. How can you shape it?
3. Feel the ball with your fingers. What is the texture like? Is it gritty (sand), silky (silt), or plastic/sticky (clay)?
4. Roll the dirt into a ball again. With your thumb, gently press it out over your forefinger to make a hanging ribbon.
5. If you can make a short ribbon, your soil texture is more loamy, a mixture of sand and clay.
6. The longer the ribbon, the more clay is in your soil. Try this technique again with the same soil or with a different soil sample. What do you notice?

Explore further:
Find a local farmer and ask what they do to test their soil! What combination of sand, silt, and clay is best for planting their crops?

Institute of Museum and Library Services

1701 Mountain Rd. NW, Albuquerque, NM 87104 | 505-600-6072 | www.explora.us

STEM activity cards are a way to share education resources on a range of topics for at-home learning, a pathway Explora has utilized for reaching individuals and communities outside the museum.

Explora Science Center and Children's Museum will continue to work with community partners across New Mexico to develop STEM Activity Cards that highlight both conventional and indigenous science-based climate mitigation strategies so the next generation will continue to adapt and thrive. We would like to acknowledge our funding from IMLS Planting Seeds of STEM, the NISE Network Earth & Space Project-Based Professional Learning Community, and the IMLS Howtosmile At-Home Activities project for the development, printing, and translation of the cards.

Lauren Butcher is school and community programs manager and Rachel Zollinger is an educator at Explora Science Center and Children's Museum in Albuquerque, New Mexico.

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Seeing the Future and Taking Steps to Get There

Discovery Museum Acts on Its Commitment to Sustainability

Neil Gordon
Discovery Museum

Our actions—how we operate and what we model for the world around us—are as important and maybe even more so than what we strive to explicitly teach as a museum. W.E.B. Du Bois said, "Children learn more from what you are than what you teach."

The news about climate change, the environment, and the state of our planet is frightening and discouraging. In the face of it all, how do we create hope? John Fraser, noted conservation psychologist, has stated that a focus on solutions and actions can reduce fear and increase hope. And hope, Fraser says, "is a targeted way of seeing the future and taking steps to get to that future."

Children's museums are all about hope for the future, but actions to fight climate change that are environmentally positive have not been a focus for many of them. I share the experience of the Discovery Museum in the hope that any insights it yields will help us all take more action and inspire our visitors to do the same.

Building on a Foundation of Environmental Focus

This year we are celebrating Discovery Museum's fortieth year. Over the last decade, we have grown from two small museums into one large museum with pre-pandemic attendance over 200,000 and a $2.7 million budget. The museum has a strong focus on science and nature, with 4.5 acres of accessible, outdoor exhibit space adjacent to 180 acres of town-owned, wooded trails that we program. Connecting kids and families with nature and operating sustainably have long been important goals for us.

Discovery Museum first articulated its commitment to environmental sustainability in 2007. Asserting that "we are keenly aware of the interrelationships of humans and the natural world and our obligations to be good stewards of that world," the organization adopted a vision statement to become "a premier community museum that embodies discovery learning and environmental stewardship." Formal goals included becoming a "green" organization and encouraging others to take responsibility for the environment. Two years later, in 2009, a new Master Plan for Campus Expansion included a concept for building a new Environmental Discovery Museum featuring photovoltaic panels, a windmill, a composting area, and an aquifer recharge zone. Unfortunately, the 2008 recession forced the museum to focus almost exclusively on shoring up finances and building our audience. It was not until 2013 that the museum was in a place to contemplate a future campus renovation and initiate a capital campaign to fund it, this time with a focus on accessibility—by then, a pressing capital need and programmatic focus.

Over the last decade, our environmental work focused on the goal of connecting kids with nature, both to raise awareness and promote the physical and mental health benefits of outdoor play. In 2015, we hired our first Outdoor and Environmental Educator. The following year, we opened Discovery Woods, an award-winning, one-acre, fully accessible nature playscape and treehouse. With a goal of encouraging "every kid, every day, outside to play," we also deepened our Backyard and Beyond program series to offer a range of year-round outdoor experiences for children of all ages and levels of comfort with outdoor play. Coinciding with the opening of our expanded and renovated, accessible building in 2018, we also changed our longtime tagline, "Hands On, Minds at Play," to "Science. Nature. Play." This change reflected our programmatic evolution, elevating our message that getting kids outside is a first step to developing an appreciation for the natural world and a sense of responsible stewardship of its resources.

We have also taken steps to advocate publicly for these values, including signing the We Are Still In (WASI) pledge, a joint declaration of support for climate action, signed by more than 3,900 CEOs, mayors, governors, tribal leaders, college presidents, faith leaders, health care executives, and others; joining America Is All In, a coalition to develop a national climate strategy; supporting the Town of Acton in declaring a climate emergency; becoming a member of the Acton Climate Coalition; and presenting programs addressing environmental topics through our Discovery Museum Speaker Series.

Walking the Talk

We have increasingly wrestled with how to take concrete steps to be visibly and demonstrably sustainable in our own operations as a key strategy for inspiring the next generation of environmental stewards.

Our actions—how we operate and what we model for the world around us—are as

important and maybe even more so than what we strive to explicitly teach as a museum. W.E.B. Du Bois said, "Children learn more from what you are than what you teach." The environment we create, and what kids and families take from that, is an influential tool. The goal is to motivate families to adopt more sustainable viewpoints and practices at home, and support environmentally sound public policy. We wanted to more visibly "walk the talk" as a critical element of our educational approach.

Recognizing this, we knew we needed a plan.

One of the first things we decided to do was look for advice and guidance. We had lots of questions about scope, level of detail, what kinds of goals we should have, and even how we should define "sustainability" for our organization. Luckily, we had some prior experience working with Sarah Sutton, who helps places like ours through her organization Environment & Culture Partners. She provided positive feedback on our goals, an invitation to join with other cultural institutions as part of We Are Still In, and some great links to useful resources.

One especially useful resource for us was the WASI list of commitments. Sarah noted that others had used this list as a framework for creating their own sustainability plans. A white paper from Museums Australia had a very similar list. Based on a review of these examples, it made sense for us to follow their approach.

Our framework was built around a set of "commitments":

1. Commit to increased use of renewable power
2. Commit to understand and reduce greenhouse gas emissions
3. Commit to reduce materials consumption and waste
4. Commit to reduce the impact of transportation
5. Commit to reduce water usage
6. Be publicly committed to sustainability
7. Commit to education and communication
8. Integrate climate change into portfolio analyses and decision making

The process for developing our plan was relatively simple and streamlined. Given our long commitment to environmental education, little discussion was needed about whether to formalize our goals and objectives. We moved straight to researching and producing a plan focused on action steps. Key to this was establishing the museum's baseline environmental impact, which we did with the tremendous support of a skilled intern who self-described as a "sustainability geek." With her help, we found answers to a range of questions. How much energy do we use, and in what ways? What level of greenhouse gas emissions do we produce? What does our water consumption look like? How many miles are we driving? How many deliveries do we get? How much waste do we generate? What are our cleaning supplies and the materials in our exhibits and programs made of? In what ways do we talk about the environment? And many more.

For some of these questions the data was readily available. Our utility company is very good about keeping track of our electricity, oil, and natural gas usage. Our water company was a bit trickier, as they do a poor job in regularly reading the meter. In some areas, no real good data source existed. For example, the waste collector empties the dumpster on a regular schedule, whether it is full or half empty.

Turning Our Vision into Reality

There are a number of models that can estimate greenhouse gas emissions based on energy usage or miles driven; our goal was to find one that was relatively simple to use and easily available to us. The model used by our intern produced easy-to-understand visual representations of our greenhouse gas sources. This was useful for discussing our action steps with staff and the board, as it made the priorities much clearer.

One interesting data point stems from our being a suburban museum with effectively no public transportation option. Everyone (mostly) drives here, so we used visitor zip code data to come to a pretty good estimate of miles driven by our visitors. As it turns out, this is the single biggest source of greenhouse gas emissions for the museum, and as you would expect, not the easiest to address.

We recognized that our data collection efforts were not perfect, but we decided rather than devote lots of time and resources to get perfect data, we would create objectives for filling in the blanks later. Even though our measures of progress would be less than precise, we were moving forward.

Our analysis of this imperfect data became the platform for the development of concrete goals and actions, and what we hoped were reasonable timeframes for accomplishing them. We also committed early on to implementing our plan transparently

FINANCIALLY SOUND SOLAR

Once you decide that solar electricity is the right thing for your organization, the question quickly turns to: does it make financial sense? In the Discovery Museum's case, we were pleasantly surprised by the financial sense that an investment in solar made.

We started with a very simple model in mind: we would fundraise for the cost of installation and use the annual electricity savings to support our environmental education programs. Thus, we would describe the investment in solar as an endowment of the programs. This idea made some sense pre-pandemic, but quickly looked silly in the face of needing to raise funds just to stay open. That led us to understand the economics in much more detail.

We quickly identified several companies that specialize in working with nonprofits on solar projects and chose to work with Resonant Energy, based in Boston. Resonant was able to show us a model of solar financing that involved "selling" the federal tax credits (obviously, we would not be able to use them directly), estimating our energy savings, selling excess electricity to other nonprofits at a discount, and maximizing other incentives (in our case, solar incentives offered by the state of Massachusetts). The access to the federal credits is a bit complicated and you'll want a lawyer for that work, but it results in a 12 to 15 percent "savings" right off the top. Resonant was able to show a 25-year financial model that accounts for decreased production over time (we were surprised to learn that panels wear out), operating costs such as maintenance, changes in electricity rates, and so forth. To support our analysis, we put together a Solar Task Force of board and non-board experts that reviewed the modeling and evaluated our options.

The Solar Task Force was able to recommend to our board that the museum finance this project. With low interest rates and a good bank, we put in place a loan that should be paid back in about eleven to twelve years. The projected cash flow is positive in year one, thus actually meeting one of our original goals to support programs using the sun!

To us, becoming more sustainable is about more than just leaving our children a planet with adequate resources. It is also about achieving greater harmony in the present between the environmental, economic, and social outcomes—both locally and globally—of our choices and actions. We are therefore committed to pursuing our sustainability objectives in ways that also promote equity.

and allowing for flexibility as we make progress and learn along the way.

The most visible part of the plan is our project, to be completed in mid-2022, to produce solar electricity onsite to meet 100 percent of our campus energy needs—and then some. The plan also outlines our approach to reducing greenhouse gas emissions and becoming carbon neutral; reducing water usage; minimizing waste generation; investing sustainably; and advocating for climate action. All of this will support an environmental education effort that will connect kids and families with nature, help them learn in partnership with the natural world, and inspire them to advocate for sustainability—all in the fun, hands-on Discovery Museum way. The final plan includes 29 action steps, spanning all areas of museum operations, to be taken over the next several years. These actions include discrete tasks such as replacing pavement with permeable surfaces and redirecting stormwater to groundwater recharge. The plan also outlines goals for ongoing action, such as investing sustainably, building community partnerships to advance our environmental work, and advocating publicly for our values.

A Commitment to Flexibility and Progress

Implementation of our plan is now underway. We have created a Sustainability Plan Team made up of staff members throughout the museum who have primary responsibilities for one or more of the action steps articulated in the plan. The team meets monthly to review progress on each of the steps, share ideas or concerns in moving steps forward, and identify new or modified actions that we might take. In this way we have peer support and peer accountability for the plan, making sustainability more of an organizational norm.

The Sustainability Plan Team holds regular discussions on our progress, providing a good tool to address the built-in imperfections of the plan itself. For certain action steps, better ideas have emerged from the work together. The team has become comfortable with the idea that we are both implementing the plan and improving the plan at the same time.

A good example of this approach centers on our ideas about visitor vehicle emissions. The plan calls for the museum to implement a system of visitor-purchased carbon offsets as a means of mitigating the emissions, not eliminating them. The plan anticipated a mandatory approach as well as a significant visitor education component. The team realized, however, that the logistics of promoting, educating about, and collecting offsets would be challenging. We will likely need to implement the plan on a targeted basis first, such as to members, to work out the kinks. Efforts to address this biggest source of our greenhouse gas emissions continue.

Importantly, we also want to model external accountability. We engaged outside voices to review our plan drafts, adding perspective. The current version has been published on our website and shared across our audience with a request for feedback. The Board of Directors has formally approved and adopted the plan, and we have begun to recruit for an external Sustainability Advisory Group, which will conduct an annual review of our progress and report on recommendations for improvements and changes.

We recognize our vision will take time and resources and are honored that many have stepped up to help support our work. Most notably, the Sheth Sangreal Foundation has committed $1 million over the next five years to activate our sustainability and inclusion goals, and has challenged the community to match their investment in our plans. We will be asking everyone to join them in helping us leverage our culture of play-based learning to inspire families to help sustain our world.

It's also important to note that we are approaching our sustainability work with full knowledge we must also be engaged in its intersections with racial and social justice. We know that the impacts of climate change and environmental degradation disproportionately affect people with low incomes and people of color. And we know that access to the outdoors and nature-based learning experiences are less available to many. To us, becoming more sustainable is about more than just leaving our children a planet with adequate resources. It is also about achieving greater harmony in the present between the environmental, economic, and social outcomes—both locally and globally—of our choices and actions. We are therefore committed to pursuing our sustainability objectives in ways that also promote equity. In many ways, all of this is integral work for the museum. In other ways it is new and fresh, because we've made a renewed commitment to sustainability, made urgent by the world around us. We are energized and motivated and we hope others in our field will join with us, with combined, greater effect on both our communities and the natural world.

Neil Gordon has served as CEO of the Discovery Museum in Acton, Massachusetts, since 2009.

How to Engage a Community in Fire Season Education

Chris White
The Discovery
Reno, Nevada

When I first moved out to Nevada from Maryland to join the Discovery team, one of the first phrases I had to get used to was "fire season," the time of year when fires naturally occur in the drier parts of Nevada and other western states. Over the past few years, these fires have become more common, more intense, and more devastating.

Fire season is evolving faster than normal, and it's drier now. We either get no rain or dumped on. Sometimes if there is no rain at all in the fall, we have to wait for winter snowfall to provide moisture. Fire season used to run for about three months, starting at the end of August; now it runs five to six months, starting end of June and going late into fall. The cycle is out of whack.

Fires happen often in remote mountain areas. Some are due to natural causes, such as lightning strikes, but some result from human activities, such as shooting, campfires, and cigarettes. In 2021, the Portola, California, fire burned just fifty miles away. Reno sits in a bowl—once smoke comes, it settles in for weeks. We can wait for a "Washoe wind" (a strong, late-day summer wind that blows from the west to southwest) to blow it away, or just sit tight until it dissipates. But in 2021, school was cancelled due to poor air quality, and people were warned to stay indoors and keep windows shut. Not everyone has air conditioning; it became a social issue.

Fire season isn't all bad. It is a crucial part of the region's ecosystem. The West wouldn't be as beautiful or environmentally diverse without these fires. However, the fires are getting bigger and more destructive. According to the Center for Disaster Philanthropy, over the past two years, California and Nevada have lost more than 6,000 square miles of land. For comparison, that is 80 percent of New Jersey's landmass. As a science museum, our responsibility is to provide useful information about this climate-related change to our community while engaging and empowering them with that knowledge.

To that end, we have developed a three-part plan to help us create a vibrant and dynamic collaborative space within our existing Spark!Lab Smithsonian gallery, in which half of the gallery's footprint will be dedicated to teaching families about fire season while still engaging them through play. Visitors will be able to meet community members to whom fire season matters most—instructors and graduate students from the University of Nevada, Reno, local firefighters (if they aren't fighting fires…), and members of the Bureau of Land Management—and learn how they respond to this increasingly longer time of year.

We are also working with these key community members to create easy-to-understand infographics that visually convey what happened in past fire seasons compared to what is happening now. Infographics that not only describe what is happening, but why will be placed throughout Spark!Lab and in some parts of our Nevada Stories exhibition. For our family audience, messages will be directed primarily to parents in an effort to get them involved in the education process with their kids

The second part of the plan involves the creation of interactive, collaborative activities in which visitors work together to solve fire-related problems. The first will be a firefighting game where up to three visitors will assume the roles of community leaders tasked with managing assets affected by fire season. By pulling connected strings, they can work toward extinguishing as many fires as possible in the time allotted. Also under development is a tile-based, firefighting board game, similar to Catan (a popular electronic seafaring discovery game). In our game, one player is the wildfire, and the other player(s) try to contain the spread while each tries to fulfill roles within the community.

The final pillar of the plan will bring community leaders and stakeholders most involved in protecting our community during fire season to the museum for a "meet and greet." We want our visitors to put a face to the heroes in our community who choose to take on this yeoman's work. Visitors will hear firsthand the issues affecting our hometown and what these frontline experts think we can do to mitigate and manage what is happening.

It is hoped that fire season content, launched in Spark!Lab and periodically distributed among existing exhibits at The Discovery, may eventually become a portable exhibit available for outreach events or temporary installations in other community organizations and businesses.

Fire season is an integral part of what makes the West special. But for many reasons, the fires have begun to take more than they previously provided and more than we can replace. It falls to us to educate ourselves and our community if we hope to pass the beauty of living in this spectacular environment on to future generations.

Chris White is The Discovery's Spark!Lab Smithsonian Coordinator. Prior to joining the team at The Discovery, Chris worked at the original Spark!Lab in Washington, DC, which is part of the Lemelson Center for the Study of Invention and Innovation located in the Smithsonian National Museum of American History.

Reference

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Learning from Nature, Not Only about It

A Conversation with Billy Spitzer, executive director of the Hitchcock Center for the Environment in Amherst, Massachusetts, and Al DeSena, interviewer

INTRODUCTION

Billy Spitzer, executive director of the Hitchcock Center for the Environment in Amherst, Massachusetts, is a member of the coordinating team for the Action for Climate Empowerment National Strategic Planning Framework and a member of the leadership board for the Climate Literacy and Energy Awareness Network. Before coming to Hitchcock Center in August 2021, he was vice president for learning and community at the New England Aquarium in Boston, where for more than twenty years he applied learning and social science research across education programs, exhibits, visitor experience, and community outreach. He served as principal investigator for numerous informal science education projects funded by the National Science Foundation, National Oceanic and Atmospheric Administration, Institute for Museum and Library Services, and the Environmental Protection Agency. These include a series of projects focused on public engagement on climate change, including the National Network for Ocean and Climate Change Interpretation. With more than thirty years of experience developing and implementing science education programs, exhibits, and materials, he has been recognized by the White House as a Champion for Change for engaging the next generation of conservation leaders.

Al DeSena retired in 2019 after fourteen years at the National Science Foundation, where he was a program director in the Advancing Informal STEM Learning Program.

AL: For years, children's museums have provided experiences for children and their families pertaining to nature, the weather, the earth, the environment, etc. But now, given the considerable global attention to climate change, worldwide loss of biodiversity, a green economy, and environmental justice, many children's museums have been considering what opportunities they should be providing for their audiences to improve the knowledge and skills that affect their individual lives and humanity in general.

What are the overarching questions behind the important decisions that children's museums are wrestling with on this topic? How are these decisions affected by the implications of the last two years of the pandemic as museums move forward?

BILLY: Having worked in the science education field for a long time, my interest has always been: How do we give people in a participatory democracy the scientific understanding, tools, and ways of engaging that are critical to enabling us as a society, not just as individuals, to make good decisions and pursue the right courses of action? About twelve years ago, at New England Aquarium, we were wrestling with the most important issues facing the ocean. Climate change kept coming up as a major issue in the zoo and aquarium world, which I think went through what the children's museum and science museum world is going through now: if we really care about the future, what issues do we need to address in our public programs and exhibits?

We realized that we needed to start working with other aquariums and zoos to figure out how to talk about climate change. We started with the fundamentals: trying to understand the science—and the communication science—better, and then looking for what kind of interventions would make sense. Should we be developing educational materials? New exhibits? What would be the most effective way to get going? We settled on exhibit interpretation as the place to start. It's harder to change physical exhibits, but it's a lot easier to work with staff. We started a collaborative program to help educators and interpreters at aquariums and zoos talk about climate change in a way that was true to the science, but also reflected what we know about effective communication. Over time this collaboration grew into a national network that exists to this day with about 400 highly-trained climate communicators in thirty-eight states across the country who have, in turn, trained about another 40,000 informal educators and other communicators in the last ten years. Children's museums are at an interesting point now: new issues are impinging on child development—climate change being one, and the pandemic and related health issues being another.

AL: How does your work at the Hitchcock Center—and previously at the aquarium—relate to children's museums that primarily serve families with younger children?

BILLY: The Hitchcock Center started almost sixty years ago as a traditional nature center. Committed to focusing on sustainability, in 2016 they built what's called a "living building," and also committed to working on climate change and environmental justice. That new direction drew me out here last year. Like a lot of museums, the center is focused on education, particularly for children. We do programs for adults, but we have a really strong set of programs for

kids from preschool to high school, along with afterschool and homeschool programs, summer camps, and leadership programs for teens, including a climate summit program. A lot of our programs are analogous to what you'd find at a children's museum. We have a small nature exploration center inside the physical facility. So, in many ways, this place looks and feels like a lot of children's museums.

AL: How might children's museums define or frame the actual domain of climate change and what activities it entails? Should they be thinking about it as a way to develop systems thinking in children? What does it mean to learn from nature instead of about it?

BILLY: I think dealing with climate change is about shifting our perspective from thinking of it as a science or environmental issue to thinking of it as a societal issue, a social challenge. You can think about it as a crisis of public health, as an issue of social and environmental justice, as an issue related to developing a future workforce and building healthy and resilient communities. All of those perspectives are important to consider when framing the subject of climate change and a museum's role in relation to it.

Once you start diving into climate change as an issue, it becomes not so much about learning climate content, but more about developing the skills, habits of mind, attitudes, and behaviors that will enable us collectively to find a path forward in terms of what we need to do to both mitigate and slow down climate change and also adapt to it. Systems thinking is a great example of that approach. Young kids are natural systems thinkers; educators can cultivate that skill. Kids are also very natural problem-solvers. And we need creative and hopeful problem-solvers to help us work our way through all that we need to do to respond to climate change.

At the Hitchcock Center, we've been focusing on moving from learning about nature to learning from nature, using the principles of ecological design, like those we used to design our living building, to help us design better human systems.

AL: Many children's museums are wondering whether they should engage in the climate change domain at all. What are some of the major factors that are important to consider when museum leaders are deciding whether their organizations should get into it?

BILLY: Start with your organization's mission: what does it tell you? A lot of museums, and a lot of children's museums in particular, have strong community-based missions. What are your community needs in relation to climate change? Who is already working on this issue that you could talk to, learn from, and partner with? What do you know about what's going on in your own community around climate? What are public attitudes? What is the general level of knowledge people have? Where are the gaps?

The Yale Project on Climate Communication, a great resource, offers a wealth of data on public knowledge, attitudes, and behaviors around climate. People are often surprised by the fact that the vast majority of the public understands climate change is a problem, is looking for help in figuring out what to do about it, and often look to places like museums for those answers.

Understanding the readiness levels of both staff and your board is also really important. If you're facing a lack of readiness in either group then you need to figure out how you're going to work on that. But again, there are probably a lot of good resources in your community already, including community organizations or public health agencies. Many cities and towns have climate action plans. Figure out what's already happening and where can you connect to it.

AL: How can children's museums customize their programs based on what they know about their audiences? Visitors of different ages, knowledge, abilities, interests, skills, cultural backgrounds, etc.?

BILLY: There's a mantra from environmental educator David Sobel, "No global disasters before 4th grade." Years ago, kids learned about the rainforest before they learned about their own backyards. You have to start with where your audience is already in terms of environmental education—what kind of prior experiences do they have, what are they interested in, what kind of questions are they asking—and respond to that. In the case of climate, you don't want to start with, "Well, here's what's happening to the planet." Instead, "Here's what's happening that you can see and observe."

You can introduce systems thinking at many different ages or levels of sophistication and depth. For example, if you're talking about a squirrel, how do you help kids understand that it's not just about a squirrel, but it's also about the acorns and the trees and the forest, and what other animals are like squirrels. How do squirrels relate to chipmunks? What do squirrels eat, and what eats them? Where do they fit in the big picture? Using that perspective to look beyond an individual animal or phenomenon and think about the bigger system, is the skill you need eventually to understand what's happening with the climate system and how it interacts with ecosystems and with us.

Finally, what worldviews are your audiences coming with? They might not be all come from a western scientific or cultural worldview. What cultural backgrounds are your audience coming from, and how do you incorporate these different perspectives? These aren't new ideas to people working in children's museums: the same principles that apply to good child education in general apply to climate education.

AL: In your programs at the Hitchcock Center, what different approaches do you use for preschool kids vs. kids who are nine years old, for example?

BILLY: At all age levels, but particularly at younger levels, we incorporate a multi-sensory approach, combining experiential and tactile learning with social and emotional learning. For really young kids, it's important to foster physical comfort in the natural world. An affective connection and appreciation are really, really important ingredients to build on. But if you're working with older kids who haven't had much experience with nature or environmental education, you need to start there.

AL: Are there particular experience formats that might be more appropriate to children of different ages or cultural backgrounds? The Hitchcock Center's tagline is "Education for a Healthy Planet." What kinds of learning experiences relate to that basic idea?

BILLY: Things often overlooked are the aspects of an experience that you provide that are not necessarily what you consider formal parts of the program. Take our building's composting toilets, a wonderful example of how nature never wastes anything. Kids—especially young kids—are incredibly fascinated by them. They often go home and when their parents ask, "well, what did you do today?" that's what they talk about first. Kids who spend a lot of time at the

center end up taking it all for granted. Of course, you get your energy from the sun and your waste gets recycled, and that's just how things work.

In our programs, the games may change depending on the age level, but the concept of play and using the arts as a form of expression are common threads all the way through. Although language abilities and attention spans differ by age, kids' interests are quite similar. Activities that we've done with young kids come back in a slightly different format with older kids. Maybe the program is a bit longer and the level of depth is a bit greater, but some of the same program formats work across a wide range, whether it's an afterschool format or a summer camp format. As kids get older, we emphasize learning and applying their learning to some kind of community action. As kids get into the teen years, we focus on programs that develop leadership skills. We participate in the Youth Climate Summit, where we bring teams together to learn how to create climate action plans and programs and projects in their schools. So, staff-led preschool programs eventually lead to youth-led work.

AL: At what age do you think that the approach should align with what kids are hearing on TV or other media about climate crisis? There are reports of many kids experiencing anxiety about it.

BILLY: Unfortunately, there have been more and more reasons to figure out how to help kids process really scary and difficult things, from terrorist attacks to school shootings, pandemics, climate change, disasters and so on. Often, the first thing kids want to know is, "Am I safe? Is my family safe? Are we going to be OK right now?" Usually the answer is yes, and it's really important to provide that reassurance.

And then listen to what kids are asking about rather than just dumping a lot of information on them. They're not necessarily asking about the same things that are on an adult's mind. From educators, to interpreters, to visitors—kids and adults—fostering hope and self-efficacy are the keys to keeping people motivated and involved. The idea isn't to ignore the problems, but to understand that collectively we have the power to change things. We can be creative problem-solvers and come up with collective solutions. If we see things in the world that we don't like or don't think are right, we have the power to change them. That's really a critical attitude to cultivate in people of all ages, but particularly young people.

AL: Are there strategies you might suggest to children's museum professionals for how they might make timely adjustments to the conditions of our fast-changing world, and in particular to challenges their communities and regions might be facing?

BILLY: First, understand which things aren't changing quickly. What is enduring? The kind of values you want to help promote in people, the kind of skills and habits of mind you want to develop and encourage, tend to be more durable than the latest crisis. Second, you should do this work alone. This is an opportunity to work with other organizations in your community that have their fingers on the pulse of what's happening—people working on public health, social justice issues, poverty alleviation or racial and environmental justice. People working at the grassroots level, who see people facing daily challenges, and who are very focused on responding to those challenges. This gives you a very good perspective on which of today's concerns are really important in the community around you.

AL: Circumstances are going to be quite different for different institutions at different locations and points in time, whether a hurricane has just gone through a region, or whether fires or a drought are dominant issues, as well as how active individual communities are in terms of being responsive to such things.

BILLY: There have been some wonderful examples of museums responding in times of need or crises, whether serving as physical places of refuge for people in the aftermath of natural disasters, or as places for COVID testing and vaccination clinics. There are all sorts of ways in which museums can participate in community and civic life which helps build trust and familiarity that can be really helpful the next time a crisis or controversial issue comes up.

AL: Ideas about climate change have evolved. Are we engaged in crisis mitigation or adaptation? Some geoscientists think we're probably beyond the possibility of humanity to mitigate. We're just going to have to learn how to adapt. How do you deal with local/global adaptation/mitigation issues?

BILLY: To mitigate or adapt is not a choice. We need to do both, and there are actions that meet the criteria for both. As people learn about what we need to do to prepare and adapt to all of the consequences of climate change, their reaction is, "Oh, my god, how are we going to do it? Is there anything that we can do to make it easier?" And then you start getting into mitigation: "Well, if we start shifting where our energy comes from and become more efficient, then we will have less to adapt to."

There's a Chinese proverb that says, "the best time to plant a tree is fifty years ago, but the second best time is today." There is not the time for delay. This is a time for doing everything we can. We need a big transformation in how we operate as a society, as an economy. But a lot of the technology and resources we need are there—what's not there is the political will. And that's where public engagement is so critical.

We also need to work at a scale that's bigger than the individual but smaller than the whole planet. Working at a community scale, where people have the strongest sphere of influence and can actually see change happen, feels doable. You can take advantage of the social diffusion of innovation and knowledge that tends to happen among people who have some kind of a connection, whether it's a town, a neighborhood, a faith community, a school, a workplace, etc. And you can build from there—from local to regional to global. If you start with the global it tends to be really, really overwhelming and puts people off. It doesn't enable you to cultivate that sense of self-efficacy as effectively.

AL: In the beginning of this discussion, you talked about staff training. Do you have any thoughts about the role of staff training and the best approaches to it?

BILLY: Education staff at museums—even more than exhibits or programs—are an incredible resource to help effectively engage the public. Because they can have the responsive and adaptive conversations, whether it's with kids or adults, needed to develop human relationships. Educators can be very, very skilled at reading their audience and responding to their questions and interests. But to do that effectively on an issue like climate, you need to understand what effective communication looks and sounds like and develop the skills to do it.

In a project with the National Network for Ocean and Climate Change Interpretation, originally funded by the National Science Foundation and now continuing with

funding from NOAA and other sources, we developed an effective training model for acquiring these skills. The training program, which originally took about 100 hours, is now available as a "crash course" that takes about 25 hours and can be done online. We're happy to partner and share that work with children's museums.

But it's not just about training, it's also about building a supportive community of peer professionals, at your institution and at other institutions, so that when issues come up you can share resources, problem solve together, and give each other emotional support in what can sometimes be very challenging work. The network worked a lot with the Association of Zoos and Aquariums and the Association of Science and Technology Centers to advance the state of the art in climate communications. Organizations like ACM can play a really important role in the same way.

...listen to what kids are asking about rather than just dumping a lot of information on them. They're not necessarily asking about the same things that are on an adult's mind.

AL: Some children's museum they might say they don't have sufficient in-house expertise to work successfully in the climate change domain. What recommendations do you have about possible collaborations that could bring the required expertise to the table to maximize their impact?

BILLY: Start locally: who can you work with? It could be another museum, your public health department, a university, or another community organization. If museum leadership is ready and willing, think about what kind of role you want to play. A museum can directly engage and educate the public, but it can also be a place for conversation, a forum for deliberative discussions to engage the public. Think about how you want to demonstrate sustainable practices at your institution. Or about how you want to partner with community organizations to help strengthen community resilience, which could be about climate, or it could also be about building social capital and social cohesion. Think about working with youth organizations to help cultivate youth leadership and advocacy in some form.

More broadly, think about how you want to work regionally and nationally, whether it's with other children's museums or other organizations to be part the larger public engagement movement around climate change. Over the past couple years, I have been working with what is now called the US ACE (Action for Climate Empowerment) Coalition, which focuses on a part of the Paris Agreement that's focused on promoting public engagement, and not just reducing carbon emissions. We've started building a nationwide coalition of non-government actors who are involved in that kind of work to join those on the government side. There are a lot of opportunities for coalition building and collaboration at multiple levels.

AL: In seeking climate education collaborations, aside from the public health entities you mentioned, what other folks in the community should we be paying more attention to?

BILLY: Think about community organizations that are working on issues that you might not immediately think are climate-related. A lot of artists and arts organizations are interpreting climate issues. In my work at the Hitchcock Center, I've been talking to folks who are doing different kinds of community work—health, housing, economic opportunity, or food security. They're really interested in the intersection of their work and climate and partnering with other groups like us to explore that. Children's museums have some incredible assets as places that focus on holistic wellness and child development, and those are important resources to bring to the table. Once you start stating your interests and intentions, you find more and more people interested in exploring partnerships. Every time you talk to a potential partner, ask them, "Who else should be I talking to?" The number of contacts starts to grow exponentially. Cast a wide net.

AL: How does the issue of environmental justice factor into the work that you do?

BILLY: The intersection of climate and environmental justice issues is becoming more apparent. Who is disproportionately impacted by environmental issues, climate and other economic disparities, social risk factors, health risk factors? They're all interconnected, and folks in the public health world really see that intersection systematically. A population with some vulnerability is likely to have multiple vulnerabilities in multiple areas. At the Hitchcock Center, we used Census data to identify populations facing a predominance of risk factors—economic, social, and health—and then overlaid them with the environmental and climate risk factors to help target who's most important to reach first in terms of programming and partnerships. The unfortunate fact is that the populations who tend to bear the brunt of climate-related issues are the ones who can least afford to deal with it, and have done the least to contribute to the problem.

AL: Final thoughts?

BILLY: It's clear we're facing some really, really big challenges around climate, and as a society. This is the time for all of our institutions to think about stepping up to the plate and understanding how critical education is to a healthy and effective democratic society. This is our opportunity to think about how the work we do is so necessary and can become even more impactful. We have a high hill to climb but we can do this together. I've seen so much progress in the last few years in the aquarium and zoo field. Climate has gone from an issue that was rarely talked about to the norm. The children's museum field can take heart in that and really get excited about working together.

A complete recording of this live interview will be posted on the ACM blog.

Building Sustainability, Inside and Out

Lance Cutrer
Museum of Discovery and Science

The Museum of Discovery and Science (MODS) in Fort Lauderdale, Florida, has embarked on a journey to claim our position in the community as a leader in sustainability and resiliency. Our vision is to create a hub for learning, planning, and community discussion focused on tackling issues related to climate change. This comprehensive approach, built upon decades of environmental education and science-based learning, began at our founding in 1977 (when we were called the Discovery Center). In 1992, we opened our current location and took another step toward environmental education with the introduction of our EcoScapes exhibit. Still open today, an updated EcoScapes carries museum guests through the various ecosystems of South Florida to highlight the importance of a healthy natural environment. Our next step, in 2011, allowed us to enter the world of green building when we opened a 25-million-dollar expansion called the EcoDiscovery Center. The center, which doubled our public space, was designed to meet LEED Silver designation under the U.S. Green Building Council LEED rating system.

In 2019, CEO Joe Cox and the board of trustees built upon this long history and solidified our commitment to sustainability with our 2020-2025 strategic plan. Along with early childhood learning, health and wellness education, and physical science education, the strategic plan now incorporates environmental sustainability as the museum's fourth content pillar. The new pillar has led us to take numerous industry-first steps. In addition to hiring our first ever environmental sustainability manager, MODS has begun the design process for a new permanent exhibit focused on addressing climate issues. We have also implemented new internships designed to educate youth on resiliency issues, and taken steps toward lowering our own resource footprint. To fulfill our vision to become a community hub for resilience and sustainability, MODS is joining forces with dozens of local partners and experts to bring the community together and show that large-scale action can show real results when addressing climate change.

Why Focus on Sustainability and Resiliency?

Being more sustainable, focusing on more efficient building processes, and seeking green energy alternatives is not new. Many institutions have successfully undertaken such initiatives, often to great success. Like many others, we believe we must become good stewards of the Earth and address many issues to ensure that future generations inherit the same, or better, living standards currently available. These issues include carbon pollution, sea-level rise, extreme heat, more extreme weather events, environmental degradation, resource scarcity, and environmental justice. Our South Florida location is ground zero for negative outcomes related to all these issues. Hurricanes are predicted to become stronger, sea levels have already begun to rise, and extreme heat will put our most vulnerable stakeholders at risk. So, becoming more sustainable and resilient is an easy decision.

However, MODS is not embarking on a stealth or siloed operation. Leveraging our long history of institutional sustainability and green building practices and building on society's trust in museums, we will actively involve as many stakeholders as we can to bolster the whole community. According to the American Alliance of Museums, people believe that museums, and especially science centers, are a highly credible source of information (Merritt, 2019). In addition, the American Academy of Arts and Sciences found that people trust science news from museums more than any other institution or news outlet (American Academy of Arts and Sciences, 2019). MODS wants to be a good steward of that trust and make positive change not only for the museum, but for the entire community. Through various education initiatives, the museum will focus on solutions to address the effects of climate change and lead museum guests, employees, and outside stakeholders to action.

Luckily, we are not starting from scratch. The City of Fort Lauderdale and, more broadly, Broward County, have already started research and policy implementation on a number of issues related to sustainability and resiliency. MODS is partnering with government and business interests to educate the community on climate issues and the solutions being implemented and developed, including the Broward County Resilient Environment Department and its Chief Resiliency Officer, plus the Greater Fort Lauderdale Alliance. This work is guided by the Broward County Climate Action Plan; a multi-disciplinary and inclusive document that focuses on reducing greenhouse gas emission and making sure communities are equally adapted to the changes coming through a warmer world.

Programs and Initiative Highlights

Despite a global pandemic, with the creation of the new strategic plan in 2020 and the support of new and existing funders, MODS began several new sustainability initiatives.

• Environmental Sustainability Manager

In the summer of 2021, MODS invested in creating a new staff position, Environmental Sustainability Manager (ESM). Because of our education-first mindset and our mission to connect people to inspiring science, the position is appropriately housed in the education department. The ESM creates new educational programs and curricula focused on sustainability and resilience issues. They are also charged with incorporating these principles into existing educational offerings.

Along with educational goals, the ESM is also responsible for helping museum leadership manage the museum's overall sustainability plans. From aiding in the design of a new resilience exhibit, to creating a Sustainability Action Plan, the ESM's role at MODS crosses boundaries into exhibits, building operations, and procurement departments.

Because environmental sustainability is one of the museum's four core pillars, a cross-departmental perspective and interdisciplinary cooperation are essential to create a good sustainability action plan. To this end, the museum has adopted a philosophy from the sustainable business world: the Triple Bottom Line (TBL), is an accounting framework that measures an organization's success not only in terms of monetary success but includes positive outcomes in the environmental and social realms. To put it simply, the Triple Bottom Line endeavors to drive positive change for people, planet, and profit. As MODS continues to evolve toward higher levels of sustainability and resiliency, we plan to incorporate the TBL philosophy more and more into every day and strategic planning.

• Educational Programming Focused on Sustainability and Resilience

Since starting in the summer of 2021, the ESM began implementing educational programs centered on sustainability and resilience, the first being the Everglades EcoExplorer Internship, a paid internship intended to motivate high school students to become Environmental Ambassadors. EcoExplorer interns learn about the environment of South Florida, namely the Everglades, and how the natural resources of the community contribute to social health and prosperity. The students then become museum ambassadors, taking the knowledge they gain from field excursions and classroom experiences and delivering it to museum guests. This supports the internship program's goal to help students develop their work readiness by teaching them professionalism and public speaking skills.

In addition, the ESM, with help from museum leadership and several community partners, has begun a monthly guest speaker series focused on careers in resilience. Through this series, interns gain valuable insight from professionals in the sustainability and resiliency arena and learn about a number of possible career pathways, including careers in public policy with local/state government or private consulting firms, careers in engineering and architecture specializing in building resilient infrastructure and green buildings, careers in education specifically focused on climate education and healthy ecosystems, and careers in scientific research to find the best solutions for adapting to a changing climate. In addition to sparking interest in new fields, the series will create future change-makers for our community. Following its first-year success, the Everglades EcoExplorer internship program will nearly double enrollment, growing from thirty interns in four high schools to fifty interns from eight high schools. In addition, we will be moving from paying the interns a set stipend to paying them an hourly wage to promote accessibility and equity.

Furthering our goal to become a hub for resilience and putting our outside spaces to better use, the MODS Food Forest was installed during the summer of 2021. The once simple grassy area surrounding our outdoor Science Park is now planted with saplings and seedlings of a plethora of tropical fruit trees and shrubs. This rejuvenated space was generously brought to life by our partner organization, Thrive Lot, a public benefit corporation that designs, installs, and maintains edible landscapes and forest gardens in collaboration with local master growers and skilled specialists. The Food Forest demonstrates our commitment to community-scale actions achievable through partnerships—we would not have been able to install the garden without them. Utilizing local knowledge through an organiza-

Members of the Everglades EcoExplorer Internship program, a paid internship intended to motivate high school students to become Environmental Ambassadors. EcoExplorer interns learn about the environment of South Florida, namely the Everglades, and how the natural resources of the community contribute to social health and prosperity.

tion called New River Gardens, Thrive Lot helps us maintain the Food Forest as well. The Food Forest is also a great example of an initiative that drives Triple Bottom Line positivity. Planet: Replacing grass with drought-tolerant plants means less maintenance and lowering irrigation needs means saving water. People: Carrying forward our mission of connecting more people to inspiring science, we are showing them where food comes from and giving them ideas on how they can do the same at home or in their neighborhood. Prosperity: The Food Forest has already garnered positive attention from community leaders and the local school district and has raised the profile of MODS as an organizational leader. Through their involvement in the Food Forest project, the ESM has become a new liaison for Broward County Public Schools (BCPS). Deepening this existing partnership allows MODS to collaborate with county educators to create impactful curriculum for both the county's youth and MODS guests.

Carrying forward our mission of connecting more people to inspiring science, we are showing them where food comes from and giving them ideas on how they can do the same at home or in their neighborhood.

The partnership with BCPS is not limited to the Food Forest. MODS collaborates extensively with BCPS on many efforts; however, one event stands out for advancing sustainability and resiliency education: the Youth Climate Summit which will engage over 3,000 middle and high school students from all over the county on issues related to climate change. This upcoming summit is the fourth annual meeting and plans to expand on previous summits by offering two events: a virtual two-day conference and an in-person, in-depth climate solutions summit. Taking place this spring at MODS, the Youth Climate Summit will bring in local, regional, and national experts to lead sessions focused on solutions and how to take action, with a particular focus on environmental justice and inspiring youth to work toward fair and just solutions.

A Look to the Future

In leading a museum-wide transformation toward sustainability and resiliency, we see a bright, at times challenging, future. We are ready to adapt to the effects of a changing climate and lead our community to a better future by taking what we are already doing and expanding it one-hundred-fold.

At the center of our efforts lies a new permanent exhibit solely focused on resilience. Pathways to Resilience, now in the early stages of development, will occupy approximately 4,000 square feet on the museum's first floor. This exhibit will aim to educate museum guests on current issues related to climate change and inspire them to take action of their own. By concentrating on solutions to local issues, such as water conservation, lowering individual carbon footprints, and learning how to successfully advocate on neighborhood issues, as well as highlighting aspirational actions across the world, we anticipate that guests will leave with concrete ideas of what they can do to address the issues that are most important to them. In addition to creating a new exhibit, we are also updating current exhibits with an increased focus on resiliency. These updates will key in on topics such as hurricane and extreme weather preparation in our Storm Center exhibit, the benefits of healthy ecosystems provide, like flood protection and natural cooling through shade, native species conservation in our Ecoscapes area, and the science of human-induced climate change in the Prehistoric Florida exhibit. These updates will align with messages in the new exhibit, creating a cohesive guest experience.

All building operations are also being evaluated to ensure internal systems are as efficient as possible. We are planning to expand the existing efficiencies of our LEED Silver designed Eco Discovery Center to the entire museum; the Sustainability Action Plan will detail steps to reduce energy, water, and waste and improve the indoor and outdoor experience for all stakeholders. Specific actions such as switching to all LED-powered lights, renewing our building envelope to ensure unwanted warm air isn't leaking in, and installing low-flow water fixtures throughout the museum are low-hanging fruit we know will help us save resources. Going beyond these simple fixes will include developing a Sustainable Purchasing Policy and Green Cleaning Policy to ensure environmentally and socially favorable products are brought into the museum, installing more renewable energy generation on-site via solar, wind, or green hydrogen, and installing rainwater catch systems for outside irrigation needs. As MODS takes steps to bolster our own sustainability and resiliency, we will share our experiences and encourage as many community partners and stakeholder as possible to work together to drive positive change for TBL's planet, people, and profit.

We have set a high bar for MODS: transform our community into one that is more resource responsible and able to bounce back from disruptions caused by a changing climate. But we will fail if we tackle this issue alone. We don't have time for a world where individuals all try their hardest; we must work together to avoid catastrophic failure. We believe that museums have a unique power to bring communities together and lead them to a better tomorrow.

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Lance Cutrer is the first environmental sustainability manager at the Museum of Discovery and Science in Fort Lauderdale, Florida. Prior to this, he was a middle school science teacher and educational coordinator for an environmental learning program.

Many children's museums are thinking about whether to introduce the difficult but increasingly important topic of climate science into their programs. They are looking for guidance not only on where to start, but does it make sense for their primary audience of very young visitors. Will preschoolers even remember anything about this complex and sometimes scary topic?

When to Begin? Early Memories Build the Foundation for Environmental Learning

Charlie Trautmann, PhD
Cornell University

Many children's museums are thinking about whether to introduce the difficult but increasingly important topic of climate science into their programs. They are looking for guidance not only on where to start, but does it make sense for their primary audience of very young visitors. Will preschoolers even remember anything about this complex and sometimes scary topic?

Whether the purpose of a visit to a children's museum is education, relationship-building, entertainment, or some other goal, the visit often involves making memories. When museum professionals understand the basic elements of how human memory works, they can design for the types of memories they want children and families to have when developing experiences for their audiences.

THE ELEMENT OF TIME

Before we apply the science of memory to museums, it is helpful to understand the time element of memory. Psychologists use three timeframes when discussing memory: sensory, short term, and long term.

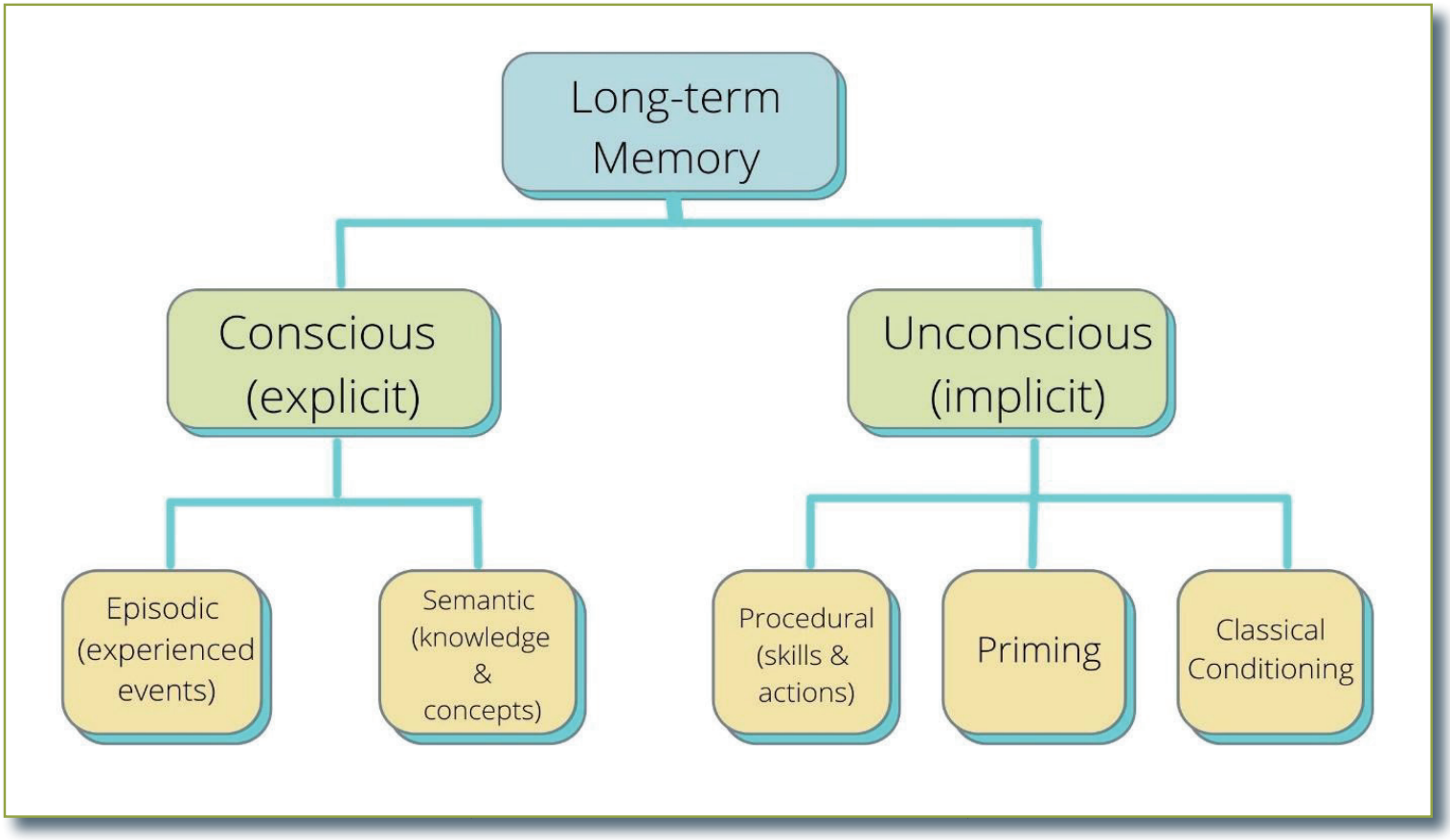
Sensory memory is ultra-short, ranging from a few milliseconds to seconds. Our five senses provide information continuously, and most of it cannot be processed fully or stored (Sperling 1963; Orey 2021a). The image of a giant robotic dinosaur, the sound of the spark from a Van de Graaff generator, or the voice of the staff member who asked us not to run are all sensory memories. Some sensory information does survive and moves to a different part of the brain, becoming retained in short-term memory.

Short-term memory, also called "active" or "working" memory, lasts for only 20-45 seconds (Miller 1956). We have a relatively small capacity to keep information in working memory, with a limit of five to nine items, and so after sensing something, we need to do something with the information, or it will be lost (Miller 1956).

Some short-term memories become preserved, or "consolidated," into long-term memories (Dudai et al. 2015). Long-term memories can last a lifetime. However, since short- and long-term memories occur in different parts of the brain, a transfer of information is required. In many cases, consolidation takes place during sleep. Key Point #1: Getting adequate sleep promotes improved memory (Ruch et al. 2012).

FIVE TYPES OF MEMORY

To describe five common types of long-term memory, psychologists usually divide them into two groups: conscious and un-



How can we prepare our children for the future without: 1) boring them with semantic knowledge about the climate they will largely forget, 2) traumatizing them with episodic memories of climate change in a way that scares them and prevents them from connecting with the topic, or 3) conditioning them, through repetition, to simply ignore or shut down on the topic of climate change?

conscious, as shown below in Figure 1 on preceding page (adapted from Saylor Academy 2012).

Conscious Memory: Conscious memory involves consciously recalling information, such as what that happened a minute ago, or last year, or what two plus two equals (Cherry 2020). Within this broad category, episodic memory is recalling specific personal events, such as the time, place, and description of something that happened to us. Can you remember your first kiss or the senior high-school prom? These are episodic memories. In contrast, a semantic memory is a piece of general knowledge that has no specific time or place associated with it, such as "dogs have four legs" or "grass is green."

The two types of conscious memory interact: semantic knowledge often starts as a sensory experience and becomes an episodic memory for a period of time. The child who releases a blown-up balloon taped to a straw on a string experiences the phenomenon of jet propulsion, which might stick in her mind as an episodic memory for that day. Eventually the time and place will become lost to her, and the concept of Newton's Third Law—that "every action has an equal and opposite reaction"—will just become part of her general (semantic) knowledge about the way the world works.

On the other hand, episodic memory relies on our framework of semantic knowledge: the more we know about a subject, the more likely we are to be interested in further learning about it, paying attention to new sensory information that comes to us, and remembering it. The young boy who can watch birds at a window feeder during breakfast is much more likely to engage with an exhibit about the migration of birds at the museum. Key Point #2: Episodic memory and semantic memory can support each other.

Another important fact is that most humans have few episodic memories before the age of four or five. This universal phenomenon, called "infantile amnesia," means that although children hungrily learn from the time of birth, young children are unlikely to reward their caregivers or museum educators with descriptions of their learning experiences.

Unconscious memory: In contrast to conscious memories, unconscious memories, also called "implicit" or "automatic" memories, are those that we don't think about on a conscious level (Squire and Dede 2015). These kinds of memories are also important, because they influence our actions and behavior. Three primary types of implicit memories are of particular interest to museums.

Procedural memory refers to motor and cognitive skills that allow us to walk, talk, ride a bike, or type without consciously thinking. Children's museums provide many opportunities, particularly for children with the fewest opportunities, to develop their procedural memory. In designed spaces, early learners can develop and practice gross motor skills, fine motor skills, observational skills, and sensory perception, often in ways they can't at home. Although some would consider such activities frivolous, children at play are often testing their theories about the way the world works and, in so doing, are developing the foundations of scientific thinking (Gopnik, Meltzoff, and Kuhl 1999). Key Point #3: It is important that we emphasize the concept of learning through play to our stakeholders, and particularly to funders, who sometimes balk at the idea of supporting "play" with their funding.

Priming refers to how recalling information from one domain can trigger memories in another domain. In other words, by strategically activating knowledge in one area, we can use that activated knowledge to elicit knowledge in another area. Staff and volunteers can use priming questions with museum visitors, activating their prior knowledge—perhaps in an unrelated field—as a way of engaging them with a topic (Tulving and Schacter 1990).

Classical conditioning, the third kind of unconscious memory was discovered by Pavlov, who found that one stimulus can become associated, through repetition, with an unrelated stimulus that has a specific response (Cherry 2019). In his famous experiment, Pavlov rang a bell when feeding dogs, and this feeding caused them to salivate. Eventually the dogs would salivate whenever he rang the bell, even if no food were present. Marketers employ classical conditioning when they associate a logo or audio jingle with a pleasurable experience; the McDonald's jingle can conjure up images, thoughts, and even smells of burgers and fries on the radio. Museums seeking to evoke positive thoughts and increased visitation can use their sounds, logos, and other images in much the same way.

PUTTING MEMORY TO WORK TO SUPPORT ENVIRONMENTAL LEARNING

Now that we have an understanding of the common types of memory, let's apply it to a current topic of interest to many children's museums: climate change. How can we prepare our children for the future without: 1) boring them with semantic knowledge about the climate they will largely forget, 2) traumatizing them with episodic memories of climate change in a way that scares them and prevents them from connecting with the topic, or 3) conditioning them, through repetition, to simply ignore or shut down on the topic of climate change?

One approach is first for children's museums to capitalize on their ability to inspire relationships among people, objects, places, and concepts. As poignantly expressed by Baba Dioum, "In the end we will conserve only what we love, we will love only what we understand, and we will understand only what we are taught" (Valenti and Tavana 2005).

Museums are well-positioned to inspire a child's love for the natural environment by creating positive semantic memories about animals, places, water, and other elements of the environment that will last a lifetime. These positive memories about the environment can form a foundation to support later learning about the environment and its key systems, in a way that is age-appropriate and in line with a child's cognitive learning abilities.

Second, through their programs and exhibits, children's museums can encourage children to improve their critical thinking skills, which are important in countering much of the disinformation about climate change. Museums can help children become

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more comfortable in asking good questions, and simultaneously building children's confidence to seek help from adults in answering their own questions. Museums can advance these goals by helping adults understand how children learn and form memories so that they can support childhood learning most effectively.

SUMMARY

The science of climate change is complex. Many children's museums struggle with the decision to include it at all for their primarily very young audiences. What engaging activities related to climate change could be presented in a playful way that a four-year-old would even remember? But as many other authors in this issue have stated, the early years are the optimal time for laying a learning foundation of critical thinking skills and building a sense of wonder and appreciation for the natural world, which in time, can blossom into a conservation mindset. By understanding how memory works, children's museums can enhance learning and other positive impacts for the children and families they serve. Positive episodic memories and semantic memories can enhance each other, and museum educators can use this understanding to create the most effective programs and exhibits.

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Charlie Trautmann is an adjunct associate professor in the Department of Psychology at Cornell University. He is director emeritus of the Sciencenter of Ithaca, New York, and a past board member of the Association of Children's Museums and the Association of Science and Technology Centers. At Cornell, he teaches Environmental Psychology and directs the Environment and Community Relations (EnCoRe) Lab. He can be reached at cht2@cornell.edu.

For Our Children, the Planet, and Our Budgets: Museums Learn to Manage Energy

Stephanie Shapiro and Sarah Sutton
Environment & Culture Partners

Culture Over Carbon is a research project designed to improve the museum field's understanding of energy use by examining data from five types of museums (art, science, children's, history, and natural history), plus zoos and aquariums, gardens, and historic sites. The two-year research period, which began in September 2021, will cover at least 150 institutions in all geographic regions of the United States, spanning varying sizes and types of buildings (e.g., office vs. collection storage). The project will collect enough information to establish an energy carbon footprint estimate for the museum sector, while creating individual "roadmaps" to help participating institutions understand and use energy more efficiently. Resulting aggragate data will boost the cultural sector's broad understanding of its current energy practices and help to plan for future expected changes in energy availability, policies, and regulations.

Culture Over Carbon is funded by a National Leadership grant from the Institute of Museum and Library Services to the New England Museum Association, which leads the project in partnership with Environment & Culture Partners and the nonprofit energy consultants New Buildings Institute (NBI).

Why this Project?

Very few museums have the ability or resources to monitor and assess their own energy use, especially during this prolonged period of economic stress due to the COVID-19 pandemic. Yet without this data they are unable to make strategic energy management decisions to save money or reduce the greenhouse gas emissions (GHG) that worsen the climate crisis.

Museum staff interested in benchmarking their energy use and comparing use reductions struggle with the lack of comparisons. While the Leadership for Energy and Environmental Design (LEED) building certification program and the Environmental Protection Agency's EnergyStar program provide energy performance ratings for buildings, there is no comparison framework/Energy Star score specifically for museums. (There are too few museum-user entries to create appropriate comparisons from a broad base of information.) Museums can join the International Association of Museum Facilities Administrators, which provides access to comparative data from about 200 institutions, but at a cost. Even with this information, staff and leadership often still struggle with how to make good energy use choices and how to pay for them, especially when they may require sometimes costly changes to existing operations.

Nearly every other major US sector understands that its energy use impacts the climate in some ways and has paths to strategically reduce their emissions. Without this context or guides to implementation, it is difficult for museums to find the means to make these shifts. As codes and regulations change—and budgets get tighter—museums need a strong case for competing for public and private funding for compliance.

The Culture Over Carbon project seeks to build a research foundation by focusing on the following questions:

- What are key aspects of the current state of energy consumption and management in the US museum field?
- What is the best available estimate of the field's current energy use?
- Can the information derived from energy meter data in samplings of similar institutions or spaces (animal and plant life support, material collections care, education spaces, exhibit galleries, and office spaces) reveal areas where most museums of that type are likely to expend the most energy?
- Can these use profiles support individual institutions as they prioritize modifications to operations, buildings, or mechanical systems for energy savings that reduce cost and GHG emissions?

The climate challenge is so significant that all who can possibly participate in creating solutions must do what they can. Until now, the museum sector has done little research on its own energy use, spent little time looking ahead to predict changes, and has expended minimal effort into articulating the need for investment in our energy systems to make better decisions. As nonprofit institutions, many museums recognize that they have a mission-driven responsibility to limit negative impacts of their work while modeling thoughtful, responsible behavior. Recognizing our fiduciary responsibility, this project tackles both the global and institutional issues that are so important to our futures.

How it Works

Participating museums provide general building information describing their building design and construction, and how it is used. Based on their submission of twelve months of past energy use data, they will receive a profile of their site which prioritizes areas of concern and provides a roadmap of next steps, including working with an energy technician or engineer to achieve results. Many are eligible to receive a stipend for sharing their data.

Using all the data collected during the project, NBI will create a free report that identifies the variety and extent of energy formats and uses in the museum sector, comments on the most common areas for improvement, and offers recommendations for how the field can collectively reduce energy use that contributes to global warming.

Culture over Carbon participants share their energy use data through Energy Star Portfolio Manager (ESPM), a free online software program provided by the U.S. Environmental Protection Agency (EPA). Anyone running a home or a building can use ESPM to understand how much energy is used on a monthly and yearly basis, and what the GHG emissions are. Many museums of all types or sizes already use ESPM for budgeting and managing energy consumption. However, the Carbon Over Culture project will move beyond this basic level by processing the data through First View, a software program developed by NBI with EPA funding to explore the research-questions stated earlier.

If you are interested in learning more, please contact Sarah Sutton (sarah@ecprs.org) or Brenda Baker (bbaker@madison-childrensmuseum.org), children's museum sector organizer and project advisor.

Stephanie Shapiro and Sarah Sutton co-founded the nonprofit organization Environment & Culture Partners (previously Sustainable Museums) in 2021 to strengthen and broaden the environmental leadership of the cultural sector. Sutton, CEO, now lives in Tacoma, Washington; Shapiro, managing director, lives in Washington, DC.

Climate Action Heroes in the Museum, Online, and Soon at Dulles Airport

Langley Lease and Paige Childs
National Children's Museum

As an institution that combines children's museum experiences with science center content, it felt both natural and necessary to dedicate exhibit space to such a timely and critical science topic.

Engaging children and their families in a meaningful dialogue around climate change can be tricky, to say the least. How do we playfully introduce children to this serious topic and inspire them to take action?

Answering this question became a priority in 2018 during the early stages of developing the newest iteration of National Children's Museum, which opened in February 2020 in Washington, DC. It was evident that climate change lacked representation when assessing the landscape of children's museum content at that time. As an institution that combines children's museum experiences with science center content, it felt both natural and necessary to dedicate exhibit space to such a timely and critical science topic.

With the help of educators and experts, the museum developed its Climate Action Heroes framework, which empowers young activists to defeat climate "villains" while exploring the science behind climate change. Located in our Innovation Sandbox space, this exhibit will live in our museum for at least the next two years. (More can be learned about the museum's in-person and virtual Climate Action Heroes experiences in the November 2020 issue of *Hand to Hand*.)

Since the museum's reopening to the public in September 2021, the in-person Climate Action Heroes experience has been named a favorite exhibit by 28 percent of visitors who complete a post-visit survey. The climate science-dedicated space in the museum has influenced our on-site and digital programming priorities, community partnerships, and future exhibit development. In fact, a Climate Action Heroes experience will soon make its debut at Dulles International Airport, where children will be invited to discover climate-friendly travel tips and challenges. Content is continuously added to the digital experience at www.climate-heroes.org, including monthly missions that share small ways young activists can help protect the planet.

At National Children's Museum, our mission is to inspire children to care about and change the world. Our changing climate is one of the most important issues facing our world today. As stewards of the next generation, we believe it is our duty to empower and inspire young innovators and activists. This means committing to and expanding upon our work in climate science. Climate change and the important role today's children will have in tomorrow's solutions will remain an undercurrent in every facet of National Children's Museum's work, from our daily operations to the programs we offer. Climate Action Heroes is just the start.

Langley Lease is exhibits + experience manager and Paige Childs is communications + digital specialist at the National Children's Museum in Washington, DC.

Rebounding through Making and Tinkering

Rachel Daigre, Cate Heroman, and Alexandra Pearson
Knock Knock Children's Museum

In 2019, MakerEd, a nonprofit organization that brings maker education to communities, selected Knock Knock Children's Museum to be a regional hub for Making Spaces, a two-year professional learning and capacity-building program designed to support local leadership around maker education, with an emphasis on sustainability and growth. Knock Knock then selected program participants, including fifty preK-third grade educators and administrators from eight elementary schools as well as staff from the nearby public library.

After Hurricane Ida passed through our region in August 2021, Knock Knock provided resources and guidance to help children cope after this natural disaster. To extend our reach, we decided to use our October Making Spaces training as an opportunity to help educators create supportive learning environments in response to severe weather events. We brainstormed how we might use making and tinkering experiences to accomplish two goals: 1) support the emotional needs of children during traumatic events and 2) help deepen their knowledge and understanding of weather-related events in our community.

To reach the first goal, we wanted to inspire teachers to create environments and provide experiences to help children:

- calm themselves;
- express feelings and emotions; and
- cope with frustration (C. Heroman & J. Bilmes 2005).

To achieve the second goal, we talked about all the things that children might experience during hurricanes: strong winds, power outages, downed trees, flooding, community helpers, lost or destroyed toys, lost pets, gas shortages, long lines, no electronic games to play, giving/receiving donations, damaged buildings, evacuating, relocating, and more.

With these two goals in mind, we set up activities throughout the museum that educators could explore and later implement in their classrooms. The public library assisted by sharing children's books—both fiction and nonfiction—to support children's understanding of this weather disaster and to help them cope with their feelings. Teachers quickly realized how they could use the making and tinkering experiences listed below to help children recover from the effects of severe weather events:

Big Backyard: creating weavings and faces with items from nature;

Maker Shop: creating homemade circuit switches in a homemade neighborhood that could be broken by tree limbs, making battery-operated fans and flashlights, making whirligigs powered by wind;

Art Garden: creating miniature Zen gardens, making string art by hammering nails and wrapping them with string, wrapping sticks with yarn to make patterns;

By-You Building: exploring wind at the wind tunnel, building strong houses and water bottle forts;

Paws & Claws: designing and building pet carriers, creating lost pet posters;

Geaux Figure! Playhouse: creating homemade board games;

Go Go Garage: using a homemade grappler tool and working as a team to move roadblocks and ease traffic on the racetrack, playing with model bucket trucks;

Bubble Playground: making floating boats, discovering items that sink or float;

Story Tree: exploring books related to hurricanes as well as supporting the emotional needs of children.

After an hour of exploration, the educators met by grade levels to reflect on these questions:

- What was a big "aha moment"—a new activity you really liked and want to try in your classroom?
- How might you adapt this for your class and available resources?
- What similar activities have you already done in your programs?
- How might you integrate these activities into your curriculum?
- How would you use any of these experiences as documentation in your assessment of children's learning?
- How did these making and tinkering experiences support the emotional needs of children?

With the increasing occurrence of hurricanes and floods, children in our community are experiencing phenomena that are difficult to comprehend. Planning new ways to help them and their families understand and rebound after disasters is critical. Making Spaces teachers walked away with making and tinkering strategies to use now and in the future to help children cope, deepen their knowledge, and spark their curiosities.

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Rachel Daigre is director of learning innovation; Cate Heroman is education committee chair; and Alexandra Pearson is Maker Shop manager at Knock Knock Children's Museum in Baton Rouge, Louisiana.