Snow: Tiny Crystals, Global Impact

Summative Evaluation Report

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Prepared for

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Executive Summary

The *Snow: Tiny Crystals, Global Impact* exhibition, a 2,000-square-foot, family-oriented museum experience designed for children ages 9 to 14 and their families, immersed visitors in the wonders of snow and its critical roles on Earth. The exhibition explored snow formation, its ecological and societal significance, and the impacts of climate change on snow systems, fostering curiosity, emotional connection, and active learning.

Developed through the National Science Foundation's Advancing Informal STEM Learning grant, the exhibition represents a collaborative effort by the University of Alaska Fairbanks, the Oregon Museum of Science and Industry (OMSI), and the Center of Science and Industry (COSI). Following its debut at OMSI, the exhibition traveled to the Fleet Science Center in San Diego, California, in Summer 2022, and the Buffalo Museum of Science Museum of Science in Buffalo Museum of Science, New York, in Fall 2022. It will continue to tour North America over an eight-year period.

To engage families and children effectively, the exhibition employed several strategies:

- **Family-friendly design:** Readable, relevant, accessible, multi-modal, multi-outcome, multi-user, and multi-sided features.
- **Interactive exploration:** Hands-on components to reveal the surprising properties of snow.
- **Personal connections:** Stories highlighting life in snow, climate change impacts, and adaptation strategies.
- **Emotional resonance:** Thematic areas inspired emotions such as awe, curiosity, empathy, urgency, hope, and belonging.

Evaluation findings, drawn from 127 multigenerational visitor groups, relied on four data collection methods: observations, audio recordings, written post-exhibition questionnaires, and brief exit interviews. These methods addressed three key evaluation questions:

- **Visitor Engagement:** How engaged are visitors with the exhibit, and how do their values and expectations shape their experience?
- **Visitor Emotions:** What emotions does the exhibition evoke, and which elements elicit these responses?
- **Visitor Learning:** What do visitors learn about climate change's impact on snow, and which aspects enhance their knowledge and interest?

Visitor Engagement

The exhibition achieved high levels of engagement, with various metrics underscoring its success. The Sweep Rate Index, which measures engagement by dividing the exhibition's square footage by average visit time, was calculated at 144.75—a strong indicator of thorough use compared to industry benchmarks. Visitors spent an average of 13 minutes and 49 seconds exploring the exhibition, with durations ranging from as short as 41 seconds to over 46 minutes, showcasing varying levels of interaction depth.

Visitor diligence was another critical indicator of engagement. Over 95% of visitor groups interacted with more than half of the exhibition components, far exceeding the threshold for thorough use. Popular components included *Watching Snow Grow* (95% interaction rate) and *Adapting Our Water Use* (97% interaction rate), which drew visitors in with their dynamic, tactile design.

Behavioral observations highlighted key actions demonstrating engagement. For example, 55% of visitors at *Snow on the Ground* pointed at exhibits, while 51% did so at *Watching Snow Grow*. Calling others over was another common behavior, observed in 30% of groups at *Snow on the Ground*. Additionally, tactile interaction was a strong indicator, with 47% of visitors touching components at *Snow on the Ground* and 45% at *Watching Snow Grow*. Sitting and pausing were also prevalent behaviors, particularly at *Storing Water for Later*, where 24% of visitors took time to sit and engage.

Visitor experiences were overwhelmingly positive, with 85% of adult visitors agreeing that the exhibition allowed them to explore ideas that were interesting, and 84% noting that it maintained their interest. Furthermore, 86% found the exhibition fun, and 75% reported they would recommend it to others. The strong correlations between perceived interest, fun, and educational value (ranging from 0.717 to 0.934) highlight how these factors reinforced overall visitor satisfaction.

Entry experiences, values, and expectations significantly influenced engagement. Visitors who expressed positive emotions, curiosity, and prior connections to snow reported higher satisfaction. For example, individuals with fond childhood experiences of snow exhibited heightened interest and enjoyment during their visit. The correlations between these entry conditions and overall visitor experience emphasize the importance of designing exhibitions that resonate with diverse visitor backgrounds and pre-existing knowledge.

Motivation to continue learning was another notable outcome. Most adult visitors expressed a desire to learn more about snow, citing both its importance and the enjoyment of gaining knowledge. Approximately 85% of respondents valued the opportunity to explore snow's properties and ecological roles, while 81% reported intrinsic motivation, highlighting the exhibition's ability to foster curiosity and inspire ongoing interest.

Visitor Emotions

The exhibition successfully evoked a diverse range of emotional responses, with a total of 1,462 verbalized emotions recorded. Awe and wonder were the most frequently expressed emotions, accounting for 540 instances, followed by curiosity at 264 instances. These emotions were particularly prominent in visually compelling components like *Watching Snow Grow* and *Snow on the Ground*, which featured dynamic, interactive, and relatable content.

Personal connections also emerged as a significant emotional response, with 187 instances of visitors verbalizing connections to their own lives or experiences. These connections were frequently observed at components such as *Snowmelt Journeys* and *Changing Global Patterns of Snow*, which included relatable themes and maps linking snow systems to communities and ecosystems.

While awe and curiosity dominated, other emotions such as empathy, urgency, and belonging were less frequently verbalized but nonetheless present. Components designed to inspire collective action, such as *Working Together for a Better World*, elicited feelings of urgency and belonging. However, these emotions were often not explicitly articulated by visitors, suggesting an opportunity for future evaluations to inquire directly about these responses. Key findings from this section include:

- **Most Frequent Emotions**: Awe/Wonder (540 instances) and Curiosity (264 instances) dominated visitor reactions, particularly in visually compelling components like *Watching Snow Grow* and *Snow on the Ground*.

- **Emotional Connections**: Components such as *Snowmelt Journeys* and *Changing Global Patterns of Snow* fostered personal connections by featuring maps and relatable themes.

- **Emotional Range**: While awe and curiosity were most common, components like *Working Together for a Better World* and *Adapting Our Water Use* prompted feelings of urgency, care, and belonging. These less verbalized emotions suggest opportunities for future evaluations to directly inquire about visitors' emotional experiences.

Visitor Learning

The exhibition effectively advanced visitors' understanding of snow, snow systems, and their significance. Visitors frequently engaged in learning behaviors such as reading aloud, asking and answering questions, and discussing content with their group. For instance, 86% of visitors at *Making Sense of Snow Crystals* placed puzzle pieces to classify crystal shapes, and 83% at *Snowmelt Journeys* pressed buttons to explore snow's role in water systems.

Key learning outcomes were organized around the exhibition's four themes. In the *Falling Snow* theme, visitors gained insights into snow crystal formation through interactive components like *Watching Snow Grow*. The *Snowpack* theme highlighted snow's role as an insulating layer and habitat, with components like *Snow on the Ground* demonstrating snowpack structure and ecological significance. The *Snowscape* theme educated visitors about snow's role in water storage, particularly through *Snowmelt Journeys*. Finally, the *Melting Snow* theme addressed climate change's impact on snow systems. While visitors grasped basic concepts about snow variability, fewer verbalized connections to climate change, highlighting an area for improvement.

Adults played a pivotal role in facilitating learning. Many used questions and observations to prompt children's exploration, deepening understanding. However, the findings also revealed a need for more explicit content linking snow to climate change and water systems. Addressing this gap through guided interpretation or enhanced exhibit design could strengthen learning outcomes.

Highlights include:

- **_Theme 1: Falling Snow_**: Visitors engaged deeply with components like _Watching Snow Grow_, where they learned how atmospheric conditions influence snow crystal growth, and _Making Sense of Snow Crystals_, where they applied knowledge to classify crystal shapes.
- **_Theme 2: Snowpack_**: The _Snow on the Ground_ component stood out, contributing to visitors' understanding of snowpack layers, insulation properties, and habitats. Visitors frequently discussed depth hoar and expressed excitement about the warm bottom snow layer and snow's role as animal shelter.
- **_Theme 3: Snowscape_**: Visitors learned about the water storage role of snow in _Storing Water for Later_ and the dependency of distant communities on snowmelt in _Snowmelt Journeys_.
- **_Theme 4: Melting Snow_**: Components like _Changing Global Patterns of Snow_ contributed to understanding the extent and variability of snow cover. However, fewer visitors verbalized learning about snow's role in climate change, suggesting an area for improvement.

Discussion

The findings underscore the exhibition's success in engaging diverse audiences and fostering emotional connections and learning about snow. Several insights emerge for enhancing future exhibitions:

- The interactive design of the exhibition was instrumental in driving engagement. Components with hands-on, tactile elements, such as _Watching Snow Grow_ and _Adapting Our Water Use_, were particularly effective. Future designs should continue to prioritize multi-sensory experiences to sustain high levels of interaction.

- The emotional depth of the exhibition could be further enhanced. While awe and curiosity were prominent, emotions such as empathy, urgency, and hope were less frequently articulated. Introducing interpretive strategies or prompts to explicitly evoke these emotions could deepen visitors' emotional engagement and drive more meaningful connections to climate action.

- Despite the exhibition's strengths in fostering learning about snow's properties and ecological roles, connections to climate change were less apparent. Future iterations could incorporate clearer messaging or guided interpretation to bridge this gap and enhance climate literacy.

- Family dynamics played a critical role in shaping visitor experiences. Adult-child interactions were pivotal in facilitating learning and sustaining engagement. Enhancing opportunities for collaborative activities could further enrich these interactions.

An analysis comparing findings across the three exhibition locations revealed no statistically significant differences in engagement, emotions, or learning outcomes. This consistency highlighted the robustness of the exhibition design and its capacity to deliver a

uniformly impactful experience, regardless of venue. Detailed statistical findings for this analysis are presented in the Appendix A.

In conclusion, *Snow: Tiny Crystals, Global Impact* was a resounding success, captivating audiences through its interactive, visually compelling design. Addressing identified gaps offers an opportunity to amplify its impact on climate literacy and environmental awareness.

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Introduction

Snow: Tiny Crystals, Global Impact is a 2,000-square-foot museum exhibition designed for families with children ages 9 to 14. This engaging and interactive exhibit immersed visitors in the wonders of snow, its formation, and its critical roles in sustaining life and regulating the planet's climate. Visitors experienced the marvel of snowstorms, explored the intricate structures of snow crystals, delved into the dynamics of snowpacks and their ecological significance, and learned about snow's vital contributions to water resources and global cooling.

This exhibition was developed as part of the National Science Foundation's Advancing Informal STEM Learning grant, Winter Worlds: Snow in Climate, Culture, and Learning. It was a collaborative effort led by snow scientists at the University of Alaska Fairbanks in partnership with the Oregon Museum of Science and Industry (OMSI) in Portland, Oregon and the Center of Science and Industry (COSI) in Columbus, Ohio.

The exhibition is organized around four central themes:

1. **Falling Snow:** Visitors dive into the science of snow crystals through interactive experiences that evoke wonder, curiosity, and inspiration. Components include *Falling Snow, Watching Snow Grow*, and *Making Sense of Snow Crystals*.
2. **Snowpack:** This theme highlights the connections between snow-covered landscapes and living organisms, fostering empathy and caring. Components include *Snow and Arctic Life, Snow on the Ground*, and *Snow Play*.
3. **Snowscape:** This theme explores how snow impacts ecosystems worldwide, emphasizing motivation and the need for protection. Components include *Storing Water for Later*, *Snowmelt Journeys*, and *Adapting Our Water Use*.
4. **Melting Snow:** Focused on the effects of climate change, this theme inspires emotions of caring, grief, hope, and action. Components include *Keeping the Earth Cool*, *Changing Global Patterns of Snow*, and *Working Together for a Better World*.

The exhibit used various strategies to engage visitors:

- Designed with family-friendly features, ensuring it was readable, relevant, accessible, and multi-faceted.
- Encouraged hands-on exploration of snow's surprising properties.
- Incorporated personal stories about life in snowy environments and adaptations to climate change.
- Elicited emotional connections across thematic areas, including feelings of awe, curiosity, empathy, urgency, hope, and belonging.

The exhibition debuted at OMSI on December 18, 2021, and ran through April 10, 2022. It was installed along the north wall of OMSI's 7,950-square-foot Life Science Hall, adjacent to other exhibits and the Life Science Lab. After its run at OMSI, the exhibition traveled to the Fleet Science Center in San Diego, California, in Summer 2022, and the Buffalo

Museum of Science in Buffalo, New York, in Fall 2022. It will continue to tour North America over an eight-year period (Appendix B: Exhibit Floor Plan).

This report summarizes the summative evaluation findings from its installations at OMSI, the Fleet Science Center, and the Buffalo Museum of Science Museum of Science. The report is structured into three sections:

1. Evaluation approach, including data collection and analysis methods.
2. Findings, organized by evaluation questions: visitor engagement, emotional engagement, and visitor learning. Emotional engagement and visitor learning findings are further categorized by exhibition themes (*Falling Snow*, *Snowpack*, *Snowscape*, and *Melting Snow*).
3. Conclusions and recommendations for future iterations.

Evaluation Approach

The overall purpose of the summative evaluation was to assess how well the strategies used in the exhibition (e.g., incorporate family-friendly characteristics) contributed to the expected impacts to increase the following in visitors:

- awareness of snow and the vital role that it plays in our global climate system and in providing essential water resources,
- knowledge of snow's properties,
- awareness of snow's role in human society and the global climate system,
- knowledge of climate change and water supply as it relates to snow, and
- interest and motivation to help mitigate and/or adapt to climate change.

The evaluation used a descriptive research design, focused on describing the ways in which visitors engaged with the exhibits, the emotions they verbalized, and the learning they verbalized and reported.

Question 1: Visitor Engagement.	Question 2: Visitor Emotions.	Question 3: Visitor Learning.
How engaged are visitor groups with *Snow: Tiny Crystals, Global Impact*? How is engagement influenced by the experiences, values, and expectations visitor groups have when they enter the exhibition?	What type of emotions do visitor groups experience from *Snow: Tiny Crystals, Global Impact*? What aspects of the exhibition elicit different emotions?	What do visitor groups learn about how climate change affects snow? What new interest and knowledge of climate change do visitors take away from the exhibition? What aspects of the exhibition elicit learning?

Data Collection Methods

To evaluate the exhibition, four methods were employed: cued visitor group observations, naturalistic cued visitor group audio recordings, a written post-exhibition questionnaire completed by one adult member of a cued visitor group, and a two-question exit interview asked of all cued visitor group members.

a. **Cued Visitor Group Observations**: Observations of visitor groups assessed dwell time and behaviors related to engagement and learning. The unit of analysis for behavioral "event" observations was a group. Group behaviors were coded under the assumption that engagement with the exhibition could occur not only through direct manipulation of a component but also by observing others manipulate components and interacting through words or gestures (see Serrell and Associates, 2009; and Hammerman et al., 2013). Specific individuals were not identified in these observations; instead, the focus was on the occurrence of behaviors while the group was near a component. (Appendix C: Evaluation Instruments)

b. **Naturalistic Visitor Group Audio Recording**: Family group recordings during their exhibition visit provided insights into engagement, emotional responses, and learning from the exhibition content. Each participating cued visitor group received an audio recorder with a wearable microphone and returned it upon self-determined completion of their time in the exhibition. Participating groups received a $10 cash incentive. (Appendix C: Evaluation Instruments)

c. **Adult Group Member Post-Exhibition Questionnaire**: A post-exhibition questionnaire was administered to one adult in each cued visitor group after completing their exploration of the exhibition. The questionnaire utilized scales developed by the Center of Science and Industry to measure respondents' 1) entry experience of "snow" (cultural and emotional relationship to the topic), 2) anticipated learning experience, 3) perceived learning experience, and 4) motivation to continue learning about snow. Demographic information was also collected. Respondents who completed the questionnaire received a $10 cash incentive. (Appendix C: Evaluation Instruments)

d. **Cued Visitor Group Exit Interview**: Before concluding the cued visitor group audio recording, two exit interview questions were asked: "What did you like most about the Snow exhibition?" and "What is one thing you learned about snow that you didn't already know?"

Informed Consent

All cued visitor groups who agreed to participate in the observation and recording signed an informed consent. In addition, the following message was posted at the entrance of the exhibition to inform OMSI visitors that evaluation was happening in the *Snow: Tiny Crystals, Global Impact* exhibition:

> Help improve exhibitions like *Snow: Tiny Crystals, Global Impact*
> We are observing, audio recording, and surveying people using this exhibition in order to make exhibitions like this one better.
> If we approach you to be observed and audio recorded but you prefer not to participate, just let us know and we will ask someone else.
> Observations and recordings are anonymous. No identifying information is collected.
> Results may be shared at education or museum conferences to inform our colleagues.

IRB Review and Ongoing Oversight

The University of Alaska Fairbanks Institutional Review Board (IRB) conducted a thorough review of the evaluation plan for the *Snow: Tiny Crystals, Global Impact* exhibition. This review was part of the broader evaluation of the research and assessment plans for the NSF-funded project, Winter Worlds: Snow in Climate, Culture, and Learning. The IRB ensured that all evaluation activities adhered to ethical standards, safeguarded participant confidentiality, and maintained the integrity of the research process.

Sample

Family groups visiting the *Snow: Tiny Crystals, Global Impact* exhibition, including at least one child aged 9 to 14, were sampled for observation. Some groups also included younger children. A "family group" was defined as a multigenerational visiting unit of no more than six members, with at least one child between the ages of 9 to 14 and one adult aged 19 or older (Borun et al., 1998). The group size was limited to six individuals to enhance the ability to identify group members on audio recordings.

Instrument	Sample Size
Cued Visitor Group Observations	127
Naturalistic Visitor Group Audio Recordings (subset of cued visitor group observations)	121
Adult Group Member Post-Exhibition Questionnaires (subset of cued visitor group observations)	104

Every family entering the exhibition area and crossing an imaginary line in front of the Title and Credit panel was approached to participate in the observation. One adult member from each observed group was invited to complete a written post-exhibition questionnaire. The table above presents the cued visitor group sample size for each instrument. Below is a summary of the respondents' demographics.

Sample Demographics

Race/Ethnicity (n=104[1])

White	77%
Hispanic or Latino/a	15%
Asian American	7%
Black or African American	4%
Native American or Alaska Native	2%
Pacific Islander/Native Hawaiian	2%
Prefer not to say/Other	10%

[1] Does not sum to 100% because visitors were able to select more than one race/ethnicity

Snow Zone (n=104)

Ephemeral	31%
Taiga	28%
Maritime	19%
Warm Forest	10%
Prairie	9%
Tundra	1%
Live Outside North America	2%
No Response	1%

Rural Living (n=104)

No	67%
Yes	33%

Location of Sample (n=104)

Buffalo 9%
San Diego 21%
Oregon 69%

Gender Breakdown (n=104)

Prefer not to say 2%
Male 30%
Female 67%
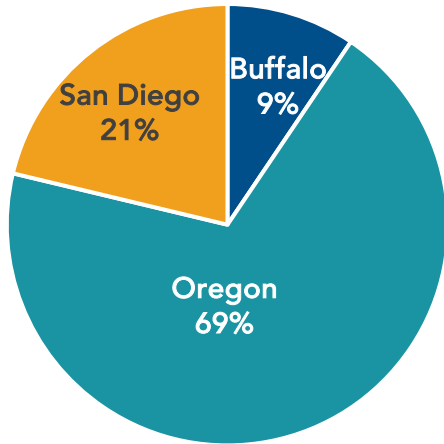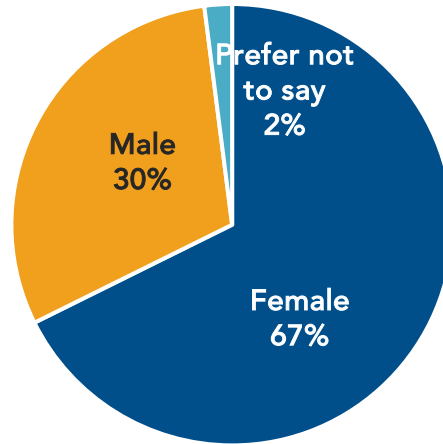
Age Breakdown (n=104)
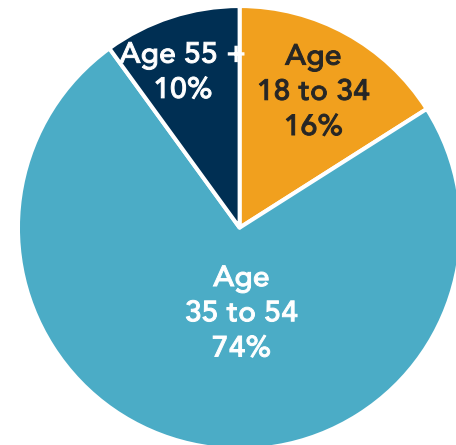
Age 55 + 10%
Age 18 to 34 16%
Age 35 to 54 74%

Data Analysis

A combination of R, Excel, and IBM SPSS Statistics Version 22 was used to analyze observations, post-exhibition questionnaires, and recorded conversations. Recorded conversations and statements were coded using ATLAS.ti. Analyses included frequency distributions (e.g., the percentage of visitors who stopped at a component or engaged in specific behaviors), summary statistics (e.g., average time spent at a component), and inferential statistics. The specific calculations and statistical tests used to address each evaluation question are outlined below.

Question 1: Visitor Engagement. How engaged are visitor groups with *Snow: Tiny Crystals, Global Impact*? How is engagement influenced by the experiences, values, and expectations visitor groups bring to the exhibition?

To assess visitor engagement, several metrics were used. First, the average time spent in the exhibition was calculated for each cued visitor group. This data was then used to create a histogram, categorizing the time spent in the exhibition into the following intervals: less than 5 minutes, 5 to 9 minutes, 10 to 14 minutes, 15 to 19 minutes, 20 to 24 minutes, 25 to 30 minutes, and more than 30 minutes. This breakdown helped to highlight patterns in the amount of time visitors spent interacting with the exhibition.

Next, the Sweep Rate Index, developed by Serrell in 2010, was calculated for the exhibition. The Sweep Rate Index is determined by dividing the exhibition's square footage (2,000 square feet) by the average total time spent by visitors. A lower Sweep Rate Index, on a scale from 0 to 1,000, suggested higher engagement, as visitors spend more time exploring and engaging with the exhibition's content.

In addition, visitor group diligence was assessed by determining the percentage of cued visitor groups that interacted with more than half of the exhibition components. This measure of engagement, referred to as the "thorough use" metric, was calculated by comparing the number of diligent visitor groups to the Sweep Rate Index. This metric provides insight into how thoroughly visitors engaged with the exhibition.
Visitor behaviors indicative of engagement was also quantified. These behaviors included actions such as pointing and calling others over to view a specific component, as well as interacting with the exhibition by touching or manipulating components (e.g., pushing a button or turning a handle). The percentage of cued visitor groups that exhibited these behaviors was calculated for each exhibition component, providing a further measure of visitor engagement.

Finally, Pearson's Correlation Coefficient was used to assess the strength and direction of the linear relationships between various variables. These variables included the quality of the learning experience as reported by adult visitors in the post-exhibition questionnaire and the amount of time spent in the exhibition, as well as visitors' entry experiences, values, and expectations. The analysis also explored correlations between visitors' anticipated feelings of autonomy, relatedness, and competence (both positive and negative), and their motivation to learn more about snow.

<u>Question 2: Visitor Emotions</u>. What type of emotions do visitor groups experience from *Snow: Tiny Crystals, Global Impact*? What aspects of the exhibition elicit different emotions?

To assess the emotions experienced by visitors, audio recordings from cued visitor groups were transcribed and analyzed for verbalized emotions. A predefined set of *a priori* codes was applied to the transcripts to identify emotional expressions. These emotional responses were then counted and categorized by exhibition component to determine which areas of the exhibition elicited the most emotional reactions. In addition to the counts, illustrative examples of emotional expressions were provided to give context and highlight specific components that provoked strong emotions in visitors.

Table 1: A priori codes for emotions

Emotion Code	Example Quotations
Awe	"Wow, this is amazing"
Attraction	"I am interested in this" "This calls to me"
Wonder	"I am surprised by this!"
Curiosity	Asks a question "I wonder what would happen if….." "I want to learn more about that"
Inspiration	Describes a want to create or express themselves
Relationship	Describes a close association or role within a system
Connection	Describes a close association or role within a system
Empathy	Describes a deep understanding / sharing an emotion or feeling "I relate to XXX"
Caring	Describes a concern or want to support something
Motivation	"I want to help" "I can make a change"
Protection	Person describes a want to protect people, animals, and other life – preventing harm
Urgency	A time-based need to become active in climate change- related cause
Grief	Sadness, guilt, anxiety, helplessness
Hope	"This is possible" "We can do it!"
Belonging in collective action	"Together, we can make a difference" "We can do this together" "If we make small changes, we can stop climate change" "Our efforts together are important"
Dislike/ frustration	Person describes dislike or annoyance or frustration toward a component or experience (e.g. "I don't like this," "I don't want to do this anymore," "I'm bored," or "This is too hard."
Bizarre/ strange	"ohhhh weird!!!" Describes something as unusual or unexpected

Question 3: Visitor Learning. What do visitor groups learn about how climate change affects snow? What new interest and knowledge of climate change do visitors take away from the exhibition? What aspects of the exhibition elicit learning?

To evaluate visitor learning, the number of times cued visitor groups engaged in behaviors that facilitate learning was counted. These behaviors included actions such as reading aloud, asking and answering questions, and parent/child interactions. The percentage of cued visitor groups that engaged in each of these behaviors was then calculated for each exhibition component. This analysis provided insight into which parts of the exhibition encouraged learning behaviors.

Additionally, cued visitor groups were asked to share what they had learned about snow during their visit to the exhibition. A total of 121 responses were collected, with multiple participants often providing answers within a group. These responses were transcribed and analyzed using ATLAS.ti software. The responses were coded to identify key learning outcomes and to better understand what visitors retained from the exhibition experience.

Finally, audio recordings were transcribed, and verbal statements indicating learning were coded using a set of predefined *a priori* codes. The total number of learning-related statements was calculated for each exhibition component, providing further evidence of the areas of the exhibition that were most effective in promoting learning. Illustrative examples of learning statements were also included to highlight the specific ways in which visitors engaged with and internalized the exhibition content.

Table 2: A priori codes for learning

Learning Code	Example Quotations
Utilize scientific language	"That is a capped column snowflake!" "Woahhhhh a graupel!" "Awww how cute, the pika is sleeping."
Evidence of higher order thinking	"That's kind of the way satellites... Take pictures." "Okay, are all the pictures the same or are they a little different?" "And then what happened?" "Alaska is up there, so that's Alaska, and then Arctic region." "Let's see what happens when they get close to each other, because they don't have water vapor."
Content Specific Learning Goals Described in Exhibition Records	"The water in this dam has decreased dramatically."
	"Snow reflects the heat of the sun because it is white, more reflective." "Emissions cause global temperatures to rise." "More wildfires are a result of climate change." "Loss of snow accelerates climate change."
	"Snowmelt saves water for later use." "Animals rely on snowmelt for water."
	"All snowflakes have six sides!" "Look at how symmetrical the snowflakes are!"
	"Homes use less water than farms!" "This globe is hotter!" "Water travels faster than snow!"
	"Dry snow is better for building snowmen." "Temperature, humidity, changes snowflake formation."
	"Water is snow!" "Water in solid state is a snowflake." "Water changes form when…." "Water is transferred between objects (in various ways)."
Verbalized new information	"Wow, I didn't know that before!"

Findings

The findings are organized to address the primary evaluation questions guiding this evaluation:

- **Visitor Engagement**: To what extent are visitor groups engaged with the *Snow: Tiny Crystals, Global Impact* exhibition? How do visitor groups' prior experiences, values, and expectations influence their engagement with the exhibition content and activities? Metrics such as time spent, thoroughness of exploration, and observed behaviors are analyzed to provide a comprehensive assessment of engagement.

- **Visitor Emotions**: What emotions do visitor groups experience during their visit to the exhibition? Which specific aspects of the exhibition evoke these emotional responses? By examining self-reported and observed emotions, the study seeks to understand the role of affective experiences in shaping visitors' overall perception of the exhibition.

- **Visitor Learning**: What do visitor groups learn about the impact of climate change on snow? How does the exhibition foster new interest and knowledge about this critical topic? Findings highlight the aspects of the exhibition that most effectively promote learning and curiosity, as well as the ways in which visitors connect the content to broader environmental issues.

This section presents a detailed analysis of the data collected across the three exhibition locations, utilizing both qualitative and quantitative methods. Key themes and patterns are identified, with findings supported by statistical correlations, observational data, and visitor feedback to provide actionable insights for enhancing engagement, emotional resonance, and learning outcomes in future exhibitions.

Visitor Engagement

Visitor engagement is a multidimensional construct that includes the time spent in the exhibition, the thoroughness of exploration, and the behaviors exhibited by cued visitor groups. This evaluation considers several key metrics: the average time spent in the exhibition, Serrell's Sweep Rate Index (2010), visitor diligence, and Serrell's thorough use metric. Additionally, observed cued visitor behaviors that demonstrate active engagement—such as participation in interactive elements, discussions within groups, and extended viewing—are reported. The analysis also explores learning experience satisfaction, which is closely linked to engagement, and examines how factors like visitors' entry experiences, values, and expectations influence their interactions with the exhibit.

Findings are analyzed and reported across three exhibition locations, highlighting patterns and variations in engagement. These insights provide actionable information on how visitors connect with the exhibit's content and design.

Average time spent in the exhibition

On average, cued visitor groups spent 13 minutes and 49 seconds in the exhibition. The least time spent by a group was 41 seconds, and the most time spent by a group was 46 minutes and 17 seconds.
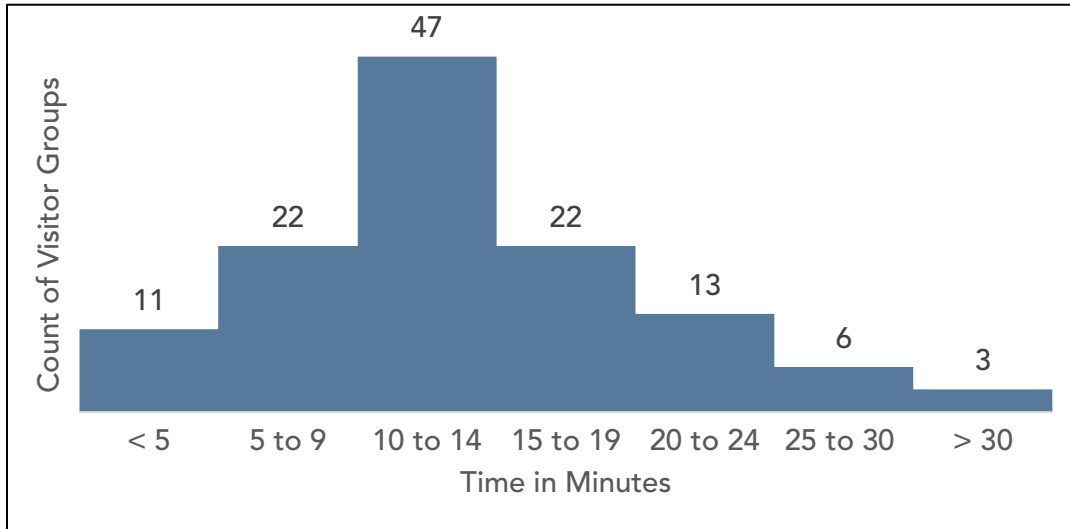

Figure 1: Histogram of total time spent in the Snow: Tiny Crystals, Global Impact exhibition

Serrell's Sweep Rate Index

Serrell's Sweep Rate Index (2010) for the *Snow: Tiny Crystals, Global Impact* exhibition was 144.75 which is on the lower (and thus more positive) end of Serrell's scale of 0 to 1,000. A lower sweep rate indicates that visitors spent more time in the exhibition.

Visitor Diligence

Cued visitor groups in the *Snow: Tiny Crystals, Global Impact* exhibition demonstrated high levels of diligence, with more than 95% of groups stopping at over half of the exhibition components. Among the components, the most frequently visited was *Snow on the Ground*, a large, visually striking structure shaped to resemble a snowpack, showcasing distinctive snow layers in Taiga/Tundra and Maritime snowpacks.

In contrast, the least visited component was *Working Together for a Better World*, which invited visitors to engage in a reflective activity by cutting out snowflakes, writing their thoughts on snow and climate change, and contributing their creations to a collective display. Figure 2 provides a visual representation of the cued visitor group stop rates for each exhibition component, highlighting patterns of visitor interaction across the exhibition.

Falling Snow	87%
Watching Snow Grow	90%
Making Sense of Snow Crystals	82%
Snow and Arctic Life	80%
Snow on the Ground	97%
Snow Play	63%
Storing Water for Later	81%
Snowmelt Journeys	81%
Adapting Our Water Use	77%
Keeping Earth Cool	81%
Changing Global Patterns of Snow	84%
Working Together for a Better World	62%

Percent of Tracked Visitor Groups that Stopped
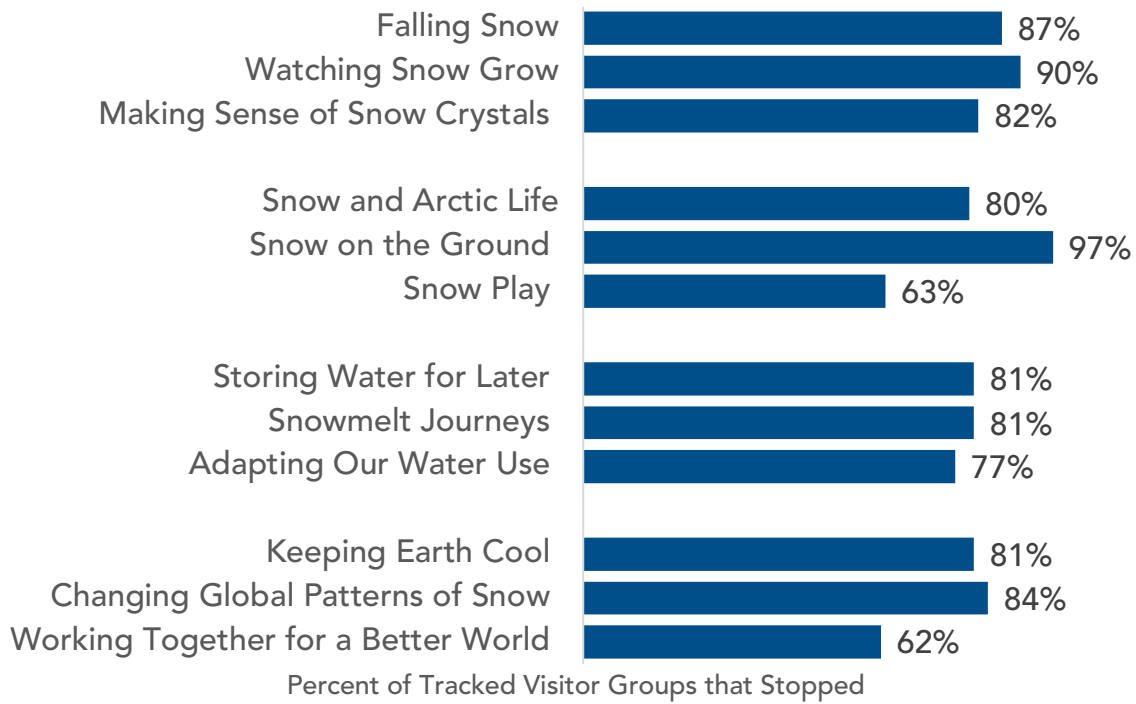
Figure 2: Percent of cued visitor groups that stopped at each component

Thorough Use

Serrell's (2010) thorough use metric provides strong evidence that the *Snow: Tiny Crystals, Global Impact* exhibition effectively engaged cued visitor groups. According to Serrell's criteria, exhibitions with a Sweep Rate Index (SRI) of less than 300 and a Percent Diligent Visitor greater than 50% are classified as "exceptionally thoroughly" used. The exhibition met and exceeded these benchmarks, indicating exceptionally thorough engagement (Figure 3). This performance situates the exhibition as highly competitive when compared to Serrell's broader exhibition database, underscoring its success in capturing and maintaining visitor attention through its design and content.

Figure 3: "Thorough Use" metric, or Percent Diligent Visitors vs. Sweep Rate by Serrell (2010); Snow: Tiny Crystals, Global Impact *score indicated by snowflake, blue shaded area is considered "exceptionally thoroughly" used*
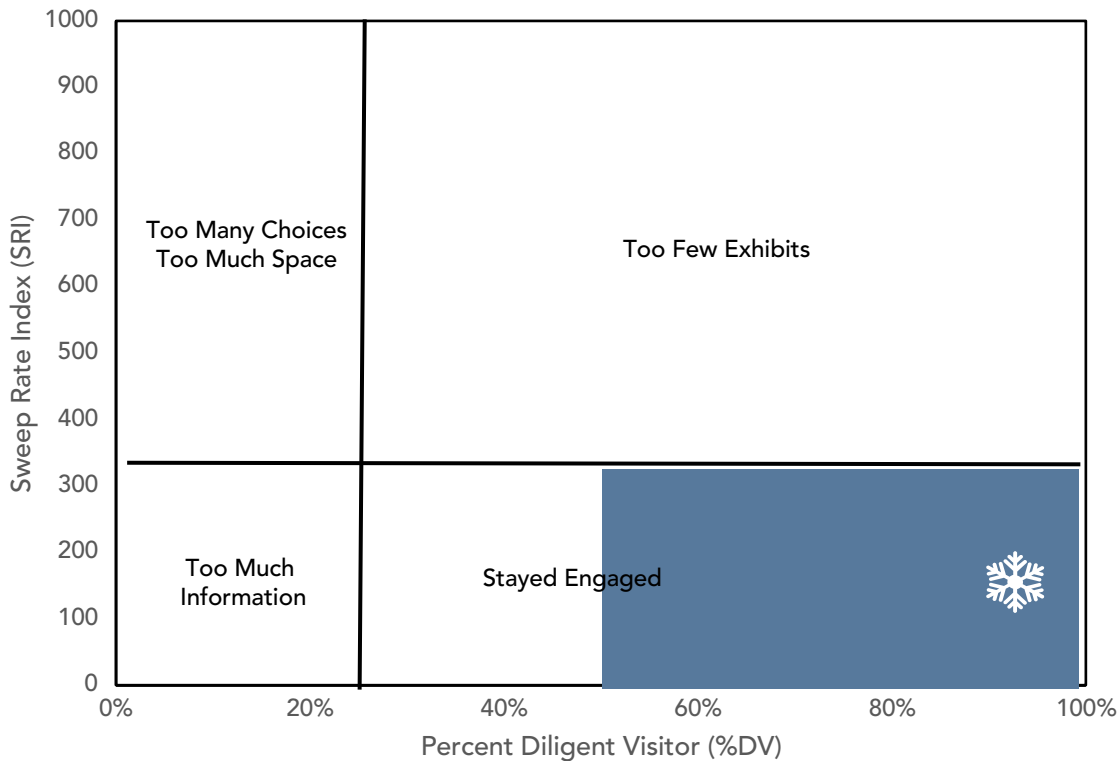
Behaviors Indicative of Engagement

During the observation phase, various physical behaviors, indicative of visitor engagement, were recorded across the exhibition's components. These behaviors included calling someone over, pointing at exhibits, sitting on benches or stools, and touching objects. The most frequently observed behaviors varied by exhibition theme and component:

- In *Theme 1: Falling Snow,* the *Grow a Snow Crystal* component saw the highest levels of pointing (51%) and touching (45%), while calling someone over was observed in 17% of the visitors. The *Nakaya Diagram* component had 43% of visitors pointing and 42% touching, while calling someone over occurred in 3% of the visitors.

- In *Theme 2: Snowpack,* the *Snowpack* component had the highest pointing rate (55%), with 47% of visitors touching the display. The *Snow Play* component saw 33% of visitors touching, with 19% pointing and 8% calling someone over.

- For *Theme 3: Snowscape,* the *Snowmelt Map* recorded the highest pointing (63%) and sitting (24%), with 45% of visitors touching. The *Climate*

Adaptation component had 47% of visitors pointing, with 43% touching, and 2% calling others over.

- In **Theme 4: Melting Snow**, the *Talk Back Blizzard* component had notable sitting (42%), pointing (37%), and touching (33%) behaviors, while the *Compare Climates* component recorded 46% of visitors touching the exhibit and 31% pointing. The *Snow Cover Over Time* component saw 37% of visitors pointing and 35% touching.

These observed behaviors reflected the varied ways visitors engaged with different components of the exhibition, demonstrating particular interest in tactile and interactive experiences. The full breakdown of engagement behaviors across all components is detailed in Table 3.

Table 3: Percent of cued visitor groups that showed general physical behaviors indicative of engagement, organized by Snow: Tiny Crystals, Global Impact component

Exhibition Component	n	Call someone over	Point	Sit	Touch
Theme 1: Falling Snow					
Falling Snow	102	7%	43%	1%	7%
Watching Snow Grow	111	17%	51%	-	45%
Making Sense of Snow Crystals	99	3%	43%	10%	42%
Theme 2: Snowpack					
Snow and the Arctic	83	5%	34%	17%	39%
Snow on the Ground	116	30%	55%	1%	47%
Snow Play	78	8%	19%	5%	33%
Theme 3: Snowscape					
Storing Water for Later	97	11%	63%	24%	45%
Snowmelt Journeys	94	4%	40%	7%	41%
Adapting Our Water Use	88	2%	47%	16%	43%
Theme 4: Melting Snow					
Keeping Earth Cool	97	12%	31%	2%	46%
Changing Global Patterns of Snow	105	6%	37%	-	35%
Working Together for a Better World	76	8%	37%	42%	33%

Observations of visitor interactions revealed varied levels of engagement with the unique interactive features of each exhibition component. Many components saw strong participation, with *Watching Snow Grow* showing 95% of visitors turning the knob to engage with the exhibit. Similarly, *Adapting Our Water Use* recorded 97% of visitors picking up weights, highlighting its high level of interaction.

Highlights included *Watching Snow Grow*, where 95% of visitors turned the knob, and *Adapting Our Water Use*, where 97% picked up weights. Other popular activities included spinning the interactive element in *Changing Global Patterns of Snow* (93%) and pressing buttons in *Snowmelt Journeys* (up to 83%).

Some components saw moderate interaction, such as *Build a Snowman* in *Snow Play* (72%) and *Making Sense of Snow Crystals*, where 86% placed puzzle pieces. However, components with reading or video elements, like *Snow and Arctic Life* and *Snow on the Ground* panels, had lower engagement, with less than 50% of visitors interacting with these features.

These observations, detailed in Table 4 provide insights into which interactive features resonate most with visitors, highlighting strengths while identifying opportunities for improvement.

Table 4: Percent of cued visitor groups that used interactive features, organized by Snow: Tiny Crystals, Global Impact component

Exhibition Component	n	Count	Percent
Theme 1: Falling Snow			
Falling Snow			
Move body(ies) to interact with different kinds of falling snow	102	89	87%
Watching Snow Grow			
Turn knob	111	105	**95%**
Making Sense of Snow Crystals			
Place puzzle pieces - ANY (incomplete)	99	85	86%
Place puzzle pieces - One or more sequences correct (for either set of puzzle pieces)	99	55	56%
Theme 2: Snowpack			
Snow and Arctic Life			
Look at ptarmigan (viewing hole)	83	34	41%
Watch video 1: Words for Snow	83	44	53%
Watch video 2: Snow is Shelter	83	12	14%
Watch video 3: Snow and Arctic Life	83	13	16%
Watch video 4: Travel in Snow	83	5	6%
Watch video 5: Snow and Ice as a Water Source	83	5	6%
Snow on the Ground			
Maritime - Lift the microscope - slider (Maritime)	116	77	66%
Maritime - Look at marmot (lower - viewing hole of Marmot)	116	63	54%
Maritime - Look at pika - viewing hole of habitat	116	60	52%
Maritime - Look at watermelon snow (upper - viewing hole)	116	64	55%
Read/ look at Maritime panel - temperatures, water/ ice***	116	31	27%
Read/ look at P1 - Snow on the ground overview (map at top, brief overviews of all 3 types)	116	19	16%
Read/ look at P2 - Snow crystals maritime (back - inside of arch)	116	25	22%
Read/ look at P3 - Snow crystals taiga/ tundra (front inside arch)	116	25	22%
Read/ look at P4 - Life in the snow (who can you find in the snow?)	116	48	41%
Snow on the Ground panels	116	7	6%
Taiga - Look at lemming (upper / closest to arch)	116	88	76%
Taiga - Look at frog (lower - viewing hole of habitat in ground)	116	94	81%
Taiga - Read drawer content	116	77	66%
Tundra - Read drawer content	116	81	70%
Tundra - Look at ermine - hole viewing habitat in ground	116	74	64%
Tundra - Read drawer content (2)	116	81	70%

Exhibition Component	n	Count	Percent
Snow Play			
Build a snowman	78	56	72%
Knock snowman down	78	15	19%
Look at images	78	18	23%
Place velcro items inside snowman mold	78	18	23%
Theme 3: Snowscape			
Storing Water for Later			
Press Button	94	82	87%
Snowmelt Journeys			
Button 1: Colorado River	97	78	80%
Button 2: Dams	97	81	83%
Button 2: Snow Monitoring Sites	97	78	80%
Button 4: Las Vegas	97	73	75%
Button 5: Farms	97	71	73%
Button 6: Grand Junction	97	75	77%
Button 7: Long distance water users	97	78	80%
Button 8: Los Angeles	97	70	72%
Adapting Our Water Use			
Look Through Book	88	25	28%
Pick up Weights	88	85	**97%**
Theme 4: Melting Snow			
Keeping Earth Cool			
Puts hand between lamp and globe (air temperature)	97	45	46%
Touch globes	97	93	**96%**
Changing Global Patterns of Snow			
Spin	105	98	**93%**
Working Together for a Better World			
Make a snowflake	76	52	68%
Write / draw on the snowflake	76	37	49%
Drop snowflake in a slot	76	38	50%
Look at Snowflakes that were hung up	76	38	50%
Look up QR code info on phone	76	-	-

Visitor Experience Overall

The findings from the post-exhibition questionnaire indicated that most adult members of cued visitor groups had a positive engagement with the *Snow: Tiny Crystals, Global Impact* exhibition. A high percentage of respondents (85%) agreed that they were able to explore ideas that were interesting to them, and 84% felt that the exhibition kept them

interested. Additionally, 83% liked the exhibition, and 86% found it fun. Respondents also expressed increased enjoyment of snow after experiencing the exhibition, with 66% agreeing that they would enjoy snow more as a result of their visit. Furthermore, 75% of participants would recommend the exhibition to others. On the educational front, 85% of respondents learned something new about snow, and 85% felt that the exhibition helped them understand the world around them. However, fewer respondents (45%) reported learning something new about another culture.

Overall, the results demonstrated that the exhibition successfully engaged visitors, sparked their interest, and contributed to both emotional and intellectual takeaways. See Figure 4 for a full breakdown.
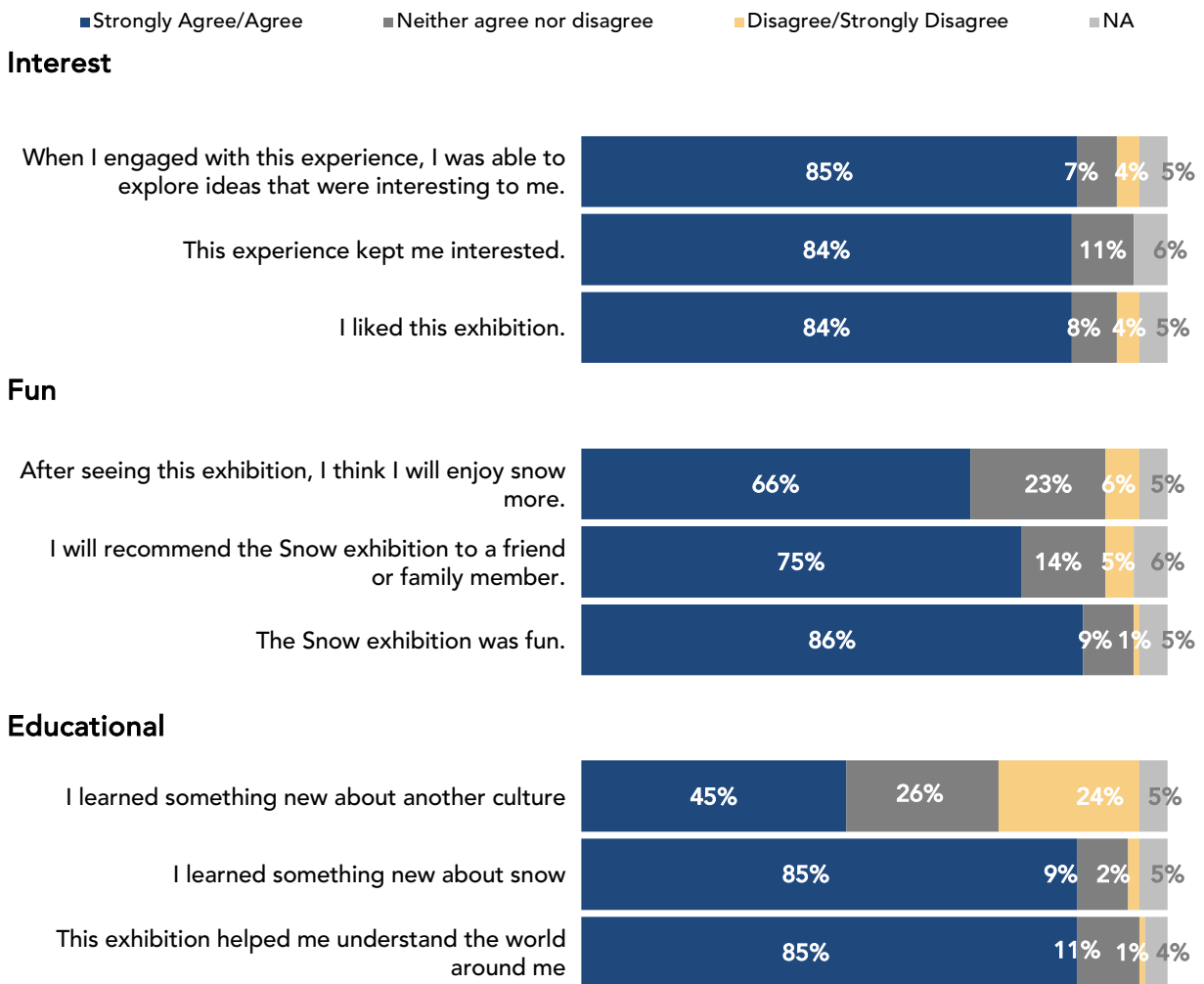
■Strongly Agree/Agree   ■Neither agree nor disagree   ■Disagree/Strongly Disagree   ■NA

Interest

When I engaged with this experience, I was able to explore ideas that were interesting to me. | 85% | 7% 4% 5%
This experience kept me interested. | 84% | 11% 6%
I liked this exhibition. | 84% | 8% 4% 5%

Fun

After seeing this exhibition, I think I will enjoy snow more. | 66% | 23% 6% 5%
I will recommend the Snow exhibition to a friend or family member. | 75% | 14% 5% 6%
The Snow exhibition was fun. | 86% | 9% 1% 5%

Educational

I learned something new about another culture | 45% | 26% 24% 5%
I learned something new about snow | 85% | 9% 2% 5%
This exhibition helped me understand the world around me | 85% | 11% 1% 4%

Figure 4: Percent distribution of those who found the exhibition to be interesting, fun, or educational.

As reported by adult members of cued visitor groups who completed the post-exhibition questionnaire, there were strong positive correlations between the key factors of interest, fun, and educational values, indicating that as one factor increases, the others tend to improve as well. Specifically, these three elements all contributed meaningfully to

the overall visitor experience, with each factor reinforcing the others. The high correlation values (ranging from 0.717 to 0.934) suggest that a more engaging, fun, and educational experience is closely linked to a more positive overall perception. These findings highlighted the importance of designing learning experiences that integrate interest, fun, and educational components effectively. Improving any one of these elements is likely to enhance the overall learning experience for visitors. For further details, refer to Table 5: Pearson's correlations for time and visitor experiences-educational, fun and interesting (n=104).

Table 5: Pearson's correlations for time and visitor experiences-educational, fun and interesting (n=104).

	Visitor Experience Overall	Interest	Fun	Educational
Interest	0.920**	1	0.826**	0.717**
Fun	0.934**	0.826**	1	0.738**
Educational	0.896**	0.717**	0.738**	1

Note. ** = Correlation is statistically significant at the 0.01 level (2 tailed)

Entry experiences, values, and expectations

The correlation analysis revealed varying degrees of significance between several factors related to visitor experience, interest, fun, and educational values, and how they relate to other variables such as experiences with snow as a child, cultural background, current beliefs about snow, snow images, positive emotions, intrigued, and other conditions (Table 6).

Table 6: Pearson's correlations for entrance narratives and visitor experiences – educational, fun, and interesting (n = 104)

	Experiences with Snow as a Child	Cultural Background	Current Beliefs About Snow	Snow Images	Positive Emotions	Intrigued	Other Conditions
Visitor Experience Overall	0.217	0.053	0.389**	0.324**	0.518**	0.333**	0.138**
Interest	0.332*	0.100*	0.399**	0.280**	0.490**	0.332**	0.235**
Fun	0.125	0.043	0.392**	0.325**	0.408**	0.286**	0.114
Educational	0.151	0.008	0.281*	0.285**	0.527**	0.300**	0.04

Note. * = Correlation is statistically significant at the 0.05 level (2 tailed); ** = Correlation is statistically significant at the 0.01 level (2 tailed)

- Visitor experience overall showed statistically significant positive correlations with current beliefs about snow (0.389), snow images (0.324), positive emotions (0.518), intrigued (0.333), and other conditions (0.138), with the strongest

association being with positive emotions. These correlations suggested that visitors' positive emotional responses to snow significantly enhance their overall experience.

- Interest demonstrated significant positive correlations with experiences with snow as a child (0.332), current beliefs about snow (0.399), snow images (0.280), positive emotions (0.490), intrigued (0.332), and other conditions (0.235), highlighting that increased interest was associated with several factors that influence the overall learning experience.

- Fun showed moderate yet significant correlations with current beliefs about snow (0.392), snow images (0.325), and positive emotions (0.408), indicating that fun was strongly connected to emotional responses and perceptions about snow.

- Educational was positively correlated with current beliefs about snow (0.281), snow images (0.285), positive emotions (0.527), and intrigued (0.300), suggesting that the educational impact was more significant when visitors feel emotionally connected to the content.

Overall, the results underscored the vital role of positive emotions and intrigue in shaping visitor experiences, interest, and educational engagement with the snow exhibition. The statistically significant relationships emphasized the importance of designing experiences that elicit positive emotional responses and stimulate curiosity, especially through snow imagery and personal beliefs about snow.

Four anticipated learning experiences were also positively correlated with questionnaire respondents' visitor experiences (Table 7). Overall, visitor experience was positively correlated with anticipated feelings of autonomy (0.429), relatedness (0.324), and competence satisfaction (0.456), and negatively correlated with competence frustration (0.209). This finding indicated that visitors who anticipate a sense of control, connection, and competence are more likely to report a positive overall experience.

Interest also showed strong positive correlations with autonomy (0.526), relatedness (0.413), and competence satisfaction (0.477), and a moderate negative correlation with competence frustration (-0.267), suggesting that feelings of autonomy and competence significantly boost visitors' interest.

Similarly, fun is positively linked to autonomy (0.474), relatedness (0.300), and competence satisfaction (0.491), and negatively correlated with competence frustration (-0.263), indicating that fun is influenced by these cognitive and emotional factors.

Finally, educational value showed weaker but still significant correlations with autonomy (0.192), relatedness (0.188), and competence satisfaction (0.292), with no significant link to competence frustration (-0.053), suggesting that while educational value is positively impacted by autonomy and competence, its influence is less pronounced than for interest and fun. These findings highlighted the importance of fostering a sense of autonomy, connection, and competence to enhance visitor engagement, interest, enjoyment, and overall learning experience.

Table 7: Pearson's correlations for anticipated feeling of autonomy, relatedness, sense of competence, and competence frustrations and visitor experience quality – educational, fun, and interesting (n = 104)

	Anticipated feelings of autonomy	Anticipated feelings of relatedness	Anticipated satisfied sense of competence	Anticipated competence frustration
Visitor Experience Overall	0.429**	0.324**	0.456**	-0.209**
Interest	0.526**	0.413**	0.477**	-0.267**
Fun	0.474**	0.300**	0.491**	-0.263**
Educational	0.192**	0.188**	0.292**	-0.053

Note. * = Correlation is statistically significant at the 0.05 level (2 tailed); ** = Correlation is statistically significant at the 0.01 level (2 tailed)

Motivation to Continue Learning[1]

Most adult members of cued visitor groups who completed the post-exhibition questionnaire were motivated to continue learning about snow either because it is important to learn more about snow or because "It will be fun."

- A large majority (85%) of respondents agreed that it is important to learn about the exhibition's subject, and 86% expressed that they value learning new things.
- Additionally, 81% of visitors indicated that they enjoy learning about such topics, and 80% found the exhibition to be fun and interesting.
- A substantial portion of respondents also showed intrinsic motivation, with 80% believing the experience would be interesting and fun, and 75% anticipating it would be satisfying.
- However, a significant number of visitors did not agree with statements reflecting introjected values, such as feeling bad about themselves if they didn't participate, indicating that engagement was not primarily driven by feelings of obligation or guilt.

These findings emphasized that intrinsic interest, rather than a sense of personal responsibility, is the primary motivation driving visitor engagement. This suggested the exhibition successfully tapped into positive and self-determined motivation factors to engage visitors. See Figure 5 for a breakdown of each variable.

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[1] **Motivation to Continue Learning** was measured with items derived from the self-regulation questionnaires (Ryan & Connell, 1989) that defines motivational qualities as either internally or externally regulated. Internally regulated motivation can be intrinsic (characterized by engaging in an activity for its own sake because it is inherently interesting or enjoyable) or identified (characterized by engaging in an activity because it is important to do so). Externally regulated motivation can be introjected (motivated by feelings of guilt) or extrinsic (characterized by participating under threat of punishment). Finally, people can be amotivated (not motivated at all). Most adult members of cued visitor groups who completed the post-exhibition questionnaire were internally motivated to continue learning about snow either because it is important to learn more about snow (identified) or because it will be fun (intrinsic).

Intrinsic motivation and identified motivation were positively and strongly correlated with questionnaire respondent's visitor experience quality (n=104).
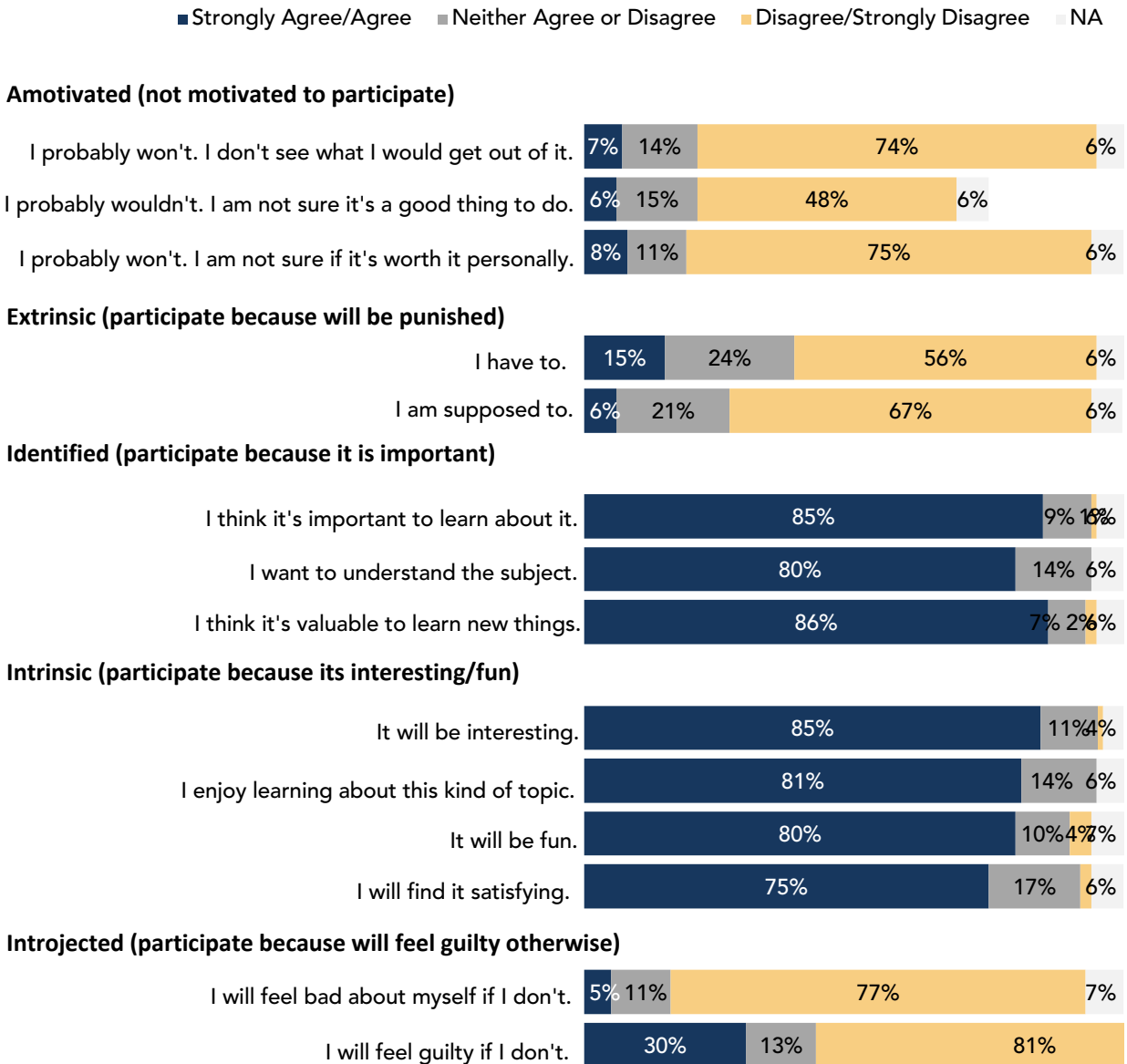
■ Strongly Agree/Agree ■ Neither Agree or Disagree ■ Disagree/Strongly Disagree ■ NA

Amotivated (not motivated to participate)

Statement				
I probably won't. I don't see what I would get out of it.	7%	14%	74%	6%
I probably wouldn't. I am not sure it's a good thing to do.	6%	15%	48%	6%
I probably won't. I am not sure if it's worth it personally.	8%	11%	75%	6%

Extrinsic (participate because will be punished)

Statement				
I have to.	15%	24%	56%	6%
I am supposed to.	6%	21%	67%	6%

Identified (participate because it is important)

Statement				
I think it's important to learn about it.	85%	9%	1%	6%
I want to understand the subject.	80%	14%		6%
I think it's valuable to learn new things.	86%	7%	2%	6%

Intrinsic (participate because its interesting/fun)

Statement				
It will be interesting.	85%	11%		4%
I enjoy learning about this kind of topic.	81%	14%		6%
It will be fun.	80%	10%	4%	7%
I will find it satisfying.	75%	17%		6%

Introjected (participate because will feel guilty otherwise)

Statement				
I will feel bad about myself if I don't.	5%	11%	77%	7%
I will feel guilty if I don't.	30%	13%	81%	

Figure 5: Motivation to continue learning

The analysis revealed that intrinsic and identified motivations were strongly and positively associated with visitor experience dimensions, including overall satisfaction, interest, fun, and educational value. The highest correlations were observed between intrinsic motivation and overall visitor experience ($r = 0.861$, $p < 0.01$), underscoring the importance of fostering intrinsic interest in enhancing engagement. Identified motivation also showed significant positive relationships across all dimensions, particularly with overall experience ($r = 0.751$, $p < 0.01$). In contrast, amotivation is negatively correlated with all visitors experience

dimensions, indicating that a lack of motivation detracted from engagement and enjoyment. Extrinsic and introjected motivations displayed weaker and less consistent relationships, suggesting they were less impactful in driving a meaningful visitor experience. These findings emphasized the critical role of intrinsic and identified motivations in shaping positive exhibition outcomes. See Table 8 for the breakdown.

Table 8: Pearson's correlations for anticipated motivation to further explore the topic of snow and visitor experiences – educational, fun, and interesting (n =104)

	Intrinsic	Identified	Amotivated	Extrinsic	Introjected
Visitor Experience Overall	0.861**	0.751**	-0.536**	-0.312	-0.228*
Interest	0.815**	0.758**	-0.530**	-0.314*	-0.288
Fun	0.818**	0.692**	-0.524**	-0.340	-0.291*
Educational	0.738**	0.622**	-0.424**	-0.206	-0.054

Note. ** = Correlation is significant at the 0.01 level (2-tailed); * = Correlation is significant at the 0.05 level (2-tailed).

Visitor Emotions

This section of the report addressed Evaluation Question 2: What types of emotions do visitor groups experience from *Snow: Tiny Crystals, Global Impact*, and what aspects of the exhibition elicit different emotions? Emotions are first described overall, comparing the frequency of each tracked emotion verbalized by visitors. This is followed by an analysis of emotions expressed in relation to each component of *Snow: Tiny Crystals, Global Impact*.

Emotions Overall

Visitor groups were clearly emotionally engaged with the *Snow: Tiny Crystals, Global Impact* exhibition. In total, 1,462 instances of verbalized emotions were coded from visitor recordings. The most frequently expressed emotions were awe/wonder (e.g., fascination, amazement) with 540 instances, followed by curiosity (e.g., questioning, exploration) with 264 instances, attraction (e.g., interest, appeal) with 297 instances, and connection (e.g., personal association, emotional linkage) with 187 instances. Other emotions, such as dislike/frustration (71 instances) and caring/empathy (32 instances), were less frequent but still notable, reflecting a range of responses. The data highlighted the exhibition's ability to inspire awe and engagement while evoking both positive and challenging emotions (Figure 6).

The most frequently expressed emotions were awe/wonder
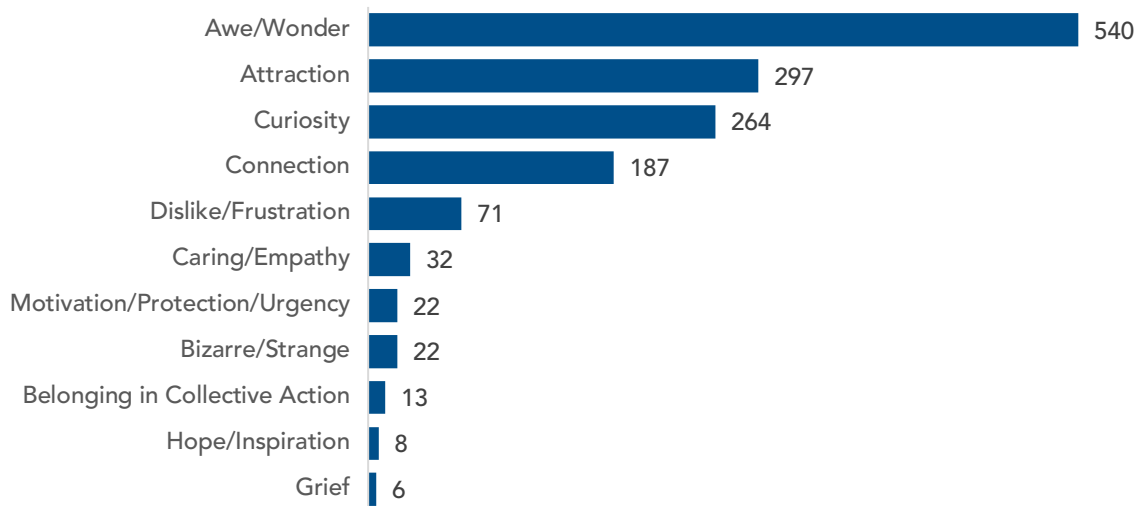
Figure 6: Count of verbalized emotions by emotion type (includes only those with 5 or more instances observed)

Emotions by Exhibition Theme and Component

The following figure (Figure 7) illustrates the rate of verbalized emotions recorded by component. *Snow on the Ground* (3.19 verbalized emotions per cued visitor group that stopped) and *Watching Snow Grow* (2.59 verbalized emotions per cued visitor group that stopped) had the highest rates, indicating strong visitor engagement. *Snowmelt Journeys* (1.95) and *Falling Snow* (1.65) also elicited moderate emotional responses. In contrast, components such as *Snow and Arctic Life* (0.69 verbalized emotions per group) and *Snow Play* (0.86 verbalized emotions per group) recorded lower engagement levels, suggesting areas with less emotional impact for visitors.

Theme 1: Falling Snow

Component	Value
Falling Snow	1.96
Watching Snow Grow	2.82
Making Sense of Snow Crystals	1.59

Theme 2: Snowpack

Component	Value
Snow and Artic Life	1.00
Snow on the Ground	3.33
Snow Play	1.33

Theme 3: Snowscape

Component	Value
Storing Water for Later	1.23
Snowmelt Journeys	2.51
Adapating Our Water Use	1.60

Theme 4: Melting Snow

Component	Value
Keeping Earth Cool	1.18
Changing Global Patterns of Snow	1.30
Working Together for a Better World	1.63

Figure 7: Count of verbalized emotions by number of cued visitor groups that stopped at each component

Overall, the verbalized emotions across the components of *Snow: Tiny Crystals, Global Impact* revealed varied levels of visitor engagement, with awe/wonder being the most expressed emotion, particularly in visually stimulating components such as *Watching Snow Grow* and *Snow on the Ground*. Attraction and curiosity also featured prominently, highlighting visitors' interest in the phenomena of snow and its environmental impact. Emotional engagement was highest in components that focused on collective action, like *Working Together for a Better World*, while components with more scientific or technical content, such as *Making Sense of Snow Crystals*, evoked lower emotional responses. These findings suggest that visitors' emotional connections to the exhibition were influenced by both the presentation style and the themes explored, with visually compelling and action-oriented content generating the strongest emotional responses.

While some components, like *Snow Play*, generated more playful emotions and nostalgic connections, others focused on intellectual and environmental concerns, evoking curiosity, concern, and a call to action, especially within the context of *Melting Snow*. Overall, the varied emotional engagement across these themes and components underscored the diverse ways in which visitors interacted with and responded to the exhibition. Table 9 breaks down the counts of each emotion by component.

Table 9: Counts of emotions by theme and component (N represents the total number of visitor groups that stopped at a given component, as recorded in the Observation Survey.

	Theme 1: Falling Snow			Theme 2: Snowpack			Theme 3: Snowscape			Theme 4: Melting Snow		
	Falling Snow (n=102)	Watching Snow Grow (n=111)	Making Sense of Snow Crystals (n=99)	Snow and Artic Life (n=83)	Snow on the Ground (n=116)	Snow Play (n=78)	Storing Water for Later (n=97)	Snowmelt Journeys (n=94)	Adapting Our Water Use (n=88)	Keeping Earth Cool (n=97)	Changing Global Patterns of Snow (n=105)	Working Together for a Better World (n=76)
Awe/Wonder	41	116	20	19	93	20	27	54	34	14	33	19
Attraction	24	41	13	6	66	34	5	13	2	8	21	41
Curiosity	30	40	20	16	59	2	19	35	9	13	12	3
Connection	10	22	4	11	28	8	10	32	18	5	19	10
Dislike/ Frustration	15	3	7	3	3	2	2	1	3	2	1	16
Caring/Empathy	1	-	-	4	1	1	3	5	10	1	2	2
Motivation/ Protection/ Urgency	-	-	-	-	1	-	1	1	5	2	-	7
Bizarre/Strange	5	3	-	1	4	1	-	-	1	2	3	-
Belonging in Collective Action	-	-	-	1	-	-	-	-	8	-	1	4
Hope/Inspiration	-	1	-	-	-	1	-	-	1	-	-	4
Grief	-	-	-	-	1	-	-	1	2	1	-	-
Total	126	226	64	61	256	69	67	142	93	48	92	106

The following section describes the emotions visitors expressed for each exhibition theme and component, supported by quotes that illustrate how these emotions were verbalized. This section provides insight into the ways visitors engaged with and responded to the exhibition.

Theme 1: Falling Snow: The analysis of verbalized emotions across the components of **Theme 1: Falling Snow** showed varying levels of emotional engagement from visitors (Table 10).

- *Falling Snow* generated 126 verbalized emotions and an average of 1.24 emotions per visitor group, with awe/wonder (0.40) and curiosity (0.29) being the primary emotional responses. Though it elicited fewer emotions than *Watching Snow Grow* it still garnered moderate engagement, particularly in terms of awe. Often, those who exhibited the emotion of awe/wonder also exhibited emotions of curiosity and learning at the same time (see quote box).

> Speaker 1: Okay. So, see. What happens when you move closer? See. What happens?
> Okay, what about when you move to the side?
>
> Speaker 2: It's almost too high, mommy. And it's raining. It's on the side, and then it's raining.
>
> Speaker 1: Well, it's snow.
>
> Speaker 2: Yeah, it's almost on the high part. Look.
>
> Speaker 1: Whoa. You see those?
>
> Speaker 2: Whoa. Whoa. It's going down, it's going down. It went down.
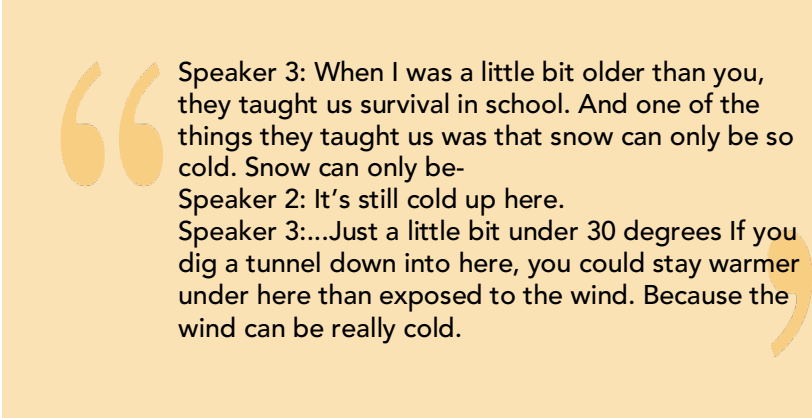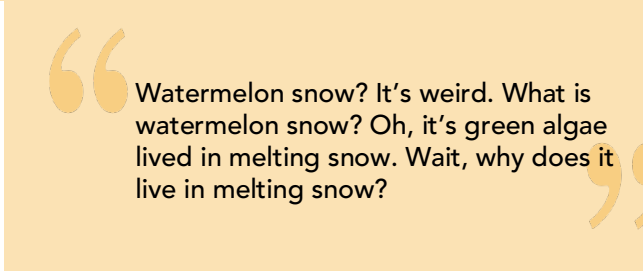
- *Watching Snow Grow* elicited the highest emotional engagement, with a total of 226 verbalized emotions and an average of 2.04 emotions per visitor group. The most frequently expressed emotions were awe/wonder (1.05 per visitor group) and curiosity (0.36 per visitor group), suggesting that this component generated strong feelings of fascination and intellectual engagement.

- *Making Sense of Snow Crystals* saw the lowest emotional engagement with 64 verbalized emotions and 0.65 emotions per visitor group. The highest emotional response here was curiosity (0.20), with awe/wonder and attraction being less pronounced compared to the other components.

Overall, *Watching Snow Grow* was the most emotionally engaging component, particularly due to the feelings of awe and wonder it inspired, while *Making Sense of Snow Crystals* showed the least emotional engagement, likely due to its more specialized or educational focus.

*Table 10: Counts and verbalized emotions per visitor group rates for **Theme 1: Falling Snow**.*

	Theme 1: Falling Snow					
	Falling Snow (n=102)	Verbalized Emotions Per Visitor Group	*Watching Snow Grow* (n=111)	Verbalized Emotions Per Visitor Group	*Making Sense of Snow Crystals* (n=99)	Verbalized Emotions Per Visitor Group
Awe/Wonder	41	0.4	116	1.05	20	0.2
Attraction	24	0.24	41	0.37	13	0.13
Curiosity	30	0.29	40	0.36	20	0.2
Connection	10	0.1	22	0.2	4	0.04
Dislike/Frustration	15	0.15	3	0.03	7	0.07
Caring/Empathy	1	0.01	-	-	-	-
Motivation/ Protection/Urgency	-	-	-	-	-	-
Bizarre/Strange	5	0.05	3	0.03	-	-
Belonging in Collective Action	-	-	-	-	-	-
Hope/Inspiration	-	-	1	0.01	-	-
Grief	-	-	-	-	-	-
Total	126	1.24	226	2.04	64	0.65

Theme 2: Snowpack: The analysis of verbalized emotions across the components of **Theme 2: Snowpack** revealed varied levels of emotional engagement, with certain components eliciting stronger emotional reactions than others (

Table 11).

- *Snow and Arctic Life* showed the lowest emotional engagement, with 61 verbalized emotions and an average of 0.73 emotions per visitor group. The primary emotions expressed were awe/wonder (0.23) and curiosity (0.19), suggesting that while the topic sparked interest, it did not evoke as strong an emotional response as the other components. However, several visitors made personal connections between their own lives and the *Snow and Artic Life* component, primarily around the weather, but also related to food *("Is that the same thing when I literally eat ice straight out of the freezer?")* and to people who visitors know who live in cold climates.

> Speaker 3: When I was a little bit older than you, they taught us survival in school. And one of the things they taught us was that snow can only be so cold. Snow can only be-
> Speaker 2: It's still cold up here.
> Speaker 3:...Just a little bit under 30 degrees If you dig a tunnel down into here, you could stay warmer under here than exposed to the wind. Because the wind can be really cold.

- *Snow on the Ground* generated the highest emotional engagement, with 256 verbalized emotions and an average of 2.21 emotions per visitor group. The most common emotions expressed were awe/wonder (0.80 per visitor group) and attraction (0.57 per visitor group). These responses suggest that visitors were both captivated and intrigued by the components including the vertical panel that describes the temperature of different layers of snow, the video of magnified snow crystals, and the Watermelon Snow (watermelon snow is snow that has a specific alga in it that makes the snow look pink).

> Watermelon snow? It's weird. What is watermelon snow? Oh, it's green algae lived in melting snow. Wait, why does it live in melting snow?

- *Snow Play,* with 69 verbalized emotions and an average of 0.88 emotions per visitor group, showed more moderate emotional engagement. The emotional responses here were somewhat more balanced across categories, with attraction (0.44) (e.g., interest and pull), followed by awe/wonder (0.26) (e.g., excitement, wow factor). standing out. Some visitors voiced the desire to build a snowman, *"I wish I could build a snowman right now. I really love snowmen"* which highlighted the attraction associated with the concept of snow play.

Overall, *Snow on the Ground* generated the strongest emotional reactions, likely due to its relatable and visually impactful content, while *Snow and Arctic Life* elicited more subdued, intellectual responses. *Snow Play* provided a balance of emotional responses, with both attraction and wonder drawing visitors in. The emotional range across these components suggested diverse visitor reactions, from fascination and curiosity to personal nostalgia and

intellectual engagement.

Snow on the Ground component

*Table 11: Counts of emotion and verbalized emotions per visitor group rate for **Theme 2: Snowpack***

	Theme 2: Snowpack					
	Snow and Artic Life (n=83)	Verbalized Emotions Per Visitor Group	*Snow on the Ground* (n=116)	Verbalized Emotions Per Visitor Group	*Snow Play* (n=78)	Verbalized Emotions Per Visitor Group
Awe/Wonder	19	0.23	93	0.80	20	0.26
Attraction	6	0.07	66	0.57	34	0.44
Curiosity	16	0.19	59	0.51	2	0.03
Connection	11	0.13	28	0.24	8	0.10
Dislike/Frustration	3	0.04	3	0.03	2	0.03
Caring/Empathy	4	0.05	1	0.01	1	0.01
Motivation/Protection/Urgency	-	0.00	1	0.01	-	
Bizarre/Strange	1	0.01	4	0.03	1	0.01
Belonging in Collective Action	1	0.01	-	-	-	-
Hope/Inspiration	-	0.00	-	-	1	0.01
Grief	-	0.00	1	0.01	-	-
Total	61	0.73	256	2.21	69	0.88

Theme 3: Snowscape: The **Snowscape** theme, encompassing the components *Storing Water for Later, Snowmelt Journeys,* and *Adapting Our Water Use*, elicited a diverse range of emotional responses, with the highest levels of engagement observed in *Snowmelt Journeys* (1.46 verbalized emotions per visitor group) and *Adapting Our Water Use* (1.22 verbalized emotions per visitor group). Awe/wonder was the most frequently expressed emotion across all three components, particularly in *Snowmelt Journeys*, where its rate was 0.56 per group, reflecting the powerful impression of visual and conceptual elements related to snow's role in the water cycle. See Table 12 for a breakdown.

- *Storing Water for Later* showed lower emotional engagement compared to the other components, with 67 verbalized emotions and an average of 0.69 emotions per visitor group. Awe/wonder (0.28 per visitor group) and curiosity (0.20 per visitor group) were the most prominent emotions, suggesting visitors were intrigued but less emotionally invested overall. Some questions were specifically about what was happening when the small blue balls ran down the mountain to simulate water, which provided opportunities for the visitors to speak to one another about the phenomena modeled by the *Storing Water for Later* component. Other visitors used questions to prompt others in their group, often children, to think about *Storing Water for Later's* message that mountain snow stores water and slowly releases it, which provides water for a longer period and snow provides water to the environment and people during drier months of spring and summer.

- *Snowmelt Journeys* elicited the highest emotional engagement within the Snowscape theme, with 142 verbalized emotions and an average of 1.46 emotions per visitor group. The most common emotions were awe/wonder (0.56 per visitor group) and connection (0.33 per visitor group), indicating that visitors found the content both captivating and personally meaningful. One visitor commented, "It's amazing how something as simple as snow can fuel entire ecosystems," highlighting the sense of awe and appreciation for snow's role in nature. Quotes for this component that were coded for curiosity were also frequently coded for awe/wonder and connection. For example, in the following quote, the speaker asked several questions, connected the questions to a place they had lived, and in the end reflected amazement.

> " Start here. Colorado River. Okay. Carries the snow melt from the high mountains and then it goes to the seven states. Look at these states right here. Does it go to New Mexico? No, it doesn't. We used to live in New Mexico. Then the snow monitoring. Let's press this one. Where are the snow monitoring sites? Wow. "

- *Adapting Our Water Use* followed with 93 verbalized emotions and an average of 1.22 emotions per visitor group. Visitors expressed awe/wonder (0.45 per visitor group) and connection (0.24 per visitor group) most frequently, reflecting their engagement with the practical implications of sustainable water management. Many visitors' connections were related to how they are already conserving water, "So *my high school is being rebuilt right now, and they are putting green plants on the roof so that it generates its own water supply and gives food to the school.*"

*Table 12: Counts of emotions and verbalized emotions per visitor group rate for **Theme 3: Snowscape***

	Storing Water for Later (n=97)	Verbalized Emotions Per Visitor Group	Snowmelt Journeys (n=94)	Verbalized Emotions Per Visitor Group	Adapting Our Water Use (n=88)	Verbalized Emotions Per Visitor Group
Theme 3: Snowscape						
Awe/Wonder	27	0.28	54	0.56	34	0.45
Attraction	5	0.05	13	0.13	2	0.03
Curiosity	19	0.20	35	0.36	9	0.12
Connection	10	0.10	32	0.33	18	0.24
Dislike/Frustration	2	0.02	1	0.01	3	0.04
Caring/Empathy	3	0.03	5	0.05	10	0.13
Motivation/Protection/Urgency	1	0.01	1	0.01	5	0.07
Bizarre/Strange	-	-	-	-	1	0.01
Belonging in Collective Action	-	-	-	-	8	0.11
Hope/Inspiration	-	-	-	-	1	0.01
Grief	-	-	1	0.01	2	0.03
Total	67	0.69	142	1.46	93	1.22

Theme 4: Melting Snow: The analysis of verbalized emotions across the components of ***Theme 4: Melting Snow*** highlighted varying levels of emotional engagement, with certain components prompting more emotional responses than others (Table 13).

- *Keeping Earth Cool* generated the lowest emotional engagement within this theme, with 48 verbalized emotions and an average of 0.49 emotions per visitor group. The predominant emotions were awe/wonder (0.14) and curiosity (0.13), indicating a more intellectual response to the content. Awe/wonder was characterized by visitors' reactions to feeling the difference between the globes – the blue warmer ball and the white cooler ball.

- *Changing Global Patterns of Snow* also evoked significant emotional engagement, with 92 verbalized emotions and an average of 0.88 emotions per visitor group. Awe/wonder (0.31) and attraction (0.20) were the most frequent emotions here, showing that visitors found the topic intriguing and somewhat awe-inspiring. Notably, this component consisted of a praxinoscope with 12 months of satellite images of snow cover of North America; visitors spun the component to make the images seem like a moving image of snow cover encroaching and receding with the seasons, in a loop. visitors frequently displayed attraction and awe at the same time. For example, in the following quote the speaker was both excited about the praxinoscope and attracted to the fact that they can reverse time: *"Caution, spinning to the left can reverse time. I would love to see that happen. Okay now look in the…Oh, that's cool. You can see the…spin."*

Changing Global Patterns of Snow

- *Working Together for a Better World* stands out with the highest emotional engagement, generating 106 verbalized emotions and an average of 1.39 emotions per visitor group. The most notable emotions were attraction (0.54 per visitor group)

> Speaker 2: Working together for a better world. Action for climate. Our moment in
> history is defined by the climate crisis. Human actions, especially burning fossil fuels ...
> Remember, we were talking about this the other day
>
> Speaker 3: Yeah.
>
> Speaker 2: ... are overheating our planet and disrupting our climate. People around the world are working together to respond to the climate crisis. All our actions matter. First steps: Learn how the climate crisis is impacting the place where you live. How is your community responding? Talk with others about what you learn. Join a community to take action. Work with nature. Intact ecosystems naturally cool our planet, store carbon, and protect the water. We can help by planting trees and restoring natural areas. Isn't that what we were talking about the other day?
>
> Speaker 3: I really love how they're talking about it because it's kind of like letting everybody know about it and trying to get people ... And it's letting people know that, "You can help."
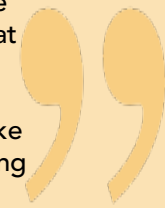
and awe/wonder (0.25 per visitor group), reflecting a strong sense of involvement and interest in collective efforts to address environmental challenges. While cutting

out snowflakes, the visitors talked about what they would write on their snowflakes. During this time, the *Working Together for a Better World* visitors made numerous connections. Visitors related making snowflakes as children or at another time, talked about their favorite things about snow, and referred to previous conversations. In one conversation that referred to a previous conversation, the cued visitor group also talked about belonging in collective action and was motivated to change after reading the prompts at the *Working Together for a Better World* component.

*Table 13: Counts of emotions and verbalized emotions per visitor group rate for **Theme 4: Melting Snow**.*

	Theme 4: Melting Snow					
	Keeping Earth Cool (n=97)	Verbalized Emotions Per Visitor Group	*Changing Global Patterns of Snow* (n=105)	Verbalized Emotions Per Visitor Group	*Working Together for a Better World* (n=76)	Verbalized Emotions Per Visitor Group
Awe/Wonder	14	0.14	33	0.31	19	0.25
Attraction	8	0.08	21	0.20	41	0.54
Curiosity	13	0.13	12	0.11	3	0.04
Connection	5	0.05	19	0.18	10	0.13
Dislike/ Frustration	2	0.02	1	0.01	16	0.21
Caring/Empathy	1	0.01	2	0.02	2	0.03
Motivation/ Protection/ Urgency	2	0.02	-	-	7	0.09
Bizarre/Strange	2	0.02	3	0.03	-	-
Belonging in Collective Action	-	-	1	0.01	4	0.05
Hope/Inspiration	-	-	-	-	4	0.05
Grief	1	0.01	-	-	-	-
Total	48	0.49	92	0.88	106	1.39

Overall, *Working Together for a Better World* was the most emotionally engaging, likely due to its message of collective action and empowerment. *Changing Global Patterns of Snow* also prompted significant emotional responses, particularly awe and concern about the environment. *Keeping Earth Cool*, on the other hand, showed more subdued emotional responses, with visitors expressing curiosity rather than strong feelings of awe or connection. The differences across these components suggest that while visitors are engaged with the environmental themes, the emotional impact varies depending on the content and the ways in which the themes are presented.

Visitor Learning

This section of the report addressed findings related to Evaluation Question 3: What do visitors to the *Snow* exhibition learn about how climate change affects snow? What new interest and knowledge of climate change do visitors take away from the exhibition?

Observed Learning

To evaluate visitor behaviors, the number of times cued visitor groups engaged in actions that facilitate exploration and understanding was counted. These behaviors included actions such as reading aloud, asking and answering questions, and parent/child interactions. The percentage of cued visitor groups that engaged in each of these behaviors was then calculated for each exhibition component. This provided insight into which parts of the exhibition encouraged these behaviors (see Table 14 for a breakdown).

In **Theme 1: Falling Snow,** components demonstrated strong visitor behaviors. *Watching Snow Grow* stood out, with 93% of visitors reading text or labels, showcasing high levels of cognitive engagement. Parent/child interactions were also prevalent, with 82% engaging collaboratively, while 41% read aloud, highlighting the family-friendly design. Similarly, *Falling Snow* and *Making Sense of Snow Crystals* maintained high levels of reading (78% and 92%, respectively) and parent/child interactions (50% and 77%), indicating that these exhibits successfully fostered collaborative exploration.

In **Theme 2: Snowpack**, visitor behaviors varied significantly across components. *Snow on the Ground* saw a high volume of visitors, with 60% reading text or labels and 76% engaging in parent/child interactions. However, components like *Snow and Arctic Life* and *Snow Play* showed lower levels of behaviors like asking questions or reading aloud (8% and 6%, respectively). This finding suggests opportunities to enhance these exhibits to better encourage active exploration.

Theme 3: Snowscape included components that elicited diverse visitor behaviors. *Snowmelt Journeys and Adapting Our Water Use* had notable levels of participation, with 90% and 84% of visitors reading text or labels, respectively. These components also prompted active inquiry, particularly in *Adapting Our Water Use*, where 45% of visitors asked questions—the highest rate among all exhibits. This suggested that interactive elements in this theme were particularly effective in sparking curiosity and involvement.

Finally, in **Theme 4: Melting Snow**, exhibits like *Changing Global Patterns of Snow* and *Keeping Earth Cool* demonstrated strong engagement with text, with 85% and 90% of visitors reading text or labels. While *Working Together for a Better World* attracted fewer visitors overall, it achieved notable interaction, with 37% asking questions and 32% engaging in parent/child interactions, indicating its success in promoting reflective behaviors.

Overall, these findings highlight the success of interactive and text-based components in encouraging behaviors that promote visitor understanding. The data suggested that components fostering inquiry, collaboration, and reflection were particularly effective in prompting visitors to engage deeply with the content. Components with lower levels of engagement offer opportunities for redesign to better meet visitor behavior needs.

Table 14: Percent of tracked visitors who were observed engaging in behaviors that promote learning.

	n	Answer a Question	Ask a Question	Look at/Read Text or Labels	Parent/Child Interaction	Read Aloud
Theme 1: Falling Snow						
Watching Snow Grow	111	13%	27%	93%	82%	41%
Falling Snow	102	20%	39%	78%	78%	50%
Making Sense of Snow Crystals	99	14%	35%	92%	77%	49%
Theme 2: Snowpack						
Snow on the Ground	116	13%	25%	60%	76%	39%
Snow and Artic Life	83	8%	13%	61%	57%	20%
Snow Play	78	9%	26%	22%	77%	6%
Theme 3: Snowscape						
Snowmelt Journeys	97	23%	31%	90%	74%	53%
Storing Water for Later	94	18%	26%	86%	69%	30%
Adapting our Water Use	88	38%	45%	84%	74%	58%
Theme 4: Melting Snow						
Changing Global Patterns of Snow	105	12%	20%	85%	70%	25%
Keeping Earth Cool	97	28%	32%	90%	71%	36%
Working Together for a Better World	76	26%	37%	78%	72%	32%

Recorded Learning

Audio recordings were transcribed, and verbal statements indicating learning were coded using a set of predefined *a priori* codes. The total number of learning-related statements was calculated for each exhibition component, providing further evidence of the areas of the exhibition that were most effective in promoting visitor engagement. Illustrative examples of these statements were included to highlight the specific ways in which visitors interacted with and internalized the exhibition content.

The *Watching Snow Grow, Snowmelt Journeys,* and *Snow on the Ground* components had the highest number of recorded statements reflecting learning, showcasing significant visitor interaction. See Figure 8 to see the verbalized learning statements by the number of cued visitor groups that stopped at each component.

Theme 1: Falling Snow
- Falling Snow: 1.96
- Watching Snow Grow: 2.82
- Making Sense of Snow Crystals: 1.59

Theme 2: Snowpack
- Snow Play: 1.25
- Snow on the Ground: 3.33
- Snow and Artic Life: 1.06

Theme 3: Snowscape
- Adapting our Water Use: 1.45
- Snowmelt Journeys: 2.51
- Storing Water for Later: 1.35

Theme 4: Melting Snow
- Keeping Earth Cool: 1.18
- Changing Global Patterns of Snow: 1.30
- Working Together for a Better World: 1.63
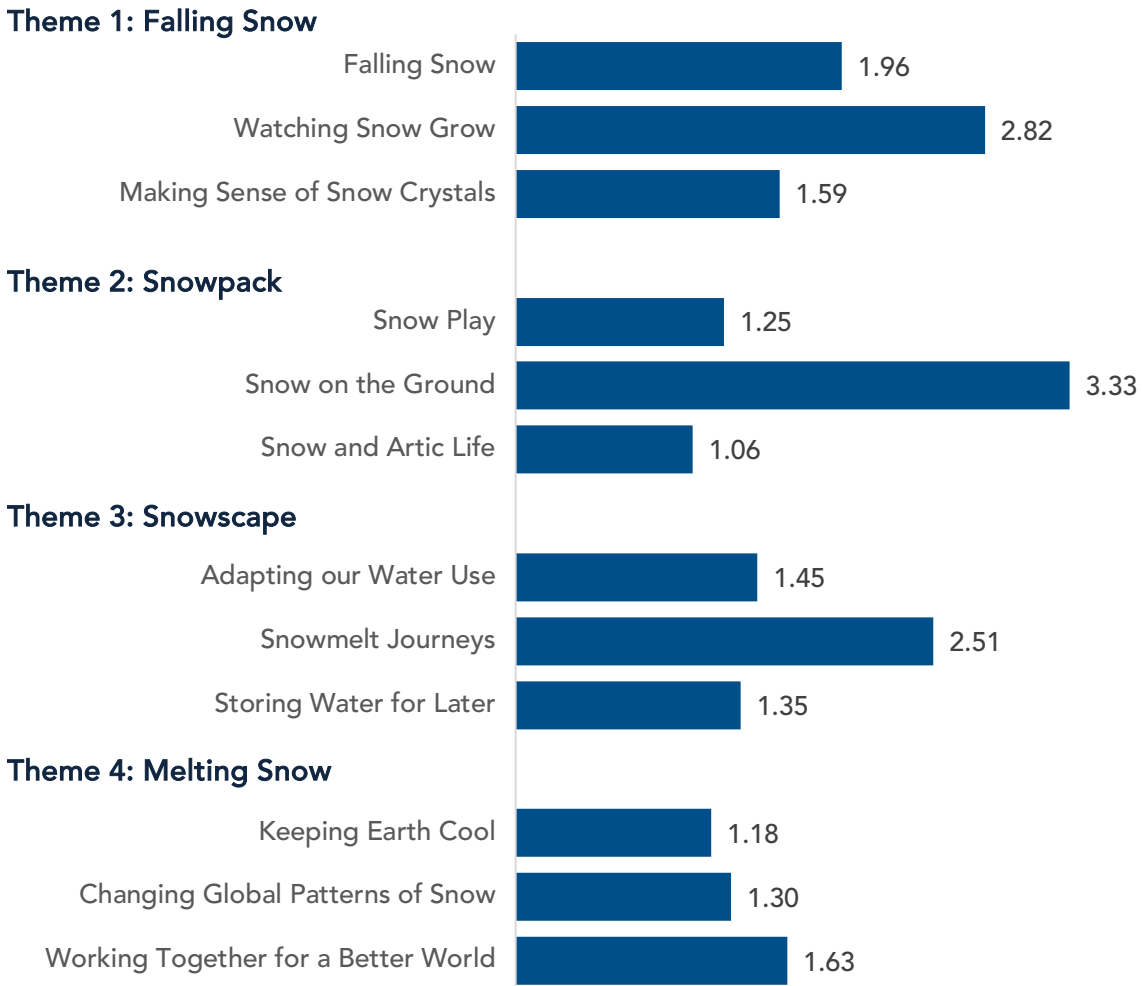
Figure 8: Verbalized learning statements by the number of cued visitor groups that stopped at each component.

These outcomes varied by theme and component (Table 15). The most observed behaviors included evidence of higher order thinking and utilizing scientific language, indicating that many visitors engaged in analyzing complex ideas and articulating their understanding using appropriate scientific terminology.

Components such as *Snow on the Ground* and *Storing Water for Later* emerged as the most impactful, recording the highest numbers of learning-related statements at 292 and 195, respectively. These components excelled at fostering analytical and system-based thinking. Conversely, simpler, or less immersive components, like *Snow Play* and *Working Together for a Better World,* demonstrated fewer learning behaviors, suggesting potential for enhancement in promoting deeper cognitive engagement.

Theme 1: Falling Snow: The components under this theme revealed varied behaviors. *Watching Snow Grow* had the highest learning outcomes, with 213 learning-

related statements. Key behaviors included evidence of higher order thinking (67 statements) and utilizing scientific language (72 statements), indicating that visitors engaged deeply with the material by processing complex information and articulating scientific concepts. *Falling Snow* showed moderate levels of engagement, totaling 113 statements, with notable instances of scientific language (47 statements) and higher order thinking (34 statements), suggesting that visitors were thoughtfully interpreting and discussing snow-related phenomena.

Theme 2: Snowpack: *Snow on the Ground* stood out with 292 learning-related statements, the highest across all components. It excelled in fostering evidence of higher order thinking (117 statements) and scientific language (119 statements), reflecting its success in encouraging analytical discussions and conceptual understanding. In comparison*, Snow and Arctic Life* recorded fewer learning-related statements (41), primarily focused on scientific language (27 statements), indicating a focus on factual learning. *Snow Play* demonstrated minimal engagement (6 statements), revealeding limited opportunities for visitors to engage in deeper cognitive or interpretive activities.

Theme 3: Snowscape: This theme supported significant learning behaviors. *Storing Water for Later* recorded 195 learning-related statements, with higher order thinking (85 statements) as the dominant behavior, showing visitors' ability to synthesize information about water storage systems. *Snowmelt Journeys* showed a broad learning profile, with 116 statements and a strong focus on scale, proportion, and quantity (33 statements) and systems and system models (46 statements), indicating that visitors explored interconnections in snowmelt systems. *Adapting Our Water Use* recorded 129 statements, with a particular emphasis on scale, proportion, and quantity (53 statements), demonstrating visitors' engagement with the quantitative aspects of the content.

Theme 4: Melting Snow: Components under this theme showed moderate learning outcomes. Keeping Earth Cool and Changing Global Patterns of Snow recorded 119 and 116 learning-related statements, respectively, with notable contributions from higher order thinking (54 and 39 statements) and scale, proportion, and quantity (36 and 13 statements). These components facilitated analytical exploration of environmental patterns and the global impact of snow. *Working Together for a Better World* recorded the fewest learning-related statements (9), primarily in utilizing scientific language (7 statements), highlighting its narrower educational focus.

This analysis highlighted the varied ways exhibition components supported visitor engagement, from encouraging analytical thought to promoting scientific language use, enriching visitors' understanding of snow and its global implications.

Table 15: Counts of recorded learning

	Theme 1: Falling Snow			Theme 2: Snowpack			Theme 3: Snowscape			Theme 4: Melting Snow		
	Falling Snow	Watching Snow Grow	Making Sense of Snow Crystals	Snow on the Ground	Snow and Arctic Life	Snow Play	Storing Water for Later	Snowmelt Journeys	Adapting Our Water Use	Keeping Earth Cool	Changing Global Patterns of Snow	Working together for a better world
	(n=102)	(n=111)	(n=99)	(n=83)	(n=116)	(n=78)	(n=97)	(n=94)	(n=88)	(n=97)	(n=105)	(n=76)
Cause and Effect	9	12	14	7	1	-	1	2	4	11	2	-
Energy and Matter	-	1	-	-	-	-	1	2	1	-	-	-
Evidence of higher order thinking	34	67	74	117	11	1	85	50	46	54	39	2
Patterns	4	32	6	2	-	-	-	1	1	-	23	-
Scale, Proportion and quantity	5	11	2	29	2	2	28	33	53	36	13	-
Stability and Change	2	6	-	4	-	-	-	1	5	1	25	-
Structure and Function	12	12	15	13	-	-	1	5	-	8	-	-
Systems and System Models	-	-	-	1	-	-	46	12	6	-	1	-
Utilize Scientific Language	47	72	28	119	27	3	33	10	13	9	13	7
Total	113	213	139	292	41	6	195	116	129	119	116	9

Visitor Reported Learning

Theme 1: Falling Snow

The *Falling Snow* component contributed to tracked visitors' understanding that falling snow is dynamic and takes many different forms, and that form depends on humidity and temperature. Most of the tracked visitors understood that snow is dynamic and takes many different forms.

> Speaker 1: So capped column, stellar... I can't tell. Am I controlling one of them, where? I can't find one. So wait, it starts off as a hollow column, then a capped column, then a stellar plate, then a stellar dendrite, rimmed dendrite, and then a graupel. Graupel. Now we are the hollow columns.
>
> Speaker 5: So that's not hail, it's graupel.
>
> Speaker 1: Graupel. Thick rime on frozen water droplets creates graupel, something between snow and sleet. Okay. Now we got a capped column.
>
> Speaker 5: So we're a column? Capped column.
>
> Speaker 1: Okay. Now we got stellar plate. Ah, and this showed the temperature at which this form.

Watching Snow Grow: The *Watching Snow Grow* component contributed to tracked visitors' understanding of how snow crystals develop intricate patterns in response to changing atmospheric conditions. Many visitors focused on observing the general patterns of the crystals, while others concentrated on pinpointing the exact moments when the crystals transitioned from one form to another. Additionally, several groups made connections between the growth of the crystals and the atmospheric conditions influencing their development.

> Speaker 2: Did you know that not all of the snowflakes look the same? They look alike
> but they're not the same.
>
> Speaker 1: They're never the same.
>
> Speaker 2: Yeah, because when they come down, they go different directions, and then
> from different air courses they go like different ways. Other way.
>
> Speaker 1: That's cool.

Making Sense of Snow Crystals: component contributed to tracked visitors' understanding that the shapes of snow crystals are determined by the conditions they encounter as they grow. This component invites visitors to apply knowledge gained from *Watching Snow Grow* and the accompanying informational panel text. Although none of the tracked

visitors mentioned Nakaya or his process of connecting snow crystal shapes to environmental conditions through natural observation—either on their audio recordings or in the post-interview—visitors actively engaged with the component and frequently completed the task.

Theme 2: Snowpack

Snow and Arctic Life: The *Snow and Arctic Life* component enhanced tracked visitors' knowledge of the various ways snow is integral to life in the Arctic. Visitors gained insights into the terminology for snow, its uses for travel, shelter, and water, and what life is like in Arctic regions.

> " I don't think of how people use snow. Interesting….Oh, that's cool. And then right here is American. Oh, mom, I didn't do this. Words for snow. Wow. There's a lot of different types of snow. "

Snow on the Ground: The *Snow on the Ground* component significantly contributed to tracked visitors' understanding of snowpack properties and their importance to both people and animals. Visitors explored how snowpacks are classified based on their distinct layers, how the crystal structures within these layers change over time, and how snowpacks serve as vital habitats.

> " Speaker 3: A pound of snow into a hardened layer [is] called [a] wooden slab. The lower snow layers form into large crystals. This pattern can repeat when new snow falls and is, again, blown by the wind. Kind of like sediment.
>
> Speaker 1: Yeah, it is. Kind of like snow sediment.
>
> Speaker 3: At the bottom of the river "

This component also deepened visitors' understanding of the evolving structure of snowpack crystals. Visitors were recorded discussing the layers within snowpacks, with many expressing excitement upon learning that the bottom layer is the warmest. The topic of depth hoar in relation to snow layers sparked further discussions, and many visitors made meaningful connections while exploring these changes.

Snow Play: *Snow Play* did not elicit verbalized statements that reflected the overall exhibition's learning goals.

Theme 3: Snowscapes

Storing Water for Later: *Storing Water for Later* clearly contributed to tracked visitors understanding that snow stores water and slowly releases it, which provides water for a longer period, and that snow provides water to the environment and people during drier months of spring and summer. This understanding was exemplified in a conversation between two visitors:

> Speaker 2: "It says to compare the rain and the snow falling on the mountain, and watch the balls go down as the rain on the right side and the snow [inaudible] on the right side. Why does this matter?"
> Speaker 1: "I think [inaudible] more snow melts."
> Speaker 2: "What did you notice happening between the snow and the [inaudible]?"
> Speaker 1: "There's more snow."
> Speaker 2: "But look at how the balls are rolling down. It looks like more snow, but which one moved faster?"
> Speaker 1: "That one."
> Speaker 2: "The rain. Water flows at [inaudible] left, but the snow [inaudible] the snow melts during the Spring and the Summer. This is the way our towns and farms get water when we need it, in the drier months. Cool."

This interactive dialogue highlighted how the component effectively engaged visitors in understanding the critical role of snowmelt in sustaining water supplies for human and environmental needs. Later, the child involved in this conversation reported key takeaways, reinforcing the component's educational impact.

Snowmelt Journeys: The *Snowmelt Journeys* component contributed to visitors understanding that many places far from snow depend on snow for their water. Most talked about two topics: the number of people who rely on snowmelt as their primary source of water, and how far away the mountain snowpack is from the cities that rely upon it. Several of the tracked visitors talked about the impact of less snow in Colorado on the water users in California and other big cities: "*Ooh. It's trying to show you how the snow melt travels to all these people. Do you see it at the western United States relies on water supply… So at home, they're talking about a drought right now, because there's not enough snow pack in our mountains, so this summer, we might have a lot of forest fires.*"

Adapting our Water Use: Tracked visitors to the Climate Adaptation component clearly learned about which categories – farm and irrigation, homes, industry and mines, power plants, and public supply – use the most and least water. Many were surprised by this information:

> Speaker 1: Farms region. Farm region, 40%.
> Speaker 2: 40% of water, they use? Is that –
> Speaker 1: Yeah, I think so.
> Speaker 2: Okay.
> Speaker 1: Homes, one percentage of water. And industry and mines, 6% of water. Water plants, 41% of water. And then public supply, 12% of the water.
> Speaker 2: So homes only use 1%.
> Speaker 1: Really? That's sort of surprising. I thought they would be using way more
> than that.
> Speaker 2: I know. Out of all of it, just 1% of the water.
> Speaker 1: Yeah.
> Speaker 2: Farms and irrigation is the most, wasn't it?
> Speaker 1: No. Power plants.

Theme 4: Melting Snow

***Keeping Earth Cool*:** Tracked visitors to the *Keeping Earth Cool* component understood that the white globe is cooler because it represents snow, a highly reflective substance. Tracked visitors also appeared to understand that global snow cover reflects heat from the sun, but did not voice understanding that loss of snow cover accelerates climate change. One visitor, when asked what they learned from the exhibition, indicated that "snow reflects a good portion of the sun and keep the temperature down here." This suggested an understanding of the role of snow in maintaining current temperatures but does not explicitly connect the loss of snow cover to that loss's role in accelerating climate change.

> Speaker 1: The snow is the most reflective substance on the surface of earth. It provides
> light. At the peak of winter—
> Speaker 2: Well doesn't it make sense though?
> Speaker 1: ... snow covers above one third of the planet. What do you mean?
> Speaker 2: What color is snow?
> Speaker 1: White.
> Speaker 2: So does white absorb or reflect heat?
> Speaker 1: It reflects like a white shirt.

***Changing Global Patterns of Snow*:** *Changing Global Patterns of Snow* contributed to tracked visitors' understanding of the extent of snow cover on the planet and how snow cover changes over the year. The following quote is illustrative of the dialogue that occurred around the *Changing Global Patterns of Snow* component:

> So, January. So let's begin all the way in the beginning of the year, January. Start there. February, starts melting a little bit. March, snow going more far away. April, snow going even more far away. May, going even more far away. June, [inaudible].
>
> July, almost not even there. August, starts coming back a little bit. September, and everything start... October, November and December and everything starts coming back.

None of the visitors verbalized learning that as the climate warms, snow covers the Earth for less time each year, which in turn contributes to global warming.

Discussion

The *Snow: Tiny Crystals, Global Impact* exhibition successfully engaged multigenerational audiences, providing a family-friendly environment that fostered emotional connections and meaningful learning about snow. Tracked visitor groups, consisting of adults and children aged 9 to 14, demonstrated high levels of engagement across the exhibition, with most groups exploring multiple components and interacting with hands-on features. Adults frequently facilitated learning for children, highlighting the value of family participation in the museum experience. The exhibition's design strategies—emphasizing interactivity, accessibility, and relatable narratives—contributed to its success in capturing visitors' interest.

Engagement and Emotional Resonance
Visitor engagement was evident in the time spent exploring the exhibition and the interactions observed. The average dwell time for cued visitor groups was 13 minutes and 49 seconds, with some groups spending as much as 46 minutes. Popular components such as *Watching Snow Grow* (95% interaction rate) and *Adapting Our Water Use* (97% interaction rate) encouraged participation, with visitors frequently pointing, touching, and calling others over to engage with the exhibits.

Emotional responses were also a key indicator of the exhibition's impact. Across all components, 1,462 emotional reactions were recorded, with awe and wonder accounting for 540 instances and curiosity for 264. Components like *Snow on the Ground* (3.19 emotions per group) and *Watching Snow Grow* (2.59 emotions per group) were particularly effective in eliciting strong emotional engagement. Maps in components such as *Snowmelt Journeys* and *Changing Global Patterns of Snow* fostered personal connections, with 171 verbalized statements coded as "connection."

An analysis comparing findings across the three exhibition locations revealed no statistically significant differences in engagement, emotional responses, or learning outcomes. This consistency highlighted the robustness of the exhibition design and its capacity to deliver a uniformly impactful experience across venues. The detailed statistical findings for this analysis are presented in the Appendix A.

Key Findings
- **Learning Outcomes**:
  - *Snow on the Ground* was one of the most impactful components, contributing to visitors' understanding of snowpack layers, depth hoar, and snow's insulating properties, with 256 verbalized learning-related statements recorded.
  - Visitors frequently discussed the roles of snow as a habitat and its ability to insulate animals, with many expressing excitement about discoveries such as the warm bottom layer of snowpacks.
  - *Adapting Our Water Use* highlighted surprising learning moments, with visitors verbalizing shock at the lower water consumption of homes compared to farms and industry.
- **Opportunities for Emotional Engagement**:

- o Components designed to elicit emotions such as caring/empathy and urgency—like *Working Together for a Better World*— evoked fewer verbalized responses, suggesting some emotions may have been felt but not expressed. Future evaluations should consider directly asking visitors about these emotions to better capture their experiences.

Limitations

While the evaluation yielded valuable insights, it is essential to consider the following limitations:

1. **Sample Representation**: Only one adult member of each visitor group completed the post-exhibition questionnaire, limiting insight into the experiences and perspectives of children and other group members.
2. **Audio Quality**: Background noise and crosstalk among group members sometimes disrupted recordings, potentially underreporting verbalized emotions and learning.
3. **Uncued Visitor Comparisons**: Engagement data focused solely on cued visitor groups, making it unclear how their behavior compares to uncued visitors. However, thorough use metrics and average dwell times align with benchmarks for highly engaging exhibitions.
4. **Climate Literacy**: Limited visitor understanding of snow's relationship to climate change suggested that broader challenges in climate literacy may have impacted learning outcomes.

Areas for Improvement

While the exhibition effectively increased visitors' understanding of snow's properties and role in water systems, fewer visitors reported learning about snow's relationship to climate change or water supply. Observations and audio recordings suggest that visitors often focused on tangible elements, such as snow crystals or snowpacks, but less frequently connected these phenomena to broader environmental issues.

To address these gaps, future exhibitions could:
- Integrate explicit messaging about climate change and its connections to snow.
- Include more cause-effect displays and guided interpretation by museum educators to contextualize complex topics.
- Expand interactive elements to emphasize the relationships between snow, climate change, and human adaptation.

Conclusion

The *Snow: Tiny Crystals, Global Impact* exhibition was a resounding success in engaging visitors, fostering emotional connections, and promoting learning. Its family-friendly design and interactive components provided a platform for visitors to explore snow's ecological and societal importance. However, addressing barriers such as climate literacy and designing for less-verbalized emotions like urgency and empathy could further enhance future iterations.

Appendix A: Differences Among Venues

Engagement Behaviors

Overall, the data indicates some trends, with Buffalo Museum of Science often leading in autonomy and competence, OMSI standing out in educational value and low amotivation, and Fleet Science Center generally scoring lower but still showing positive results. Despite these differences, the lack of statistical significance suggested that the variations may not reflect meaningful disparities between the locations.

Overall Visitor Experience

In terms of overall visitor experience, scores are generally high (Figure 9), with visitor experience being rated similarly across Buffalo Museum of Science (4.08) and OMSI (4.09), while Fleet Science Center scores slightly lower (3.87). Interest follows a similar trend, with Buffalo Museum of Science leading (4.33), OMSI slightly lower (4.19), and Fleet Science Center trailing (3.97). Fun is rated consistently across Buffalo Museum of Science (4.08) and OMSI (4.10), with Fleet Science Center slightly behind (3.92). Educational experiences are more variable, with OMSI scoring the highest (3.97), followed by Buffalo Museum of Science (3.83) and Fleet Science Center (3.80), indicating slightly stronger perceptions of educational value in OMSI.
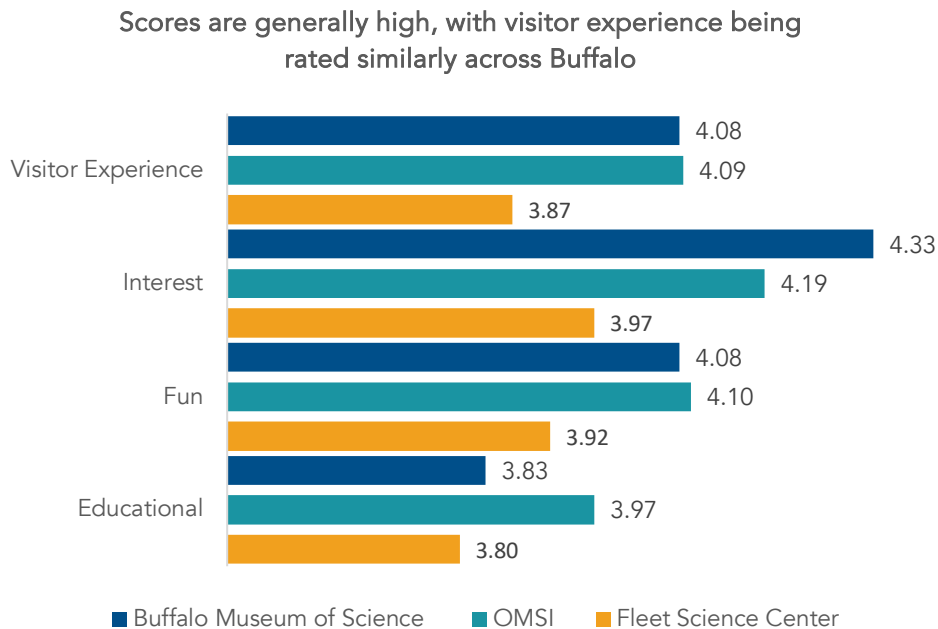
Figure 9: Overall visitor experience. There were not statistically significant differences in entry experiences by location.

Entry Experiences and Values with Snow

The data revealed varying levels of engagement with snow-related experiences across the three locations—Buffalo Museum of Science, OMSI, and Fleet Science Center—though no

statistically significant differences were found between the locations and the means (Figure 10). Buffalo Museum of Science consistently showed the strongest connection to snow, with the highest ratings across most categories. For example, childhood experiences with snow (3.69) and other conditions (4.25) are rated the highest, reflecting a deep familiarity and positive emotional connection to snow. OMSI followed closely behind, with strong beliefs about snow (3.77) and intrigue (4.09), but not quite matching Buffalo Museum of Science's levels. In contrast, Fleet Science Center showed the lowest ratings across several categories, including snow images (2.69) and childhood experiences (2.99), indicating that snow-related experiences are less familiar or emotionally engaging for its residents.

Despite this, all locations report relatively high positive emotions (3.73) and curiosity about snow, especially in OMSI and Buffalo Museum of Science, where intrigue is rated above 4. This finding suggested that while snow may not be as integral to daily life in Fleet Science Center, there is still a notable level of interest and positivity surrounding it.

Buffalo respondents consistently showed the strongest connection to snow

Category	Buffalo Museum of Science	OMSI	Fleet Science Center
Experiences with snow as a child	3.69	3.41	2.99
Cultural background	3.61	3.49	2.99
Current beliefs about snow	3.60	3.77	3.31
Snow images	3.02	3.18	2.69
Positive emotions	3.69	3.73	3.73
Other conditions	4.25	4.09	3.52
Intrigued	4.06	4.09	3.99
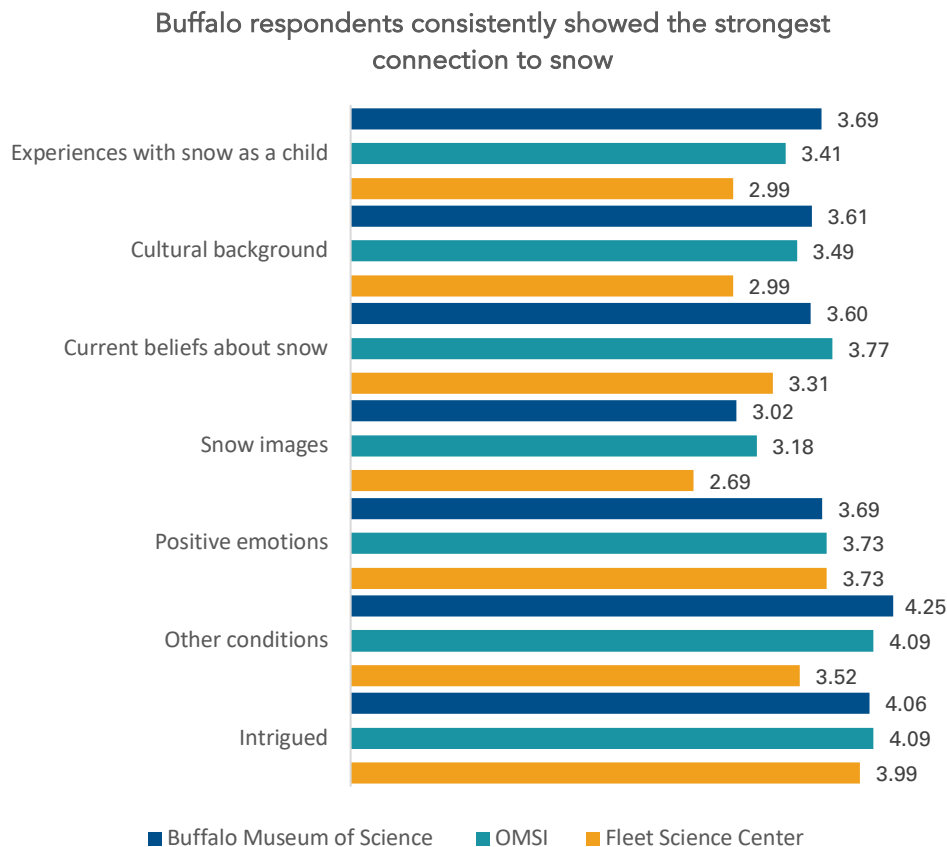
Figure 10: Entry experiences and values with snow before entering the exhibition. There were not statistically significant differences in entry experiences by location.

Autonomy, Relatedness, and Sense of Competence

For autonomy, relatedness, and sense of competence, anticipated feelings of autonomy were highest in Buffalo Museum of Science (4.07), with OMSI (3.77) and Fleet Science Center (3.66) following. This finding indicates that participants in Buffalo Museum of Science feel slightly more independent compared to the other locations (Figure 11). Anticipated feelings of relatedness were consistently high across all locations, with Buffalo Museum of Science

scoring the highest (4.55), followed by OMSI (4.19) and Fleet Science Center (4.11), reflecting strong interpersonal or environmental connections. Similarly, Buffalo Museum of Science also led in the anticipated satisfied sense of competence (4.45), while OMSI (3.87) and Fleet Science Center (3.68) reported lower but still positive expectations. Anticipated competence frustration, however, was minimal across all locations, with Buffalo Museum of Science (1.30) reporting the least frustration and Fleet Science Center (1.53) slightly higher.

For autonomy, relatedness, and sense of competence, anticipated feelings of autonomy are highest in Buffalo Museum of Science
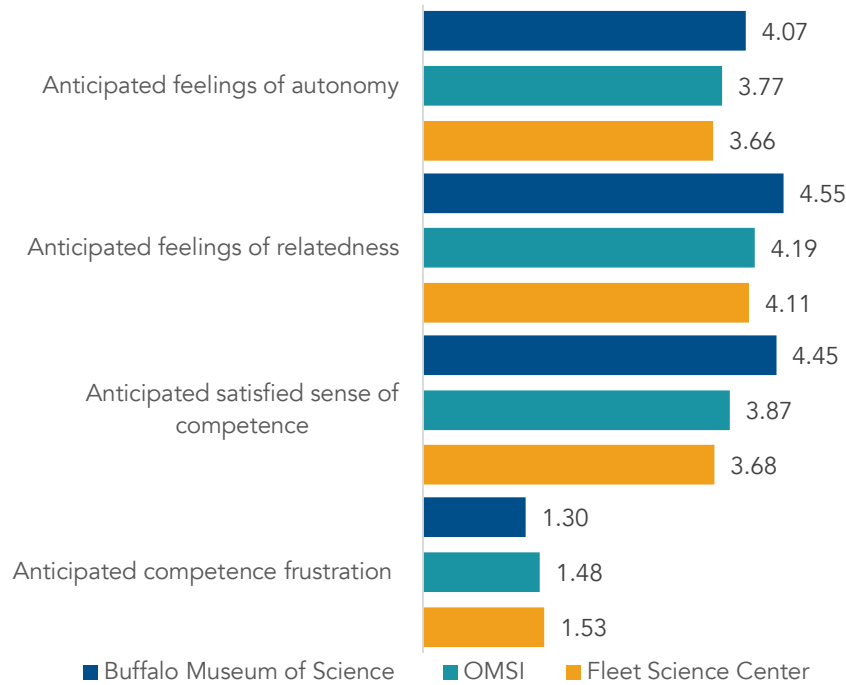
Figure 11: Autonomy, relatedness, and sense of competence. There were not statistically significant differences in entry experiences by location.

Motivation to Continue Learning

Motivation scores also showed some differences, though none were statistically significant (Figure 12). Identified motivation was strong across all locations, with OMSI (4.23) slightly leading, followed by Fleet Science Center (4.22) and Buffalo Museum of Science (4.08). Intrinsic motivation was similarly high, with only minor variations across Buffalo Museum of Science (4.06), OMSI (4.09), and Fleet Science Center (4.08). Amotivation was relatively low, with OMSI reporting the lowest score (1.72) and Buffalo Museum of Science (2.03) and Fleet Science Center (1.99) being slightly higher. Introjected motivation was also low overall, with OMSI again reporting the lowest (1.55), followed by Buffalo Museum of Science (1.75) and Fleet Science Center (1.89).

Identified motivation is strong across all locations

	Buffalo Museum of Science	OMSI	Fleet Science Center
Identified	4.08	4.23	4.22
Intrinsic	4.06	4.09	4.08
Amotivated	2.03	1.72	1.99
Introjected	1.75	1.55	1.89
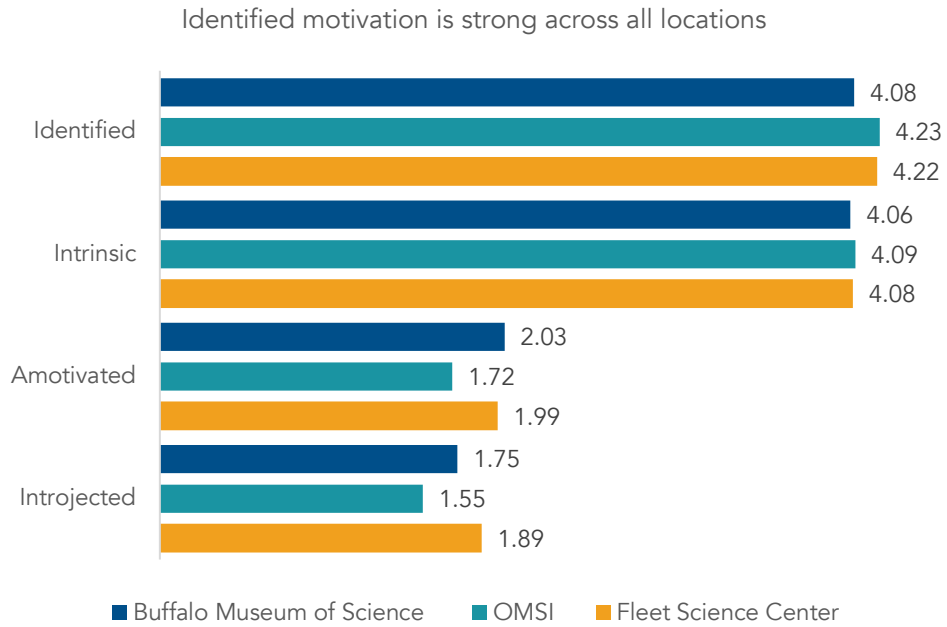
Figure 12: Motivation to continue learning. There were not statistically significant differences in entry experiences by location.

Appendix B: Exhibit Floor Plan

Floor Plan Overview

The following is a suggested floor plan for *Snow: Tiny Crystals, Global Impact* installed in a 2,500 sq. ft. exhibit hall. Many arrangements are possible depending on your facility.
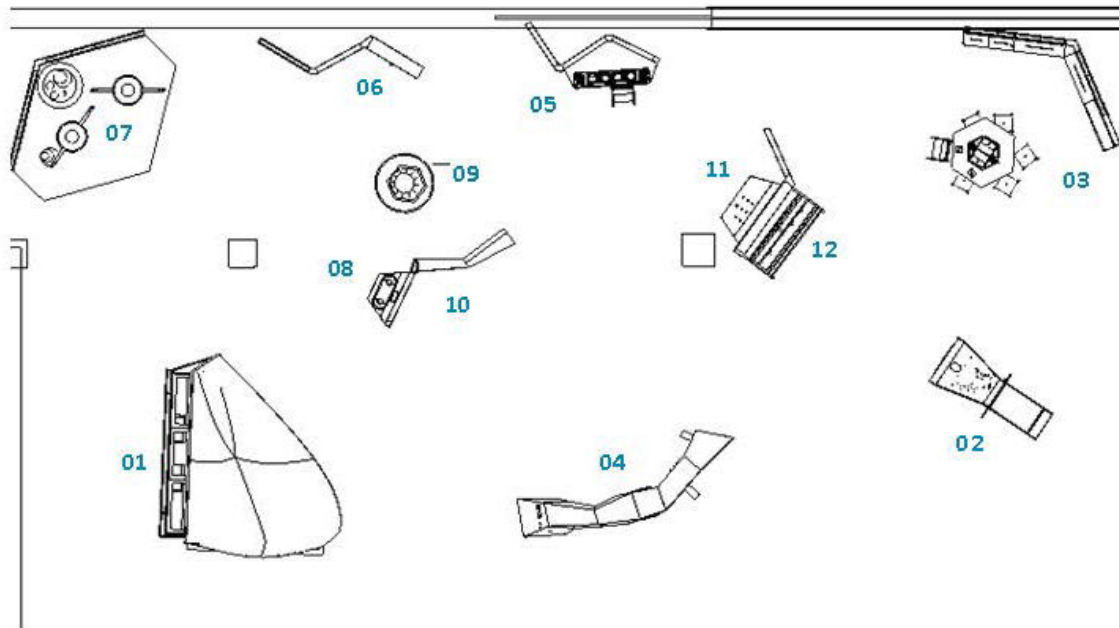
01 *Falling Snow/Title Panel*	**07** *Snow Play*
02 *Storing Water for Later*	**08** *Keeping Earth Cool*
03 *Working Together for a Better World*	**09** *Changing Global Patterns of Snow*
04 *Snow on the Ground*	**10** *Snow and Arctic Life*
05 *Making Sense of Snow Crystals*	**11** *Adapting Our Water Us*
06 *Watching Snow Grow*	**12** *Snowmelt Journeys*

Oregon Museum of Science and Industry

Appendix C: Evaluation Instruments

		Order					
ID:							
Exhibition component		09 Snow Cover Over time	08_Compare Climates	01_Falling Snow	05_Nakaya Diagram	02_Snowmelt Mountain	12_Snow melt map
Start							
End							
Length of Time							
Look at/read text or labels							
Touch							
Read aloud							
Call someone over							
Point							
Verbal observation/explanation							
Verbal enthusiasm (everything emoted)							
Ask a question							
Answer a question							
Shares personal connection							
Take a picture							
Sit down							
Watch others							
Parent / child interaction							
Spin							
Get down on level to see changes on map							
Touch globes							
Puts hand between lamp and globe (air temperature)							
Move body(ies) to interact with different kinds of falling now							
Place puzzle pieces - ANY (incomplete)							
Place puzzle pieces - One or more **sequences** correct (any							
Press button							
Button 1: Colorado River							
Button 2: Snow Monitoring Sites							
Button 2 : Dams							
Button 4: Las Vegas							
Button 5: Farms							
Button 6: Grand Junction							
Button 7: Long distance water users							
Button 8: Los Angeles							
Build a snowman							
Knock snowman down							
Place velcro items inside snowman mold							
Look at images							

Field Notes: Return:

ID:	11_Climate Adaptation	10_Tundra Stories	04_Snowpack	06_Grow a snow crystal	03_Talk Back Blizzard	07_Play component
Exhibition component						
Start						
End						
Length of Time						
Look at/read text or labels						
Touch						
Read aloud						
Call someone over						
Point						
Verbal observation/explanation						
Verbal enthusiasm (everything emoted)						
Ask a question						
Answer a question						
Shares personal connection						
Take a picture						
Sit down						
Watch others (Children watching others inside or outside of their group)						
Parent / child interaction						
Look through book						
Pick up weights						
Comparing weights						
Look at light up bar graph						
Look at ptarmigan (viewing hole)						
Watch video 1: Words for Snow						
Watch video 2: Snow is Shelter						
Watch video 3: Snow and Arctic Life						
Watch video 4: Travel in Snow						
Watch video 5: Snow and Ice as a Water Source						
Taiga - Pull out drawer						
Taiga - Read drawer content						
Taiga - Look at frog (lower - viewing hole of habitat in ground)						
Taiga - Look at lemming (upper / closest to arch)						
Tundra - Pull out drawer drawer						
Tundra - Read drawer content						
Tundra - Look at ermine - hole viewing habitat in ground						
Maritime - Look at pika - viewing hole of habitat						
Maritime - Lift the microscope - slider (Maritime)						
Maritime - Look at marmot (lower - viewing hole of Marmot)						
Maritime - Look at watermelon snow (upper - viewing hole)						
Read/ look at Maritime panel - temperatures, water/ ice						
Read/ look at P1 - Snow on the ground overview (map at top, brief overviews of all 3 types)						
Read/ look at P2 - Snow crystals maritime (back - inside of arch)						
Read/ look at P3 - Snow srystals taiga/ tundra (front inside arch)						
Read/ look at P4 - Life in the snow (who can you find in the snow?)						
Turn knob						
Look at Snowflakes that were hung up						
Make a snowflake						
Write / draw on the snowflake						
Drop snowflake in a slot						
Watch fan blow snowflakes						
Look up QR code info on phone						
Build a snowman						
Knock snowman down						
Place velcro items inside snowman mold						
Look at images						
Field Notes: Return:						

Post-Expedition Questionnaire

Intro

[IRB Language]

Demos

What is your current age?

[   ]

The map below shows snow zones across North America. Please locate where you live and the color that represents it. Then, select from the list below your corresponding snow zone.
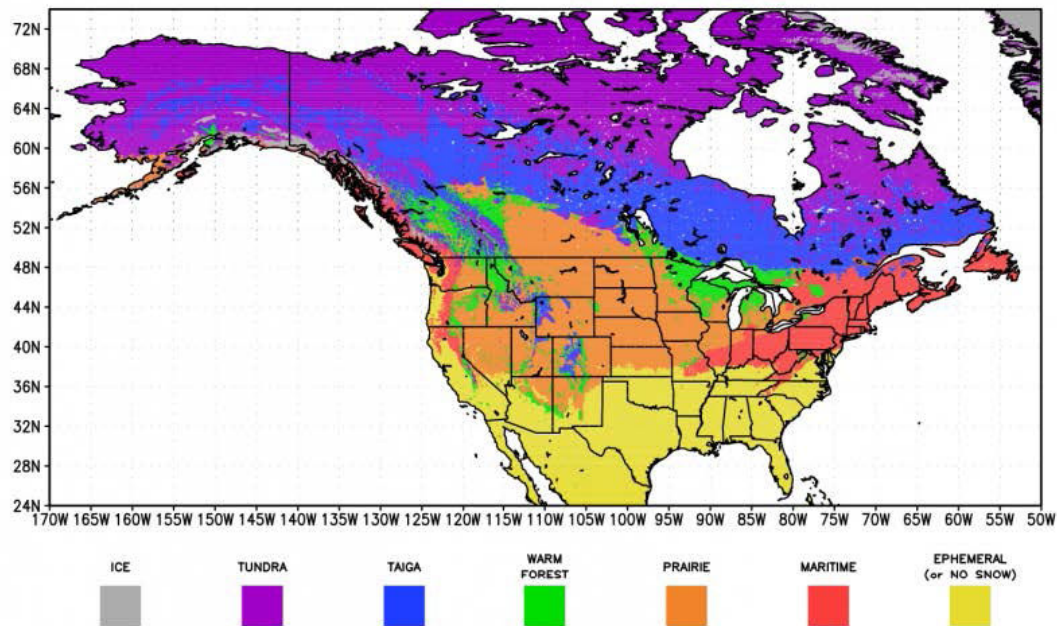
○ Ice
○ Tundra
○ Taiga
○ Wam Forest
○ Prairie
○ Maritime
○ Ephemeral

With what race/races or ethnicity/ethnicities do you identify? Please select all that apply.

- ☐ American Indian or Alaska Native
- ☐ Black or African American
- ☐ White/Caucasian
- ☐ Asian
- ☐ Native Hawaiian or Pacific Islander
- ☐ Latina/o/x or Hispanic
- ☐ [_____] Another identity not listed (please describe):
- ☐ Not sure
- ☐ Prefer not to say

Which of the following best describes your gender?

- ○ Male
- ○ Female
- ○ Non-binary
- ○ [_____] Another identity not listed (please describe):
- ○ Prefer not to say

Would you describe yourself as living in a rural area?

- ○ Yes
- ○ No

EN Matrix

These statements are about your experiences growing up. Please tell us how much you agree or disagree with these statements about **your experience _as a child_**.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I loved snow.	○	○	○	○	○
Snow was important to my life.	○	○	○	○	○

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I needed snow to do something I cared about.	O	O	O	O	O

The next statement is about **the experiences of the *people closest to you when you were growing up***. Please tell us how much you agree or disagree with this statement.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
They needed snow to do something they cared about.	O	O	O	O	O

These questions are about the **traditions and history of people who share your cultural background**. Please tell us how much you agree or disagree with these statements *traditionally or historically*.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Snow brought them joy.	O	O	O	O	O
They knew how to live with snow.	O	O	O	O	O
They needed snow to do something they cared about.	O	O	O	O	O

These statements are about **your *current beliefs and experiences***. Please tell us how much you agree or disagree with these statements.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Snow is important to me personally.	O	O	O	O	O
I look forward to the first snow.	O	O	O	O	O
When I think of snow, I think of positive experiences.	O	O	O	O	O

Please tell us how much you agree or disagree with this statement.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Images of snowflakes are important in my culture.	O	O	O	O	O

Imagine a **picture that best represents your personal experience** (e.g., a picture of your life and who you are). The picture includes images of:

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Snow.	O	O	O	O	O
Playing or recreation in snow.	O	O	O	O	O
Traveling in snow.	O	O	O	O	O
Working in snow.	O	O	O	O	O

These next statements are about **how you thought and felt about snow just before visiting this exhibition.** Please tell us how much you agree or disagree with each statement.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Snow intrigued me.	O	O	O	O	O
I felt awe and wonder about snow.	O	O	O	O	O
Snow made me feel unsafe.	O	O	O	O	O

These next statements are about **things you can learn about snow.** Please tell us how much you agree or disagree with each statement.

I am intrigued by how snow...

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Affects people's well-being.	O	O	O	O	O
Affects the economy.	O	O	O	O	O
Relates to climate change.	O	O	O	O	O

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Is affected by other things.	O	O	O	O	O

The next statements are about **what you *already* knew about snow before visiting this exhibition**. Please tell us how much you agree or disagree with each statement.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I know how to stay safe in snow.	O	O	O	O	O
I know how to take care of my belongings when it snows.	O	O	O	O	O
I have experience with snow.	O	O	O	O	O

Values Matrix

In this section you will find a number of life goals, presented one at a time. Everyone has long-term goals or aspirations. We would like to know how important snow is to you for achieving your goals and aspirations, the things you hope to accomplish over the course of your life.

Please note the response options have changed for this section.

How important is snow to your goal or aspiration for…

	Not at all Important 1	2	3	Moderately Important 4	5	6	Very important 7
Personal growth and learning new things.	O	O	O	O	O	O	O
Having my name known by many people.	O	O	O	O	O	O	O
Being physically healthy.	O	O	O	O	O	O	O
Working to make the world a better place.	O	O	O	O	O	O	O
Being rich.	O	O	O	O	O	O	O

	Not at all Important 1	2	3	Moderately Important 4	5	6	Very important 7
Knowing and accepting who I really am.	O	O	O	O	O	O	O
Having my name appear frequently in the media.	O	O	O	O	O	O	O

How important is snow to your goal or aspiration for…

	Not at all Important 1	2	3	Moderately Important 4	5	6	Very important 7
Feeling that there are people who really love me, and whom I love.	O	O	O	O	O	O	O
Achieving the "look" I've been after.	O	O	O	O	O	O	O
Having enough money to buy everything I want.	O	O	O	O	O	O	O
Having deep enduring relationships.	O	O	O	O	O	O	O
Having an image others find appealing.	O	O	O	O	O	O	O
Helping people in need.	O	O	O	O	O	O	O
Having a physically healthy life style.	O	O	O	O	O	O	O

BPNSF Matrix

You just visited an interactive exhibition about snow. We want to know about your **expectations just before** entering the exhibition. Please respond to each statement by telling us how true the statement was for you.

Please note the response options have changed for this section.

I expected that in an interactive exhibition about snow, I would feel…

Completely Untrue	Mostly Untrue	Somewhat True	Mostly True	Completely True

	Completely Untrue	Mostly Untrue	Somewhat True	Mostly True	Completely True
a sense of choice and freedom.	O	O	O	O	O
I was doing it because "I had to."	O	O	O	O	O
that the people I care about also care about me.	O	O	O	O	O
excluded from the group I wanted to belong to.	O	O	O	O	O
confident that I could do things well.	O	O	O	O	O
serious doubts about whether I could do things well.	O	O	O	O	O
my decisions would reflect what I really want.	O	O	O	O	O
forced to do something I wouldn't choose to do.	O	O	O	O	O
that people who are important to me would be cold and distant towards me.	O	O	O	O	O

I expected that in an interactive exhibition about snow, I would feel…

	Completely Untrue	Mostly Untrue	Somewhat True	Mostly True	Completely True
capable at what I do.	O	O	O	O	O
disappointed with my performance.	O	O	O	O	O
that my choices would express who I really am.	O	O	O	O	O
pressured to do it.	O	O	O	O	O
that people I spend time with would dislike me.	O	O	O	O	O
competent to achieve my goals.	O	O	O	O	O

	Completely Untrue	Mostly Untrue	Somewhat True	Mostly True	Completely True
insecure about my abilities.	O	O	O	O	O

I expected that in an interactive exhibition about snow, I would feel...

	Completely Untrue	Mostly Untrue	Somewhat True	Mostly True	Completely True
I was doing something that really interests me.	O	O	O	O	O
obligated to do it.	O	O	O	O	O
a warm feeling with others.	O	O	O	O	O
the relationships I have would be just superficial during the activity.	O	O	O	O	O
that I could successfully complete the task.	O	O	O	O	O
like a failure because of the mistakes I could make.	O	O	O	O	O

LEQ Matrix

You just visited an exhibition about snow. We want to know about **your experience with this exhibition**. Please respond to each statement by telling us how much you agree with each statement.

Please tell us how much you agree or disagree with these statements.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I liked this exhibition.	O	O	O	O	O
After seeing this exhibition, I think I will enjoy snow more.	O	O	O	O	O
This exhibition helped me understand the world around me.	O	O	O	O	O

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
When I engaged with this experience, I was able to explore ideas that were interesting to me.	O	O	O	O	O
The Snow exhibition was fun.	O	O	O	O	O
I learned something new about snow.	O	O	O	O	O
This experience was boring.	O	O	O	O	O
I will recommend the Snow exhibition to a friend or family member.	O	O	O	O	O
I learned something new about another culture.	O	O	O	O	O
This experience kept me interested.	O	O	O	O	O

CA Matrix

Please tell us how much you agree or disagree with these statements about the exhibition you just saw.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
My everyday life involves these objects and ideas.	O	O	O	O	O
I associate these objects and ideas with my heritage.	O	O	O	O	O
These objects and ideas are familiar to me.	O	O	O	O	O

The ideas presented...

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Show why snow matters to people.	O	O	O	O	O
Reflected my experiences.	O	O	O	O	O
Offended me.	O	O	O	O	O
Emphasized the right things about snow.	O	O	O	O	O
Were similar to ideas I already had.	O	O	O	O	O
Had enough detail.	O	O	O	O	O
Conflicted with my own ideas.	O	O	O	O	O
Were important things to learn about snow.	O	O	O	O	O

SRQ Matrix

In this final section, we would like to know about what would motivate you (or not!) to **learn more about snow.**.

A reason I will engage with another opportunity to learn more about snow is. . .

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I have to.	O	O	O	O	O
I think it's important to learn about it.	O	O	O	O	O
I want to understand the subject.	O	O	O	O	O
It will be interesting.	O	O	O	O	O
I probably won't. I don't see what I would get out of it.	O	O	O	O	O

A reason I would engage with another opportunity to learn more about snow is. . .

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I think its valuable to learn new things.	O	O	O	O	O

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I enjoy learning about this kind of topic.	O	O	O	O	O
I probably wouldn't. I am not sure it's a good thing to do.	O	O	O	O	O
I am supposed to.	O	O	O	O	O

A reason I would engage with another opportunity to learn more about snow is. . .

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I will feel bad about myself if I don't.	O	O	O	O	O
It will be fun.	O	O	O	O	O
I probably won't. I am not sure if it's worth it personally.	O	O	O	O	O
I will feel guilty if I don't.	O	O	O	O	O
I will find it satisfying.	O	O	O	O	O

Thanks so much for completing this questionnaire! Please click the arrow to submit your responses!

Powered by Qualtrics

Citations

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