

Organic features preserved in permafrost offer clues to both the past and the drastic ecological changes possible in the future. A bison skull, ancient squirrel nest, woolly mammoth tusk, willow roots, and other replica fossils are sculpted into the tunnel walls for visitors to discover. Visitors also discover permafrost's distinctive smell of decay.

The permafrost tunnel is freezing cold, frozen solid, and funny smelling;

Permafrost contains plant and animal fossils that have been frozen for thousands of years.

When they are exposed to air in the tunnel, they start to decay.

Decay gives permafrost its distinctive smell—like an old barn or compost pile.

Connecting People and Places as an Exhibition Strategy for Climate-Change Learning

Suzanne Perin, Laura Carsten Conner, Victoria Coats, Angela Larson

The permanently frozen soil of permafrost is ancient, covers vast landscapes in the Arctic, and is predicted to thaw as temperatures rise, with significant implications for the global climate. For most North Americans, permafrost is essentially invisible – far away, hidden underground, and entirely outside their experience. Creating an exhibition about the consequences of thawing permafrost meant bridging the divides of physical distance, knowledge about abstract scientific concepts, and the divides known to exist around people’s attitudes and stances towards climate change.¹ Studies have shown

that the majority of individuals in the United States and other industrialized countries are aware that climate change is happening,² but for people only starting to experience changes directly, the consequences of climate change can seem far away and less personally relevant. A key interpretive strategy in the development of *Under the Arctic: Digging into Permafrost* was to connect people across distant places, lifeways, and beliefs in order to communicate the importance of permafrost for the global climate, and ultimately inspire hope and action around climate change.

1 Jan Semenza, David Hall, Daniel Wilson, Brian Bontempo, David Sailor, and Linda George, “Public Perceptions, Understanding and Knowledge of Climate Change,” *American Journal of Preventive Medicine* 35, no. 5 (2008): 478–97, [www.ajpmonline.org/article/S0749-3797\(08\)00683-1/fulltext](http://www.ajpmonline.org/article/S0749-3797(08)00683-1/fulltext).

2 C. Tobler, V. H. Visschers, and M. Siegrist, “Addressing Climate Change: Determinants of Consumers’ Willingness to Act and to Support Policy Measures,” *Journal of Environmental Psychology* 32, no. 3 (2012): 197–207, www.sciencedirect.com/science/article/pii/S0272494412000102.

How could we communicate the importance of permafrost for climate change in a traveling exhibition where the audiences would likely span the range of socioeconomic levels, educational backgrounds, ideological or political stances, and values that influence people's beliefs about the causes of climate change?

Under the Arctic, produced collaboratively by the University of Alaska Fairbanks (UAF) and the Oregon Museum of Science and Industry (OMSI), is a traveling exhibition exploring the interrelationship between thawing permafrost and global climate change. Underlying about a quarter of the land in the northern hemisphere, much of this permanently frozen soil is already thawing, leading to large emissions of greenhouse gases. Of particular concern is methane, a greenhouse gas more potent than carbon dioxide. Methane release from thawing permafrost can accelerate climate change beyond the current scale of gas-emitting human activity. Thus, thawing permafrost is an important driver of climate change, yet many people outside of the Arctic are unaware of its existence. The exhibition team approached the challenges of this exhibition – to communicate the scale and location of this permanently frozen ground, scientific concepts around atmospheric gases, and consequences to local people and global climate as it thaws – by partnering with geoscientists and Alaska Native advisors, and using intentional interpretive and design strategies to connect visitors with the lived experience of these people in the Arctic.

The following sections describe specific exhibition development strategies we used to connect people to climate change, and how visitors responded to these strategies. In this article, we compare our exhibition development team's intentions with visitor learning outcomes. The authors led learning research, project evaluation, and OMSI exhibit development in collaboration with the full exhibition development team at OMSI and UAF. We draw on a variety of sources from throughout the development process, including formative evaluation reports, project meeting notes, exhibit

components, label drafts and revisions, and interviews with the OMSI exhibition team conducted by two of the authors. Summative evaluation and an educational research study provide evidence of visitor's learning outcomes.

Strategies for Bridging Divides and Cultivating Connection

Early in the development process, through literature reviews, expert advice, and many discussions and brainstorms, our exhibition team laid out specific strategies for a key challenge: How could we communicate the importance of permafrost for climate change in a traveling exhibition where the audiences would likely span the range of socioeconomic levels, educational backgrounds, ideological or political stances, and values that influence people's beliefs about the causes of climate change?

The team generated specific strategies regarding visitor learning and experience that aimed to: 1) harness emotions to elicit empathy for the people living in places already impacted by climate change, and 2) encourage visitors to experience the world of a climate science investigator in order to engage with the methods and outcomes of science.

Eliciting Emotional Connection to those Living in the North

Emotions that arise in response to climate change information often include fear, sadness, hopelessness, and other negative feelings, which can lead to information avoidance rather than information seeking. This problem can hinder the goals of museums and science centers, which seek to engage the public in science learning.

The permafrost exhibition aimed to meet this challenge head on. The team acknowledged that these negative emotions were likely to emerge, and used strategies to allow the visitor to feel sadness but then move towards more positive emotions, such as wonder, caring, concern, and hope. This trajectory was inspired by the Inzovu Curve,³ which maps a transformative museum experience through pain, reflection, hope and action. After introducing permafrost in the first components, visitors move through to exhibits where Alaskans share stories of their lives in a changing environment that are filled with loss and sadness, but also include expressions of resilience. Other exhibits are more solution-based, encouraging reflection on effective strategies for living on permafrost, and local community action towards climate change solutions.

One central interpretive strategy in generating these emotions was to connect people in the 48 contiguous states of the U.S. with the lived experiences of Alaskans confronting climate change. Lifeways in Alaska are different because of permafrost and cold, dark winters. Houses and roads are built on permanently frozen ground, requiring creative structural engineering. It can mean using outhouses instead of indoor plumbing. For villages, this can mean storing food in underground ice cellars. Climate change can have negative effects on all of this infrastructure. In more remote villages, climate change has caused coastal erosion that requires re-siting of entire villages to more stable land, and has disrupted the range and migration patterns of important subsistence foods such as salmon and caribou. Because of the close connection

³ See *Inzovu Curve* at <http://inzovucurve.org>. The website notes that the "Inzovu Curve maps a prototypical journey of a person going through the transformative experience of a museum reaching a state of motivation and action."

between Alaska Native people and the land, climate change can literally mean the loss of food sources, the loss of traditional lands, and the loss of associated cultural practices.

Despite the many differences between living in Alaska versus the contiguous states, we wished to convey a universal sense of home and place that would build connection from one side of the continent to the other – people visiting friends, berry picking in favorite family spots, hunting to provide for one’s family and friends, savoring the beauty of the landscape, teenagers dreaming of their futures, and strength in the face of unrelenting change. In this case, the focus of the connection was how living in a changing place impacts day-to-day living, even if those daily routines look a little different from museum visitors’ lives.

To share these stories of life and change, two exhibit components – “Northern Stories” videos and “Stories of Change” graphic panels – feature people living on permafrost (fig. 1). The panels present a series of direct observations of the changing environment made by Alaska Native people and other residents. The “Northern Stories” video features first-person accounts of youth and elders about living on permafrost that had been created by Alaska Native youth and were edited for the exhibition by an OMSI videographer.⁴ All content for these components was sourced and reviewed by our Alaska Native project advisors. A young woman in Shishmaref tells of her love for her village and her fears about relocating to escape the severe coastal erosion caused

4 The Arctic Youth Ambassador program was established by the U.S. Fish and Wildlife Service-Alaska Region, U.S. Department of the Interior, and U.S. Department of State in partnership with nonprofit partner Alaska Geographic. The ambassadors hail from Alaska and understand the Arctic, its people, and can explain it from a youth perspective for their peers across the United States and around the world. See “Arctic Youth Ambassadors Program,” *Alaska Geographic*, www.akgeo.org/youth-programs/arctic-youth-ambassadors.

by thawing permafrost. A grandmother expresses her sadness that places on the tundra where she used to pick berries have sunken in and cracked open in ways never known before. A young man talks about losing his uncle during a winter hunting trip. The ocean ice had always been frozen solid in the past, but in 2007, it was unusually thin and his uncle fell through.

The exhibit developers knew these stories were going to be emotional, as one noted in an interview about the development process: “The Northern Stories mini-theater has videos of...being in Alaska, and ‘Stories of Change’ panels on adaptation are shaping up to be really beautiful... it has a couple of parts that really help take you on that emotional journey, both feeling really sad and really happy, but mostly sad.”⁵ As intended, *Under the Arctic* visitors commented on how it affects them, in these examples from the summative evaluation,⁶ captured while visitors were at these exhibits:

Girl at “Northern Stories”:
Crazy [after learning about Esau’s story of his uncle falling through the ice].

Girl at “Stories of Change”:
Mm, hilly. [pause] What? This is sad.

Boy at “Stories of Change” panel about when permafrost thaws, to girl:
Oh whooah... that’s not good and that happens all the time.

Girl: *Wouldn’t it be awful if you had a house that you built and it eroded like that? I would be so mad. That’d be so sad.*

5 Allyson Woodard, personal interview by Suzanne Perin and Laura Conner, July 6, 2017.

6 Angela Larson and Kelly Kealy, *Under the Arctic: Digging into Permafrost Summative Evaluation* (Portland: Oregon Museum of Science and Industry, 2018), <https://omsi.edu/museum-services/evaluations>.

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Fig. 1. The Northern Stories mini-theater invites visitors to sit for a bit and hear from permafrost-dependent cultures and ways of life in the Alaska Native villages of Shishmaref, Unalakleet, and Savoonga. Residents of these villages share their stories of change and find hope for the future.



Fig. 2. Visitors are invited to join the research team at the field lab and further their investigation of permafrost. The black and white graphics show University of Alaska Fairbanks geoscientists at work.

In looking at the summative evaluation and research results, we found that visitors did experience emotional connections to the exhibition. At the “Northern Stories” and “Stories of Change” exhibits, expressions of sadness and worry about climate change dominated those verbalized aloud, although only a few individuals verbally voiced emotion while being observed in the evaluation.

Sadness may in fact stimulate a strong call to action: We found the “Northern Stories” exhibit, which generated feelings of sadness, also elicited the most talk about how to mitigate or adapt to climate change, and generated the most discussion around solutions to addressing climate change.

The intention at these exhibits was to generate empathy for people who are showing resilience despite their sorrows, so that visitors would not feel pity for an “other” who is far away or very different from themselves. As the OMSI videographer/exhibit developer put it, “there are conceptual themes [in the exhibition] we’re trying to emphasize about resilience and hope and adaptability and...what life is like living on the frontier of a place that is changing because of climate shift.”⁷ For example, the young man whose uncle died served as an Alaska Geographic Arctic Youth Ambassador,⁸ representing his community at national and international climate meetings. He shares during his video interview that he plans to run for governor of Alaska in 2030. He is not discouraged; he dreams of a future in which an Alaska Native person from a small village is governor. The videos show resiliency in the face of challenge as the message for visitors to carry with them

7 Allyson Woodard, personal interview by Suzanne Perin and Laura Conner, July 6, 2017.

8 “Arctic Youth Ambassadors Program,” *Alaska Geographic*, www.akgeo.org/youth-programs/arctic-youth-ambassadors.

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into the next section of the exhibition, where they think about scientific approaches to the problems caused by thawing permafrost, both with respect to local community actions to take and larger scale engineering for life in a changing landscape.

Exploring the World of Climate Scientists

Another strategy we used to connect people to the lived experiences of those in the North was to share the experience of investigating permafrost from a scientist’s perspective. By encouraging visitors to explore the world of a climate scientist, we hoped they would gain a sense of how such scientists approach problems, as well as their awe for the earth’s features that they experience first-hand. We hoped that in so doing, visitors would feel connected to the exhibition content. To do this, we created a mock permafrost field laboratory (fig. 2), where it looked as if a scientist had just stepped away from their research for a coffee break. This space invited visitors to explore. They could see and touch the tools laying on desks, hardhats and warm coats hanging from hooks, use a video microscope to examine fossil fragments

Fig. 3.

Visitors rotate a tray of rocks, silt, gold, and fossil fragments from the Fox, Alaska permafrost research tunnel, use a video microscope to examine them up close, and look through a field guide to identify the fossils.



found in permafrost (fig. 3), touch an Ice Age steppe bison skull fossil, weigh replica ice core samples, and measure frozen methane bubbles in lake ice. Visitors could meander inside a replica tunnel into permafrost, modeled after the nation's only permafrost research tunnel located in Fox, Alaska (figs. 4 & 5). While permafrost is frozen soil, and is normally hidden from sight underground, visitors to this replica tunnel could touch and see the different textures and features of permafrost's icy soil, smell permafrost's distinctive odor of decomposing organic matter (fig. 6, intro image), and see tools used by the tunnel's research scientists. A projection of an aurora flickering over a snowy landscape lent a sense of the beauty of the tunnel's location in the Arctic.

Just as we partnered with Alaska Native advisors to create exhibits about living in northern villages, we partnered with scientists in order to authentically represent the experience of studying climate change from a scientific perspective. Geoscientists and engineers from the University of Alaska Fairbanks' Geophysical Institute were Principal Investigators or worked closely with OMSI exhibit developers, meeting by video conference weekly for much of the development process, sourcing specimens and fossils, and providing access into the permafrost research tunnel which

was replicated for the exhibition. Other specialists at UAF, road engineers at the Alaska Department of Transportation, and paleontologists from UAF's Museum of the North were consultants.

Our summative evaluation captured evidence that visitors felt emotionally connected to the exhibits that allowed them to experience the world of a climate scientist. Visitors expressed positive emotions such as pleasure, awe, and surprise. In particular, the fossil exploration station, the replica tunnel, and the field laboratory yielded the most instances of positive emotional responses (78 percent, 74 percent and 63 percent respectively) among 99 groups tracked. Visitors also expressed negative emotions, such as disgust after pushing the smell button in the replica tunnel, or watching a cooler of food rot on the researcher's desk.

But beyond finding that visitors emotionally connected to the exhibits, evidence from the summative evaluation showed visitors had conversations about how scientists study the climate, and the importance of permafrost to climate change. Two-thirds of the tracked visitor groups reported learning "some" or "a lot" about main exhibit topics: problems caused by permafrost, relationship between permafrost/climate change, permafrost, methane and carbon dioxide release, how



Fig. 4.
The replica tunnel was carefully modeled on the tunnel located in Fox, Alaska. This image shows the exterior and entrance to the tunnel.



Fig. 5.
Visitors are invited into an immersive environment to explore fossils and ice features frozen in time since the last ice age from about 30,000 years ago.

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scientists are studying permafrost, and how people are adapting to thawing permafrost. The following conversation between an adult and child illustrates how people were making sense of the causes and consequences of thawing permafrost:

Adult: *...everything stayed frozen, what would happen if every summer was unusually warm...everything would melt and sink, what would that do to the ground around it?*

Girl: *It would pull in the ground.*

Adult: *It would make it all very unstable; think about all the structures around that rely on the permafrost to be almost like a kind of foundation.*

Girl: *Like concrete.*

Adult: *It would all start to sink in.*

Girl: *That would be scary. Thousands of people could die. That is why Alaska is very cold.*

The positive emotional responses evoked by immersive and role-playing experiences in the tunnel and lab engaged visitors in investigating permafrost and provided emotional balance to the loss and sadness expressed in other exhibits.

Conclusions

Many museums and science centers are currently wrestling with communicating climate change in ways that do not overwhelm visitors or exacerbate existing political, socioeconomic, or ideological divides. In developing *Under the Arctic*, we applied specific interpretive strategies to 1) harness emotions to elicit empathy for

the people living in places already impacted by climate change, and 2) encourage visitors to experience the world of a climate science investigator in order to engage with science and scientists. We desired to guard against museum visitors walking away feeling discouraged or hopeless in the face of a global problem, which could lead to inaction. Rather than overwhelm visitors with dire predictions or complicated content, our focus on making connections with people across geographic distances, ways of life, and scientific knowledge encouraged visitors to find the similarities in daily life and shared human emotions.

We found that taking people on the full range of an emotional journey, from sadness through resiliency, hope and action, was a key strategy for generating connection to the people living with and scientists studying our changing climate. Generating empathy for the resilience of people despite their sorrows and the challenges posed by a changing environment was a way of inspiring community-level action for the future. While we desired to generate empathy, we needed to avoid generating feelings of pity for “other” people who live in the Arctic when telling their stories in the exhibition, since the effects of climate change will require resilience in us all. Taken as a whole, our exhibition strategies were successful in engaging audience members with the exhibition’s stories and communicating the importance of permafrost in global climate change. We encourage others to explicitly leverage emotional connection when creating exhibits around the often fraught issue of climate change.

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Suzanne Perin is Post-Doctoral Researcher at the University of Alaska Fairbanks. smperin@alaska.edu

Laura Carsten Conner is Research Associate Professor, University of Alaska Fairbanks. ldconner@alaska.edu

Victoria Coats is Exhibit Research and Development Manager, Oregon Museum of Science and Industry. vcoats@omsi.edu

Angela Larson is Principal, Goldstream Group, Fairbanks, Alaska. alarson@goldstreamgroup.com