Ute STEM Project: A Study in the Integration of Western Knowledge and Native American Knowledge Bases NSF AISL Grant No. 1612311

MASTER LIST OF ALL UTE STEM EVALUATION REPORTS (w/ links)

Process Evaluation

Process evaluation was designed to help the Ute STEM leadership and project team assess ongoing progress and learning, identify needed course corrections, and document the implementation of the project. Originally envisioned as occurring via online surveys 2x/project year over the five-year award period (and with the intention to include museum staff from Denver's History Colorado Center and Montrose's Ute Indian Museum, tribal representatives from the three participating Ute tribes—Southern Ute Indian Tribe, Ute Mountain Ute Tribe, and Ute Indian Tribe - Uintah and Ouray Reservation, archeologists and other scientists from the Dominguez Archeological Research Group (DARG), and the project's lead videographer), two rounds occurred early in the project: July 2017 and April 2018. Participation was inconsistent, and process evaluation was suspended. At the close of the project (2022), key History Colorado staff were interviewed (by phone) as a final process evaluation. In all cases, open-ended questions were designed to to prompt and facilitate reflection and used to capture details of concerns and successes that participants experienced.

Findings from the process evaluation supported the following measurable learning outcomes:

Audience 4: Tribal, Museum and STEM Professional Communities

- Better understand successful collaborative models at a strategy for STEM learning (Strand 5).
- Demonstrate increased competence in using and adapting Ute STEM collaborative model tools (Strand 5).
- View collaborations between tribes, museums and scientists as an important part of STEM knowledge creation and learning (Strand 6).
- View history museums as partners in informal STEM learning (Strand 6).

Evaluation Reports:
Ute STEM Process Evaluation 1 Report (July 2017)-attached
Ute STEM Process Evaluation 2 Report (April 2018)-attached
Ute STEM Process Evaluation 3 Report (2022)-attached

Fieldwork Evaluation

Fieldwork evaluation (completed post-fieldwork in 2017 and 2018) was designed to facilitate reflection and enable the Ute STEM project team and fieldwork participants to look back on their fieldwork experiences, assess progress and learning, and document any concerns identified to apply to future fieldwork sessions and/or the Ute STEM project overall. The project's Co-Principal Investigators (Co-PIs), participating project staff from History Colorado, tribal representatives and participants (adults and youth) from the three participating Ute tribes—Southern Ute Indian Tribe,

Ute Mountain Ute Tribe, and Ute Indian Tribe - Uintah and Ouray Reservation, archeologists and other scientists from the Dominguez Archeological Research Group (DARG), and the project's videographers participated in phone interviews and were asked to reflect on their fieldwork experiences. This included 18 interviews in 2017 and 17 interviews in 2018. Additionally, short videos were created to summarize fieldwork evaluation findings.

Findings from the fieldwork evaluation supported the following measurable learning outcomes:

Audience 1: Ute People
Ute participants will:

- Be motivated to learn about traditional Ute approaches to engineering, technology, botany, geography, climate and weather and will be interested in archaeological research methods and tools (Strand 1).
- Understand TEK and archaeology field practices through studying wickiup sites and regional ecology (Strand 2).
- Observe, gather and analyze data to answer questions, and formulate their own research questions and hypotheses to test and explore as part of the research team (Strand 3).
- Reflect on how TEK and archaeology inform one another, and will view Ute science, technology, engineering and math as contemporary STEM practice (Strand 4).
- Participate in scientific activity, use the tools of archaeological surveying and site field work, engage in scientific inquiry, and use STEM findings to inform exhibits and programs (Strand 5).
- Identify as someone who uses and contributes to traditional Ute STEM knowledge, archaeology,engineering, and science (Strand 5).

Audience 4: Tribal, Museum and STEM Professional Communities
Tribal, Museum, and STEM communities will:

- Better understand successful collaborative models at a strategy for STEM learning (Strand 5).
- Demonstrate increased competence in using and adapting Ute STEM collaborative model tools (Strand 5).
- View collaborations between tribes, museums and scientists as an important part of STEM knowledge creation and learning (Strand 6).
- View history museums as partners in informal STEM learning (Strand 6).

Evaluation Reports:
Ute STEM 2017 Fieldwork Evaluation-attached (see association video here)
Ute STEM 2018 Fieldwork Evaluation-attached (see association video here)

Exhibit Evaluation
Exhibit evaluation was conducted at several stages to inform History Colorado Center's "Written on the Land" exhibition and the traveling/portable exhibits. Front-end and topic tested provided baseline information, used to guide exhibition and program planning for "Written on the Land." This included interviews with 114 participants in May 2018. Once "Written on the Land" opened (in early 2019), 66 visitors were observed in the Ute STEM-specific area of the exhibition (i.e., STEM

interactives) and 60 of those were also interviewed. These observations and interviews centered on visitors' perception of the STEM interactive components/exhibits. Additionally, 66 visitors were interviewed after exiting the full exhibition. These interviews focused on: 1) visitors' key take-aways, or "big ideas" within the exhibition, 2) what visitors perceived as the most compelling elements of the exhibition, and 3) If and how the exhibition conveyed the Ute peoples' relationship to the land and to Colorado. Once the traveling/portable STEM exhibits were created and distributed (based on those in "Written on the Land"), additional evaluation was conducted with Red Rocks Community College, who hosted the exhibis at two of their sites.

Findings from the exhibit evaluation supported the following measurable learning outcomes:

Audience 2: Family and Adult STEM learners (including in rural and underserved communities in Colorado and surrounding states)
Museum visitors and public programs attendees will:

- Increase their interest in Ute STEM, Ute culture, and archaeological research methods and tools; they will be curious about STEM connections to their own lives (Strand 1).
- Understand TEK concepts and modern archaeological explanations (Strand 2).
- Test building methods, explore patterns, and observe plants to make sense of the natural and physical world (Strand 3).
- Reflect on how TEK and archaeology inform one another, and will view Ute science, technology, engineering and math as contemporary STEM practice (Strand 4).

Evaluation reports:
Ute STEM 2018 Front End Topic Testing Evaluation-attached
Ute STEM 2018 Interactive Exhibits Prototyping Summary (internal document)-attached
Ute STEM 2019 Written on the Land Summative Evaluation-attached
Ute STEM 2023 Traveling Exhibit Evaluation Report-attached

History Take-Out EvaluationUte STEM Traveling Exhibit Evaluation Report
History Take-Out evaluation was designed to assess project outcomes related to the project's K–12 education programs. History Take-Out is a kit-based education program designed for preschool through 5th grade students. The Ute STEM-specific kit is called "Ute Knowledge: Colorado's Original Scientists." In this facilitated hands-on program, students use objects, photographs and a large walk-on map of the state to explore the stories of people, places, and industries throughout Colorado's history. History Take-Out is offered as a facilitated program by History Colorado's museum educators 1) at the museum as part of school field trips, or 2) at schools as a visiting program; alternatively, teachers/educators can acquire a History Take-Out kit and facilitate the program themselves (supported by online/virtual training). History Take-Out evaluation consisted of observing lessons facilitated by History Colorado museum educators, online surveys completed by teachers whose classrooms had the History Take-Out program at their schools, online surveys and/or one-on-one interviews with educators (both school teachers and community-based education program providers) who had completed all modules of the virtual training and facilitated the program, online surveys with partners provided with access to

kits and virtual training, and phone interviews with History Colorado staff members who created, expanded, facilitated, and created History Take-Out training.

Findings from the History Take-Out evaluation supported the following measurable learning outcomes:

Audience 3: K-12 Learners and Educators across Colorado and Utah
Outreach program participants and educators will:

- Develop an interest in Ute STEM approaches to engineering, technology, botany, geography, climate, and weather, and will be curious about STEM connections to STEM in their own lives (Strand 1).
- Understand TEK concepts and modern archaeological explanations (Strand 2).
- Explore and generate scientific questions and hypotheses about construction, ecosystems, and patterns (Strand 3).
- Test building methods, explore patterns, and observe plants to make sense of the natural and physical world (Strand 3).
- Reflect on how TEK and archaeology inform one another, and will view Ute science, technology,engineering and math as contemporary STEM practice (Strand 4).

Educator training participants will:

- Be motivated to incorporate Ute STEM knowledge in their classrooms and/or informal science settings (Strand 1).
- Apply Ute STEM content and skills in their classrooms and other settings (Strand 2).
- Explore scientific practices, scientific explanation, and argument in Ute STEM and archaeology that can be used in learning settings (Strand 3).
- Reflect on how TEK and archaeology inform one another and view Ute science, technology, engineering and math as contemporary STEM practice (Strand 4).

Evaluation report:
Ute STEM 2023 History Take-Out Evaluation Report-attached

Additional Evaluation Materials

- Ute STEM logic model-attached (with list of measurable outcomes)
- Ute Indian Museum garden video (interviews)

Ute STEM Program

Process Evaluation Report #1

10 October 2017

Report prepared by:
Lauren Wilson on behalf of ExposeYourMuseum LLC

Introduction

Two times per year during the five-year award period for *Ute STEM* program, a grant funded by the National Science Foundation (NSF), the project's Principal Investigator (PI), Co-Principal Investigators (Co-PIs), participating project staff from History Colorado (HC; both Denver's History Colorado Center and Montrose's Ute Indian Museum), tribal representatives from the three participating Ute tribes— Southern Ute Indian Tribe, Ute Mountain Ute Tribe, and Ute Indian Tribe - Uintah and Ouray Reservation, archeologists and other scientists from the Dominguez Archeological Research Group (DARG), and the project's lead videographer are contacted and asked to reflect on their grant and project experiences to date. This "process evaluation" is designed to help the *Ute STEM* leadership and project team assess progress and learning, identify needed course corrections, and document the implementation of the project.

In total, 15 participating project team members shared responses to an online survey in July 2017, marking the start of the NSF grant. Respondents included project leadership, with representation from HC (n=7), tribal representatives (n=3), DARG scientists (n=4), and the lead videographer. Open-ended questions were used to capture details of concerns and successes that participants experienced. Questions were designed to prompt and facilitate reflection; the following report discusses responses based on common themes that emerged as a result of these questions.

Involvement with *Ute STEM*

Respondents reported on their role and involvement with the project to date. With nearly half of respondents working on the project daily or weekly (47%; n=7/15) and with in-person meetings scheduled across the state, it is useful to see where groups have had heavy or light representation to date. In the table below, darker blue indicates greater representation of a given team. Notably, none of the tribal representatives who responded to the survey reported attending the tribal consultation in Denver in December 2016, and fewer HC staff members were represented at the tribal consultation and kick-off meeting in Montrose (April 2017) than were in attendance at the Denver tribal consultation. Other involvement (written in by survey participants) included: phone meetings, working as director of the Ute Indian Museum, recruiting and supporting youth and chaperones, and conducting archaeological fieldwork.

Involvement	Proportion N=15	HC n=7	Scientists n=4	Tribal Representative n=3	Videographer n=1
Key part of my job; I work on the Ute STEM project daily/weekly.	**47%** n= 7/15	5	2		
Attended the **Tribal Consultation for the Ute Indian Museum** at History Colorado Center in Denver December 1, 2016	**40%** n= (6/15)	5	1		
Attended the **Tribal Consultation for the Ute Indian Museum** at the Ute Indian Museum in Montrose April 11, 2017	**33%** n= (5/15)	3		2	
Attended the **Kick-Off Meeting for the Ute STEM project** at the Ute Indian Museum in Montrose April 12, 2017	**53%** n= (8/15)	3	3	2	
Other Involvement	**27%** n= (4/15)	1	1	1	1

A Study in the Integration of Western Knowledge and Native American Knowledge Bases (Ute STEM) is supported by an award from the National Science Foundation (Award # 1612311).

Top Questions

Respondents considered the top three questions they had about the project to date. Ten respondents contributed a total of 23 questions. More than a third of questions regarded the project schedule and expectations (35%; n=8/23), with nearly another third concerned recruitment and participation (30%; n=7/23). Others were interested in goal setting and learning (22%; n=5/23) or sharing findings (17%; n=4/23). All questions are listed as follows:

Project Schedule + Expectations (35%; N=8/23)

- Chaperones want to know more about what to expect.
- In addition to the archaeology field trips, what other projects are planned?
- Will we be adding more hands-on elements from Ute STEM into the exhibit?
- When will the first workshop start?
- What is the role of the UMU THPO?
- How long is the funding for this project?
- Will it continue and maybe we can collaborate as a regular summer enrichment program for Southern Ute?
- Why can't the invoices be paid in a timely manner?

Recruitment + Participation (30%; N=7/23)

- How can we attract Ute interns to work with archaeologists in the field and lab?
- Do we know how many tribal students will be attending?
- How can we make sure as many Ute people as possible are involved?
- I am curious as to how the Ute youth enjoy, engage, and interact during the upcoming fieldwork - what will be their takeaway? *[Also learning, below.]*
- What are some ways to get us all somewhat comfortable and loose with the camera rolling?
- How do we address needs and opportunities (like elder oral histories) that come up?
- How hot and sunburned will I be for fieldwork?

Goal-Setting + Learning (22%; N=5/23)

- How can we fold in lessons learned after the first field visit?
- What will the students gain from it?
- I am curious as to how the Ute youth enjoy, engage, and interact during the upcoming fieldwork - what will be their takeaway? *[Also participation, above.]*
- How can we best get the project goals top of mind of most partners and participants?
- How can we carry forward our new relationships with HC and Ute participants, and apply what we've learned to future projects and programs?

Sharing Findings (17%; N=4/23)

- Can other museums participate in the knowledge gathering part of the process?
- How will we come to an agreement among program partners regarding appropriate "ownership" of project findings/conclusions in relation to TEK/cultural intellectual property?
- How will we document the process of coming to said agreement in order to describe it 1) in our grant reporting, and 2) in the part of our investigation which creates a model that can be replicated by other museums/scientists/indigenous collaborations?
- What knowledge coming out of this project should be shared with a broader public, and how?

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Challenges

Group members were asked to reflect on the challenges they have encountered to date during involvement with the *Ute STEM* project.

Have there been any challenges during *Ute STEM* so far?

Just over half of respondents had experienced challenges while working on the project (53%; n=8/15). Half of respondents who mentioned difficulty had trouble with **timing or timelines** (50%; n=4/8). One shared that NSF award dates were difficult to find on the website, and knowledge of these dates from the start "…would have made our grant process and timeline more clear." Others felt timing was difficult because of conflicting priorities. One respondent considered "…the tribal calendars and activities, plus the timing for chaperones (burn out at the end of the summer), it never seems like a good time as our community always has something going," and another agreed that with such a variety of schedules, it was a challenge to keep all involved project partners up to speed. Finally, one mentioned the challenge of opening the Ute Indian Museum while planning for fieldwork "…is tough but is pretty un-avoidable."

Two respondents had difficulty with **recruitment**, two with **administrative challenges**, and two with **understanding their role** (25% each). One respondent with recruitment difficulties reflected, "We are asking ourselves how we can rethink our approach, and hope to discuss that question with Ute cultural reps, educators and students during this year's field visit." Those who noted administrative difficulties explained, "It's been challenging for HC to get contracts and POs set up internally for our partners," and "meeting cash flow" as pain-points. For the two individuals whose project roles were cited as difficulties, one had started the project late and needed to catch up on understanding project needs and their tasks, while another explained, "I have been involved from the stage of putting together the proposal and feel like I have a lot to offer and have contributed, but my specific role was never really outlined."

Lessons Learned

Participants were asked to share their "one lesson learned" on the *Ute STEM* project to date. Although 4 respondents wrote in that they were not yet sure of their lesson learned, sixty percent of respondents offered a reflection (n=9/15). Respondents shared lessons regarding **communication**, **relationships**, or **flexibility**. Some responses reflected more than one category.

<u>Communication</u>

- "Adjusting upcoming presentations to a high school aged audience, rather than college seniors."
- "Probably conversation rather than formal presentations is better."
- "Review of the meeting minutes at the end of the meeting (or soon after) would be helpful and may prevent misunderstandings."
- "We need to have conference calls to ensure that we are all on the same page."

<u>Relationships</u>

- "All the partner organizations are on very different schedules. Therefore, the project will have moments of shared synergy with different partner organizations at different times. There will be lots of fluidity and change in who will have capacity at any given time."

It's great how engaged everyone is so far, I'm hoping that we can maintain that throughout the full run of the project.

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- "Partnering with History Colorado and Ute tribal educators has provided a useful forum for us to broaden our experience and hopefully learn ways we can deepen our efforts to work collaboratively with research partners."
- "We are listening to the communities (Utes) and telling their stories the way they see it and their cultural protocol(s)."

Flexibility

- "It's been a good reminder on being flexible and adaptive."
- "Making sure we always have adequate time for nitty-gritty logistics AND deeper, intellectual conversations."

Key Findings

- Nearly half of respondents work on the Ute STEM project daily or weekly; none of the tribal representatives who responded to the survey attended the tribal consultation that took place in Denver, and HC staff had less representation at the tribal consultation and kick-off meeting in Montrose.

- Respondents were curious about the project schedule and expectations, recruitment and participation, goal-setting and learning, and sharing findings.

- Just over half of respondents indicated they had encountered challenges during the *Ute STEM* project. Many found timing or timelines to be a challenge, and others encountered difficulty with recruitment, administrative challenges, or understanding their role.

- Lessons learned emphasized the importance of frequent or tailored communication, strong relationships with project partners and Ute communities, and maintaining flexibility.

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Ute STEM Program

Process Evaluation Report #2

15 June 2018

Report prepared by:
Lauren Wilson on behalf of ExposeYourMuseum LLC

Introduction

One to two times per year during the five-year award period for *Ute STEM* program, a grant funded by the National Science Foundation (NSF), the project's Principal Investigator (PI), Co-Principal Investigators (Co-PIs), participating project staff from History Colorado (HC; both Denver's History Colorado Center and Montrose's Ute Indian Museum), tribal representatives from the three participating Ute tribes— Southern Ute Indian Tribe, Ute Mountain Ute Tribe, and Ute Indian Tribe - Uintah and Ouray Reservation, archeologists and other scientists from the Dominguez Archeological Research Group (DARG), and the project's lead videographer are contacted and asked to reflect on their grant and project experiences to date. This "process evaluation" is designed to help the *Ute STEM* leadership and project team assess progress and learning, identify needed course corrections, and document the implementation of the project.

In total, 16 participating project team members shared responses to an online survey in April 2018. Respondents included project leadership, with representation from HC (n=6), tribal representatives (n=5), DARG scientists (n=4), and the lead videographer. Open-ended questions were used to capture details of concerns and successes that participants experienced. Questions were designed to prompt and facilitate reflection; the following report discusses responses based on common themes that emerged as a result of these questions.

Involvement with *Ute STEM*

Respondents reported on their role and involvement with the project to date. With half of respondents working on the project daily or weekly (50%; n=8/16) and with in-person meetings scheduled across the state, it is useful to see where groups have had heavy or light representation to date. In the table below, darker blue indicates greater representation of a given team. Although the option was provided, no respondents indicated that they were new to the project. Notably, none of the scientists who responded to the survey reported attending the tribal consultation in Denver in December 2017. Other involvement (written in by survey participants) included: phone meetings, work prior to 2017, seasonal/variable involvement (e.g., working on the project monthly), conducting archaeological fieldwork, and attending the Fieldwork Visit during July 26-28, 2017, in Montrose.

Involvement	Proportion N=16	HC n=6	Scientists n=4	Tribal Rep. n=5	Videographer n=1
Key part of my job; I work on the Ute STEM project daily/weekly.	**50%** n= (8/16)	6	1	1	
I come to **most of the Ute STEM Tribal Consultations** and/or meetings.	**50%** n= (8/16)	2	2	4	
I was at one or more **Tribal Consultations in 2017**.	**56%** n= (9/16)	3	2	4	
I was at the **Tribal Consultation** at History Colorado Center in Denver on December 7, 2017.	**50%** n= (8/16)	4		4	
Attended the **project Kick-Off Meeting** at the Ute Indian Museum in Montrose April 12, 2017	**50%** n= (8/16)	2	2	4	
I was at the **re-opening celebration of the Ute Indian Museum** on June 9-10, 2017 in Montrose.	**44%** n= (7/16)	3	1	3	
Other Involvement	**31%** n= (5/16)	1	3		1

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Top Questions

Respondents considered the top three questions they had about the project to date. Fifteen respondents contributed a total of 34 questions. Nearly a third of questions regarded project planning (29%; n=10/34) or concerned recruitment and participation (29%; n=10/34) and about a quarter discussed goals and learning (24%; n=8/34). A few considered how findings would be shared or the products that resulted from the project (18%; n=6/34). All questions are listed as follows:

Project Planning (29%; n=10/34)

- Detail for preparation and implementation for 2018 Field work.
- What is happening this summer?
- Where are we at?
- What evening activities will be available for the participants in the location of the project?
- What activities for the project will directly engage the youth and elder participants striving for the end deliverables?
- How can we increase the frequency and range of field trips, and include more Ute participants? *[Also recruitment, below]*
- What else do I need to consider?
- What items/supplies will each participants be held responsible for providing?
- Will 4 days of fieldwork this summer prove to be more beneficial or too long for participants, compared to 3 days last summer?
- Will t-shirts be available for students and staff for safety and identification purposes?

Recruitment + Participation (29%; n=10/34)

- How many elders/youth are signed up to attend?
- If a student who was 16 attended last year, can they go again?
- Should we recruit new students each year?
- Allowing other HC staff members to attend the field experience
- Are we engaging tribal leadership and HC leadership enough for shared pride in the project?
- Are we making sure all our partners are getting what they need out of the project?
- How can we bring more people into the conversation with tribal members, without overwhelming them?
- How can this kind of cultural exchange be sustained going forward?
- How can I be most effective in my tasks?
- How can I be most helpful to the project as a whole?

Goals + Learning (24%; n=8/34)

- How do we keep the interest in learning more about themselves?
- Are Ute kids seeing TEK and STEM as both overlapping and also distinct?
- How do we marry technology and hands-on from their perspective not our expectations?
- Does it foster a desire in the participant to pursue a career in this area?
- How can we extend STEM goals as applied to public archaeology to other communities of interest?
- How does this project benefit the Tribe other than the youth who attend the field trips?
- How will we make this all work?
- Is the project building concretely enough for all core team members? Or is too elusive and philosophical?

Sharing Findings + Products (18%; n=6/34)

- What has been done with everything from last summer?
- How will the videos be distributed?
- Will an educational book be created from the STEM Grant that will be used in the development of the state educational cirriculum?
- Will publications be developed from the STEM Grant?
- How will we take the project's TEK experiences & knowledge, and effectively present them to an even wider audience?
- What makes the most sense to start sharing with the public?

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Challenges

Group members were asked to reflect on the challenges they have encountered to date during involvement with the *Ute STEM* project.

Have there been any challenges during *Ute STEM* so far?

Some respondents had experienced challenges while working on the project (38%; n=6/16). Three respondents who mentioned difficulty had trouble with **devoting time** to the project. Conflicting priorities and busy team members made involvement difficult, as one expressed, "My biggest challenge is that other projects has diverted my time and energies from Ute STEM. I'm thankful for HC team members who have been picking up my slack." Two others found **keeping participants engaged with the program** to be difficult. These respondents described two different areas of challenge:

> "Keeping the participants actively engaged with the project and allowing them to feel like genuine contributors. Ensuring that participants have full knowledge there will be an end product desired, i.e. museum exhibit."

> "We have had difficulty attracting Ute interns to participate directly with archaeologists in the field. We believe this objective was too aggressive in scope, and lacked a foundation of introductory experiences and knowledge. Consequently, we have been discussing ways we might modify our project scope of work to organize short-term outings and workshops for Ute students in collaboration with Ute Indian Museum and possibly Southern Ute Museum and Ute Mountain communities."

Finally, one respondent found the recent **absence of the Ute Indian Museum Education Director** to be a challenge.

Lessons Learned

Participants were asked to share their "one lesson learned" on the *Ute STEM* project to date. All but two respondents offered a reflection (n=14/16). Respondents shared lessons regarding **planning and flexibility, communication**, **participant focus,** and **project goals**. Some responses reflected more than one category.

<u>Planning + Flexibility</u>

- "Don't wait until the last day, last hours to interview students. Start that process earlier so everyone gets to participate."
- "Make sure there are facilitated activities for the fieldwork (which are being planned for June 2018)."
- "Patience"
- "Everything takes longer than anticipated, there are benefits to slowing down.
- "Flexibility."
- "Planning does not always produce expected results."
- "I am curious as to the extent of tribal involvement in the planning of this project prior to submitting the grant proposal."

<u>Communication</u>

- "Communicating the roles of staff, youth, elders, chaperones and scientists. Communicating clear expectations for each participant."
- "Focus on clear communication between partner groups."

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Participant Focus

- "Engage and listen to the kids"
- "How they articulated their desire to know more about what being "Ute" is."

Goals

- "The elders and Ute youth benefit so immensely from seeing these places together." *(Also Participant Focus, above)*
- "I believe that the Ute STEM project, so far, has shown that helping Indigenous Americans preserve their cultural connections to ancestral homelands can build trust and open new channels for public archaeology and STEM learning."
- "The integration of cultural and traditional ecological knowledge, paired with scientific analyses, is a power[ful] and important combination for telling a well-balanced history."

Key Findings

- Half of respondents work on the Ute STEM project daily or weekly; none of the scientists who responded to the survey reported attending the tribal consultation in Denver in December 2017, which was moderately to well attended by responding History Colorado staff and tribal representatives.

- Respondents were curious about project planning, recruitment and participation, goals and learning, and sharing findings, which was consistent topics of interest on the first Process Evaluation.

- Fewer respondents indicated they had encountered challenges during the *Ute STEM* project; although devoting sufficient time to the project remained a key difficulty, past challenges like recruitment, administrative challenges, and understanding roles had subsided. In this round, participants found it difficult to keep participants engaged and struggled with the recent departure of the Ute Indian Museum Education Director.

- Lessons learned highlighted patience and flexibility in planning, clear communication, a focus on participants, and understanding the impact of project goals.

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Ute STEM
Final Reflections on the Project by History Colorado Staff

History Colorado
January 15, 2023
Prepared by Kate Livingston, ExposeYourMuseum LLC

2017 Ute STEM Fieldwork

Introduction and Methodology

As the National Science Foundation-supported Ute STEM project concluded, external evaluator Kate Livingston (ExposeYourMuseum) interviewed key project staff members from History Colorado:

Liz Cook, History Colorado Center, Exhibit Developer, Principal Investigator for NSF grant;
Sheila Goff, History Colorado Center, Curator of Ethnology and NAGPRA Coordinator (retired);
Shannon Voirol, History Colorado Center, Manager of Exhibit Planning;
CJ Brafford, History Colorado's Ute Indian Museum, Director;
Carly Jones, History Colorado Center, Ute STEM K-12 Education Coordinator.

The purpose of the interviews was to facilitate a systematic reflection about the six-year project, including highlights, lessons learned, and thoughts about how to sustain momentum and continue the project's desired outcomes at History Colorado and beyond moving ahead (i.e., after the grant period). Specifically, the measurable learning outcomes that were articulated for this internal museum audience were:

- *Better understand successful collaborative models as a strategy for STEM learning*
- *Demonstrate increased competence in using and adapting Ute STEM collaborative model tools*
- *View collaborations between tribes, museums, and scientists as an important part of STEM knowledge creation and learning*
- *View history museums as partners in informal STEM learning*

The following sections highlight key themes from staff members' perspectives at the close of the project [1], pointing to progress toward all of the desired outcomes bulleted above.

[1] Quotations from interviews are included to illustrate themes, however individual names are not associated with quotes.

Centering Ute Voices, Needs, Priorities, and Perspectives

History Colorado staff members observed that Ute STEM did not position the Ute people involved as "equal project partners" in a traditional sense—for example, with matched or distributed power in decision-making. Rather, project partnerships with the three Ute tribes centered Ute voices, needs, priorities, and perspectives (i.e., before the museum's or other non-Ute partners). Deferring to the expertise of tribal partners was viewed as essential in a respectful and equitable project approach. Additionally, History Colorado staff recognized the historical and contemporary harms perpetrated on Native and Indigenous communities—including by museums.

Time to make a change here [at the museum]. *Time to rewrite the history of this. You can see so many ways from the voices of the people themselves.*

You must be humble when you are working with tribal experts. You don't know everything. You know some stuff, but you don't know everything. And they know tremendous amounts of things. And the fact that they are willing to share any of that with you after what they've been through in their history… you must be thankful. You must be respectful. You must be humble.

Tribal people are going to share in a way that makes sense for them and we don't have to force that sharing. We don't have to say, "Here's 10 minutes when [one elder is] *going to speak and then* [another elder is] *going to speak for 10 minutes." They are going to do it their way and it's going to be so much more impactful if we can just let go of our need to control it. They are teachers. They have an oral tradition. The more we can back off and let them direct that sharing, the more authentic it's going to be.*

If the archeologists or the ethnobotanists would start to talk, it inevitably quieted the Ute elders. And so the second time around [during fieldwork] *we were incredibly specific, with the elders speaking first and the scientists speaking second.*

We made [the fieldwork sites] *more accessible for the tribal elders. That was a big moment where we were like, "Okay, the science might be a little cooler* [at another site], *but it's just not accessible, so we can't go there."*

Going back to this idea of tribally-driven priorities—we wanted to go [to a different fieldwork site] *but nixed it because* [the Ute partners] *told us it wasn't a good thing to do.*

The existing relationships that [the non-Ute, non-museum project partners on fieldwork trips] *had showed the* [Ute] *youth that these agencies* [e.g., Bureau of Land Management] *respected their elders and themselves and their place and the land. So it forefronted, for the kids, the relationship and the trust that the tribal folks had built with these federal agencies.*

These are real materials. We've heard that about corn-grinding activities that museums and education programs have done. Native people, particularly Pueblo people, have said, "If you're going to be processing food, you eat that food. Don't just do it and then throw it away." So we were like, "Oh, that's an interesting idea," and decided to push that a little bit with our hands-on activities [in the museum exhibition] *to make them a little more like modeling. You're not really making a basket. You're not really making a shelter. We're taking high-tech materials and modeling—STEM modeling with those materials. That was a choice that we talked in consultation with* [Ute] *folks.*

I do see myself now more as a listener than a talker. Working with elders, working with tribal people, I used to think—and maybe this was youth as well—that the power was in the talking and the doing. And now I feel like it takes a lot of skill and patience to be quiet and let others speak and shine. And that's where the good product comes from. Even though it might not further your career because you look invisible a little bit, the work is so much stronger and better. We were all really conscious about not putting ourselves in the films and we're last on the credits and we're the facilitators, right? We just decided we're going to really take that backseat. And now I feel that not only is that how I'm wired, and also a skill, but that I can see the professional power and the products that flow out of that.

Moving Beyond Traditional Measures and Metrics

It is common, especially in grant-funded projects, for grantees to cite intended reach (e.g., numbers of expected participants, etc.). For example, the NSF Ute STEM proposal stated: *400 K-12 teachers and informal educators will have an increased ability to teach STEM as they participate in the educator trainings.* In many cases, the project met or exceeded stated quantitative goals. That said, History Colorado staff members recognized that Ute STEM offered opportunities to prioritize depth over breadth; while sometimes reaching fewer participants (e.g., due to COVID), the project did so in a profound way. Additionally, the project was meaningful to staff members personally, changing their perspectives and approaches to their work and the ways they interact with nature.

It's breadth and depth. I feel like currently, in terms of like what History Colorado wants, it's obviously breadth—to reach a lot of people in a lot of ways. And I feel like we've really succeeded at that, which is good. Thousands and thousands of people get this opportunity to think about Ute knowledge and think about TEK [traditional ecological knowledge] *and STEM and learn about Ute people. In that sense, with all the exhibits, the decision to go from doing the exhibition in Montrose [at the Ute Indian Museum], to doing the exhibition in Denver [at History Colorado Center], then all of the traveling [exhibits]… we've made all of these decisions to hit more people if we can, and that feels really good. In all the evaluation we've done; we're doing that.*

I think for us, as museum program people, that was hard for us to get comfortable with. We were thinking about the funders. You're supposed to reach a bunch of kids and flipping it and realizing what an amazing deep experience those [few] *kids had* [during fieldwork]*… and, because cameras were rolling, we got this amazing documented set of moments and messages. It was amazing to learn to be okay with the lower numbers, and seeing just how amazing it was for the kids who were there.*

We took a small number of kids out on the landscape. People are doing that now—trying to do that as well. They're seeing that as [native communities] *try to maintain their culture and language, the concept of taking elders out with kids is super important.*

There's nothing like sitting around and listening to [the Ute elders] *speak of the land and the resources, what their people did. I mean, that's just really magical. And then, when you are sitting there listening to those elders speak and you're watching the reaction of some of those* [Ute] *kids, that's really beautiful too. Like we keep saying over and over, they hadn't had this opportunity to be on the land that their ancestors were on. And it just meant so much to them. To see that and to know that we helped facilitate that was a gift.*

In terms of our community collaboration, understanding that things can be hard and serious and require a lot of intent and thoughtfulness, but there's also the opportunity for fun and creativity; not to totally shut that off just because you're coming at it with intent and seriousness.

I am forever changed by sitting there under the junipers, listening to [a Ute elder] *with the kids. I have a deeper respect for those trees and that landscape because of that day. I can't even articulate how it changed me, but I know that it has.*

Just to be out on our mother earth, the land, our feet. For the Ute people too, because there were emotional times with some of the elders; they said, "I've never even been here. This is where my ancestors were." Because now some of these places are BLM lands, forest land. It was amazing to bring a group of many people. Diverse people. So much learning and different perspectives of how we all see different things. And then having the youth there was amazing because they would say, "My grandpa, my grandmother, my uncle…." They've heard similar stories like this and they might add onto it. It was just very much of sharing from one's heart.

I go into sites differently now than I did in the past. I may not say it out loud, because I'm not going to "play Indian," but I give thanks when I go into a site and when I leave. I just do. Since this project, that feels important.

Informing the Museum Field

History Colorado staff has received many inquiries about Ute STEM, particularly from other museums and history centers who would like to start similar initiatives and partner with local native and indigenous communities. Staff members recognize the importance of Ute STEM in establishing best practices for such partnerships, and realize History Colorado's role in informing the field. During interviews, staff members shared tips and advice gleaned through Ute STEM. Additionally, the project has continued to inform new History Colorado projects and partnerships.

I have given talks about this project and about the [History Colorado Center*] exhibit and about the Ute Indian Museum—university classes at the University of Colorado in Colorado Springs. CU-Boulder. And every time at the end, in the Q&A, it's always—and these are young people who are going to be museum professionals going forward—they always say, "How do you do this? How do you get started?" So something like this that can be shared out is going to be invaluable. The museum field is changing. And people are finally waking up to, "If we're going to talk about native people, we need to have native voices, and they need to take priority."*

If you have an idea for a project that's wonderful, but don't start running with it until you've checked to see if the tribes actually have any interest to be involved or if you're on the right track. Because, over and over, people make the mistake of coming to a tribe and saying, "Here's our great idea. We've already done six months of work on this. What do you think?" You. Have to start with [tribal partners] *at the very, very, very beginning.*

It can't happen overnight because [tribal partners] *have to gain trust. We're human; we're people and getting to know each other matters. Pursue it, but take it slow; it will come. It takes patience and understanding.*

I feel like people want to go out with kids and scientists and elders to these sites…. I talked to people and they were interested in doing some of that. So the fact that other people are thinking about it, the next energetic wave of people may do it, and hopefully somebody will apply for an n NSF grant just to do that. That would be awesome.

I would say budget for travel and consultation. The value that you will get from that, the return on investment for that, even when the number seems huge. It's immeasurable the amount of good work that happens when you're having dinner together or just not being in Denver, being outside of Denver. How much human relationships are benefited from being out on the land together.

To do things takes money. And the STEM [grant] *allowed us to develop and present what we now present. It's so valuable to the people out here. Here at the museum we want to create a better understanding and awareness. You can get little grants here and there, but it was so nice. This was money to distribute so many different ways.*

Trying to find somebody who was in that dissemination role at the tribal level, whether it's Instagram or Facebook or their newspaper or whatever. Having some more connections there would really be great. One thing that benefited us is knowing the two administrators at the Colorado Tribes.

We [at History Colorado] *took what we learned from the Ute projects and did it with three other tribes. It was a transformational moment.*

We're so lucky to have had this opportunity and to have been able to do this work with the Ute folks and it has changed us as people. It has changed our institution. It's changed future projects.

Now we are making more films and podcasts, but frankly, when we made those movies [during fieldwork], when [the videographer] *made those movies with us, that felt like a pretty big deal. We were content creators right then. And I think that paved the way for more of that content creation.*

There's a lot of internal capacity around federal grants now, because of what Ute STEM has done. We've gotten so many more federal grants, and yes, it is hats off to a lot of work in philanthropy, but we have shown that we're able to do it.

[Ute STEM is] *giving us a language to parlay into other community projects, and especially tribal projects. I don't think we could have done* [a current tribal project at History Colorado] *if we hadn't done Ute STEM.*

The Importance of STEM in History Museums

During grant-writing and soon after the project was awarded NSF funding, History Colorado was going through sizable leadership shifts. These changes influenced the way the project was acknowledged and also how key staff members felt about the project's perceived importance and value institutionally. As leadership at the museum stabilized, the project received greater attention and its significance became more recognized. Particularly for a museum focused on local state history, an NSF award supporting parallels between indigenous ecological knowledge and STEM was unpreceded.

In the middle of the process of us writing the proposal and getting the grant, there was turnover at History Colorado—leadership changes and no one on the leadership level ever owned it. We felt like we were filling all these holes financially and in terms of exhibits here in Denver [at History Colorado Center], *but it never felt embraced.*

From 2015 until the opening of the Ute Indian Museum, it was just like, "Does anybody even care? Is anybody excited about this $2 million?" And then when they gave the go-ahead to putting the exhibit in Denver [at History Colorado Center]*, that sort of felt like, "Okay, it's an acknowledgement that it's worthwhile even if nobody is explicitly giving that good feedback." That felt like a moment. That first period it was tough.*

We never felt like people [inside History Colorado] *got it or cared. I kept trying to reword it to certain folks in leadership, couch it appropriately…. "You guys should be so proud of us and you're not."*

It was hard when [a key staff member] *retired I was doing a new job. We just lost so much momentum…. I have a document somewhere that says, "Restarting the Ute STEM machine," and we were just trying to figure out how. That was hard.*

What strikes everybody as different from other anthropological or archeological exhibits they've seen is this STEM component. They've all commented on that—that that's what makes our exhibits unique. Because people don't happen to address that. I think interesting. It sounds simple but it's not. It's very, very special.

It's been an evolution for History Colorado for sure. when we got the grant, we were one of very few history museums that had ever gotten National Science Foundation funding. It wasn't part and parcel of what history museums thought they should be doing. I think that has opened up a little bit.

With today's STEM-focused education drive—that focus—the idea of putting history education with science, technology, engineering and math skills allows it not only to further the goals of the districts or to make it relevant to today's education, but it also drives home the fact that this concept hasn't been around for just this short period of time. We've now identified that science and all of these skills are something that everyone has been doing or has had exposure to since the beginning of time.

COVID as a Prompt for Important Project Changes

When the Ute STEM project was proposed to NSF, History Colorado staff members could not have predicted a global pandemic, nor its potential effects on the project design and goals. In interviews, staff members commented on the many impacts of COVID on the project, frequently citing how adaptations required in response to COVID led to long-lasting changed they believe have improved Ute STEM. This was especially true in the case of History

Takeout, a kit program for teachers, community groups/centers, and other educators who want to facilitate lessons about Ute STEM for students and/or youth programs. Additionally, COVID changed the museum's approach to traveling exhibits and presenting at conferences. Ultimately, the changes made because of the pandemic appeared to have contributed to the project's desired outcomes.

I think we moved from a model of us flying and going to conferences and talking to rooms of 200 people to more of a coaching role, one-on-one with organizations.

Originally the History Takeout [kit program] *was primarily facilitated by* [museum] *staff—trained staff. And we were thinking about how we could make it something teachers could check out. Our comfort with doing that had increased. I think those were the COVID impacts. I think that was when we were like, "Okay, we're just going to get it out to everybody." And we may not see the numbers during the grant, but we know the numbers will continue and we've trained a hundred-some people on how to do the kit and hope that it will have that impact.*

We were looking for ways to get [History Takeout] *kits out, as opposed to the original idea of making 40 kits and paying for their facilitation* [by History Colorado staff] *across the state. COVID obviously altered all that. So the new task was to make as many kits as we could and get them into as many hands as we possibly could…. I'm happy with where it's gotten, because even had we done 40 kits and gotten facilitators out, I don't think we would've hit the possible scope that we have now. I think getting them into educators' hands, even if that wasn't the original intent, allows the kits more opportunity for use. And hopefully allows more students across Colorado access to them.*

Because of the way things turned out with COVID and the switch to like making a ton of [History Takeout] *kits… they're able to give them to people with very minimal obligation. Their obligation is to be trained on the kit, use the kit, tell us if you use the kit. I just think it's so much less stressful for all of them. They're happy to have it and* see [in the training videos provided], *"Here's how we're going to use it"…. It's so much more freeing. I actually think the kits are going to reach 50 times more* [youth/students] *than they would have in the other model.*

I'm finding more teachers are using kits and teachers are excited. The kits give them something, because it was always on them. They were always sort of like, "Am I'm going to say the right thing?" These kits are put together with the blessings from and the information we have from the Ute [people], *so I think the kits are a much simpler teaching tool for the teachers, which they really appreciate.*

I know a lot of the folks that we reached out to who have eventually ended up taking kits were super excited that it was material that had been collaborated on with the tribes. So they had a tribal voice, they had a tribal backing. That was incredibly important to a lot of folks, because with new awareness there comes an understanding that when you're teaching things, if you don't have an authentic voice, are you actually teaching it? Or are you just paying lip service to somebody else's understanding of how things have happened?

Instead of making essentially one exhibit copy to travel, we were looking at the numbers and noticing, "Oh, we can print these banners, right?" And, "Let's make multiples." And now we're even making more. Again, put it in their hands and let them figure it out instead of us worrying about shipping and getting a truck….

Sustaining Momentum and Next Steps

History Colorado staff members spoke about their excitement and anticipation for Ute STEM having a lasting impact—both at the museums and in the lives of those the project touched. The fieldwork films were referenced frequently, as were this History Takeout kits; both products were seen as having ongoing value and utility for years to come.

We can only keep on enhancing what we first started…. That's what excites me about it. STEM will be a legacy here.

I wish [the fieldwork videos] *were on a great big screen. I wish we had had the opportunity to work with PBS and get more of them into a Colorado Experience* [TV show]. *It is a huge underutilized resource.*

The videos were taken when we were at our camps [i.e., fieldwork]*… at different times doing different things. I think it really opens up more of the story to have that visual. Listening to people. I think the videos were very well put together. Interviewing and getting people's thoughts—from park service people to our Ute elders, to the young people… and perhaps to me too.*

I envision [the films from fieldwork] *probably going to sleep for 20 years or something and then everybody's going to be so excited to find them again. It's because of the magic of those people on the films talking about being on the land and sharing the traditions and how they were scientific. It's just all there in those films. It's a huge embodiment of all the miraculousness that we pulled off.*

I hope everybody gets a [History Takeout] *kit, uses it for the next 10 years, and that first graders at all these schools get to experience the videos and everything they're going to experience through doing the kit. I actually feel pretty confident that is going to happen. I feel really good about that.*

Having a next generation of land managers. Growing up and becoming preservationists for the peel trees…. It is just so cool that those trees are being protected, and what if it was those kids [who were part of fieldwork] *who get to grow up and protect those trees?*

I would love for the traveling exhibits and the films to get brought out every once in a while at the reservations, at the three communities. That would be so cool. I would love it if the exhibition in Montrose [at the Ute Indian Museum] *and the exhibition in Denver* [at History Colorado Center] *just kept helping people see Ute people as scientists.*

Ute STEM Program

2017 Post-Fieldwork Interviews

10 November 2017 (final; reviewed/approved for distribution)

Report prepared by:
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Introduction

After the National Science Foundation (NSF) funded *Ute STEM* program's two-and-a-half day fieldwork session in July 2017, the project's Co-Principal Investigators (Co-PIs), participating project staff from History Colorado (HC; both Denver's History Colorado Center and Montrose's Ute Indian Museum), tribal representatives and participants (adults and youth) from the three participating Ute tribes— Southern Ute Indian Tribe, Ute Mountain Ute Tribe, and Ute Indian Tribe - Uintah and Ouray Reservation, archeologists and other scientists from the Dominguez Archeological Research Group (DARG), and the project's videographers participated in phone interviews and were asked to reflect on their fieldwork experiences. This post-fieldwork evaluation was designed to facilitate reflection and enable the *Ute STEM* project team and fieldwork participants to look back on their fieldwork experiences, assess progress and learning, and document any concerns identified to apply to future fieldwork sessions and/or the *Ute STEM* project overall.

Of the approximately 40 fieldwork participants, eighteen participants discussed their fieldwork experiences via phone interviews conducted by *Ute STEM*'s external evaluator (Kate Livingston, Principal at ExposeYourMuseum LLC). The interviews were held in September of 2017, approximately 6 weeks following the fieldwork. Respondents included 3 HC staff and project leadership, 2 Ute archeologists, 1 Ute elder, 1 Ute adult, 5 Ute youth (including at least one youth from each of the three participating Ute tribes), 4 DARG scientists, and 2 videographers. Open-ended questions were designed and asked to prompt and facilitate reflection; the following report discusses responses based on common themes that emerged as a result of these questions.

Key Fieldwork Memories

Respondents were asked to share their most significant memories from the fieldwork, or what continued to resonate with them over a month later. Many shared positive reactions and considerations.

In-person connections to sites and people

The experiences of being on the sites and spending time as a group were also striking experiences for participants. A Ute archeologist expressed, "It was good to see the kids out in the field interacting with some of their traditional or aboriginal land." For an HC staff member, this meant building an experience together, where "we were able to hang out and be kids, and be adults, and be professionals, and have discussions about what it was like to be out there at the [wickiup] site." A videographer had a similar takeaway at the wickiup site; once the group had spent some time in the space, "Everybody was doing a little bit of their own thing, and then there was this moment, this collection of moments, where I just felt this experience of just being out there with the group…" An HC staff member described spending time as a group at the sites as "powerful" and considered, "How we just barely scratched the surface" and wondered, "How we can get to a level of depth that we want to get to."

> "It was just this really cool experience of being a part of what was actually happening."
> -Videographer

A Study in the Integration of Western Knowledge and Native American Knowledge Bases (Ute STEM) is supported by an award from the National Science Foundation (Award # 1612311).

Onsite experiences and discoveries under the guidance of elders

According to youth participants, being onsite, seeing things first-hand, and elements of discovery stood out. For example, finding metal from a gun shell and arrowheads near the wickiups, seeing cut markings or how water moves on the wickiups, and how long the wickiups had been standing. Although the experience was not new for all youth, one tribal youth confirmed, "Yeah, that was my first time see[ing a wickiup], like a real one." Another had their interest piqued at the Shavano site since, "When I was younger, I went and did a lot of that and seeing petroglyphs from all over and I really liked those."

Youth valued being able to have adults—elders in particular—available to discuss what was encountered and to share stories and tribal knowledge, One Ute youth appreciated "Getting to talk with the elders and learning more about the history from people themselves rather than just having to read it from a textbook or something like that, you know?" Young participants also appreciated having set activities where they experienced something they had never seen or done before:

> "I remember how they did the sacrifice and they had the water and the tobacco and they sacrificed it and used spiritual… so that evil spirits won't follow you back home, and then they also saged people down too. I've seen it before, but I've never really experienced it myself. I've seen it from museums and stuff." - Ute youth

> "They use a drone to look overhead about where the wickiups are and where the bears and where the trails used to be. And when we went outside, they gave some people a try at the drone. That drone—I thought it would be easy but when the lady showed me how when you turn around, the controls are a little messed up. I'm like, 'Whoa, okay.' What was amazing about that drone is you can see everything from your phone on a camera."- Ute youth

It was also observed by a HC participant that the fieldwork experience appeared to have also have been "a first" for some of the Ute adults, who may not have had previous opportunities for such onsite experiences with elders from their tribes.

Hearing and sharing diverse perspectives

Hearing diverse, new, or multiple perspectives from fieldwork participants was often a memorable experience. It appears that the varied viewpoints shared (e.g., Ute traditional ecological knowledge and Western science) throughout the fieldwork session were highly appreciated and encouraged. One HC team member valued, for example, when a member of the DARG team passed around plant samples and "and everybody had thoughts about what those things were from a bunch of different perspectives." A member of the DARG team found, "It was really educational for me to see the feedback from, not only the students, but the elders and other members of the tribe as well." Others agreed that hearing ideas and insights from both the Ute elders and DARG scientists was of interest. "There's definitely some sort of disconnect there, in both the Ute cultures' ideas and sentiments on these specific lands, and then what the archeologists are trying to figure out... it's an interesting contrast," noticed a member of the videography team. A member of the DARG team recalled learning a new perspective on the Bear Dance from one of the Ute elders: "…it was really quite wonderful to chat with him about it. That was probably the best part of the whole time...." Another member of the DARG team felt the fieldwork had reinforced their existing beliefs about gathering input from multiple sources: "[It] just reaffirms my feeling about collaboration, working on big projects in a collaborative way. Because, I've come to more and more appreciate the help other people can give in an effort like this. Particularly with the mix of cultures."

> "We all seemed to be learning from each other."
>
> -Ute archeologist

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Reflecting on what went well

While many had ideas about how the program might improve in future iterations (discussed in depth in other areas; see "Ideas for Future Fieldwork," beginning on p. 13), for some, takeaways consisted of reflecting on what went well in this inaugural *Ute STEM* fieldwork experience and being pleased that the project was underway after much planning. An HC staff member was glad "that we got such positive feedback from the chaperones, the educators, the tribal reps, even the kids. I guess I wasn't ... I don't know what I was expecting. It just seemed like everybody was pleased with the opportunity." Similarly, a DARG team member felt reassured by the reception participants had to the technology used in Archeology. "They seem to all be completely on board with the use of drones, metal detection, tree ring dating, etc. That was not an eye-opener to me, but it gave me a sense of satisfaction that we're not doing anything that they feel is overly invasive," the scientist said.

Thoughts and Actions After Fieldwork

Respondents were asked whether they had researched or dug deeper into anything since learning about it during the fieldwork. For many, the trip sparked interest, curiosity, and new ideas to follow up with, though some had not yet investigated further. Others mentioned the trip had inspired them to do something or consider a different perspective.

Checking facts

Returning to research and looking up more information was important after fieldwork for a few DARG team members. One recalled an occasion where, after positing a claim about the development of the wickiup, a Ute elder probed, '"They don't even have trees out in the Plains. How could they have invented the tipi?" The DARG team member reflected:

> "Yeah, that was a wonderful moment. It caught me off guard at first and I went, 'Oh man, I stepped in something here,' but as it evolved, I really enjoyed the interaction and watching the students soak that in as, 'Okay, we've got two different takes on the subject here. Everything is an opinion and we can make that work with these two different sides.' It was great. It was a great little moment."

Once they returned from the fieldwork, however, they revisited ethnographic literature to ensure their claims had been based on and supported by academic research.

Another member of the DARG team also further pursued checking information based on this interaction; they recalled that the Ute elder "said it was a fairly recent occupation because of the tipi orientation of the wickiups… He said that just simply didn't happen until later. So I had suspected that and I kind of questioned him about it, so we're looking more into their use and occupation of the Uncompahgre."

DARG team members were not the only participants to be interested in checking facts after their fieldwork interactions. One Ute Youth revealed they were curious to learn more "about the carvings… What they actually meant. 'Cause some of those carvings probably didn't mean what the guide or the person that did it said it was."

Continued interest in history and culture

For youth and adults alike, interest was sparked in building further awareness of Ute history and culture. On the drive home, a Ute elder talked with a youth about their personal history. The elder recalled the conversation: "[The youth] said, 'I thought we were named a different name.' I said, 'We were. We got two names.' And so I says, 'But the latter years of occupying over that area, they changed it to Uncompahgre.'" A Ute youth agreed, "I want to learn about more of my culture. Like how my culture goes back to the first Native Americans and I want to know how they made fires…" For one Ute Archeologist, the interest in learning more professionally motivated: "I've been more or less delving into a lot of the cultural history, Protohistoric Era of the Southern Ute, because that's what I'm working a lot with right now. And I'm looking at some of the Prehistoric Ute sites and how to manage those from being destroyed or impacted by federal undertakings."

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Expanded awareness

Some respondents were simply surprised by something they discovered during the experience, and though they had not sought more information, they felt they had an expanded awareness. One Ute youth felt it was vital to see a wickiup in person:

> "I knew some things about wickiups, but I didn't know a whole lot. Going out there, and learning all that, and seeing how small they were, and tiny the people were, and able to live in that and make those, is what I kind of got from it. I haven't really looked up too much on it lately, but I definitely learned a lot more things about wickiups when I went out there."

When Ute adults closed the fieldwork experience by sharing gifts with participants, a DARG team member reflected on the experience as unexpected and wonderful, but also uncomfortable in terms of social and cultural expectations. When gifts were shared with the Ute youths, the DARG team member was impressed thinking, "that's what it looks [like] when your parents and teachers are teaching your kids"; when gifts were then given to adults as well they were less sure how to respond: "It was kind of uncomfortable. I was wondering about the social interactions this was kind of leading to." In particular, the participant was concerned some may not have the monetary means to buy and exchange gifts. As the DARG team member was processing all of this, an HC staff member suggested hand-making gifts to exchange during for the next fieldwork experience. The DARG team member realized, "Wow, this is why you need to work with other people in collaboration. Because, none of us is the expert on all the dimensions of this."

Seeking out similar experiences

Experiences at the sites inspired several respondents to either find more examples or seek similar experiences. One Ute youth hoped to find "places where you can find wickiups because I've been to some places here in Montrose that are up in the mountains that I'd seen that look like just branches, but they also don't look like just branches laying there, but like they fell or something. More like they'd been piled there…" Another Ute youth revealed they were interested in looking at pictures of other petroglyphs. A Ute adult was planning an upcoming trip to incorporate more Ute history and culture: "I'm going back down there to Montrose and seeing a couple more sites down there."

Participants also noticed ties to other aspects of their lives and felt the fieldwork shaped their approach. A Ute archeologist noticed ties between their day-to-day work and observations made at the fieldwork sites. On a series of hikes following fieldwork, an HC staff member considered "…rock art and petroglyphs, and how old, and where they're from, and how do you visit with respect. Those are some things that have stuck with me since."

Reflection on the project

Looking into more detail about the project itself helped some situate or revise their contributions after the fieldwork. Staff at HC in particular researched more about their approach to the project; one indicated they had done research on intellectual property, and others reviewed a report from a similar project, *Roots of Wisdom*, from peers in the museum field. One felt that in reading about the analogous project, "It resonated, but it was also like, 'OK maybe this is some of the ways we need to be pushing ourselves a little bit more.'" Another thought the report "…certainly underlined what an organic process this is." After reading the report and comparing to their own project, the HC staff member realized:

> "It's tricky to have deep conversations about the overlap between STEM and tech. I had wished those had come to the forefront a little bit more when we were out in the field, and I'm thinking about [ways] we used to pull them out a bit more…It is sort of things that take a little more time to get into because, in a way, you're kind of comparing and contrasting… almost world views? There's not a slick easy way to start those conversations, especially when you're getting to know people. You've got to spend time building trust and getting to know each other."

A videographer also felt they needed to gather more detail and revisit the footage collected during fieldwork. They believed, "there's probably some very interesting perspectives in there that will come to light down the road," and

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looked forward especially to interviews and footage of youth, "since they're part of both [scientific and Ute tribal] cultures… being kind of a bridge between the two."

Reflections on the Collaboration

Fieldwork participants were asked to explore the benefits and dynamics of collaboration between tribes, scientists, and museums.

Unique sources and perspectives

Resoundingly, participants discussed the unique viewpoints brought by scientists and Ute tribal members, and at times, considered the museum staff to also contribute a unique perspective on content or questions explored during fieldwork. Although some believed the scientific and Ute tribal perspectives overlapped, distinct threads were evident within participants' descriptions of the contributions of each:

Ute Tribal Members	Scientists
Contribute: lived experience, oral history, direct ties to past, authenticity, respect, nuance, detail	**Contribute:** research, scientific rigor, methodologies and techniques, depth, detail
"The tribal people, we've lived it. They've lived this way for thousands of years, hundreds of years, and they know some of things that's then passed down, handed on the way we live. We live the culture instead of having a set culture." - Ute adult "As the tribal people, they have family that experienced it and lived it. They know how things actually went and how they did things." - Ute youth "They bring an authenticity, and the culture, and what they know themselves from being told from their grandparents and parents and their grandparents' parents. So they bring more of an authentic culture to it."- Ute youth "It goes without saying that we have so much to learn from them, not only their opinions about the past and their opinions about how we're studying their past, but their insights." - DARG team member "The Utes bring the most important part." - DARG team member "Getting all the tribes working together… it basically emphasizes the importance that generalizations are very dangerous because… even within the tribe itself, the different bands operated slightly different. And it shows that there's a lot more conversation to be had instead of just sweeping generalizations…" – Ute archeologist	"The land can tell the story, we just need to figure out how to get there and listen to it, so that's kind of where I'm coming from." - DARG team member "The scientists too, kind of bring the research behind it and bring the history to it." - Ute youth "They bring the dating of it. I guess the tribe could too, but more of the scientific part of it all." - Ute adult "The DARG folks bring more of the Western science way of looking at Ute culture and Ute history, and the message of approaching that from a Western science perspective." - DARG team member "Scientists bring more of a scientific point of view, like this is how we were able to identify these certain things, these are how old they are, here's what we think about it." – Ute youth "I do think the scientists bring a depth… There're very specific things of, what is dendrochronology? Or what's interesting about what they found out from actually doing, drawing, and recording; and every little thing with those structures is an interesting angle that is a perspective on the thing." - HC staff member

The museum's role

Although less common, some saw museums as providing a unique perspective to add to the discussion; this perspective tended to be more logistical or related to dissemination. "I think that the museum people definitely bring a really solid education background," shared one DARG team member. They continued, "In order to pull something like this together, you need to have a pretty good understanding of logistics with working with kids, and the kinds of things that they're gonna respond to, and all of those kinds of things." A HC staff member thought, "the museum perspective, in the end, is how we probably share that with other people, how we can tell that story to a wider audience— which for us, there's always that question of what is appropriate to share, how to tell that story, how to give that experience."

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Rather than seeing museum staff as active voices in the co-creation of knowledge, museums were considered purveyors of information. For some, housing objects and artifacts was a crucial contribution of the museum; "They're like our historians there, because of our artifacts," thought a Ute adult. A DARG team member agreed:

> *"That's where these objects are held, so that's where the study collections are, not only for scientists and archeologists, but for tribal members as well...I think a museum is kind of the hub of the wheel of everything that's going on because that's where we're going to store these material objects."*

In addition to housing objects, participants believed museums offer access to the public, and work as an informative and educational space. A Ute youth felt museums "…show other people from other religions how us Native Americans lived and what our rituals are, why we dance or do the Bear Dance in the summer or at the Memorial Day." A Ute adult explained the value of this public information:

> *"We've got people asking, 'What is a Ute?' Some people think it's a bird. It's not a bird. We're not a bird. No, Native Americans are people. That's what a Ute is. They don't even know what a Ute is, so I think having the museum up and us going to these things, it's good. It's educational."*

Sharing and working as public informants was a vital piece participants felt museums brought to the equation. Participants believed museums created an opportunity for people to gain exposure to Ute culture and history. Museums were "…able to place it together into one [location] so that we can share it with people so that more people can learn about the history of the world before we know it as today," shared one Ute youth.
According to a videographer, the museum's role is important:

> *"Because these stories are important, and they are not only a part of the Ute culture, and their history, but also a part of American history and world history. I think that's important, being able to not only come up with the information and make advances, but then be able to project it to those who are interested in learning or those who may not have even thought about it until they visit a museum site."*

Finally, staff at HC saw their contribution as encouraging discussion and dialogue:

> *"We are good at getting these folks together and creating the space where these conversations happen, and then we can reflect all that knowledge hopefully in an authentic way in our education programs and our exhibits, and that kind of thing. We're facilitators and disseminators."*

Cultivating respectful dialogue

In exploring each group's contribution to the project and partnership, the benefit of synergistic work was evident. "[Ute tribes and scientists] still tend to bring different ways of looking at the world to the table, and so if you don't get them at the table, then they are each in a vacuum and they are not seeing that overlap," explained a HC staff member. A Ute youth was in favor of the collaboration: "I think it's good for them to work together, because they could tell each other things that maybe they didn't know or maybe they assumed something… just go back and forth with what each other know and learn off each other." A videographer agreed that working together helped "…to meet a common goal, which is understanding." They continued, "Without that complete understanding from every side, I feel like there's a lot lacking." Looking at the history of authority and power structures over time, a Ute archeologist considered collaboration as a step in the right direction:

> "I've always felt that the only way to get an accurate and comprehensive interpretation or understanding of the past is if you work with tribes and scientists, and then museums are the places where that information can be shared."
> -HC staff member

> *"If we look at the past—of how museums and archeologists and scientists and a lot of other Anglo individuals in governmental positions or intellectual academic positions—they viewed indigenous peoples are relics of the past or as simply specimens to be analyzed. And I think that nowadays with the collaboration between archeologists, scientists, academics, and elders and youth, it's very important because it provides an opportunity for groundwork to be laid to correct the mistakes of the past but also to*

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open up the doors of the future looking at different types of research questions, [how oral tradition can] help advance the knowledge about the Utes."

Within the project, several saw these benefits of collaborative work in action. Although different perspectives emerged and led to disagreement at times, participants viewed dialogue as respectful and felt it was in the spirit of understanding and learning from one another. Their observations included:

"I thought it was really interesting to hear the discussions between the Ute children and the chaperones and other tribal members that were there discussing different views on the sites, the meaning, the interpretation, how the sites were treated, the scientific approach of documenting them and recording, and how that process happens and the scientific interpretation. But then a more traditional perspective was brought in… about treating the sites with respect. Not that the archaeologists didn't, but it was clearly of notable importance to the tribal members to think about that, and particularly leaving the site. I thought that was interesting." - Ute archeologist

"For the most part, I felt like the groups worked really well together. In terms of being present, being there, and trying to accomplish for each day some of the goals that were set forth. I think it's important because, I definitely kind of from that stepped-back view, bringing all of those three different groups together, I think, pretty quickly I realized that one of the greatest things that could come out of this project is that sharing of information between each of the groups, and the potential for that." - Videographer

"… that's what I'm interested in, is how to bring together groups like this that seem to be opposed, and in many cases are diametrically opposed, on the surface at least. And try to find the commonality. That's my whole thing. If you get everybody out on the land having a good time and talking about this stuff, then all that kind of melts away. Even though disagreements remain, if you kind of just accept those and agree to disagree on some things…" -DARG team member

"Even when there might be conflicting views, everybody was able to talk about it openly and just add all of the different perspectives and let people make up their own mind, or combine those different perspectives. I thought that must have been really great for the kids, for everyone involved, really. But for the kids to understand that there are different approaches and none of them are really more right or wrong than the others. There's just a multitude of ways to look at things." - Ute archeologist

As an active contributing voice to the project dialogue, a Ute elder appreciated having the space to share with the group. They reflected on the experience:

"And sometimes I might find it's rubbish or it might sound like they're backward or things like that but it's not that, it's given us an opportunity to express our thoughts and feelings about what goes on in that area over there and we try to tell our stories, what we were told and similar and not any different than the next person that's trying to tell their story of what they learned or what they were taught."

Overcoming barriers

Working together enabled participants to overcome barriers between various groups. A DARG team member noticed that governance often separates working with tribes. Others mentioned that Ute tribes are often disconnected from one another. A Ute youth shared their perspective on this, reflecting on their connection with youth they met from other Ute tribes during the fieldwork:

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Interviewer: *"Have you spent a lot of time, other than at the fieldwork, being with lots of people from different Ute tribes or was that one of the first times you've done that?"*

Ute youth: *"One of my first times to do that, to be honest with you."*

Interviewer: *"Yeah, what did you think about that, meeting youth from different Ute tribes?"*

Ute youth: *"I was kind of scared because, I know that there's like a rule against my religion to meet other Ute tribes… Because back in our history, my grandpa told me a story where there was like Natives have wars against other Ute tribes and like the Navajos and all that."*

Interviewer: *"Yeah. That makes sense, so you were wondering if it would feel friendly or not?"*

Ute youth: *"Mm-hmm" [affirmative]*

Interviewer: *"And what did you find out? Was everyone friendly or was it uncomfortable?"*

Ute youth: *"Actually, we got together pretty good."*

Although collaboration and discussion was seen as beneficial, a videographer noticed times when gaps between ideologies were not fully closed. They thought, "…there were some missed opportunities, seeing the groups interact. Maybe people weren't listening to each other as well as they potentially could have been." The videographer provided an example of this viewpoint:

> *"[A scientist] was giving some great information from his perspective about the wickiup and its meaning, and some of the scientific ways of measuring it and understanding it. I felt like there were individuals around the circle and in the group in the tribal community that kept offering forth information, but I just never felt like it was.... There wasn't an opportunity for it to go anywhere. Not that it was shut down or that it was ignored, but a dialogue never happened out of it. It was like seeing there was a teacher, and people were trying to offer other teaching information I guess, and it just didn't work for whatever reason."*

Exposure to STEM career paths

"It was kind of Bring Kids to Work Day; an opportunity to see potential career opportunities, or fields that they might not be very aware of to give them some exposure to that."
- Ute archeologist

Bringing together various groups during the fieldwork helped validate the study of indigenous history or culture as a possible academic or career interest for Ute youth. Due to "…the very abrasive and outright manner they had to document everything, even if it was sensitive," archeology has not always been readily supported career path within certain indigenous communities. A Ute archeologist felt:

> *"Even though there are certain cultural taboos among different indigenous groups, like interacting with the dead or if it was the male or the female's job, well, some of those things won't change. But some of them will over time, just because traditions evolve. But there's a lot of work that can be done for those who are still interested in archeology."*

By gathering Ute tribal members, scientists, and museum staff together to discuss individual and collective knowledge, youth were given an opportunity to envision career options and possibilities. A staff member at HC expressed:

> *"A lot of times you'll hear tribal members talk about how the native youth need to learn about the cultural stuff, and that's important and it's part of their heritage, and that is absolutely true, but it's also beyond that. It could be a way of making a living and a study that's serious and respected out in the world, and until they see those conversations happening between professionals, they have no way of knowing that."*

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Although several adult professionals viewed fieldwork as providing this exposure, none of the youth interviewed explicitly mentioned an interest in pursuing STEM or archeology as a possible course of study or work.

Points of Discomfort

Several participants opted to share moments where they felt uncomfortable during the fieldwork.

Challenges to power and authority

Moments where presenters or people in positions of power and authority were questioned were, at times, uncomfortable for participants. While uncomfortable, participants also viewed these challenges as important. Reflections on this included:

> *"I almost felt a little bit uncomfortable for the tribal members in my group on the last day at Shavano when he started talking about like the Fremont being there, and then Utes coming in. One of the people did step in at that point, not one of the elders. It was one of the other adults and, you know, kind of challenged that. But you could sense the discomfort a little bit at that point for sure."* - DARG team

> *"I did feel uncomfortable at first, and then I thought about it in a few seconds and was like, 'Oh no. She should say what she's saying and you can call people out and make that apparent that you don't feel the same way.'…And I think having that ability, and having people that understand that, and are OK with that, and continue to have a conversation, is where we should all be going as far as interaction between people with differing opinions."* - Videographer

> *"She was, essentially, really challenging the archeologists, and it was intellectually uncomfortable, and it was sort of that, 'How do you guys know what you think you know?' question, but I also felt like there was an awesomeness behind that tension. I wish we had found a way to talk about it a bit more. I think it was the crux of the whole STEM/TEK [traditional ecological knowledge] conversation there, and it was a little uncomfortable, but then it was good."*-HC staff

Although most Ute youth did not expressly identify moments of discomfort, one did describe a moment where their peers questioned the authority of a non-Ute presenter sharing information about Ute culture:

> Ute youth: *"Some of the people were talking beside me and they were saying that, 'Why are these people talking about history when… we're supposed to know our history?'"*
>
> Interviewer: *"How do you feel about that?"*
>
> Ute youth: *"I don't know because I just kinda understand a bit, because like they're talking about our histories. Why are these people talking about our history when we're already supposed to be knowing our history and we can talk to our elders and stuff like that about it.*"

Likewise, one HC staff member felt uncomfortable, questioning if their own actions could have better leveraged power on the behalf of others. They described:

> "*There were a couple of moments there at Shavano and I was with a guide that I think was maybe the least culturally sensitive. And I had this protective feeling. I was like, 'Oh, is [the guide] going to say something that's going to be offensive, and how that's all going to go down?' On the one hand, it was really edifying that [a tribal member] was fine saying, challenging it, but it's also one of the things where I afterwards, was like, 'Did I do enough to support [the tribal member] in that? Did I do enough to back him up?' It was good that [the tribal member] felt comfortable doing that, but at the same time, it shouldn't entirely be on [them] to have to say those things*."

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Respect created discomfort for one Ute youth participant, and touching artifacts during the fieldwork made them uncomfortable. They shared their perspective:

> *"My parents told me to never go like inside the wickiup, never touch pottery, even though they may say that we're able to touch it we're still not able.... We're not supposed to touch it cause it's from the past, and we can't touch it. It's other people's stuff."*

Participant safety

Participants were at times worried about participants' safety. A staff member at HC said, "It comes from being a mom; I just did not want any kid—or, for that matter, any of the elders—to fall, to get lost, that kind of thing." Likewise, one participant was nervous about driving on muddy mountain roads. A DARG team member was uncomfortable after a visitor at the museum (not part of the fieldwork group) approached and addressed a youth participant inappropriately, asking the youth about their heritage; the DARG team member explained, "I was so shocked that I didn't really know what to say. [The visitor] walked away, and [the youth] and I talked about it a little bit. I feel really bad that I didn't intercede more as the adult there and step in at that moment."

No discomfort

Although two Ute youth mentioned discomfort, youth overall appeared to feel more at ease during the fieldwork than adults. One Ute youth shared, "I felt good all the way around. It was pretty good trip. It was great getting to meet everybody. Yeah, I liked it. I didn't feel uncomfortable at any time. It was pretty great." Another Ute youth agreed, "It was pretty nice. I liked it a lot. There wasn't really anything that I felt uncomfortable about."

For a Ute elder, simply being at the sites brought them comfort and connection. They shared, "It just felt real easy and relaxed and I feel that way every time I go to Colorado. I have that sense of feeling that our people belong there and… spiritually I just felt good over there, my mind and body. I just enjoyed my trip over there."
Participants were asked which aspects of fieldwork they liked and which aspects could be improved or done differently. Although one SUIT youth thought, "It's perfect the way it is," many provided more specific feedback. Strengths and potential areas of improvement are included in the following table:

Specific Fieldwork Feedback

The table below summarizes feedback provided about specific components of the fieldwork from the 18 participants interviewed:

Aspect	What worked	Possible improvements
Opening, Closing, and Introductions	• Blessing; powerful and provided a view of Ute traditions • Sharing something to get to know each other • Gift giving (sage and tobacco); made an impression, especially on non-Ute adults	• Start with more social, ice-breaker activities and ease into the science to accommodate newly forming relationships and encourage openness • Facilitate introductions to new people; help participants branch out, rather than talking to people they already know • Explicitly outline roles during introductions • Intentionally include sage and tobacco, or other gifts or traditional practices
Project and fieldwork framing	• Overall, the relaxed and flexible approach seemed to work well for the group; not too tied to agenda and timeline; could adjust as needed	• Spend more time talking about overall project goals and specific fieldwork goals • Provide opportunity for participants to outline what they hoped to gain from participating • Clarify roles and goals of the program for professionals (i.e., why videographer was there, what role museum professionals serve, etc.)

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Aspect	What worked	Possible improvements
Museum exploration	• Spending time in the museum • Information was interesting and educational; youth and adults were engaged and participated • Using field books to write 5 known things and 5 new things • Response to exhibit was positive; museum staff able to see tribal members engaged in the space • Personal connections to exhibit; pride in work was evident for those who worked created the space; Ute youth identified facts or people they knew; DARG team members were enthusiastic about artifacts; Ute adults found quotes that resonated	• Smaller groups in the museum exploration may encourage sharing • A planned debrief/share out activity
Scientific presentations	• Ethnobotony presentation with tactile plant samples was memorable and engaging • Elders appeared comfortable contributing during scientific talks and presentations	• Some scientists felt their presentation time was rushed; others felt they had tried to address too much or that presentations were too academic • Shorten and/or fewer presentations; do not try to cover as much all at once • Spread presentations throughout the experience, rather than front-loading them; add more breaks • Consider teen audience (rather than university level students); simplify and reduce use of jargon • Assess if PowerPoint is best presentation approach for the fieldwork audiences • HC educators may be able to help with presentation training for scientists or by giving feedback on drafts
Timing and structure	• Good balance of structured and unstructured time; using the site locations more casually • Unstructured time was beneficial for building interpersonal connections or relationships • Exchange of ideas worked well; discussion flowed and tribal representatives and scientists both had plenty to share • Interest and enjoyment of participants	• DARG, HC, and Ute youth all suggested longer (4 day) fieldwork period or adding more frequent field experiences • Add more hands-on aspects and time out in field • Coordinate and share more logistical details with adults in advance; possibly visit sites with project team to prepare for fieldwork; include list of technologies and materials that will be available
Outdoor field experiences (i.e., wickiups and Shavano)	• Introduction to sites and prayers by Ute elders • Youth and adult participants enjoyed being outdoors • Ability for participants to choose whether they prefer to hike and explore or stay at the gathering point • Ute sign language game was memorable • Games were well-timed and gave opportunities for adults to take time away • Ute youth were comfortable asking questions • Ute youth had time with elders	• Review what gear is needed in the field, in addition to backpacks and water; include overview/presentation of why certain things are important to be safe in the field • Provide Ute leaders more intentional space to talk and contribute • Add more interaction; use maps, drawings, photos; create a structure for participation (e.g., make comparisons or try to reach a conclusion together); allow youth to set up a wickiup with guidance from elders • Do not allow machetes • Draw clear connections between activities/information shared at Ute Indian Museum and at sites
Shavano guides	• Breaking into smaller groups was a good structure • Some guides were respectful, asked questions, and were responsive to alternative perspectives • Elders appeared comfortable contributing	• Rather than interpreting the petroglyphs, recommend guides instead identify elements that can be traced across time/locations; leave interpretation to Ute elders • Not every Ute youth was in a group with an elder; they missed out on oral history and stories • Better prepare Shavano guides about this project and offer suggestions

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Aspect	What worked	Possible improvements
Transportation	• Group was able to stay together, despite the large size • During drive time, participants had casual conversations, opportunities to get to know each other better, and opportunities to make connections and ask questions	• Better caravan organization and instructions (i.e., lead car stays in sight; use flags) • Reduce number of cars; ensure every car is filled • Visit the site in advance for clearer navigation; mark paths (use flags) • Provide more thorough and detailed directions; set expectations for how strenuous hike may be in advance
Meals and evenings	• Provided time for building interpersonal connections and bonding • On the first night, dinner gave participants opportunity to continue getting to know each other • Two dinners felt like an appropriate number • Youth and professionals both enjoyed free time in evenings (not overly structured)	• Drop-in social hours in lobby, if desired by others • Some youth indicated they would have enjoyed some activities in the evening (ideas provided by youth: star guiding, how to make fires, bead work)

As clear from the table above, participants shared a wide range of feedback and ideas. Examples of responses that guided the themes in the table above are as follows, however it should be noted that quotes are examples and not exhaustive; not all key themes are represented below.

> *"I think it could have gone on a little longer [on the Shavano day]. It was a really interesting thing that **I wanted to stay longer,** that's why me and my group were one of the last ones that were coming off the mountain because we were still looking at all the stuff."*- Ute youth

> *"We didn't mean to, but we were kind of putting the **archeologists in an uncomfortable spot**, because they, in a delicate way, felt like **they needed to justify their work a little bit**. I think that was hard for them. I don't know if we could frame it a way that felt more comfortable and created that back and forth about STEM and TEK."* – HC staff member

> *"I think also maybe for us as archeologists, give a lot more thought to what we actually try to present to the kids in those settings. What is age appropriate, or educationally appropriate? Like I say, we're not really educators. We haven't taught in those terms, so **we need some training, or some help in devising our presentations**, perhaps."* - DARG team member

> *"I liked those [ethnobotany and drone] presentations because they weren't really as long or as tedious as the ones beforehand, and you were doing other things. You were looking at the plants, and you were getting to hold and touch it, and **I think hands-on work is something that I personally am kind of a fan of** because not only do you learn it by viewing it, but you also learn it by actually doing it yourself."* - Ute youth

> *"My only concern is that I think, like when we were out there listening to [one of the scientists] out there, was he talking…. He was saying some really good stuff. It might have gone over their heads a little bit. Then again, it wasn't that far out. I just felt like maybe as far as the science, and technology, and those things, he was definitely hitting on that, but I might have **started smaller with more basics and then moved to the more detailed**, 'Here's how we record the site, and here's the paper we use.'"* - Ute archeologist

> *"I think, a good idea to **interact with the elders a little bit more about the interpretations of the site**…. Shavano's cave It would have been nice to maybe have allowed the elders to speak with the kids a little bit about their interpretation of the site or their knowledge about the site in general and how it fits into our history. But I think it would have been nice to provide a couple of **different perspectives including the Southern Ute and the Ute Mountain**. It seems as if he provided a lot of the Northern Ute perspective.*"- Ute archeologist [Note: "Northern Ute" here refers to the Ute Indian Tribe - Uintah and Ouray Reservation]

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*"I think there was an intention to do this, but to not only have, for instance the DARG representation, archeology representation, but then to have that tribal representation to balance that out. I felt, again, like, it just **felt more like this one-way dialogue**, that there was a lot of potential for sharing of information that didn't happen in that particular afternoon session [on the first day, during the science presentations]."* - Videographer

*"I liked that it was outside at the mountains. That was cool and **it gets you outside**. You get some exercise."* - Ute youth

"I thought that [wickiup day] was a pretty great day. It was nice. You were able to hear stories. We had played some games like bingo, but with animals, and it was all made with sign language. I remember some of the sign language. You do this snout thing, and your tail, like mountain lions. I remember some of that." - Ute youth

"*I loved my guide [at the Shavano site]. **Our guide was pretty great**. She was awesome. She took in a lot because I was in a group with the elders, and the **elders were telling stories** and they were giving her examples and talking to her about it and she was talking back to them and it was just kind of like **a group effort conversation** when talking about the [petroglyphs] and what they mean, and all this other stuff, which I thought was pretty awesome and cool to be a part of."* - Ute youth

*"Giving each kid a little packet that they could have next time they go to one of those sites if they ever stumble upon a place like that, or go on purpose, or whatever. Talking them through how they would approach the situation if they did go back to a Ute place so that **they knew how they would respond culturally**. I don't know. I just felt like that really tied everything up really nicely, and really gave the kids a sense of something tangible that they could take away from it."* - DARG team member

*"Again, I think the one thing I would have maybe liked to have seen was just more of a layout from the beginning of the day. 'Here's what we're doing; here's how long we're going to be; we're breaking up into groups.' **A better sense of what was happening before being out there**."* - Videographer

*"I don't think any of us realized that [a scientist] wanted to go talk about that wickiup, until we were all like, 'OK, I guess we're heading out.' And I think that that could have been just a little bit more planned; just to have been **more mindful of what structure we wanted to have** while we were up there."* – HC staff member

*"I felt like... it's not quite like this, but the place had become alive again, because you had elders, you had regular people, you had the kids **all sitting together doing things that kids might have done 150 years ago there**. It was just really neat to enjoy that site in that way, because I had never done that in an archeological site. I'm always looking at the ground trying to find artifacts and whatever."* – HC staff member

*"**[An elder] rode with us, and I enjoyed talking to her** and hearing her and [an HC staff member] talk. I ate lunch with her that day. We were at the wickiup sites. Chit-chatting with her was nice and interesting, and just kind of a happy accident."* - Ute archeologist

*"I liked that we had time to be on our own, that way **we had time to relax** and go swimming and go check out other places around Montrose. Just having time to relax after walking around everywhere. That was nice."* - Ute youth

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Ideas for Future Fieldwork

Participants offered ideas and suggestions for future fieldwork. They were asked to reflect on whether they would like to participate in fieldwork again, if they would prefer to return to the same sites or choose new locations, if they would invite the same participants to return for another year or recruit new participants, and if they had ideas for additional content or activities.

Site choice and returning youth participants

There was no clear pattern in whether fieldwork participants would prefer to return to the same sites or visit a new location, and many were unsure or saw benefits to both. For DARG team members who saw value in returning to the wickiup site, they felt the site offered a visible and relatable cultural connection for youth: "It's hard not to think about the people if you're in a wickiup site and their beds are still there inside the wickiups. Those real recent sites with the wooden features and things like that really make an easier bridge to the past for someone like a high school student or a non-professional of any age." Likewise, they felt having the Ute Indian Museum as a base was an asset and a eased logistical issues, but could imagine pairing with another museum near another site. Another DARG team member weighed the benefits and drawbacks of the site visited: "I would think of [going to] the same place if we have different people come, but I'd like to find another one just a little bit more accessible and a little bit easier for everyone."

Potential benefits of visiting a new site were intriguing to a Ute archeologist, who thought, "You definitely get a different kind of experience if you went to different locations. I think I'd go to different sites." Two Ute youth agreed that if they were returning to fieldwork the next year they would prefer to visit a new location. One explained, "It's really great to see other places and explore places you don't really know, but other people know, so you're not completely lost. It's great to see other places."

Site choice was connected to whether youth were invited to return or recruitment focused on new individuals; again, many saw benefits to both new and return participants. "I think if we end up doing another session of fieldwork, I almost think... and it would be with different students... I almost think going back to the same places would be just fine," considered a HC staff member. A DARG team member shared, "I like the idea of getting the same students back and taking them to the next level, but it would be hard to do that with other students sitting in there that didn't have the background they did. I think it would be difficult without dividing it up into two groups." Weighing the idea of bringing the same youth back to the same site, an HC staff member said, "I think they'd still have a really interesting time doing it again. And I think it would kind of push them to be engaged at a deeper level," and, "The program is going to be way more impactful if we can reach the same kids more deeply. I would love that." A Ute archeologist suggested that, by returning for multiple years, youth may eventually be able to participate in more academic or career-related offerings, like helping to co-author a research paper.

Recruitment was a factor project team members considered. They were aware that, **despite a target youth audience of high school aged Ute youth, family groups with youth of varying ages were likely to be involved in future iterations.** Although attendance by family groups and a broad range of ages was unanticipated for the 2017 fieldwork, a DARG team member reflected:

> *"There's one other thing that I thought was great. That was the mix of ages that we ended up with on the part of the youths. The fact that we had high school kids. We had professional people from the tribe. We had parents… we had elders, all together."*

Youth who participated in interviews indicated that they would like to return and enjoyed meeting new people. One Ute youth was interested in returning with the same group of people "…mostly because I had a good relationship with them." When another Ute youth was asked if they had connected with youth from other tribes, they felt connections

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could have been stronger: "They were just a little shy and they kind of stuck in their groups a little. I got to kind of talk to them, but not as well as I would hope, I guess."

Future content and activities

Respondents offered ideas for new content or activities for future rounds of fieldwork. DARG team members hoped to receive feedback from youth during fieldwork, whether via an informal check-in at the end of the last day or using a reflection journal. One hoped to ask youth:

> *"'Okay, what did you learn? What did you already know? What did you like? What did you not like? What are your thoughts about what we're doing as archeologists?' And really get the instant feedback from them while it's fresh in their minds."*

Activity and topic changes were explored. Many participants had ideas for future years:

Hands-on fieldwork (use archaeology tools, mock field session, use scientific method to guide a fieldwork session, demo ground-penetrating radar or other tech, teach declination and compass use, address gear of scientists)

> *"I want to make sure that there's a lot more hands-on stuff going on all the time, and then one of my hopes had been that the kids would use the tools the archeologists use, for example. They really didn't, they saw some of them, they heard about them, but they didn't actually get physically engaged with them, except for the drone."* - HC staff member

> *"Next time, I think I'd like to take 30 or 40 minutes and drag in a couple of students to do the hands-on work and do some more of the actual field methodology in the field that we do, in terms of metal detection, collection of tree ring samples, drawing on maps, what we do when we find something we want to collect, in terms of filling out a field specimen list and a tag to go with the artifact and the bag etc."* -DARG team member

> *"It would be neat to actually set up a mock field session with kids to learn about that process that he's using and looking at the extrapolation of the data that he's collecting and what kind of inferences he is developing. So not only they can learn about developing hypotheses but how to test them with scientific methods. So if we're really talking about wrapping in the STEM program, we really need to hone in and emphasize the scientific methods and principles…"* - Ute archeologist

> *"20 years down the road we really won't be excavating that much. We'll be actually using ground-penetrating radar to look at what's beneath the surface…if we could incorporate maybe a CRM Firm or a PAC or somebody with History Colorado or DARG so on and so forth, but if you could take a moment to actually explain to kids about the total station or ground-penetrating radar, anything like that. And maybe even bring the station out there and show the kids just basically how it works and break down the intricacies of the programs at a very intelligible level..."* - Ute archeologist

> *"Maybe getting some compasses and talking to the kids about declination and about how to orient to the landscape, just a basic explanation. How to use a compass, how declination works, how it figures into true north and things of that nature."* - Ute archeologist

> *"It kind of falls into the science. I consider myself a scientist, even as an archeologist, and part of that is the gear we carry for a reason. I don't know if that was covered… I don't know if they really went down to the basics of footwear, hats, and water snacks, tweezers and first aid, and all of those things."* - Ute archeologist

Hands-on cultural experiences

> *"We could teach them how to make fire instead of using lighters, propane tanks or like one of those blow torches."* - Ute youth

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New topics (religion, constellations, and identification of flowers and plants)

"[A family member] can tell us more about my religion to my people." - Ute youth

"Tell them more about stories about Natives. One of my friends told me a really good one about the Big Dipper and that big Northern Star." - Ute youth

"Maybe having a camp-out at least one night and even talking about the celestial bodies and looking at the stars and constellations and providing the elders with time to pique their mind and maybe do some of their own research by talking to those in the community about the importance of certain stars or constellations." - Ute archeologist

"…digging further into the science aspect of biology, because we did have somebody who was out there with us…I'm pretty sure most of the kids there know what the state flower is, the columbine, and then looking at certain flowers, being able to identify those in the wilderness and breaking down the science more specifically around botany…But maybe even looking at sounding out some of the Latin words for, the scientific names for the flowers that we've used or the plants. But also getting into like the Ute word and maybe having a flashcard with a picture of it and some of the identifying qualities of that particular wildflower." - Ute archeologist

Continue with archaeology topic, but include new aspects (how to identify wickiups, pottery and ceramic analysis, flint-knapping and geology, dendrochronology lab, career path to become an archaeologist)

"I think doing the same topic again would be better before switching to a new topic, so doing more archeology before switching to plants. I feel like we need it, I guess, that we need to dive into that a little more and a little differently before switching gears" - HC staff member

"I guess being able to identify wickiups would be an improvement we could do, like on how to identify certain things that are natural and that are non-natural [i.e., built by people]." - Ute youth

"I would say more hands-on activities, maybe some different presenters… even potters or ceramic analysts who fire their own pots and its open-firing technique… bringing somebody in who flint-knaps and talk a little about the geological characteristics of different materials in flint-knap and why they use like say chert or chalcedony or obsidian over different types of materials because of the way the stone fractures. But I think just having a little more diverse activities but trying to get the kids a little more involved hands-on." - Ute archeologist

"I have this hands-on kit to explain dendrochronology that we could possibly implement this coming year… [it would create an opportunity] to talk to the kids about dendrochronology in basically a lab setting or a mock lab setting and talking about the mathematics behind it, the biology tied into it because of tree growth and environmental factors and looking at past human behavior." - Ute archeologist

"I think it would be very helpful to them, to the children, to get a real idea of what [archaeologists'] jobs are, what kind of schooling it took to get there, what kind of classes. Everyone has a different path to get to where they are… [include] some pros and cons. I talk to a lot of people who think it's super cool to be an archeologist. I'm like, 'Oh, it is. But not every day.' There are boring days, and there's the poison ivy days, and there's the low-income days, just to give a fair assessment and also the cool parts." - Ute archeologist

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Use tablets for navigation and handouts

> *"[When using a tablet] I had a map with a little blue dot, which might have been really helpful at the wickiup site. We probably wouldn't have gotten lost. Topographic maps, site maps and site forms, photos, and so many tools on one device that's easier to manage than everybody getting a bunch of paper handouts."* - Ute archeologist

Final Reflections

Participants of all ages and roles reflected positively on the experience of fieldwork. Often, when speaking of their own involvement, participants seemed to enjoy the experience on a personal level. A videographer was honored to be involved in the process:

> *"It was an amazing experience to be a part of the three groups coming together…I think I learned a lot about, you know looking from DARG perspective, History Colorado's perspective, and most definitely tribal perspective. As a documentarian, the opportunity to try and archive that kind of an experience on video is super unique and one of a kind, and for me, in a lot of ways it's kind of a career pinnacle just to be a part of it."*

A Ute youth greatly valued the program; when asked what would encourage them to return, they replied:

> *"Probably looking at everything. I'm really interested in learning about history and culture and all that, but learning about my own history and culture from where I'm from is something that becomes really interesting to me, so I really want to learn more. I love to learn. Doing a program like this is something that I really enjoy doing. I would definitely come back next year just because I like to learn"*

Finally, a DARG team member shared their admiration for *Ute STEM* project, beyond their own role:

> *"I'm so impressed with this whole project. The way it's been approached, and even though we're kind of the supporting player, I feel as though I kind of understand where you guys are coming from. At least as far as the parts we've been involved in. The commitment History Colorado has made to working with the youth on the exhibits I think is real obvious."*

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Key Findings

- Fieldwork takeaways included **seeing and sharing new perspectives**, gaining **in-person connections to sites and people**, and **ideas for new approaches or methods.** Youth often valued information they had learned or memories of seeing wickiups or petroglyphs.

- After the fieldwork, several scientists **checked facts they had shared or sought more input on information shared** by Ute tribal members. Youth and adults were **interested in learning more about history and culture, and some were inspired to seek similar experiences** (e.g., finding wickiups on other property). Museum staff and videographers revisited additional literature about similar projects or hoped to review footage collected to gain greater insight into the fieldwork experience.

- A key aspect of fieldwork was **collaboration between tribal members, scientists, and museum staff**. Participants reflected on how **each group brought unique contributions**; Ute tribal members were thought to offer lived experience, direct ties to the past, authenticity, respect, nuance and detail. Scientists were considered contributors of research, scientific rigor, mastery of methodologies or techniques, depth and detail. Museums and museum staff were perceived as having the ability to connect with a broader audience. The museum was seen as a platform for sharing information about Ute culture and history with the public.

- Discussions surrounding fieldwork were seen as a positive method of gaining a fuller picture. Likewise, **the project offered methods for overcoming barriers between separate tribes, and separation between indigenous people and scientists**. Some felt the project **helped to legitimize archaeology as a pursuit for youth**, whether in academia or future careers.

- During fieldwork, adults felt uncomfortable at times. Frequently, **moments where scientists were questioned or power and authority conventions were challenged made adults uncomfortable**. That said, they typically felt **these moments were important for growth and progress**— as well as to the partnership and collaboration between Ute tribal members, scientists, and museum staff. Some considered ways to better support tribal members or allow greater space for discussion. **Participant safety was a concern for some adults**, be it worries about navigation of the sites or interactions with members of the public who might not display cultural awareness or sensitivity. **Most Ute youth did not feel uncomfortable during fieldwork**; when one youth expressed discomfort it was due to a belief that touching artifacts was disrespectful.

- Feedback on various aspects of the fieldwork highlighted **numerous successes as well as needed updates and refinements**. Overall, the **balance of free time and structured activity** seemed to work well, and **participants remained engaged** for the duration of the experience. **Key suggestions** included: expanding introductions and clarifying goals of the fieldwork early on; shorten, reduce, and plan for scientific presentations in advance; include more hands-on activities; allow more dedicated time for Ute elders to lead experiences and actively contribute; and simplify transportation logistics and ensure all participants understand directions well in advance.

- Considering how to plan for future years was difficult for some; **participants had mixed opinions on whether they should seek new sites or return to the same location**. To some degree, encouraging both return participation and recruiting new youth participants appealed, but **project team members**

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acknowledged the difficulties of recruitment. Youth consistently indicated they would like to return, and many felt exploring a new location would be enjoyable.

- **Ideas for new activities** included: hands-on fieldwork or cultural experiences, new topics (religion, constellations, and plant identification), greater depth or new aspects of archeological topics, and using tablets for navigation or to supplement presentations.

- Generally, **respondents were enthusiastic and highly positive in their reflections** on the fieldwork and appreciated the opportunities it afforded participants.

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Ute STEM Program

2018 Post-Fieldwork Interviews

12 December 2018

Report prepared by:
Lauren Wilson and Kate Livingston on behalf of ExposeYourMuseum LLC

Introduction

After the National Science Foundation (NSF) funded *Ute STEM* program's two-and-a-half day fieldwork session in June 2018 in and around Alamosa, Colorado, the project's Principal Investigators (PI), participating project staff from History Colorado (HC; both Denver's History Colorado Center and Montrose's Ute Indian Museum), tribal representatives and adult and youth participants from the three participating Ute tribes (Southern Ute Indian Tribe, Ute Mountain Ute Tribe, and Ute Indian Tribe - Uintah and Ouray Reservation), chaperones, scientists (from the Dominguez Archeological Research Group/DARG and the University of Kansas), Forest Service staff, and the project's videographers were asked to participate in phone interviews about their fieldwork experiences. This post-fieldwork evaluation was designed to facilitate reflection and enable the *Ute STEM* project team and fieldwork participants to look back on their fieldwork experiences, assess progress and learning, and document any concerns identified to apply to future fieldwork sessions and/or the *Ute STEM* project overall.

Of the approximately 25 fieldwork participants, seventeen participants discussed their fieldwork experiences via phone interviews conducted by *Ute STEM*'s external evaluator (Kate Livingston, Principal at ExposeYourMuseum LLC). The interviews were held in July and August of 2018, approximately 4-6 weeks following the fieldwork. Respondents included 4 HC staff and project leadership (including 3 individuals from Denver's History Colorado Center and 1 from Montrose's Ute Indian Museum), 1 chaperone, 2 Ute adults (from the Southern Ute tribe), 3 Ute youth (from the Southern Ute tribe), 4 scientists (including an ethnobotanist from the University of Kansas and DARG staff members), 1 Forest Service staff member, and 1 videographer. Open-ended questions were designed and asked to prompt and facilitate reflection; the following report discusses responses based on common themes that emerged as a result of these questions.

Key Fieldwork Memories

Respondents were asked to share their most significant memories from the fieldwork, or what continued to resonate with them over a month later. Many shared positive reactions and considerations.

In-person connections to sites and people

The experience of being on the sites and spending time as a group were striking experiences for participants. "I think going to the specific places, just the importance of those places…how important it is to get out, how much that matters to people," was top of mind for one HC staff member. Another found it meaningful to "be there in their home essentially, and where their ancestors had lived and worked and walked, and [see] how moving it was for them." The importance of the specific site was evident to two adult participants; a scientist shared that the specific Ute participants shared a history with the space they visited during the fieldwork, and explained, "…it was the lineage, it wasn't northern Utes or Mountain Ute areas, it was in Ignacio. It was there." Likewise, a Ute adult felt the visit to La Ventana was memorable because of "the significance of that particular location during a certain time of the year when it depicts what it does."

> "The [elders] were there and they were experiencing the place itself, their ancestral homeland."
> -Scientist

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For others, the ability for families and tribes to connect with each other in the space of their people was an important feature. A Ute adult reflected on witnessing the connection between elders and youth together at Carnero Canyon: "That's what sticks out in mind. That finally, they're here. Finally, they arrived. And finally, our elders get to go back… it's the feeling of like completeness, almost, I guess you could say. It was that whole…I will never forget that day." The videographer also recalled a moment "where all the entire family were sitting in the back of the pickup truck" to be photographed and sensed, "for them, that familial connection, and how they're the three generations were there and what that meant for them." A similar experience occurred for the chaperone, who shared, "what really stands out for me was… from young to old, how much fun they had with [climbing up to La Ventana]. That was an incredible place, and it was just so cool to see all the generations, ages doing that together."

Onsite experiences and discoveries under the guidance of adults

According to youth participants, being onsite, seeing things first-hand, and elements of discovery stood out. Experiences mentioned included, climbing, taking in views from high elevations, sandboarding, learning about the bear cave, and searching for or making arrowheads. Two youth found the experience at the bear cave to be a highlight: one recalled, "It was really interesting when my grandpa… asked us what the bear's doing, where it was going. We all pointed left, but then he said that it's going to a cave. I'm like, 'Oh, I understand what the hole in the rock is.'" The other youth who found this experience to be memorable recounted climbing the rocks nearby.

Youth valued interactions with adults and frequently referred to them as part of these experiences. Embedded in these memories were their own relatives (e.g., "my aunt […and other youth] were climbing up there,") and other adults involved in the project (e.g., "[A group of adults] and my sister were all the way up top, sand boarding,").

Hearing and sharing perspectives

Noticiing diverse perspectives from fieldwork participants or experiencing how information is passed from generation to generation was a common memorable experience for non-Ute participants. A HC staff member felt juxtaposition between viewpoints shared (i.e., Ute Traditional Ecological Knowledge—TEK—and Western science) was interesting. They described the difference in response participants had when encountering an owl in a tree. While staff at the wildlife refuge and other participants were excited to see the bird, some Ute participants felt owls signify a negative omen or symbol; "so it was just interesting to watch different people react in different ways… some people were oblivious to the fact that it was not necessarily a welcome thing for some of the tribal people, and other people sort of had sort of a learning moment there where they learned why it wasn't necessarily a good thing. But then [a Ute adult participant] instructed the kids, 'Well, don't look at it and we'll just keep on walking,'"

For some, simply having access to Ute elder's insights was a highlight. "It's the transference of knowledge from elder to younger but also, to me, land manager," said a Forest Service participant. They continued, "I relish those very rare opportunities, and I feel like I gained more than I gave out there… Just that ability to transfer such deep and substantive knowledge of land and landscape and culture on that same land. It's pretty unforgettable." Discussions with elders about "some of the Ute concepts of energy or power through the landscape" prompted a scientist to ask whether the information was made available to Ute youth and other Ute adults. They learned that, as non-Utes, they could engage in the conversations because "this information is not for us, basically… Whereas, if you're talking to a Ute kid, they may and try to use that knowledge before they're ready or prepared." Putting this revelation into the context of the Ute STEM project had difficult implications: "It really takes this long term dedication to learn this deeper stuff about the culture and the environment and medicine and things like that… in a lot of ways, that's really what we want to help facilitate passing on and something like this [project] is just not going to be able to do that."

Youth responses

Observing the responses youth had to the fieldwork session was a stand-out positive for adult participants. Some adults noticed:

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> *"[The youth participants] soaked up every bit of it. I thought they were just great. They were just so engaged for their age. It was the kind of group that helps you keep doing it."*- Forest Service staff member
>
> *"I was overall pleased with the reception to what we were doing. The students, although few in number, I thought were interesting and fairly eager, despite being young kids."*-Scientist
>
> *"The kids wanting to learn of their culture. … And that engaged them, again that was an area of where the footprints of their ancestors were."* -HC Ute Indian Museum staff member
>
> *"The fact that the youths were taking such a lead in the activities, I thought was great."* -Scientist

Three participants (an HC staff member, a scientist, and the videographer) recalled "how much fun the kids and the students were having interviewing each other and using the camera," and believed this experience was particularly memorable for the youth as well. Likewise, the chaperone reflected on "how thrilled the kids were with everything that they got to do," including atlatl throwing, which "turned into kind of a competition," sandboarding, and climbing up to La Ventana. The chaperone noticed that the delivery of information was more effective than a traditional classroom setting:

> *"They were really attentive when the elders were talking about the [peel trees] and seemed like they were interested in learning about the past and the culture. That was good to see, because I don't always see the kids engaged in activities at school, so it was real nice to see them involved in everything."*

Although the opportunity to observe responses to the project was a highlight, not all information was positive. Upon learning that Ute were held captive at Ft. Garland, one HC staff member was touched by "seeing how everyone else reacted and everyone commenting about it afterwards." Since it was not commonly included in the narrative of the site, they felt it was "important for the museum people to hear, almost as much as the Ute people to hear that."

Evolved approach

While many had ideas about how the program might improve in future iterations (discussed in depth in other areas; see "Ideas for Future Fieldwork," beginning on p. 14, for some, takeaways consisted of reflecting on what went well in the second *Ute STEM* fieldwork experience. A HC staff member appreciated "the greater amount of time that we all sat listening to tribal elders… [In Carnero Canyon,] we would sit quietly and listen to elders for an amount of time. And then we would get up and have an activity where everyone is moving. Then we would sit again and move. And I just felt that that pace of that was really, really nice. Our students had the opportunity to listen, but also be actively engaged in archeology and ethnobotany." Additionally, a scientist felt their team had connected Utes with archaeology and, in the process, "we've learned a lot of lessons." Despite feeling less involved on planning, this scientist saw success in giving "our DARG people the experience of the event… because we're really starting to think deeply about how to move forward. We're hearing what we've learned about Ute archeology with the Utes themselves."

Information learned

Finally, information learned while participating in fieldwork was salient for several. The HC Ute Indian Museum staff member noticed that, during fieldwork, youth realized that they were surrounded by materials that could be used in daily life; they explained, "You sometimes don't pay attention…you just think, 'oh that's just a tree.' Well that tree, we talked about the scaring of the tree there. And the many different uses from the tree." In their interview, a youth verified that this was a memorable aspect of the trip, and remembered, "we saw that peel tree and they were telling

Thoughts and Actions After Fieldwork

us what they did. What they used it for. So they used the sap and stuff for sugar and syrup and then, I can't remember what they used the bark for, but yeah." Discussion was a highlight for a HC staff member, who recalled the

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group sharing their knowledge about use of juniper particularly well; “It was an amazing conversation and everybody was chiming in and everybody was just so thoughtful and reflective. That was one of the greatest experiences of my life, was just hanging out and talking about Utes’ use of junipers. So, in-depth time. That was super awesome.” Better understanding how the Forest Service protects tribal sites, including focus on fire mitigation, was a positive learning experience for another HC staff member, particularly considering “the thoughtfulness, the mindfulness that they take into those areas with regards to the people who inhabited those areas before. And I was very impressed by that.”

Respondents were asked whether they had researched or dug deeper into anything since learning about it during the fieldwork. For many, the trip sparked interest, curiosity, and new ideas. Others mentioned the trip had inspired them to do something or consider a different perspective. Although returning to checking facts was an occurrence in the first year of fieldwork, none of the participants in the second round mentioned confirming anything they heard on the trip.

Interest in history, culture, and science

For adult participants, interest was sparked in building further awareness of Ute history, culture, and ties to science. Finding an arrowhead on the trail was particularly exciting to the chaperone, while others mentioned applications or occasions in their lives after fieldwork that have triggered memories of aspects that they found interesting. Ethnobotany was a common topic of interest for several participants. The HC Ute Indian Museum staff member saw application for “some more plant identifications that I learned,” in selecting plants from their institution’s native plant garden. With insights from fieldwork, they planned to share stories and techniques, for example, rubbing paddles of prickly pear cactus with a rock to remove the spines or details about the height of peel tree scars. “[Ethnobotany] was important for the Ute people traveling through areas, but I've come back paying more attention to the plants that are around me, especially ones that are indigenous to these areas,” said one HC staff member, who hoped to learn more about the plants they saw during trips to the mountains. A videographer echoed, “I would really love to more about [ethnobotany] in the context of learning more about plants in that way. I'm always drawn to identification of the flowers… understanding how those plants are used and how they have been used for thousands of years.” Two HC staff members were interested in “the technical aspect of the pine needle basket-making” and considered applications with pine needles around their homes.

Better understanding diversity within Ute bands and their use of specific land areas was intriguing to a scientist. They were left “thinking a lot about how meaningful it was [for] the Southern Ute kids to be in what was Southern Ute territory” and considered ways “in projects [to] give an opportunity for people to connect [with] their particular part of the [land].”

Inspiration for similar experiences

Experiences at the sites inspired several respondents to pursue similar experiences. One Ute youth wanted to learn how to affix an arrowhead onto a stick so that it was securely attached: “I can do that at my house with a rock, like a really thin rock, and try to attach that to a stick with the string, but it just comes out whenever I shoot it at something or throw it at something.” Adults were inspired by the fieldwork experience to mimic a similar approach within their work, to fill gaps in ethnobotanic literature, or to collect information on specific cultural objects in more detail. A Forest Service staff member shared that fuel reduction near historic sites were uncommon, and that having a “face-to-face consultation” with Ute tribal members revealed its importance: “It certainly builds a relationship and our good will, and I think that we're using those resources to do that, that we value [the sites] right up there with someone's home. So that has inspired me to think of other ways to do that same thing on other projects.” A scientist saw that information on “some active cultural history in terms of the use of plants” was inadequate and needed more published work on the subject, and a Ute adult described the intricacies of dating culturally modified trees and was inspired to begin “really pushing to get more of that information at our office and in a centralized location so that we can start running future analyses… looking for certain patterns that may emerge due to certain environmental conditions, or cultural

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things that we may have recording in our oral tradition." They saw value in linking peel tree dates "with the oral tradition, where people were during certain time periods, when they used certain trails."

Reflection on the project

Looking into more detail about the project itself helped some situate or revise their contributions after the fieldwork. Staff at HC in particular researched more about trip content to prepare for fieldwork; one indicated the initial planning trip inspired many questions about plants, but they had researched answers in order to prepare the materials provided to youth during fieldwork. Another HC staff member realized the importance of being at the sites in person and considered ways to ensure the experience was meaningful and tied to Traditional Ecological Knowledge (TEK): they thought about "how to make sure we don't lose that sense of place-- that it's about being at the sand dunes. It's about being at Penitente Canyon and what people were doing at that spot, and that that knowledge kind of evolves around that place." A scientist also reflected on ways to learn more related to fieldwork, but was more interested in application broadly on increasing communication within archaeology, geology, and tribal members. Fieldwork "provided the opportunity for everyone to be there and talk. There just needs to be more things like that between the agencies and the private contractors and the non-profit groups and you guys," so parties could remain aware of current projects and knowledge held by unique groups.

Reflections on the Collaboration

Fieldwork participants were asked to explore the benefits and dynamics of collaboration between tribes, scientists, and museums.

Unique perspectives

Some participants discussed the unique viewpoints brought by scientists and Ute tribal members, and at times, considered the museum staff to also contribute a unique perspective on content or questions explored during fieldwork. Distinct threads were evident within participants' descriptions of their contributions:

Ute Tribal Members	Scientists
Contribute: lived experience, direct ties to past, oral history, authenticity, spirituality, nuance, detail	**Contribute:** access to political power, preservation of sites and information
"We had quite a bit of spiritual content throughout the whole thing… the idea that this is a sacred site and there needed to be a blessing…I thought that the integration of that worked pretty well." - Scientist "You can't get comprehensive interpretations unless you're working with the people who are descendants of the people that you're trying to learn about."-HC staff member "[The group can] really hear [how] the Ute tribes actually use their stuff and why they did it, I guess." -Ute Youth "So that they know what we're really about, and we're not the only tribe that are out there. [Interviewer: What do you think that the scientists probably learned about Ute people from being on that trip?] The wikiup stuff, to cross over the sticks, and that we have bark where half the side was peeled off." -Ute Youth "I think it's important to work with tribal folks because scientists and archeologists want to learn more about our people's way of their living and how they survived and adapt[ed] to the environments that they've been to...They also want to learn what resources they found and used in order to survive the environment and changes of climate."-Ute Youth	"[Scientists assist] In terms of getting the Ute tribes more fully engaged as peers, with public land managers and cultural resource management and historic preservation people. It's really a political goal, in one sense of the word… [valuing Western scientific procedure] that needs to be spread out more broadly to the tribal membership, and the tribal membership needs to understand why it's important."-Scientist "…that role of the scientists or the archeologists or the land managers as kind of the people that are preserving that place and keeping the knowledge of that place alive."- HC staff member

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Notably, Ute participants did not detail assets provided by scientists in the project. In contrast to the year before[1], respondents spoke less about specific contributions of each side and instead discussed in greater frequency the benefits of collaboration (see section titled "Cultivating respectful dialogue," below).

The museum's role

Rather than seeing museum staff as active voices in the co-creation of knowledge, participants saw the museum's role as a logistical coordinator, a forum for display, and spark for discourse. An HC staff member summed up, "we're just doing a lot of the logistics to make it happen," and a scientist thought "resources and your contacts at the museums" were vital contributions to the project.

Others saw the value of the museum as purveyors of information, via offering the public access to the content shared throughout the project, and their position as an informative and educational space. One HC staff member explained, "Then for museum people, thankfully we get to be there and document that and then share it with the general public." Their colleague agreed, "We have a vision of how we want [the project] to be shared broadly with the public, and I'll be interested to see how other people start to think about that." For one Ute youth, the museum was a source for sharing and display for the public as well; they offered an idea of how the museum might display the information discussed during the fieldwork:

> *"They could put a tree that the Native people used, and they'll put next to it a basket made from that tree, and then there'll be a little sap bleeding out of the tree, and they'll explain that the sap was used to make baskets stick together, and yeah, that's kind of like how the museum people are involved with the Ute people."*

Others saw the museum's contribution as encouraging discussion and dialogue, both among project partners as well as messaging for the public, professional peers, and future collaborations:

> *"[Museums] bring that catalyzing force, that is essential to making it happen…this year they did it even better than last year, and in more a place where it felt like we're holding space for it, as well as trying to guide it, and move it, and logistically and administratively make it happen, and it just felt like it juggled really well."*-Videographer

> *"I see the museum as the facilitator for the partnership and the vehicle for the opportunity… the middle man who was able to join the scientists and the Ute community together. But also as an important element to move that forward [at the close of the project]. I think the museum is in a really great position to be able to carry it forward and continue to pass that message along of this collaboration."*-HC staff member

> *"Some things going on here could serve as a model, and I hope that we think about that as we wrap this project up… to present our results so that other museums can look at this work as a model to develop and modify."*-Scientist

Cultivating respectful dialogue

The benefit of synergistic work was evident to several project partners. "It's an important thing for Utes and scientists to get together, because they're going to together generate new knowledge that neither of them had on their own… it's very cool to hear them bounce ideas off of each other and just create that new knowledge with both perspectives," explained a HC staff member. A Ute adult also saw the benefits of the collaboration on a broad scale:

> *"Well it just continues to provide that avenue for conversations to take place, because oftentimes, archeologists in the past have*

"That's what I like about when we can all come together and get connected. When we connect we share things that we did know, we bridge a better awareness and understanding."
-HC Ute Indian Museum staff member

[1] Contributions listed after 2017 fieldwork
Ute tribal members contribute: lived experience, oral history, direct ties to past, authenticity, respect, nuar
Scientists contribute: research, scientific rigor, methodologies and techniques, depth, detail.

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really wanted to create these neat little boxes that all cultural groups fit into. As isolated as they are, there's also a lot of melding and blending of traditions and inter-marriage that may not be completely identifiable in the archeological record…"

The HC Ute Indian Museum staff member saw discussion as a way to "find that common theme that we can all share on… if we all come together it also brings a better awareness. Because we have different perspectives, so if we come together we can start learning from one another of what we do in our environment, our culture, and things like that."

Within the context of the project, one HC staff member saw benefits of collaborative work in action. They noted, "Any time that you work on an exhibit or a program or something which deals with Native folks… I don't think that you can create a good exhibit without their equal input."

Some participants recognized the collaboration and dialogue as a tool by which traditional Ute perspectives could be corroborated and supported within the context of Western science; these ideas are described in participant's words as follow:

"I feel like it's an opportunity for them to move beyond myth and beyond legend and be able to really say, 'Our people were practicing these things, they were doing these things. It wasn't just happenstance. It was thoughtful. It was methodical, and it made a tangible difference to the lives of our people and the lives of people surrounding those areas.'…So I think that it's nice for [Ute youth] to have that opportunity to see both perspectives coming together to say, this is real, these were the teachings then, they're the teachings now, and we're working together with scientists to protect things and to validate things. And science is learning from us now as much as we are learning from them."-HC staff member

"I think it's actually a very positive thing to say about kind of Western science, is that even though there often was not sufficient recognition of TEK or Native American knowledge, now some of us have recognized that the historical record of Native American knowledge is important, and now we can help return that. Because a lot of it's in arcane journals or museums that most folks on the res, and tribal folks in general, don't know how to access because they're not academics."-Scientist

Exposure to cultural and STEM concepts for youth

Collaboration between groups during the fieldwork helped exemplify the study of indigenous history or culture and STEM concepts. Adults considered the discussions that occurred during the project were important models of collaboration; a scientist stated, "I do think it was important for the students to meet these other people, even at the National Wildlife Refuge" and felt that exposing youth to the professionals who work with Ute sites built their awareness of how their cultural history was studied and passed on in contexts outside of their families, homes, and tribes. Furthermore, a scientist felt youth benefitted from seeing the variety of perspectives and the negotiation of knowledge in action during fieldwork:

"I think from the kids one of the really good things it does is - they get bombarded a lot with outside expectations or perspectives on who they are and what that means. And the way the world works. It's a good opportunity the two ways of looking the world, and more than just the two, even the diversity within science, and obviously the diversity within the elders, like I was just mentioning. So they get to see the two kinda push back on each other. And show the different ways of looking at the same thing. I think especially seeing their elders challenged from science, is probably an important moment that they don't necessarily get to see in a public setting. Usually it's the other way around, where science is challenging their culture's perspectives, so they don't normally have an opportunity for their elder's challenging back."

With a presence in these conversations, a scientist believed it was crucial for instilling a sense of pride in their heritage and help them contextualize their position in integrating TEK and Western science.

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For Ute participants, the discussion was an important opportunity to continue sharing oral history and cultural knowledge. A youth shared that collaboration was important as a means "to learn about our culture, because our elders aren't gonna be there, or like, you never know when they're gonna go, so it will always be, just keep in mind to learn your culture just in case anything happens, you know." The chaperone saw the conversations as an example which traced the flow of historical knowledge over generations:

> *"It's really amazing to see all the different pieces involved when you're capturing history. All the way from the storytelling from the elders, and… taking the time to pass it down to the next generation, like seeing [Ute adults] involved and how they're going to step into that role someday and be taking over that piece. Then how they're bringing the next generation in and involving them, and being the ones passing information down again to another generation, and passing down the importance of [oral history] so that it will be carried down even after this generation, keep being carried down for further generations."*

Overcoming barriers

Working together enabled participants to overcome historically instilled barriers between various groups, and scientists in particular noticed this ability. The Forest Service staff member contributed their viewpoint:

> *"We were looters, we were destroyers, takers. You're helping to heal those wounds. We may not even know in what ways. I just know from being at that table for a few decades now, that if you can, not run away from the table, which we always want to cause it's too painful to kind of hear about the historical trauma all over and over again. We're doing some work to make it better and help educate their young ones in a good way.*
>
> *I think [the project] is gonna help bridge those major gaps that we've been dealing with for just decades. It's just taken us this long to even collaborate in these ways, and I think the tribes more and more are seeing these are authentic [relationships]"*

They saw projects like Ute STEM as a method to address scientific and archaeological needs of tribal members without imposing an agenda. "The TEK and what we do out there, in terms of archeology and fuels reduction and plant surveys, that's a really cool mix. That in itself [is] acknowledging the value of that TEK," they considered. A scientist, likewise, saw the collaboration as a way to rectify difficulties and wounds of the past. They noticed:

> *"I think museums are recognizing ... that repatriation is an important and good thing. And repatriation is not just returning goods, it is sharing information. Sharing information from the sciences, sharing information from the tribes… And I think this project, I would even say continuing to build, some of those bridges… And there's some trust. I mean, this whole project was only possible because of some trust. 20 years ago, there wouldn't have been enough trust in both directions probably to pull this off."*

Despite the encouraging outlook and interpretation of the relationships forged via the project, sustained partnership was an ambitious goal. "That's how I'm seeing this whole project right now, it's a great step to get some collaboration going, but I wonder about sustainability… Can we keep this going? It seems so difficult… we can play some kind of role, but we're just a tiny little group," the scientist assessed.

Interpersonal barriers were overcome through the project as well. "People just get locked into their mental constructs about people they don't know," mused one scientist. Introductions on the first evening of the fieldwork "seemed to transcend some of those limitations," and help open participants to discussion that would occur over the course of the trip.

Points of Discomfort

Several participants opted to share moments where they felt uncomfortable during the fieldwork.

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Consideration for others

There were two incidents where participants were, at times, uncomfortable because of the behavior of others in the group. Two participants discussed an occasion where a group of youth left a mess in the dorm room before checking out, and that it had been uncomfortable while making the rest of the group wait for the youth to clean the room. However, participants felt that the issue was resolved in a way that was productive: "she made them take responsibility and walk over, get the vacuum and the broom and all that and clean up, which they did. They did a really good job, and were respectful once she kind of lined them out a bit." The chaperone reflected that doing a pre-emptive check would help prevent the same challenge in the future.

Another uncomfortable moment for a participant was when a Ute tribal member "got kind of mad at those people that night [at the wildlife preserve]." The participant who voiced their discomfort worried that the interaction had damaged the relationship with the team at the wildlife preserve, who "went out of their way to be there for us that evening, and I kind of felt that was a little negative."

Symbols and interpretations

At times, specific symbols or interpretations during fieldwork made some participants uncomfortable. A staff member at HC recalled when the group encountered an owl, "There were some negative reactions to an owl, that apparently they're taught that owls aren't always happy bringers." Likewise, one Ute youth participant was uncomfortable during a portion of the fieldwork due to their interpretation of the site: "I felt okay, except for over there at the wikiups. It felt emotional… I don't know, I kind of like, like someone was over there that's listening. I felt the pain."

Youth away from home

Most frequently, participants recalled the youngest Ute youth participant struggling with homesickness, interpersonal conflicts with older youth, and nighttime fears that are common for younger children. Adults described how the youth had found comfort with the HC Ute Indian Museum staff, and that his aunt had been called to help resolve his fears. "The good thing was, there was someone there that he felt comfortable sharing whatever it was with, and he got back into the spirit of what was going on," recalled one participant.

Fieldwork planning and stress

Two participants discussed discomfort as manifest in anxiousness while planning or coordinating the program. One participant noticed, "this History Colorado group just is kind of getting really overly stressed about stuff. I get it… I've just worked in Indian country enough to just slow it down. That's just the cultural competency, I guess." This sense resonated with a memory shared by a HC staff member:

> *"So I think I was already a little stressed about just getting everybody moving… I just felt bad about having to wrap up the activities because I think everybody was having fun doing the baskets and the bead work, so I think that was uncomfortable because I was like, 'Let's go, let's go. We've gotta go. We've gotta go.'"*

No discomfort

"I would say this trip did feel a lot more comfortable than the last one in a lot of ways."
- Scientist

Although some points of discomfort were shared, many felt at ease during the fieldwork. When asked, a Ute youth said, "No. Actually, I thought, I was very comfortable with everything that we were doing." and another said, "No, it was just the heat that was uncomfortable." For four adult participants who had attended both rounds of fieldwork, the 2018 trip felt markedly more comfortable for a number of reasons. First, coordinators had a relationship with those who worked at the sites and had prepared by visiting in advance of the fieldwork. A participant reflected, "They knew the places. They knew the people, and everybody just felt in really good hands." Another thought, "I think it was more laid back. People just flowed more." Still another participant realized that a shift in approach had made the program feel more comfortable:

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"[In the first round] maybe there was a little too much science and not enough traditional knowledge shared. But I feel like the blend was much more appropriate for this set of fieldwork. The changes that we made to having the tribes always speak first. I think that was a really big benefit."

Specific Fieldwork Feedback

Participants were asked which aspects of fieldwork they liked and which aspects could be improved or done differently. Feedback from the 17 participants interviewed is summarized in the following table:

Aspect	What worked	Possible improvements
Preparation for fieldwork and framing	• Preparation for the project, including site visits, allowed for simplified logistics and greater organization • Familiarity with the sites and specimens that would be available as examples • Time to connect with project partners before youth arrived • Project partners were helpful and responsive	• Although approach was discussed thoroughly in advance of the trip, schedule changes beyond the control of the project resulted in a facilitator who did not adhere to the intended delivery techniques. • Share planning and seek feedback from scientists and Ute partners • Confirm that all participants are aware of the gift exchange
Introductions	• Icebreaker activity to get to know each other • Preview of activities and content at tables • Familiarizing youth with cameras	• Ensure tables are engaging for all ages (idea provided by scientist: include hands-on elements in addition to images)
Timing and structure	• Good balance of structured and unstructured time; using the site locations more casually • Flexibility in the schedule for comfortable discussion • Unstructured time was highly appreciated; beneficial for building interpersonal connections, allowing for in-the-moment sharing, and decompressing • Ability for participants to leave as needed • Interest and enjoyment of participants • Participatory and hands-on activities were included • Final days felt more intimate, people were closely connected	• Some activities or sites felt rushed (e.g. basket weaving and beading); more downtime or transition time was requested to ensure each site or activity receives sufficient attention • Spend more time together as a group so Ute youth do not miss important conversations • Incorporate more downtime and ability to "run off" pent up energy for youth; add "play" time for kids, and space for adults to check in • Potentially end the day earlier or take a late afternoon break • Address the challenge of "wrangling adults"
Approach	• Exchange of ideas worked well; discussion flowed and tribal representatives and scientists both had plenty to share • Presenters were amiable did not engage in "an educational power struggle" • Ute elders were invited and expected to speak first • Ute elders and adults were available for youth participants who may have questions or share fears or emotions that require cultural sensitivity and awareness	• Allow time for and make use of scientific specialists and expert knowledge; although most felt TEK and scientific information was well balanced, some topics were not addressed in detail from a scientific side due to lack of time (e.g., wickiups, peel trees, asking about an explicit biological standpoint, understanding Ute approach to fire management) • Provide more intentional space for Ute youth to talk and contribute • Consider having key teaching points, for example, diagrams, terminology, or show a video to introduce topics; likewise, ensure cohesive messaging and overarching theme is clear and apparent

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		● Include non-material focus; if Ute feel they are defined by their cultural objects, they may feel disconnected from their Ute identity in other contexts
Outdoor field experiences (i.e., peel tree, Fort Garland, Canero Canyon, Penitente Canyon, Alamosa Wildlife Refuge, La Ventana Arch)	● Introduction to sites and prayers by Ute elders ● Youth and adult participants enjoyed being outdoors ● Youth enjoyed exploring, which gave opportunities for adults to take time away ● Discussions about sites and their history, fire prevention, and ethnobotany were well received by youth and adults alike ● Ute youth were comfortable asking questions ● Ute youth heard input from elders first	● Revise additional visits to Alamosa Wildlife Refuge; this site was agreed upon by several adult participants to be less satisfactory due to prescriptive delivery of information, not enough time, and lack of staff investment ● Remind youth to bring long-sleeve shirts and pants for mosquito protection
Scheduled Activities (i.e., atlatls, sandboarding, foot mapping, basket making, beading, trail flagging, plant identification, stargazing)	● Ute youth were engaged in atlatl throwing, plant pressing, beading, making arrowheads, flagging the trail, stargazing and sandboarding ● Ability to rotate and try new things, or remain with an activity that was particularly engrossing ● Hands-on and engaging ● Interviews and peer-led interviews on camera	● Ensure youth are present for content-based activities (e.g., collecting pine needles for basket weaving) ● Provide time for youth to work on their field journals ● Offer support to scientists who hope to incorporate more interactive, hands-on techniques within their approach ● Add a closing reflection for youth to consider at the end of each day or close out the trip with a final interpersonal activity ● Consider whether activities early in the day will drain youth energy for later activities
Meals and evenings	● Provided time for building interpersonal connections and bonding ● Shared meals worked well; cafeteria seating at Adams State allowed youth and adults to have meals with peers, or mix and visit with other tables. ● Food choice was appreciated	● Add reflection activity at the end of each day

As clear from the table above, participants shared a wide range of feedback and ideas. Examples of responses that guided the themes in the table above are as follows, however it should be noted that quotes are examples and not exhaustive; not all key themes are represented below.

> *"I think [the HC Ute Indian Museum staff person] set a perfect tone in terms of **getting us all to know each other** and quirky details about each other. So, that was great. I think the tables worked better than last year. I think the kids got a little snippet and **a little bit of an overview of the content** without belaboring it."* -HC staff member

> *"At one point, [three adult participants] were over at the rock art for a while just talking about all sorts of things… That was really memorable for me 'cause I felt like **I was bearing witness to that collaborative sharing between Ute perspective and science perspective,** and I think just by the nature of the three of those people and how open they all are, it was just such a kind of beautiful experience to see. [A scientist was] sharing things, and [Ute adults were] kind of jumping in…was it about how they collected the different dyes for the rock garden, and for me that was really memorable."*-Videographer

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*"And I think **it really was pretty incredible to sit there and listen to [Ute elders] talk**, and I hope [youth] understood how much they were getting from that…It felt right. It just felt, again, like the **elders got to speak first.**"*-HC staff member

*"What I really liked was that [the group leader] **allowed the Utes to talk**. She specifically said, 'I don't wanna be the one to tell you about the history of Fort Garland' and [a Ute elder] just took off… when [a Southern Ute adult participant] especially was talking about the importance to the kids of being here… how important it was to be attached to their own land and **it was their responsibility in the future** to make sure that they knew that this was their land… It was just very moving."*-Scientist

*"I liked…that we saw the big tree with the bark, most of the bark removed. My grandpa told us on how they used the bark for sap, and then they would use the sap to make baskets and those jugs. Yeah, **that was the highlight of my day.**"* -Ute youth

*"That was interesting for me personally because you hear about peel trees and **finally getting to feel exactly what one of those looks like** and learning about the way the bark forms."* -Scientist

*"I **wish we'd spent a little bit more time** on the peeled trees as a group out there. We got a little bit scattered, and there's so much to share and hear about peeled trees. So, I wish we'd been a little bit more focused about that."*-HC staff member

*"But it would have been kinda **cool to have that juxtaposition** [between Ute fire management techniques and those used by the Forest Service] immediately right there. Because the **Ute's were fire managers**. I loved hearing them talk about setting fires because when the grass comes in that's what the animals most like, is the new and fresh stuff. And then you come back the next year and you go hunting there. So that's more of the TEK element that we were trying to get at. So I felt like that was a **little bit of a missed opportunity, to look at that from both sides**."* -Scientist

*"We took some **plants and we put them in the newspaper and cardboard and paper and squished them together**. And when me, [a Ute adult], and the boys were **making arrowheads**, learning how. And when we scared my sister in the jail cell"* -Ute youth

*"I thought it was cool the way that the kids were getting involved… It seems like we had to abruptly stop [beadwork], and some kids were in the middle of doing stuff, and to go out to the wildlife refuge, I almost think that **we should have either given them some free time,** and then gone to the refuge, or either **did extended craft time** and not gone to the refuge and done it a different time. **We were just trying to pack everything in**, that was all"* -HC staff member

*"And then **the aspects of educational stuff but also letting the kids play**. Play with cameras, jumping over picnic benches. Being in the fort, in the jail part. Listening to [a Ute adult] and flint knapping and stuff like that. I thought that was a **nice mix** of that."*-Scientist

*"In the evening, when he was really presenting about the plants, that was the piece where they were **engaged for a little but, it kind of lost their interest**. I don't know whether they were just **tired and needing some downtime**, and that might be something to think about with some of this. Those were young boys that are very, very physically active, and that was kind of their focus. I think they stayed engaged with the plant piece for a short period of time, but then they just had to run off all that physical energy that was pent up. Maybe incorporating some of that in, depending on your group, but certainly with this group, sort of reading the group and scheduling in something like that in-between."* -Chaperone

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"I think that [Alamosa Wildlife Refuge] was the one piece I think didn't work well… But I would say that ***staff there were not overly engaged in who we were, what was going on****. It was kind of a mystery when we were going to get started."*- Scientist

"There were definitely people saying that they ***didn't feel they were included enough in the planning*** *of this trip. Not just the trip, but the whole project. One of the Ute's was saying to me they didn't feel like the whole thing from the beginning was set up in a way that they felt like their opinion was really taken into account and they might have, from the proposal stage, made some changes. [On this trip, things felt] disorganized, like* ***we didn't really know what was happening or what the plan was****. Or have an opportunity to give feedback on what it could look like… I still feel like there could have been an opportunity to give some overall type feedback."* -Scientist

*"I had a great time with my friends and [a Ute adult] in the first night of the hotel room. We relaxed, talked a bit, played a game of cards, and then yeah****, it was a fun time being there first night with the inside the Adams State University dorm****."* -Ute youth

"I ***don't like to see things get over-planned; let serendipity kind of happen*** *and I think that really did. I loved when we sat down under that tree in the shade and we talked about that big Juniper, that really stands out for me."*- Forest Service staff member

"That was probably my biggest surprise was just how well all that was that ***we got some time to just kind of chill****. There was* ***time for the kids to kind of run around and be active*** *and do some things. It just had a nice, again where we had kind of given ourselves room to sort of breathe and sit in places."*-HC staff member

"Everybody was running trying to go from one spot to another. There was no down time. ***There was no time for us as adults to interact with each other about what we were thinking, only in the between times*** *that we were getting ready to do something, or close up something. So I think we need to give ourselves opportunities to have that downtime and not try to pack so much. That's the difference. Because the first trip, it seemed like it was not enough, and so I know that we tried to put more in it. But I think we need to find a happy balance"*-Ute adult

"I guess a little self-critique for myself, throughout the whole thing ***I wish I had been a little more engaged in educational techniques that would have been more exciting for the kids,*** *for the students. Just thinking about exercises that would excite them more."* -Scientist

"[In the introduction, it would be good to do] ***more hands-on stuff,*** *which really lends itself to ethnobotany, actually, to do a lot of work with, making rope out of yucca twine and stuff like that."*-Scientist

"What I liked was the ***atlatl thing, that was really interesting.*** *It was also my first time, you know. It was fun."*-Ute youth

"I liked that after the blessing and looking at the Wickiups stakes, they told us that we do ***a scavenger hunt where we put the flags*** *that we find, like arrow fletchings or anything, kind of like the Wickiups sites somewhere. It was really fun to do that."-Ute youth*

"Also the bear's cave. ***We were so excited that we climbed up and that we saw a beautiful view*** *from on the Canyon. It was really beautiful."-Ute youth*

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Ideas for Future Fieldwork

At times, participants offered ideas and suggestions for future fieldwork. Since a third year of fieldwork was not imminently planned, ideas and suggestions were not prompted and rather, emerged organically during the interview.

Site choice and participants

Both Ute youth who talked about the site liked the location. One mused, "I want the—where we go up to the bear's cave, the same, and the trip where we went into the forest, the same, and the sand dunes, the same. I think everything should be the same next year," a peer agreed, "The thing I want to do again is sand boarding and going up to that bear cave." Adult respondents did not discuss alternative or re-use of site options for future fieldwork.

Recruitment was an important factor for future iterations. Attendance in 2018 was lower than expected; four adults expressed disappointment that more youth did not attend. A HC staff member shared a "desire to have more kiddos from the other tribes. So, that was a disappointment, and something we're going to think hard about for the next time." For the chaperone, this dissatisfaction was combined with excitement of seeing returning youth:

> *"The biggest thing for me this year, I was so excited to see everyone that I had met the year before, and see the same people. I was so disappointed that we [Southern Ute tribe] were the only kids there… the first year, what was so exciting for me was seeing how quickly all of the three groups of kids just made friends immediately. They really got to know each other and enjoyed each other's company over that whole trip. For me, just that was the biggest disappointment was that the other groups did not have kids there."*

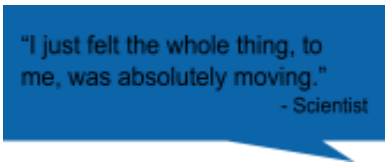
Future content and activities

Two respondents offered ideas for new content or activities for future rounds of fieldwork. One scientist considered developing more time committed to and direction for the field notebooks youth used during the project. The Forest Service staff member hoped to bring Ute participants on a camping trip to document sites, and suggested staying in guard stations or tents. They envisioned,

> *"I've always wanted to do real archeological survey with a tribal group and kind of share skills in that area so they could work for their own tribe… I'd love to do a week project where they helped us do our work, or site monitoring, site survey, and documentation. Of course, it depends on the age group, probably more able to do that with more high school age…we could do some work with culturally modified trees, document them."*

Final Reflections

Participants offered final reflections on fieldwork. One HC staff member stated, "I just feel that we were way better organized. I don't think we were disorganized last year or the first year… But, things seemed to go smoothly." They contributed this, in part, to the inclusion of another HC staff member who attended to details of the trip. The videographer mentioned an improvement in the 2018 fieldwork as well; "This year there were more directives in what I was trying to achieve, and the goals, and so that really helped and being able to actually make that happen."



A scientist was eager to review the film footage of the fieldwork because they were curious to learn what Ute tribal members said on camera that they had not yet heard. Finally, a scientist said involvement with the project was highly moving for them, gave Ute youth time with elders and exposure to non-native people, and complimented their behavior.

A Study in the Integration of Western Knowledge and Native American Knowledge Bases (Ute STEM) is supported by an award from the National Science Foundation (Award # 1612311).

Key Findings

- Fieldwork takeaways included gaining **in-person connections to sites and people**, **hearing and sharing new perspectives**, seeing **how youth responded** to activities and sites, and **ideas for new approaches or methods.** Still others **valued information they had learned** during the fieldwork.

- After the fieldwork, youth and adults were **interested in learning more about history, culture, and science.** Some were **inspired to pursue similar experiences** (e.g., affixing an arrowhead to a stick, having face-to-face consultation with tribal members in fire prevention near tribal sites). Museum staff and scientists **reflected on the fieldwork experience** and ways their goals or takeaways might be broadly applied within or beyond the project.

- A key aspect of fieldwork was **collaboration between tribal members, scientists, and museum staff**. Participants reflected on how **each group brought unique contributions**; Ute tribal members were thought to offer lived experience, direct ties to the past, oral history, authenticity, spirituality, nuance and detail. Scientists were thought to contribute access to political power, and preservation of sites and information. Museums and museum staff were perceived as a logistical coordinator, a forum for display, and spark for discourse.

- Discussions surrounding fieldwork were seen as a positive method of gaining a fuller picture. Likewise, **the project offered methods for overcoming barriers between indigenous people and scientists**. Some felt the project **gave exposure to cultural and STEM concepts for youth**.

- During fieldwork, adults felt uncomfortable at times. Moments where adults felt other participants were **not considerate of others** were a challenge. Negative **cultural symbols and interpretations** of spaces was uncomfortable for some as well. A **fearful child**, though addressed with compassion and well-managed, was the most frequently recalled and visible moment of discomfort for many adults. Finally, some were uncomfortable about the **anxiety of coordinating** the trip. Many participants **did not feel uncomfortable** during fieldwork; many revealed they felt much **more at ease** than the first round of fieldwork.

- Feedback on various aspects of the fieldwork highlighted **numerous successes as well as needed updates and refinements**. Overall, the **balance of free time and structured activity** seemed to work well, and **adult participants remained engaged** for the duration of the experience. **Key suggestions** included: incorporate more down time and anticipate youth need to “burn off” energy; incorporate scientists and Ute adults within the planning process; incorporate time to reflect on the experience during the trip for both youth and adults.

- Ideas for future fieldwork came up for a few participants; youth were eager to **return to the same location**. Project team members acknowledged the **difficulties of recruitment,** but were disappointed to have low turnout. Activities suggested included more time and direction related to fieldwork notebooks, and inspiration for an archaeological survey camping trip.

- Overall, respondents felt the **fieldwork was more streamlined and comfortable** than in the past, and felt it afforded participants meaningful opportunities for connection.

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Ute STEM Front-End Evaluation: Topic Testing

History Colorado Center

24 July 2018
Prepared by Lauren Wilson + Kate Livingston DRAFT

Overview and Methods

As part of the National Science Foundation supported Ute STEM project, ExposeYourMuseum LLC led front-end evaluation at History Colorado Center (hereafter, HCC) to assess local awareness of and interest in Traditional Ecological Knowledge (TEK) and the culture and history of the Ute Indian people. This baseline information will be used to guide exhibit and program planning on the same topic, including an exhibition to open at HCC (Denver, CO) Fall 2018. With guidance from Ute STEM project partners—including HCC staff, History Colorado staff from the Ute Indian Museum (Montrose, CO), archaeologists and other scientific partners, and Ute Indian tribal advisors—a short interview protocol was developed to prompt insights, priorities, and ideas from HCC visitors.

In May 2018, intercept interviews were conducted with 114 total participants. Although 205 individuals were approached, a refusal rate of 42% was recorded (58% accepted). Common reasons for refusal included not having enough time, visiting from another state, or looking for group members.

The following report summarizes and discusses HCC visitors': 1) awareness of Ute Indian people and Ute ecological knowledge, 2) familiarity with the term Traditional Ecological Knowledge and interpretations of its meaning, and 3) interest in content and ideas for the up-coming exhibit.

Awareness of Ute Indian People and Ute Ecological Knowledge

Participants were asked to consider what Ute Indian people might know about their environment[1]. Although most participants had an idea, 15% of participants were either unfamiliar with the Ute Indian people or were unsure about what Ute Indian people specifically might know (n=17/114). One explained, "I learned a bit about the Ute here but didn't know a lot before visiting," and another shared that they had "…never even heard of Ute-- more familiar with the Sequoia [sic] and Navajo."

However, most participants considered several topics or information that Ute Indian people would know about the environment. These participants mentioned an average of two topics each. Over one-quarter of participants mentioned agriculture and growing food, animals, and/or climate and weather. Less common, but also discussed were: geology and terrain, water, social and historical knowledge, building materials and tools, and finally, conservation. The following table includes descriptions of these topics and example quotes from visitors.

Topic	Description + Examples	%
Agriculture + growing food	Farming, where and when to plant, foraging, specific crops "Patterns for crops and foraging knowledge to help get what they need." "Know about plants to eat and use for various purposes much more in touch with plants." "Plants to use, edible or medicinal."	**51%** n=58/114
Animals	Migration patterns, hunting, understanding of ecosystems "They would probably know about good spots to hunt bison and also the spots to fish." "How they know how to hunt, to use the animals for food and to make tools with bones." "Migration of animals — buffalo & birds." "I think they would understand animal life and how they could live in harmony with the environment and the animals and plants that live nearby."	**35%** n=40/114
Climate + weather	How to survive adverse conditions, weather patterns, predictions, impact of climate/weather on food sources "How to tell the weather patterns." "They would know the air, weather. I'm sure they must have lived here hundreds and thousands of years so they would have ways of dealing with the arid climate." "They would know about rainfall and drought, the change of seasons and things like that."	**28%** n=32/114

[1] The question was asked before participants were shown a series of informative videos.

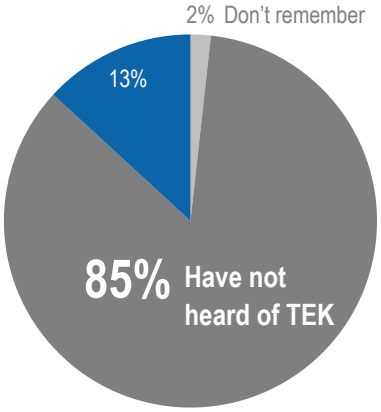
Geology + terrain	Soil, hunting grounds and campsite locations, history of land, conditions in certain areas "How to read the land." "I guess if you're tied to the land you would know a sense of place, a feeling of the geography, where things are, where rivers go, where they come from." "The hunting grounds — where to move from point to point." "They would know the soil and know about the earth."	**22%** n=25/114
Water	Where to find clean water, water collection and conservation, drought, path of river flow "Where to find water." "What happens with water; what happens to people when you pollute the water they drink." "Whether water is drinkable." "They would probably know the ecology related to river flows."	**18%** n=20/114
Social + history	Cultural knowledge, community, who lived on the land, creation stories, spiritual beliefs "What other tribes are doing. Where to get or trade horses. Religious things. Trade issues between tribes." "Tribes who lived there and creation stories." "How they use natural resources to develop their community and what brought them to Colorado." "Fantastic tribal gear. Cultural heritage, how the environment is represented. Storytelling, dance, the gear."	**11%** n=12/114
Building materials + tools	Materials for construction and tools "Where to find stone, quarries for flint that they needed." "I think that they would know the location of… stone materials that they would use for their tools." "Probably how to build a home. Tools they used." "Their campsites [in] the hills are held together with grasses from the plains. Their structures need to survive both winters in Colorado but also the hot summers."	**9%** n=10/114
Conservation	Respectful and responsible use of natural resources "Sustainability; how to deal with nature and not destroy it." "Sustainment; how to live off the land and make sure that is fit for the next generation and generations to come." "How to do things with water, like conserve it."	**4%** n=5/114

Another 13 participants (11%) discussed other resources, like general knowledge of resources, medicines, clothes, basket making, recycling, or interaction with celestial events (e.g., moon phases). For example, one thought Ute Indian people would know, "How they interact with their environment, how they lived in it." Others were more specific. They thought, "Basket making with twigs," "How to make clothes dyes," and "What they use for natural medicines," would be resources the Ute Indian people would know.

Traditional Ecological Knowledge

During the interview, participants watched a short (1:14) film clip introducing the term *Traditional Ecological Knowledge* (TEK), and then were asked about their familiarity with the term. Before watching the film clip, 13% of participants had heard the term (n=15/114), whereas 85% had not heard the term (n=97/114); 2% were unsure or could not remember (n=2/144).

87% of participants were unfamiliar with the term *Traditional Ecological Knowledge*



Regardless of pre-existing familiarity, participants were then asked how they might define or explain TEK to someone who had not heard the term before. Over half of participants described TEK as a **use of natural resources** (55%; n=63/114). Likewise, participants felt TEK was a way that people **learn about their surroundings** (34%; n=39/114). Others spoke of TEK as a way people **live in harmony with the environment** (28%; n=32/114). **Sharing values or passing on information** was an important piece of TEK to a fifth of participants (20%; n=23/114). Similarly, 15% of participants believed **sustainability** was an aspect of TEK (n=17/114). Finally, 3 participants remained unclear or unsure of a definition of TEK (3%). Many participants mentioned more than one of these concepts within their definition. Examples include:

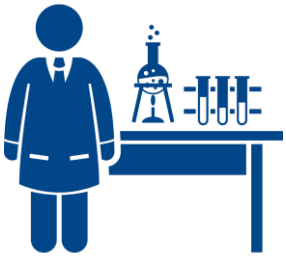
- "I would say that Traditional Ecological Knowledge is the peoples' understanding of the nature around them and the uses of nature."
  Coded to the categories "use of natural resources" and "learn about surroundings."
- "It would be a person's way of living with the land and what they learn through use; but if you put in the word *Traditional* it would be a living off the land in what we would label is an organic way but something that they've been doing probably for hundreds or thousands of years."
  Coded to the categories "use of natural resources," "learn about surroundings," and "value and information sharing."
- "It's history. When I look back at my own family, I remember lessons that my grandparents told me; things about washing themselves, how to compost, the best ways to plant certain seeds and it was all related to their knowledge of their grandparents living on the land. So I think this is a tradition passed down to families who are close to agricultural ways"
  Coded to the categories "use of natural resources" and "value and information sharing."
- "I think just time understanding your ecosystem without the modern-day science."
  Coded to the category "learn about surroundings."
- "I think of it as the balance of plants, animals, people and to mutually benefit all involved. I think [the video] was eluding to the fact that humans can benefit clearly by having their own environment in balance."
  Coded to the category "living in harmony."
- "I would describe it as knowledge of folks who have lived with the land for long periods of time and are able to do things a lot about sustainability. So it's living in an area and being able to sustain yourself but also sustaining all the land and everything around you by the way you live your life. You know bringing plants that help you but also help other parts of the environment for kind of like long-term sustainability."
  Coded to the categories "value and information sharing," "sustainability," and "living in harmony."
- "Sustainment; ensuring that the land is fit for human living for many years to come and insurance that it is protected."
  Coded to the category "sustainability."

Many participants also shared their additional thoughts about the video (71%; n=80/113[2]). More than half of those who responded reiterated something they had **learned from the video** or expressed that they had learned something new (55%; n=44/80). Often, they reiterated information including how traditional approaches involved planting and maintaining agricultural resources on the landscape, themes of sustainability, ecological awareness, and expressed interest in native cultures. One "…liked the historical part, that the Spaniards thought it was a garden." Another mentioned they "…love how they brought the animals in by planting food. I'm assuming that's what they did. So rather than having to go out far away to hunt, they actually brought the animals to them. I did not know that; that's pretty interesting.**"** Another felt the video's approach and message was important to consider: "I thought it was interesting how they were focusing on a partnership between science and traditional ecological knowledge to bring balance back to the environment." A third of those with additional thoughts remarked on the **relevance of TEK** to their own lives or current societal issues (33%; n=26/80). Several spoke of adjusting current ways of life to better support humanity and the environment in the long-term. One respondent found it vital to "…return to the old with problems of today — like climate change and the environment being out of balance. There is something to learn from the past." Another reflected, "[In school, we learned Native Americans] had their ability to live off the land and use everything that was in the land. We have gotten away from that and we tend to make 'Franken-food,' genetically modified from mass production, rather than using it for what it's designed for." Others discussed balance, and some expressed that science was a way to recalibrate. One participant worried, "Clearly we need a lot of help right now to put our environment back into balance." Another visitor explained, "Science is trying to figure out our balance in

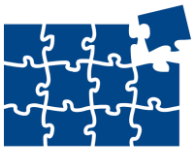
[2] Out of 113 because one respondent's answers were not recorded due to a technical issue with the tablet survey software.

today's world." Thirteen visitors (16%; n=13/80) had specific **comments related to interpretation techniques** or the future exhibit; those with suggestions felt they would like to know the names of plants in the video, noticed the video referred to California rather than Colorado, felt stories of abuse were crucial to disclose when regarding native people, believed the idea of balance could be subjective or arbitrary, or were sensitive to the word "evolve" and preferred "develop" in its place. Those who provided encouragement believed the descriptions were easy to understand, felt the images of plants and spaces in the video were "nice", appreciated representation of Native Americans as primary speakers, felt video production was high quality, thought it was a "really interesting idea for an exhibit," were interested in seeing herbal medicine and food within an exhibit space, and hoped the exhibit would discuss techniques for agricultural design. Finally, six participants (8%; n=6/80) were **curious or had a question** prompted by the video. Several were interested in more information about plants in the video; two wondered how plants were used in everyday life, one was curious whether marijuana was a plant used by Ute tribes, and another was curious which plants were grown to bring deer closer to Native American sites. Two participants believed the video had discussed Ute Indian people living in California and were curious to know more about their experience or involvement there.

TEK and School Science



Next, participants watched a second (0:42) film clip of a Ute Indian man describing how the label of "scientist" applies beyond the conventional bounds of Western educational definitions; that by using trial and error, observing the night sky, and understanding the earth and its ecology, Ute ancestors had conducted experiments and used science to understand their surroundings. In the clip, the speaker summarizes, "There were scientists before they knew there were scientists." After watching this video, participants were asked, "Can you think of any ways that Traditional Ecological Knowledge is different from the science you might have been taught in school?"



Many visitors interviewed felt **TEK offered a more direct connection to science** (39%; n=44/114), whether through hands-on problem-solving approaches, a direct connection with or dependence upon the results, or more active, self-motivated learning. Several visitors talked about how **science in school is farther removed** from their daily lives, less relevant, or learned via secondary sources (18%; n=20/114). Examples include:

- "There are hands-on experiments now but not specific to where you live and related to the area around you now. It's not like going out in your environment and hunting or gathering. Science is so global, not local, now."
- "I think [TEK is] much more problem-oriented and experimentation. Maybe the word *science* is not right, but certainly experimentation was taking place."
- "…in reality, sometimes just actual experimentation has a bigger impact than learning out of a book."
- "[TEK] was more based on experience as opposed to book knowledge, and living within the environment and experiencing things first hand."
- "All of their experiments were a matter of life and death to the Indians. If something failed, they could die."
- "I remember the term *scientific method* was used a lot in science class. We were taught to be very logical and memorize facts, numbers, equations. The Indians had to discover medicines, edible food, shelter, or safety skills to survive. They would die if they failed with a crop. We'd just go the grocery store if our dinner was burnt."
- "When I learned science, you were told, 'This is this way,' instead of living in it. It is like needing a barometer to know when the rain is coming, instead of living a life according to nature's cycles."

Also prevalent were the dichotomies between **informal approaches** of TEK (30%; n=34/114) and more **structured techniques** of Western science (28%; n=32/114). Participants discussed flexibility, attunement with nature, and cultural and verbal traditions within TEK, as compared to pre-established, controlled processes and approaches within classroom education. At times, participants spoke of differences in scientific processes, dissemination of information, and precision of or use of tools. For example:

- "We were taught to use existing equipment, telescopes, thermometers, periodic tables. [The Ute Indian people] used or made their own equipment to make discoveries."
- "So [TEK] doesn't follow the scientific method. There is not a clear definition of a study, especially the way [the video clip] portrays it. You don't use controls and the study is not by design at all."
- "Scientific process [uses] very laid out ways to do things but they were doing it just based on practical trial and error. Maybe it wasn't as formal as it is now, but it definitely works for them, clearly."
- "A more natural approach versus a scientific approach."
- "It's different in that there are people actually physically eating things, trying things without knowing whether they would be poisonous or were beneficial to them. So they just did it through trial and error rather than on chemical studies of things."
- "The truth rings clear; it's more comprehensive when you're hearing it from person to person, passed down to you, not from a textbook."
- "It's hard to demonstrate because everything was passed down verbally. Hard to keep the story straight."
- "[Western science is] very controlled instead of out in the environment where there are more variables."

Another difference mentioned was that TEK addressed more **purposeful, specific information** (8%; n=9/114), while school sciences covered a **broader spectrum of information** (4%; n=5/114). Some described how TEK incorporates local knowledge or cultural beliefs not typically taught in science classrooms.

- "I would say that it might be more specific to local context, in that the Ute people would be able to tell us information about the land in and around Colorado and the uses of the land and the nature there that I might not have learned in school."
- "School science teaching is across the board and not specialized to a particular area or culture."
- "The Native Americans knew more about controlled burns to manage forests and prevent forest fires."
- "[TEK is] probably connected to religious beliefs; we split them."
- "A lot of the Native Americans… they put their religion there but all their beliefs are tied into this so called 'science' because there are other things that we wouldn't call science involved. However, I could see that it's holistic. We were not taught that in school; we were taught, 'one and one is two' and, 'this and goes with that.'"
- "Perhaps the motives behind the traditional Scientific Revolution was different than Traditional Ecological Knowledge, in that the Utes were looking for ways to survive and thrive, not necessarily enlightenment or formalized theories of how things work."

Participants also noted that science taught in school often included **limited voices or perspectives** (10%; n=11/114). Participants were sensitive to the fact that school sciences "…only talk about specific scientists and specific discoveries" rather than expose "…that everyone can actually be a scientist." Another agreed, "European is what we focus on, but there is a spread of scientists. Think about the cumulative knowledge of population throughout the world." Some believed this perspective came as a result of school structure: "In school it was one way and we passed or failed Science. You either got it or you didn't, which is really sad. We are really all scientists and we all experience and work with our environment in the ways that best suit our needs and it's not a pass/fail." Others simply

explained that they were "…not really taught in school about the Native American type of science; basically [we were] taught European type science." Four participants (4%) expressed that the use of and focus on **technology** made school science different from TEK; for example, "School uses high tech equipment and materials. Back then, they didn't have high tech but they were still doing the science."

Despite noted differences, many participants identified similarities between TEK and science taught in schools. Nearly half of participants noticed similarities in that both use **hypothesis testing, trial and error, or experimentation** to identify information (46%; n=52/114). Participants shared:

- "Both methods used trial and error."
- "I think he said it nicely [in the video] - it's experimental. You have a theory, an experiment, and a conclusion— and that's what they were doing— the Indians, or anybody doing this now. The Utes say, 'Will this survive? Can I eat it?'"
- "It's very similar in that they all use the same type of process, whether it's discovery or hypothesizing either one. It's all the same; it's just different ways about going about it."
- "Well it's all cause-and-effect, kind of observational in most cases."
- "Experiment; try it, note the results, try again. Experimental method in basic form."

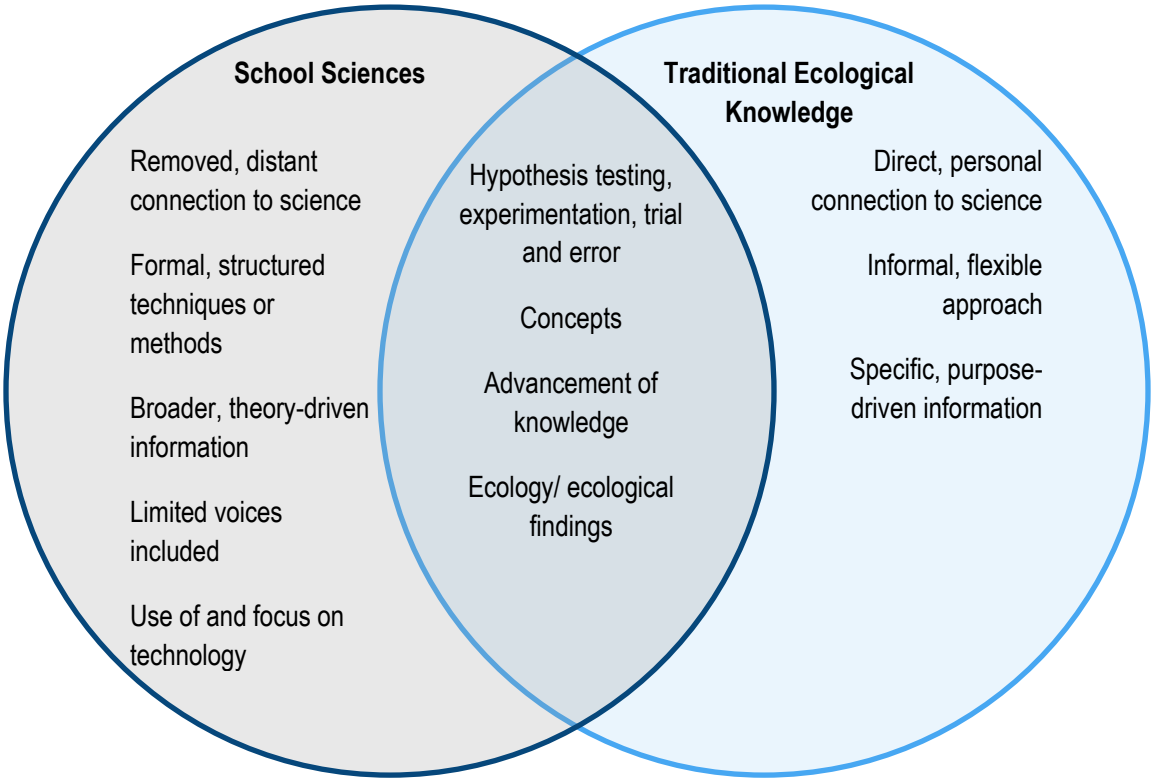
More generally, participants felt the **concepts** by which TEK and school sciences operated were similar (26%; n=30/114). For example:

- "Both are ways to observe world and ask questions about the world methodically."
- "That's one of the keys, right there [in the video] he said examining was there and trying to understand how it interacts with everything else and that's the same thing that I was taught."
- "Basics; it is all the same scientific theory."
- "No, science is science; it is all the same."
- "Trying and learning from those experiences could form theories, just like we read theories in science now."
- "Formal terms are what we use, but what differentiates it? Formalized the terminology, but all the concepts are the same."

TEK and school sciences were both considered methods to **share and advance knowledge (**13%; n=15/114**),** whether due to immediate needs (like survival) or longer-term needs (like an academic knowledge base). Examples included:

- "It's similar because we still need to know the same things, we just go about finding them in a different manner."
- "The need for knowledge is the same."
- "You need to also understand the bigger picture to be able to then apply it to your local context."
- "I think similar in the sense that you're looking for a result, and what results were positive results."
- "[People] did [science] before it was documented. The science we were taught obviously came from somewhere."
- "[Both focus on] trying to find answers to natural phenomenon around them."
- "Science is science. It's similar in that science is an exchange of knowledge in order to improve everybody's life. So whether it's learned on the land as trial and error or learned in a laboratory, it benefits people all the same."

Finally, **ecological topics or findings** were also considered a similarity (11%; n=12/114). Participants mentioned that both TEK and science taught in school were "…concerned with understanding the natural world," or, "We're both trying to figure out how to do agriculture the best way to be able to feed families." One respondent summarized, "It's similar in that Traditional Ecological Knowledge and science are both trying to answer questions about how we can make use of the environment around us and how we can be good stewards of the land around us and keep everything in balance so that we can continue to make use of those important resources."



Participants were given space to discuss anything else they noticed or found interesting in the video clip. Again, 63% of all participants had additional thoughts (n=70/114). Most who responded indicated that they had been exposed to a **new or different way of thinking about science** (40%; n=28/70). One shared, "I think it was interesting that they encourage people to realize that science is more than laboratory and a classroom and that science can be experienced as a study in many facets of life," and another realized, "Science happens everywhere without being labeled that." Some appreciated that science and culture was connected in TEK and believed TEK bridged history and science. Others expressed surprise by the revelation that **representation in science is limited** (37%; n=26/70). Many repeated the line spoken in the video: "I think what struck me the most was that there were astronomers before they were astronomers and scientists before there were scientists. So just because they didn't have a label doesn't mean that they didn't have the same approach to nature as scientist and astronomers do today." Some applied this concept to themselves; one shared, "It was interesting to think about how, because you don't call yourself scientist, maybe you are because your life is kind of an experiment." Eight individuals made **comments on the video** itself (11%), including comments about video content and perceptions of the speaker:

> Content: "There" vs "their" in captioning; Greeks referenced as if they are not Europeans; information presented in a way that was easy to understand; requested more examples of TEK science application besides testing edible foods.

Perception of Speaker: Cynical or disinterested expression; seemed angry, agitated, or defensive when explaining that scientist and astronomer labels had not been used for Ute Indian people; appeared highly educated and knowledgeable.

Another 9% were **curious or interested** in learning more (n=6/70). One participant shared, "I would be curious to learn more about the Ute people." Another felt, "It would be interesting to learn more about the non-warrior tribes of the Western Plains." Likewise, 7% mentioned they had learned something about the Ute Indian people, for example, that they used deer skin for clothing, or that they ate plants without being sure they had no poisonous properties (n=5/70).

Future Exhibit Content

Participants were asked, "What would you hope we would include in an exhibition here at the Museum on the Utes and traditional ecological knowledge? How about any specific things you would expect to see or do?" Visitors' ideas have been qualitatively analyzed, coded, and summarized below:

Looking for a Modern Connection (36%; n=40/110)

- Videos or testimonies of current experts in the field and tribal members; photographs of living Ute Indian people; description of Ute Indian people as scientists and scientific contributors
- Connection between historical Ute culture and experience with current day lives of Ute Indian people
- Topics relevant to Colorado in the present and future from the perspective of Ute Indian people; input and consultation from current-day Ute Indian people to ensure fair and accurate portrayal
- Samples of traditional foods still eaten today
- Mapped land for contextual understanding; Ute Indian lands and migration patterns in comparison to current geography

Agricultural Practices (53%; n=58/110)

- Ability to attempt agricultural techniques or experiments; hands-on planting and experimental opportunities
- Outdoor living agricultural space; LEGO agricultural village
- Try plants and herbs for traditional uses; understand plants used for food compared with those used as medicines; stories from healers using traditional medicine; analogous medicinal equivalents (e.g., Aspirin)
- Animals and hunting practices; how wildlife was corralled closer to settlements
- Relationship and cultural connections with environment; sustainable practices and takeaways for more mindful living

Artifacts (21%; n=23/110)

- Description of how natural resources were used to create clothing, tools, or objects
- Examples of tools, flint, baskets, pottery, beading, clothing; comparisons between Ute and European inventions which have similar or the same purpose
- Visual representation; maintain connection to outdoors rather than lots of text and reading

Daily Life (19%; n=21/110)

- Day-to-day tasks and living for people of all ages and genders; role of women
- Understanding seasonal and regional challenges specific to Ute Indian people; dealing with food shortages, droughts, and challenges of family life
- Impact and knowledge of astronomy and its incorporation into culture
- Social consequences and involvement with non-natives; interactions with other tribes; messaging "we're all human"

Other ideas (18%; n= 20/110) included: techniques for exhibit design (e.g., "Make it not a traditional Native American exhibit. Make it something that you can learn from...Push the grain."; "See things from a different perspective-- get

me in the world. No labels and little bits of writing."), hands-on opportunities, affective or emotional experiences, information not taught in traditional school, astronomy, geographical information or maps, historical context (e.g., "How the Ute came to CO"; "…the conflict or collaboration between Native Americans holding their ground and settlers trying to spread their culture."), description of tribal branches, and comparisons of Ute Indian people to other indigenous groups.

Additional Thoughts

Participants were given the option to share additional thoughts at the close of each interview. Although some reiterated ideas outlined above, several mentioned how they felt the **exhibit, topic, or information would be valuable** (31%; n=12/39) or indicated they were **excited to see the exhibit** (41%; n=16/39). A selection of these comments is included below:

- "Good topic. I like exhibits here. I wish they were more science based. Many of the exhibits here seem more for school groups."
- "I enjoyed watching the videos and learning about this exhibit and I think it's really important that we teach our kids how things happened in the past and why they did things the way they did and how useful it could be now and into the future."
- "Just to see how the Ute culture still exists today; if there are still Ute people here in Colorado and how they have evolved from earlier times until now."
- "Everybody knows about the Apaches and the Cheyenne, but a lot of the other tribes in the West didn't make it into the TV series in the 50s when I was a kid."
- "I'm really am very excited about this exhibit. Again, I think that the Native Americans have been kind of a forgotten people and their wisdom has been overlooked, so I'm glad you're bringing this exhibit."
- "I think it sounds like a very interesting exhibit."

Demographics and Awareness of Ute Indian People

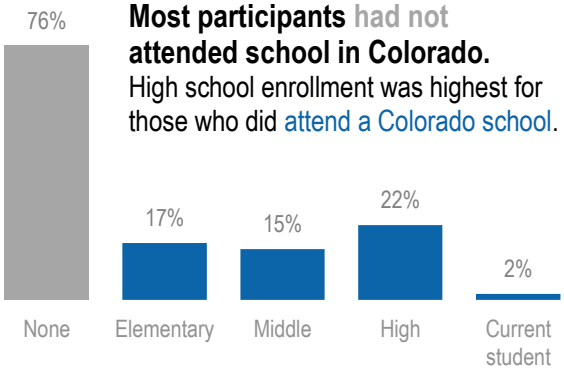
To garner more detail about those responding, participants were asked to complete a series of demographic questions and questions assessing familiarity with Ute Indian people and cultures.

Most participants reported not learning **about the Ute Indian people in school,** though some had learned about the tribe or did not remember.

Participants indicated whether they studied the Ute Indian people at any point in school. The majority had not (63%; n=71/112), but over a fifth of participants had studied Ute Indian people in school (21%; n=24/112). The remaining 15% could not remember whether it had been covered (n=17/112).

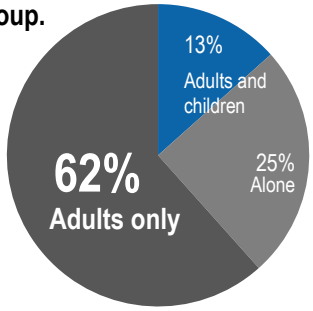
Participants were also asked whether they had attended school in Colorado. Again, the **majority had not attended school in Colorado** (76%; n=85/112). Of those who had, 59% attended all three stages of schooling within the state (n=16/27). High school was the most common educational stage that participants had perused within Colorado (22%; n=25/112). Next most common was elementary school (17%; n=19/112) followed by middle school (15%; n=17/112). Only 2% of participants indicated they were current students (n=2/112). **Participants who had gone to school in Colorado were significantly more likely to report having studied the Ute Indian people in school**[3].

Most participants had not **attended school in Colorado.** High school enrollment was highest for those who did attend a Colorado school.



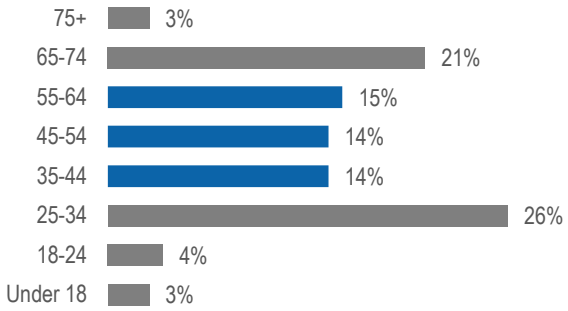
[3] χ^3 *(2, N=112) = 25.28, p <.00*

Visitors primarily came with other adults; just 13% of participants visited with children in their group.



Visiting group was also assessed. Overall, most adults attended without children[4], with 62% visiting in an adult-only group (n=69/112) and a quarter visiting on their own (25%; n=28/112). Only 13% of visiting groups included children (n=15/112).

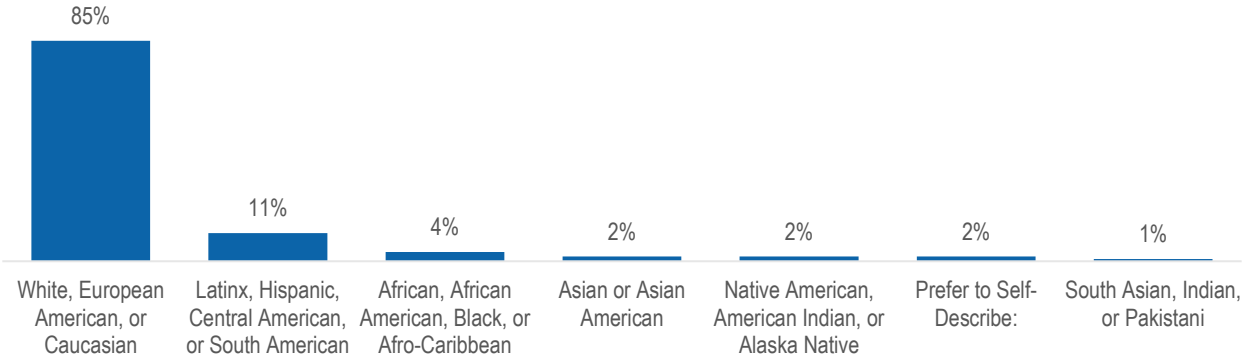
Nearly half of participants were between the ages of 35 and 64.



Participants were asked to write in their age. Of the 111 participants who completed the question, the average age was 47 years old. Nearly half of participants were between the ages of 35 and 64 (44%; n=49/111); however, there were peaks within the 25-34 age group (26%; n=29/111) and 65-74 group (21%; n=23/111).

Gender identity was requested from participants. Over half self-identified as female (51%; n=57/111), 48% as male (n=53/111), and one as "Trans" (1%).

Finally, participants were asked to indicate their racial, ethnic, and/or heritage backgrounds. Overall, 85% selected "White, European American, or Caucasian" (n=94/111). Although the options were provided, no visitors selected the categories for "Middle Eastern, Arab, or Arab American" or "Native Hawaiian, Pacific Islander, or Filipino". Five visitors selected more than one category, and all who indicated multiple categories chose "Latinx/Hispanic" as one of their descriptors. Both participants who selected "Native American" indicated they were multi-racial (one also chose "Latinx/Hispanic", another also chose "Latinx/Hispanic", and "White, European American, or Caucasian"). Those who chose to self-describe indicated "American" and "White and Jewish" as their racial, ethnic and heritage backgrounds.



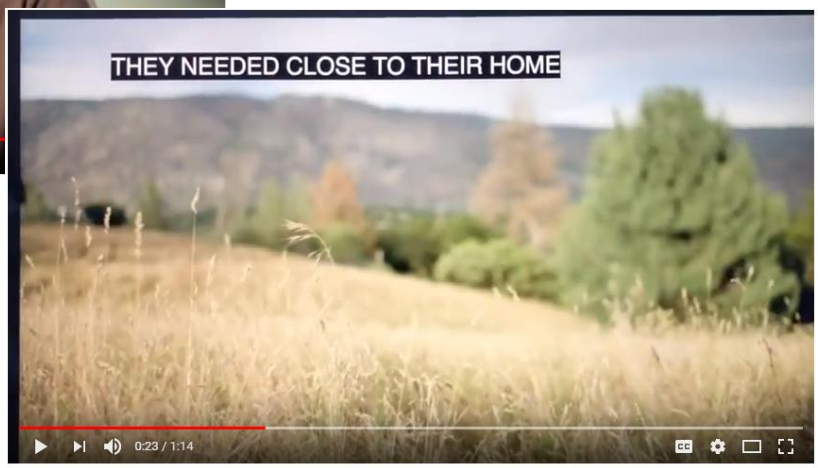
[4] School was in session during the time of data collection and may have influenced the number of groups visiting with children.

Key Findings

- Participating visitors considered what information Ute Indian people may have about their environment; participants felt agriculture and growing food, animals, and climate and weather would be well-understood topics. Less common, but also discussed were: geology and terrain, water, social and historical knowledge, building materials and tools, and conservation.
- While most participants were unfamiliar with the term *Traditional Ecological Knowledge*, most were able to define the term in one of more of the following ways: a use of natural resources; a way to learn about surroundings; a method of living in harmony with the environment; sharing values and passing on information; environmental sustainability.
- When considering TEK, visitors mentioned things they had learned from the first video (shown in the interview protocol), believed the concept/approach was relevant to their own lives or current issues. Some visitors had ideas related to future interpretation techniques, and a few wanted to know more as a result of watching the video.
- Compared with how science is typically taught in school, visitors expressed that TEK offered a more direct connection to science and nature, used more flexible, less formal methodologies, engaged cultural and verbal traditions, and addressed purposeful, specific information. Visitors noted that both TEK and school-based science used hypothesis-testing, trial and error, and experimentation to identify information, shared many of the same concepts (e.g., findings, foundational ideas about gathering information), generated communal, shared knowledge, and addressed ecological topics.
- Reflecting on the second video (shown in the interview protocol) about Ute scientists, participants were exposed to a new or different way to think about science, surprised to realize limited representation of voices and perspectives in science, had ideas about the video content or the speaker, and were curious or interested in learning more.
- Ideas for the upcoming exhibit included: including a modern connection, agricultural practices, artifacts, and daily life.
- Before leaving, many indicated they were interested in visiting the exhibit or believed the topic and information was valuable to share with the public.

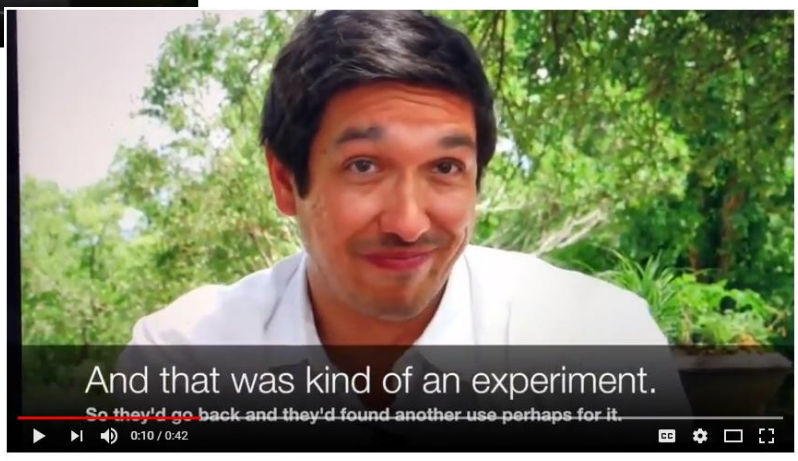
Image stills from videos:

Ute STEM Tending the Wild Front End Clip



Ute STEM Tending the Wild Front End Clip

Ute STEM GB for Front End



Ute STEM GB for Front End

HISTORY Colorado CENTER

Ute STEM front end

Instructions for Interviewers

Interviewers:

1. This doesn't need to be a random sample; try to get a representative sample of visitors

2. Only approach those appearing 18+ or youth 10+ with an adult

3. Do not intercept anyone in a school group (adult or youth)

4. Focus on one person's answers. Note when others in group add answers or information.

(You can explain, "I'm going to focus on your answers, because this is really designed for one person at a time, though the rest of you are welcome to listen in.")

Sample opening line:

"Hi! Can I talk with you about a new exhibition the Museum is working on?"

* 1. Record visit **acceptance or refusal**:

- ◯ Accepted
- ◯ Refused; please include notes:

2. This is **an idea** we are working on for a **new exhibition** which will open here at the Museum this fall:

Ute Indian people have been living in the same place in and around the Colorado mountains for a very long time. Because of this, they have learned a lot about the environment where they live. They pass information down through generations by storytelling and traditions.

Can you think of any **examples** of what Ute people would **know about their environment**?

Please watch this **video,** featuring **indigenous peoples across California**:

3. Before watching that film clip, had you **heard the term "Traditional Ecological Knowledge"**?

(Please select one.)

- ◯ NO-- I had not heard the term Traditional Ecological Knowledge before
- ◯ YES-- I had heard the term Traditional Ecological Knowledge before
- ◯ I can't remember/I don't know

4. How might you **explain or describe "traditional ecological knowledge"** to someone who hadn't heard the term before?

5. Is there **anything else you noticed or found interesting** in the video clip?

Please watch this **video,** featuring **a member of the Southern Ute Indian Tribe** :

6. Having watched that clip, can you think of any ways that traditional ecological knowledge is **different from the science you might have been taught in school**?

7. What about ways it's **similar**?

8. Is there **anything else you noticed or found interesting** in the video clip?

9. **What would you hope we would include in an exhibition** here at the Museum on the Utes and traditional ecological knowledge?

How about any specific things you would **expect to see or do**?

10. Is there **anything else that you want to add**, based on what we've talked about so far?

Thank you!

Now I'm going to **hand over the iPad over** to you so you can answer a few questions on your own-- then we'll be done!

These questions are all optional, but will help us to learn more about our visitors and audience.

You may need to **scroll down** to see all of the answer choices.

11. Did you **study the Ute Indian people** at any point in school?

(Please select one.)

- ◯ NO-- I did not study the Utes
- ◯ YES-- I did study the Utes
- ◯ I can't remember/I don't know

12. Did you go **school in Colorado**?
If so, for which grades?

(Please select all that apply.)

- ☐ NO; I didn't go to school in CO.
- ☐ YES; I went to elementary school in CO.
- ☐ YES; I went to middle school in CO.
- ☐ YES; I went to high school in CO.
- ☐ I am CURRENTLY in school in CO.

13. Which best describes the **group** you are at the Museum with?

(Please select one.)

- ◯ I am visiting on my own.
- ◯ I am visiting with adults only.
- ◯ I am visiting with adult(s) and child(ren).

14. What is your **age**?

15. What is your **gender** and/or gender identity?

16. What is your **race/ethnicity**:

(Please choose as many as apply.)

- ☐ African, African American, Black, or Afro-Caribbean
- ☐ Asian or Asian American
- ☐ Latinx, Hispanic, Central American, or South American
- ☐ Middle Eastern, Arab, or Arab American
- ☐ Native American, American Indian, or Alaska Native
- ☐ Native Hawaiian, Pacific Islander, or Filipino
- ☐ South Asian, Indian, or Pakistani
- ☐ White, European American, or Caucasian
- ☐ Prefer to Self-Describe:

That's the last question.

The exhibition based on these interviews will be opening here this fall (2018).
You can also visit the Ute Indian Museum in Montrose, CO to learn more.

Thank you. We hope you enjoy the rest of your visit today.

PLEASE RETURN THE iPAD TO STAFF.

FOR INTERVIEWERS ONLY:

Please go back and **CHECK ALL ANSWERS** before selecting "done."
You will then be taken to a new interview form.

Modern Connection | Artifacts | Agricultural Practices | Daily Life

Exhibit Content Example Quotes	Code
Farming, agricultural, how the Ute made use of our state's wildlife and rainfall. How did they live in the land and create balance? How can we do it to benefit of species and people now? Sustainability [as a] concept; we send young people to school to study, but for them it was a way of life.	Agricultural Practices
How to identify plants, like how to forage and look for different plants and understand; so maybe a demonstration set-up, a display — "OK these are the places you would find plants in Denver or up in the mountains and this is what it's used for, this is how you would distill it down." Almost like an apothecary class, but really simplified.	Modern Connection, Agricultural Practices
I think it could be it could be a pretty interactive exhibit, where you're using your senses in observing things. I could see it being pretty tactile and like when you come out of it, realize "Oh yeah, I was being a scientist but I didn't realize I was being a scientist." Maybe you're smelling things, observing things, but based on the natural resources of Colorado like someone might be if they were out hunting and gathering. What I would like to see is, if people have gone through the exhibit, they know that there is a connection between Traditional Ecological and our current science and then kind of a message of, "Where do we go next?" and "What we do with this now?"	Modern Connection, Agricultural Practices
I think it would be important to have an area where they have actual plants that they use that we don't know much about. Show that this plant is used for supper, this plant for headaches, or whatever it is. Show that they have some connection to modern science, like how modern companies use chemicals from plants, like aspirin. I think show how that would actually work, that switch, from folklore Versus modern knowledge.	Modern Connection, Agricultural Practices
I think whenever we have exhibits like that, it's always good to incorporate how the Utes that have been scientists in the modern-day-- Utes have contributed to the current sciences.	Modern Connection
I would expect to see some sort of videos or testimonies of current experts in the field, like members of the tribe. It would also be really interesting to see [a] demonstration garden or outdoor exhibit that would depict some of the plants or other natural phenomenon that the Southern Utes would use to conduct experiments.	Modern Connection, Agricultural Practices
Examples of foods would be important. Understanding that it's the same food we eat, in large part. Photo displays of traditional dress and habitat and history of that. [Group member answered:] Hands-on for certain age ranges. Tools and everyday items they would use from their environment. It would be good to have Ute representatives to teach about their history.	Modern Connection, Agricultural Practices, Artifacts, Daily Life
How TEK is being incorporated into modern policy making. How TEK should be considered equivalent and incorporated into scientific data collection and peer-to-peer knowledge transfer between TEK and university academicians.	Modern Connection
I really like the idea of using videos to explain. I would expect to see certain plants and certain farming techniques. Create gardens and the way they balance things out. See what was used for medicine, and what was used for pesticides.	Agricultural Practices, Daily Life
It would be kind of cool to see what they tried that didn't work and finding out what worked for them. I don't know how you'd be able to show that, but to see failures would be good.	Agricultural Practices
I think it's important to consult with the Ute people and make sure that they feel that it's a good representation of their culture and their history and kind of the image they want to portray.	Modern Connection
I would expect to see a First Nations perspective for sure, so an exhibit written for and about and by the Ute people. I would hope it would have some sort of hands-on component so that people would be able to see some of the different resources and the way that they were used and perhaps it might be a good idea to have an elder here who could explain some of the uses and traditions of the people.	Modern Connection
I think the chronology and the history of when they got here, how they got here, then also how long they've been here, if they're still here, and how they interact outside of their culture and how they come in and out of it. I'd like to see some of their rituals, some of their day, how they celebrate their traditions, their meals, how they prepare things; a lot to do with their kind of the day-to-day lives.	Modern Connection, Daily Life

Ute STEM Front-End Evaluation: Topic Testing

History Colorado Center

24 July 2018
Prepared by Lauren Wilson + Kate Livingston DRAFT

Overview and Methods

As part of the National Science Foundation supported Ute STEM project, ExposeYourMuseum LLC led front-end evaluation at History Colorado Center (hereafter, HCC) to assess local awareness of and interest in Traditional Ecological Knowledge (TEK) and the culture and history of the Ute Indian people. This baseline information will be used to guide exhibit and program planning on the same topic, including an exhibition to open at HCC (Denver, CO) Fall 2018. With guidance from Ute STEM project partners—including HCC staff, History Colorado staff from the Ute Indian Museum (Montrose, CO), archaeologists and other scientific partners, and Ute Indian tribal advisors—a short interview protocol was developed to prompt insights, priorities, and ideas from HCC visitors.

In May 2018, intercept interviews were conducted with 114 total participants. Although 205 individuals were approached, a refusal rate of 42% was recorded (58% accepted). Common reasons for refusal included not having enough time, visiting from another state, or looking for group members.

The following report summarizes and discusses HCC visitors': 1) awareness of Ute Indian people and Ute ecological knowledge, 2) familiarity with the term Traditional Ecological Knowledge and interpretations of its meaning, and 3) interest in content and ideas for the up-coming exhibit.

Awareness of Ute Indian People and Ute Ecological Knowledge

Participants were asked to consider what Ute Indian people might know about their environment[1]. Although most participants had an idea, 15% of participants were either unfamiliar with the Ute Indian people or were unsure about what Ute Indian people specifically might know (n=17/114). One explained, "I learned a bit about the Ute here but didn't know a lot before visiting," and another shared that they had "…never even heard of Ute-- more familiar with the Sequoia [sic] and Navajo."

However, most participants considered several topics or information that Ute Indian people would know about the environment. These participants mentioned an average of two topics each. Over one-quarter of participants mentioned agriculture and growing food, animals, and/or climate and weather. Less common, but also discussed were: geology and terrain, water, social and historical knowledge, building materials and tools, and finally, conservation. The following table includes descriptions of these topics and example quotes from visitors.

Topic	Description + Examples	%
Agriculture + growing food	Farming, where and when to plant, foraging, specific crops "Patterns for crops and foraging knowledge to help get what they need." "Know about plants to eat and use for various purposes much more in touch with plants." "Plants to use, edible or medicinal."	**51%** n=58/114
Animals	Migration patterns, hunting, understanding of ecosystems "They would probably know about good spots to hunt bison and also the spots to fish." "How they know how to hunt, to use the animals for food and to make tools with bones." "Migration of animals — buffalo & birds." "I think they would understand animal life and how they could live in harmony with the environment and the animals and plants that live nearby."	**35%** n=40/114
Climate + weather	How to survive adverse conditions, weather patterns, predictions, impact of climate/weather on food sources "How to tell the weather patterns." "They would know the air, weather. I'm sure they must have lived here hundreds and thousands of years so they would have ways of dealing with the arid climate." "They would know about rainfall and drought, the change of seasons and things like that."	**28%** n=32/114

[1] The question was asked before participants were shown a series of informative videos.

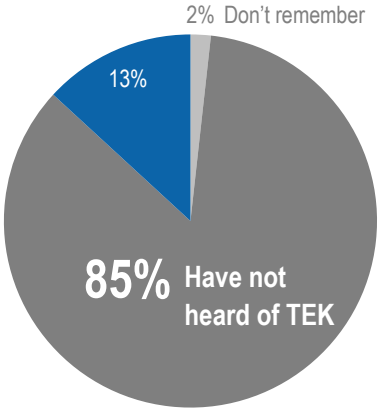
Geology + terrain	Soil, hunting grounds and campsite locations, history of land, conditions in certain areas "How to read the land." "I guess if you're tied to the land you would know a sense of place, a feeling of the geography, where things are, where rivers go, where they come from." "The hunting grounds — where to move from point to point." "They would know the soil and know about the earth."	**22%** n=25/114
Water	Where to find clean water, water collection and conservation, drought, path of river flow "Where to find water." "What happens with water; what happens to people when you pollute the water they drink." "Whether water is drinkable." "They would probably know the ecology related to river flows."	**18%** n=20/114
Social + history	Cultural knowledge, community, who lived on the land, creation stories, spiritual beliefs "What other tribes are doing. Where to get or trade horses. Religious things. Trade issues between tribes." "Tribes who lived there and creation stories." "How they use natural resources to develop their community and what brought them to Colorado." "Fantastic tribal gear. Cultural heritage, how the environment is represented. Storytelling, dance, the gear."	**11%** n=12/114
Building materials + tools	Materials for construction and tools "Where to find stone, quarries for flint that they needed." "I think that they would know the location of… stone materials that they would use for their tools." "Probably how to build a home. Tools they used." "Their campsites [in] the hills are held together with grasses from the plains. Their structures need to survive both winters in Colorado but also the hot summers."	**9%** n=10/114
Conservation	Respectful and responsible use of natural resources "Sustainability; how to deal with nature and not destroy it." "Sustainment; how to live off the land and make sure that is fit for the next generation and generations to come." "How to do things with water, like conserve it."	**4%** n=5/114

Another 13 participants (11%) discussed other resources, like general knowledge of resources, medicines, clothes, basket making, recycling, or interaction with celestial events (e.g., moon phases). For example, one thought Ute Indian people would know, "How they interact with their environment, how they lived in it." Others were more specific. They thought, "Basket making with twigs," "How to make clothes dyes," and "What they use for natural medicines," would be resources the Ute Indian people would know.

Traditional Ecological Knowledge

During the interview, participants watched a short (1:14) film clip introducing the term *Traditional Ecological Knowledge* (TEK), and then were asked about their familiarity with the term. Before watching the film clip, 13% of participants had heard the term (n=15/114), whereas 85% had not heard the term (n=97/114); 2% were unsure or could not remember (n=2/144).

87% of participants were unfamiliar with the term *Traditional Ecological Knowledge*



Regardless of pre-existing familiarity, participants were then asked how they might define or explain TEK to someone who had not heard the term before. Over half of participants described TEK as a **use of natural resources** (55%; n=63/114). Likewise, participants felt TEK was a way that people **learn about their surroundings** (34%; n=39/114). Others spoke of TEK as a way people **live in harmony with the environment** (28%; n=32/114). **Sharing values or passing on information** was an important piece of TEK to a fifth of participants (20%; n=23/114). Similarly, 15% of participants believed **sustainability** was an aspect of TEK (n=17/114). Finally, 3 participants remained unclear or unsure of a definition of TEK (3%). Many participants mentioned more than one of these concepts within their definition. Examples include:

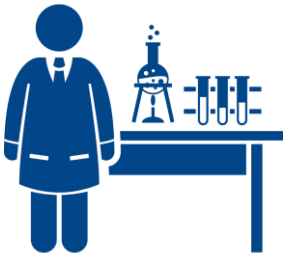
- "I would say that Traditional Ecological Knowledge is the peoples' understanding of the nature around them and the uses of nature."
  Coded to the categories "use of natural resources" and "learn about surroundings."
- "It would be a person's way of living with the land and what they learn through use; but if you put in the word *Traditional* it would be a living off the land in what we would label is an organic way but something that they've been doing probably for hundreds or thousands of years."
  Coded to the categories "use of natural resources," "learn about surroundings," and "value and information sharing."
- "It's history. When I look back at my own family, I remember lessons that my grandparents told me; things about washing themselves, how to compost, the best ways to plant certain seeds and it was all related to their knowledge of their grandparents living on the land. So I think this is a tradition passed down to families who are close to agricultural ways"
  Coded to the categories "use of natural resources" and "value and information sharing."
- "I think just time understanding your ecosystem without the modern-day science."
  Coded to the category "learn about surroundings."
- "I think of it as the balance of plants, animals, people and to mutually benefit all involved. I think [the video] was eluding to the fact that humans can benefit clearly by having their own environment in balance."
  Coded to the category "living in harmony."
- "I would describe it as knowledge of folks who have lived with the land for long periods of time and are able to do things a lot about sustainability. So it's living in an area and being able to sustain yourself but also sustaining all the land and everything around you by the way you live your life. You know bringing plants that help you but also help other parts of the environment for kind of like long-term sustainability."
  Coded to the categories "value and information sharing," "sustainability," and "living in harmony."
- "Sustainment; ensuring that the land is fit for human living for many years to come and insurance that it is protected."
  Coded to the category "sustainability."

Many participants also shared their additional thoughts about the video (71%; n=80/113[2]). More than half of those who responded reiterated something they had **learned from the video** or expressed that they had learned something new (55%; n=44/80). Often, they reiterated information including how traditional approaches involved planting and maintaining agricultural resources on the landscape, themes of sustainability, ecological awareness, and expressed interest in native cultures. One "…liked the historical part, that the Spaniards thought it was a garden." Another mentioned they "…love how they brought the animals in by planting food. I'm assuming that's what they did. So rather than having to go out far away to hunt, they actually brought the animals to them. I did not know that; that's pretty interesting.**"** Another felt the video's approach and message was important to consider: "I thought it was interesting how they were focusing on a partnership between science and traditional ecological knowledge to bring balance back to the environment." A third of those with additional thoughts remarked on the **relevance of TEK** to their own lives or current societal issues (33%; n=26/80). Several spoke of adjusting current ways of life to better support humanity and the environment in the long-term. One respondent found it vital to "…return to the old with problems of today — like climate change and the environment being out of balance. There is something to learn from the past." Another reflected, "[In school, we learned Native Americans] had their ability to live off the land and use everything that was in the land. We have gotten away from that and we tend to make 'Franken-food,' genetically modified from mass production, rather than using it for what it's designed for." Others discussed balance, and some expressed that science was a way to recalibrate. One participant worried, "Clearly we need a lot of help right now to put our environment back into balance." Another visitor explained, "Science is trying to figure out our balance in

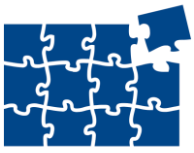
[2] Out of 113 because one respondent's answers were not recorded due to a technical issue with the tablet survey software.

today's world." Thirteen visitors (16%; n=13/80) had specific **comments related to interpretation techniques** or the future exhibit; those with suggestions felt they would like to know the names of plants in the video, noticed the video referred to California rather than Colorado, felt stories of abuse were crucial to disclose when regarding native people, believed the idea of balance could be subjective or arbitrary, or were sensitive to the word "evolve" and preferred "develop" in its place. Those who provided encouragement believed the descriptions were easy to understand, felt the images of plants and spaces in the video were "nice", appreciated representation of Native Americans as primary speakers, felt video production was high quality, thought it was a "really interesting idea for an exhibit," were interested in seeing herbal medicine and food within an exhibit space, and hoped the exhibit would discuss techniques for agricultural design. Finally, six participants (8%; n=6/80) were **curious or had a question** prompted by the video. Several were interested in more information about plants in the video; two wondered how plants were used in everyday life, one was curious whether marijuana was a plant used by Ute tribes, and another was curious which plants were grown to bring deer closer to Native American sites. Two participants believed the video had discussed Ute Indian people living in California and were curious to know more about their experience or involvement there.

TEK and School Science



Next, participants watched a second (0:42) film clip of a Ute Indian man describing how the label of "scientist" applies beyond the conventional bounds of Western educational definitions; that by using trial and error, observing the night sky, and understanding the earth and its ecology, Ute ancestors had conducted experiments and used science to understand their surroundings. In the clip, the speaker summarizes, "There were scientists before they knew there were scientists." After watching this video, participants were asked, "Can you think of any ways that Traditional Ecological Knowledge is different from the science you might have been taught in school?"



Many visitors interviewed felt **TEK offered a more direct connection to science** (39%; n=44/114), whether through hands-on problem-solving approaches, a direct connection with or dependence upon the results, or more active, self-motivated learning. Several visitors talked about how **science in school is farther removed** from their daily lives, less relevant, or learned via secondary sources (18%; n=20/114). Examples include:

- "There are hands-on experiments now but not specific to where you live and related to the area around you now. It's not like going out in your environment and hunting or gathering. Science is so global, not local, now."
- "I think [TEK is] much more problem-oriented and experimentation. Maybe the word *science* is not right, but certainly experimentation was taking place."
- "…in reality, sometimes just actual experimentation has a bigger impact than learning out of a book."
- "[TEK] was more based on experience as opposed to book knowledge, and living within the environment and experiencing things first hand."
- "All of their experiments were a matter of life and death to the Indians. If something failed, they could die."
- "I remember the term *scientific method* was used a lot in science class. We were taught to be very logical and memorize facts, numbers, equations. The Indians had to discover medicines, edible food, shelter, or safety skills to survive. They would die if they failed with a crop. We'd just go the grocery store if our dinner was burnt."
- "When I learned science, you were told, 'This is this way,' instead of living in it. It is like needing a barometer to know when the rain is coming, instead of living a life according to nature's cycles."

Also prevalent were the dichotomies between **informal approaches** of TEK (30%; n=34/114) and more **structured techniques** of Western science (28%; n=32/114). Participants discussed flexibility, attunement with nature, and cultural and verbal traditions within TEK, as compared to pre-established, controlled processes and approaches within classroom education. At times, participants spoke of differences in scientific processes, dissemination of information, and precision of or use of tools. For example:

- "We were taught to use existing equipment, telescopes, thermometers, periodic tables. [The Ute Indian people] used or made their own equipment to make discoveries."
- "So [TEK] doesn't follow the scientific method. There is not a clear definition of a study, especially the way [the video clip] portrays it. You don't use controls and the study is not by design at all."
- "Scientific process [uses] very laid out ways to do things but they were doing it just based on practical trial and error. Maybe it wasn't as formal as it is now, but it definitely works for them, clearly."
- "A more natural approach versus a scientific approach."
- "It's different in that there are people actually physically eating things, trying things without knowing whether they would be poisonous or were beneficial to them. So they just did it through trial and error rather than on chemical studies of things."
- "The truth rings clear; it's more comprehensive when you're hearing it from person to person, passed down to you, not from a textbook."
- "It's hard to demonstrate because everything was passed down verbally. Hard to keep the story straight."
- "[Western science is] very controlled instead of out in the environment where there are more variables."

Another difference mentioned was that TEK addressed more **purposeful, specific information** (8%; n=9/114), while school sciences covered a **broader spectrum of information** (4%; n=5/114). Some described how TEK incorporates local knowledge or cultural beliefs not typically taught in science classrooms.

- "I would say that it might be more specific to local context, in that the Ute people would be able to tell us information about the land in and around Colorado and the uses of the land and the nature there that I might not have learned in school."
- "School science teaching is across the board and not specialized to a particular area or culture."
- "The Native Americans knew more about controlled burns to manage forests and prevent forest fires."
- "[TEK is] probably connected to religious beliefs; we split them."
- "A lot of the Native Americans… they put their religion there but all their beliefs are tied into this so called 'science' because there are other things that we wouldn't call science involved. However, I could see that it's holistic. We were not taught that in school; we were taught, 'one and one is two' and, 'this and goes with that.'"
- "Perhaps the motives behind the traditional Scientific Revolution was different than Traditional Ecological Knowledge, in that the Utes were looking for ways to survive and thrive, not necessarily enlightenment or formalized theories of how things work."

Participants also noted that science taught in school often included **limited voices or perspectives** (10%; n=11/114). Participants were sensitive to the fact that school sciences "…only talk about specific scientists and specific discoveries" rather than expose "…that everyone can actually be a scientist." Another agreed, "European is what we focus on, but there is a spread of scientists. Think about the cumulative knowledge of population throughout the world." Some believed this perspective came as a result of school structure: "In school it was one way and we passed or failed Science. You either got it or you didn't, which is really sad. We are really all scientists and we all experience and work with our environment in the ways that best suit our needs and it's not a pass/fail." Others simply

explained that they were "…not really taught in school about the Native American type of science; basically [we were] taught European type science." Four participants (4%) expressed that the use of and focus on **technology** made school science different from TEK; for example, "School uses high tech equipment and materials. Back then, they didn't have high tech but they were still doing the science."

Despite noted differences, many participants identified similarities between TEK and science taught in schools. Nearly half of participants noticed similarities in that both use **hypothesis testing, trial and error, or experimentation** to identify information (46%; n=52/114). Participants shared:

- "Both methods used trial and error."
- "I think he said it nicely [in the video] - it's experimental. You have a theory, an experiment, and a conclusion— and that's what they were doing— the Indians, or anybody doing this now. The Utes say, 'Will this survive? Can I eat it?'"
- "It's very similar in that they all use the same type of process, whether it's discovery or hypothesizing either one. It's all the same; it's just different ways about going about it."
- "Well it's all cause-and-effect, kind of observational in most cases."
- "Experiment; try it, note the results, try again. Experimental method in basic form."

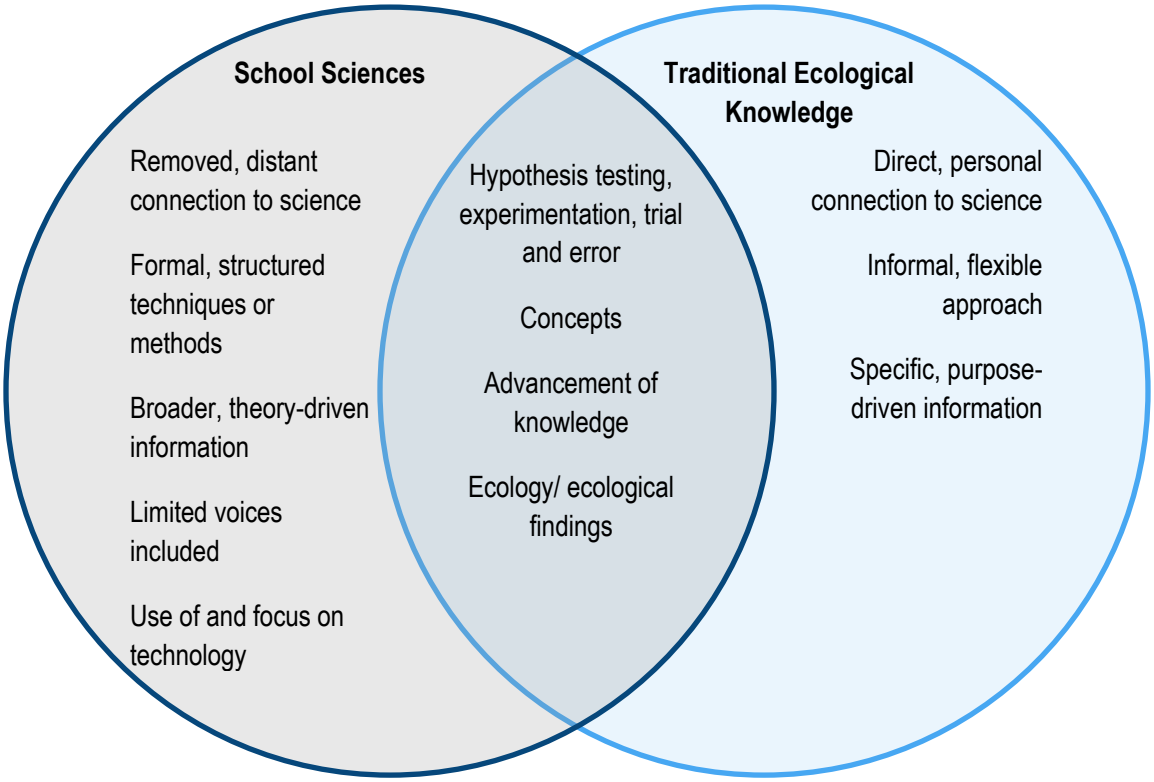
More generally, participants felt the **concepts** by which TEK and school sciences operated were similar (26%; n=30/114). For example:

- "Both are ways to observe world and ask questions about the world methodically."
- "That's one of the keys, right there [in the video] he said examining was there and trying to understand how it interacts with everything else and that's the same thing that I was taught."
- "Basics; it is all the same scientific theory."
- "No, science is science; it is all the same."
- "Trying and learning from those experiences could form theories, just like we read theories in science now."
- "Formal terms are what we use, but what differentiates it? Formalized the terminology, but all the concepts are the same."

TEK and school sciences were both considered methods to **share and advance knowledge (**13%; n=15/114**),** whether due to immediate needs (like survival) or longer-term needs (like an academic knowledge base). Examples included:

- "It's similar because we still need to know the same things, we just go about finding them in a different manner."
- "The need for knowledge is the same."
- "You need to also understand the bigger picture to be able to then apply it to your local context."
- "I think similar in the sense that you're looking for a result, and what results were positive results."
- "[People] did [science] before it was documented. The science we were taught obviously came from somewhere."
- "[Both focus on] trying to find answers to natural phenomenon around them."
- "Science is science. It's similar in that science is an exchange of knowledge in order to improve everybody's life. So whether it's learned on the land as trial and error or learned in a laboratory, it benefits people all the same."

Finally, **ecological topics or findings** were also considered a similarity (11%; n=12/114). Participants mentioned that both TEK and science taught in school were "…concerned with understanding the natural world," or, "We're both trying to figure out how to do agriculture the best way to be able to feed families." One respondent summarized, "It's similar in that Traditional Ecological Knowledge and science are both trying to answer questions about how we can make use of the environment around us and how we can be good stewards of the land around us and keep everything in balance so that we can continue to make use of those important resources."



Participants were given space to discuss anything else they noticed or found interesting in the video clip. Again, 63% of all participants had additional thoughts (n=70/114). Most who responded indicated that they had been exposed to a **new or different way of thinking about science** (40%; n=28/70). One shared, "I think it was interesting that they encourage people to realize that science is more than laboratory and a classroom and that science can be experienced as a study in many facets of life," and another realized, "Science happens everywhere without being labeled that." Some appreciated that science and culture was connected in TEK and believed TEK bridged history and science. Others expressed surprise by the revelation that **representation in science is limited** (37%; n=26/70). Many repeated the line spoken in the video: "I think what struck me the most was that there were astronomers before they were astronomers and scientists before there were scientists. So just because they didn't have a label doesn't mean that they didn't have the same approach to nature as scientist and astronomers do today." Some applied this concept to themselves; one shared, "It was interesting to think about how, because you don't call yourself scientist, maybe you are because your life is kind of an experiment." Eight individuals made **comments on the video** itself (11%), including comments about video content and perceptions of the speaker:

> Content: "There" vs "their" in captioning; Greeks referenced as if they are not Europeans; information presented in a way that was easy to understand; requested more examples of TEK science application besides testing edible foods.

Perception of Speaker: Cynical or disinterested expression; seemed angry, agitated, or defensive when explaining that scientist and astronomer labels had not been used for Ute Indian people; appeared highly educated and knowledgeable.

Another 9% were **curious or interested** in learning more (n=6/70). One participant shared, "I would be curious to learn more about the Ute people." Another felt, "It would be interesting to learn more about the non-warrior tribes of the Western Plains." Likewise, 7% mentioned they had learned something about the Ute Indian people, for example, that they used deer skin for clothing, or that they ate plants without being sure they had no poisonous properties (n=5/70).

Future Exhibit Content

Participants were asked, "What would you hope we would include in an exhibition here at the Museum on the Utes and traditional ecological knowledge? How about any specific things you would expect to see or do?" Visitors' ideas have been qualitatively analyzed, coded, and summarized below:

Looking for a Modern Connection (36%; n=40/110)

- Videos or testimonies of current experts in the field and tribal members; photographs of living Ute Indian people; description of Ute Indian people as scientists and scientific contributors
- Connection between historical Ute culture and experience with current day lives of Ute Indian people
- Topics relevant to Colorado in the present and future from the perspective of Ute Indian people; input and consultation from current-day Ute Indian people to ensure fair and accurate portrayal
- Samples of traditional foods still eaten today
- Mapped land for contextual understanding; Ute Indian lands and migration patterns in comparison to current geography

Agricultural Practices (53%; n=58/110)

- Ability to attempt agricultural techniques or experiments; hands-on planting and experimental opportunities
- Outdoor living agricultural space; LEGO agricultural village
- Try plants and herbs for traditional uses; understand plants used for food compared with those used as medicines; stories from healers using traditional medicine; analogous medicinal equivalents (e.g., Aspirin)
- Animals and hunting practices; how wildlife was corralled closer to settlements
- Relationship and cultural connections with environment; sustainable practices and takeaways for more mindful living

Artifacts (21%; n=23/110)

- Description of how natural resources were used to create clothing, tools, or objects
- Examples of tools, flint, baskets, pottery, beading, clothing; comparisons between Ute and European inventions which have similar or the same purpose
- Visual representation; maintain connection to outdoors rather than lots of text and reading

Daily Life (19%; n=21/110)

- Day-to-day tasks and living for people of all ages and genders; role of women
- Understanding seasonal and regional challenges specific to Ute Indian people; dealing with food shortages, droughts, and challenges of family life
- Impact and knowledge of astronomy and its incorporation into culture
- Social consequences and involvement with non-natives; interactions with other tribes; messaging "we're all human"

Other ideas (18%; n= 20/110) included: techniques for exhibit design (e.g., "Make it not a traditional Native American exhibit. Make it something that you can learn from...Push the grain."; "See things from a different perspective-- get

me in the world. No labels and little bits of writing."), hands-on opportunities, affective or emotional experiences, information not taught in traditional school, astronomy, geographical information or maps, historical context (e.g., "How the Ute came to CO"; "…the conflict or collaboration between Native Americans holding their ground and settlers trying to spread their culture."), description of tribal branches, and comparisons of Ute Indian people to other indigenous groups.

Additional Thoughts

Participants were given the option to share additional thoughts at the close of each interview. Although some reiterated ideas outlined above, several mentioned how they felt the **exhibit, topic, or information would be valuable** (31%; n=12/39) or indicated they were **excited to see the exhibit** (41%; n=16/39). A selection of these comments is included below:

- "Good topic. I like exhibits here. I wish they were more science based. Many of the exhibits here seem more for school groups."
- "I enjoyed watching the videos and learning about this exhibit and I think it's really important that we teach our kids how things happened in the past and why they did things the way they did and how useful it could be now and into the future."
- "Just to see how the Ute culture still exists today; if there are still Ute people here in Colorado and how they have evolved from earlier times until now."
- "Everybody knows about the Apaches and the Cheyenne, but a lot of the other tribes in the West didn't make it into the TV series in the 50s when I was a kid."
- "I'm really am very excited about this exhibit. Again, I think that the Native Americans have been kind of a forgotten people and their wisdom has been overlooked, so I'm glad you're bringing this exhibit."
- "I think it sounds like a very interesting exhibit."

Demographics and Awareness of Ute Indian People

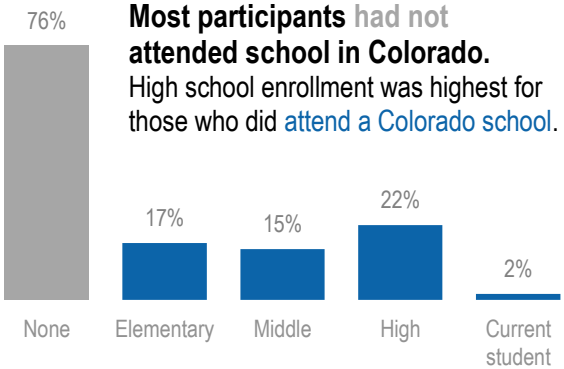
To garner more detail about those responding, participants were asked to complete a series of demographic questions and questions assessing familiarity with Ute Indian people and cultures.

Most participants reported not learning **about the Ute Indian people in school,** though some had learned about the tribe or did not remember.

Participants indicated whether they studied the Ute Indian people at any point in school. The majority had not (63%; n=71/112), but over a fifth of participants had studied Ute Indian people in school (21%; n=24/112). The remaining 15% could not remember whether it had been covered (n=17/112).

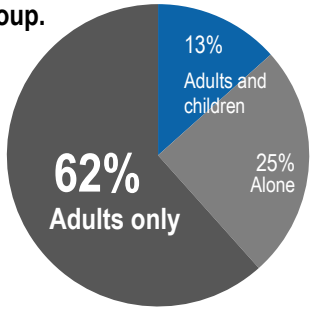
Participants were also asked whether they had attended school in Colorado. Again, the **majority had not attended school in Colorado** (76%; n=85/112). Of those who had, 59% attended all three stages of schooling within the state (n=16/27). High school was the most common educational stage that participants had perused within Colorado (22%; n=25/112). Next most common was elementary school (17%; n=19/112) followed by middle school (15%; n=17/112). Only 2% of participants indicated they were current students (n=2/112). **Participants who had gone to school in Colorado were significantly more likely to report having studied the Ute Indian people in school**[3].

Most participants had not **attended school in Colorado.** High school enrollment was highest for those who did attend a Colorado school.



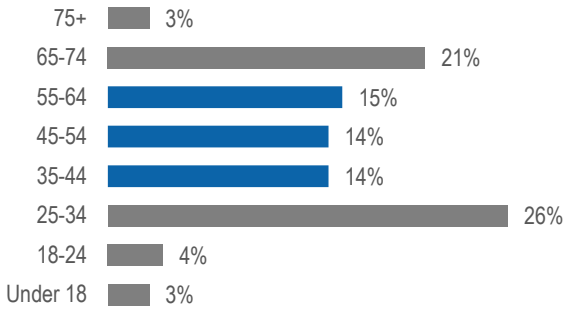
[3] χ^3 *(2, N=112) = 25.28, p <.00*

Visitors primarily came with other adults; just 13% of participants visited with children in their group.



Visiting group was also assessed. Overall, most adults attended without children[4], with 62% visiting in an adult-only group (n=69/112) and a quarter visiting on their own (25%; n=28/112). Only 13% of visiting groups included children (n=15/112).

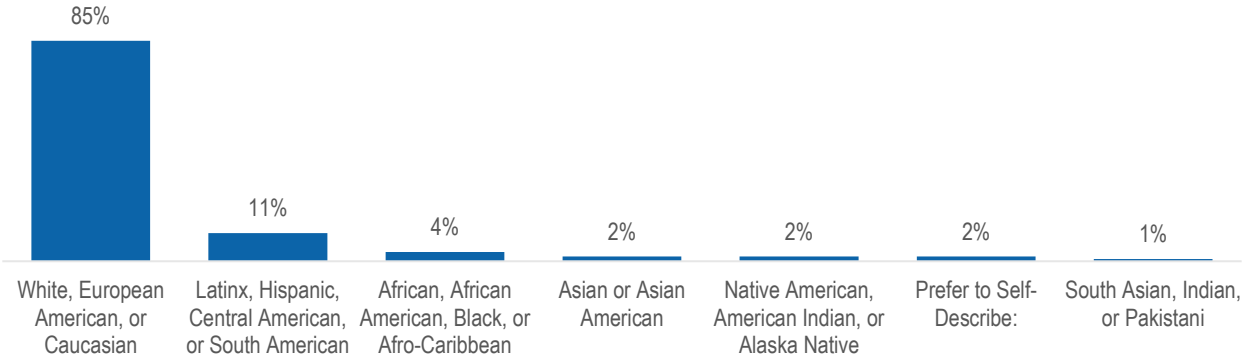
Nearly half of participants were between the ages of 35 and 64.



Participants were asked to write in their age. Of the 111 participants who completed the question, the average age was 47 years old. Nearly half of participants were between the ages of 35 and 64 (44%; n=49/111); however, there were peaks within the 25-34 age group (26%; n=29/111) and 65-74 group (21%; n=23/111).

Gender identity was requested from participants. Over half self-identified as female (51%; n=57/111), 48% as male (n=53/111), and one as "Trans" (1%).

Finally, participants were asked to indicate their racial, ethnic, and/or heritage backgrounds. Overall, 85% selected "White, European American, or Caucasian" (n=94/111). Although the options were provided, no visitors selected the categories for "Middle Eastern, Arab, or Arab American" or "Native Hawaiian, Pacific Islander, or Filipino". Five visitors selected more than one category, and all who indicated multiple categories chose "Latinx/Hispanic" as one of their descriptors. Both participants who selected "Native American" indicated they were multi-racial (one also chose "Latinx/Hispanic", another also chose "Latinx/Hispanic", and "White, European American, or Caucasian"). Those who chose to self-describe indicated "American" and "White and Jewish" as their racial, ethnic and heritage backgrounds.



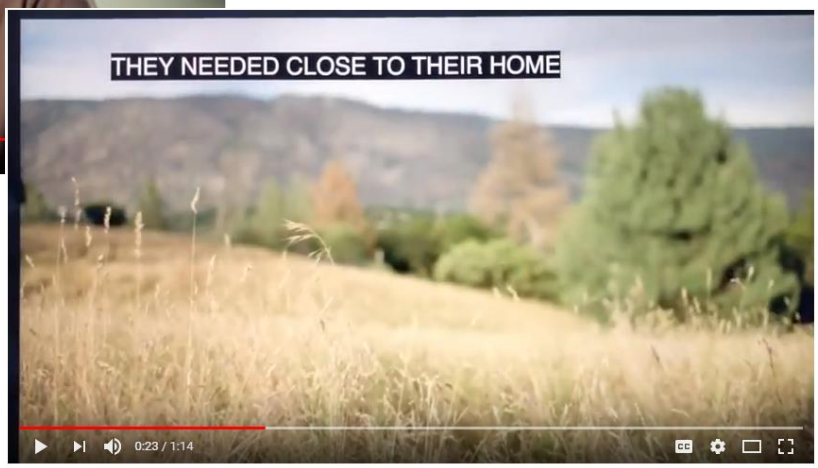
[4] School was in session during the time of data collection and may have influenced the number of groups visiting with children.

Key Findings

- Participating visitors considered what information Ute Indian people may have about their environment; participants felt agriculture and growing food, animals, and climate and weather would be well-understood topics. Less common, but also discussed were: geology and terrain, water, social and historical knowledge, building materials and tools, and conservation.
- While most participants were unfamiliar with the term *Traditional Ecological Knowledge*, most were able to define the term in one of more of the following ways: a use of natural resources; a way to learn about surroundings; a method of living in harmony with the environment; sharing values and passing on information; environmental sustainability.
- When considering TEK, visitors mentioned things they had learned from the first video (shown in the interview protocol), believed the concept/approach was relevant to their own lives or current issues. Some visitors had ideas related to future interpretation techniques, and a few wanted to know more as a result of watching the video.
- Compared with how science is typically taught in school, visitors expressed that TEK offered a more direct connection to science and nature, used more flexible, less formal methodologies, engaged cultural and verbal traditions, and addressed purposeful, specific information. Visitors noted that both TEK and school-based science used hypothesis-testing, trial and error, and experimentation to identify information, shared many of the same concepts (e.g., findings, foundational ideas about gathering information), generated communal, shared knowledge, and addressed ecological topics.
- Reflecting on the second video (shown in the interview protocol) about Ute scientists, participants were exposed to a new or different way to think about science, surprised to realize limited representation of voices and perspectives in science, had ideas about the video content or the speaker, and were curious or interested in learning more.
- Ideas for the upcoming exhibit included: including a modern connection, agricultural practices, artifacts, and daily life.
- Before leaving, many indicated they were interested in visiting the exhibit or believed the topic and information was valuable to share with the public.

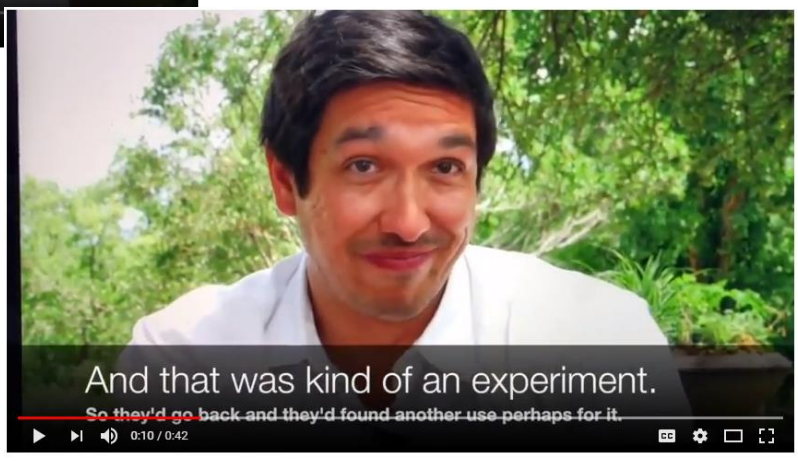
Image stills from videos:

Ute STEM Tending the Wild Front End Clip



Ute STEM Tending the Wild Front End Clip

Ute STEM GB for Front End



Ute STEM GB for Front End

HISTORY Colorado CENTER

Ute STEM front end

Instructions for Interviewers

Interviewers:

1. This doesn't need to be a random sample; try to get a representative sample of visitors

2. Only approach those appearing 18+ or youth 10+ with an adult

3. Do not intercept anyone in a school group (adult or youth)

4. Focus on one person's answers. Note when others in group add answers or information.

(You can explain, "I'm going to focus on your answers, because this is really designed for one person at a time, though the rest of you are welcome to listen in.")

Sample opening line:

"Hi! Can I talk with you about a new exhibition the Museum is working on?"

* 1. Record visit **acceptance or refusal**:

- ◯ Accepted
- ◯ Refused; please include notes:

2. This is **an idea** we are working on for a **new exhibition** which will open here at the Museum this fall:

Ute Indian people have been living in the same place in and around the Colorado mountains for a very long time. Because of this, they have learned a lot about the environment where they live. They pass information down through generations by storytelling and traditions.

Can you think of any **examples** of what Ute people would **know about their environment**?

Please watch this **video,** featuring **indigenous peoples across California**:

3. Before watching that film clip, had you **heard the term "Traditional Ecological Knowledge"**?

(Please select one.)

- ◯ NO-- I had not heard the term Traditional Ecological Knowledge before
- ◯ YES-- I had heard the term Traditional Ecological Knowledge before
- ◯ I can't remember/I don't know

4. How might you **explain or describe "traditional ecological knowledge"** to someone who hadn't heard the term before?

5. Is there **anything else you noticed or found interesting** in the video clip?

Please watch this **video,** featuring **a member of the Southern Ute Indian Tribe** :

6. Having watched that clip, can you think of any ways that traditional ecological knowledge is **different from the science you might have been taught in school**?

7. What about ways it's **similar**?

8. Is there **anything else you noticed or found interesting** in the video clip?

9. **What would you hope we would include in an exhibition** here at the Museum on the Utes and traditional ecological knowledge?

How about any specific things you would **expect to see or do**?

10. Is there **anything else that you want to add**, based on what we've talked about so far?

Thank you!

Now I'm going to **hand over the iPad over** to you so you can answer a few questions on your own-- then we'll be done!

These questions are all optional, but will help us to learn more about our visitors and audience.

You may need to **scroll down** to see all of the answer choices.

11. Did you **study the Ute Indian people** at any point in school?

(Please select one.)

- ◯ NO-- I did not study the Utes
- ◯ YES-- I did study the Utes
- ◯ I can't remember/I don't know

12. Did you go **school in Colorado**?
If so, for which grades?

(Please select all that apply.)

- ☐ NO; I didn't go to school in CO.
- ☐ YES; I went to elementary school in CO.
- ☐ YES; I went to middle school in CO.
- ☐ YES; I went to high school in CO.
- ☐ I am CURRENTLY in school in CO.

13. Which best describes the **group** you are at the Museum with?

(Please select one.)

- ◯ I am visiting on my own.
- ◯ I am visiting with adults only.
- ◯ I am visiting with adult(s) and child(ren).

14. What is your **age**?

15. What is your **gender** and/or gender identity?

16. What is your **race/ethnicity**:

(Please choose as many as apply.)

- ☐ African, African American, Black, or Afro-Caribbean
- ☐ Asian or Asian American
- ☐ Latinx, Hispanic, Central American, or South American
- ☐ Middle Eastern, Arab, or Arab American
- ☐ Native American, American Indian, or Alaska Native
- ☐ Native Hawaiian, Pacific Islander, or Filipino
- ☐ South Asian, Indian, or Pakistani
- ☐ White, European American, or Caucasian
- ☐ Prefer to Self-Describe:

That's the last question.

The exhibition based on these interviews will be opening here this fall (2018).
You can also visit the Ute Indian Museum in Montrose, CO to learn more.

Thank you. We hope you enjoy the rest of your visit today.

PLEASE RETURN THE iPAD TO STAFF.

FOR INTERVIEWERS ONLY:

Please go back and **CHECK ALL ANSWERS** before selecting "done."
You will then be taken to a new interview form.

Modern Connection | Artifacts | Agricultural Practices | Daily Life

Exhibit Content Example Quotes	Code
Farming, agricultural, how the Ute made use of our state's wildlife and rainfall. How did they live in the land and create balance? How can we do it to benefit of species and people now? Sustainability [as a] concept; we send young people to school to study, but for them it was a way of life.	Agricultural Practices
How to identify plants, like how to forage and look for different plants and understand; so maybe a demonstration set-up, a display — "OK these are the places you would find plants in Denver or up in the mountains and this is what it's used for, this is how you would distill it down." Almost like an apothecary class, but really simplified.	Modern Connection, Agricultural Practices
I think it could be it could be a pretty interactive exhibit, where you're using your senses in observing things. I could see it being pretty tactile and like when you come out of it, realize "Oh yeah, I was being a scientist but I didn't realize I was being a scientist." Maybe you're smelling things, observing things, but based on the natural resources of Colorado like someone might be if they were out hunting and gathering. What I would like to see is, if people have gone through the exhibit, they know that there is a connection between Traditional Ecological and our current science and then kind of a message of, "Where do we go next?" and "What we do with this now?"	Modern Connection, Agricultural Practices
I think it would be important to have an area where they have actual plants that they use that we don't know much about. Show that this plant is used for supper, this plant for headaches, or whatever it is. Show that they have some connection to modern science, like how modern companies use chemicals from plants, like aspirin. I think show how that would actually work, that switch, from folklore Versus modern knowledge.	Modern Connection, Agricultural Practices
I think whenever we have exhibits like that, it's always good to incorporate how the Utes that have been scientists in the modern-day-- Utes have contributed to the current sciences.	Modern Connection
I would expect to see some sort of videos or testimonies of current experts in the field, like members of the tribe. It would also be really interesting to see [a] demonstration garden or outdoor exhibit that would depict some of the plants or other natural phenomenon that the Southern Utes would use to conduct experiments.	Modern Connection, Agricultural Practices
Examples of foods would be important. Understanding that it's the same food we eat, in large part. Photo displays of traditional dress and habitat and history of that. [Group member answered:] Hands-on for certain age ranges. Tools and everyday items they would use from their environment. It would be good to have Ute representatives to teach about their history.	Modern Connection, Agricultural Practices, Artifacts, Daily Life
How TEK is being incorporated into modern policy making. How TEK should be considered equivalent and incorporated into scientific data collection and peer-to-peer knowledge transfer between TEK and university academicians.	Modern Connection
I really like the idea of using videos to explain. I would expect to see certain plants and certain farming techniques. Create gardens and the way they balance things out. See what was used for medicine, and what was used for pesticides.	Agricultural Practices, Daily Life
It would be kind of cool to see what they tried that didn't work and finding out what worked for them. I don't know how you'd be able to show that, but to see failures would be good.	Agricultural Practices
I think it's important to consult with the Ute people and make sure that they feel that it's a good representation of their culture and their history and kind of the image they want to portray.	Modern Connection
I would expect to see a First Nations perspective for sure, so an exhibit written for and about and by the Ute people. I would hope it would have some sort of hands-on component so that people would be able to see some of the different resources and the way that they were used and perhaps it might be a good idea to have an elder here who could explain some of the uses and traditions of the people.	Modern Connection
I think the chronology and the history of when they got here, how they got here, then also how long they've been here, if they're still here, and how they interact outside of their culture and how they come in and out of it. I'd like to see some of their rituals, some of their day, how they celebrate their traditions, their meals, how they prepare things; a lot to do with their kind of the day-to-day lives.	Modern Connection, Daily Life

2018 Interactive Exhibits Prototyping Summary

Kate Livingston, ExposeYourMuseum

August 15-18, 2018: Beading (Math) and Wickiups (Engineering)

116 ppl observed: 3 solo and 33 groups (from 2-7 ppl/group)
All ages (~4 to 70+)
Few speaking languages other than English
~5 of above were HCC staff

- At tribal consultation on August 14, 2018, had materials out for attendees (see slides)
- All visitors who approached/engaged in prototypes were offered an IRB-approved information sheet
- After testing the form, evaluation team used this observation form with visitors

1st iteration (photo)

Included tech patterns (e.g., ASCII rabbit)
Tech patterns were trickier for visitors and didn't seem as intuitive as the pattern rows
Some visitors noted red/blue colors in pattern rows might be tough for color blind visitors

2nd iteration (photo 1 and photo 2)

No photos of Ute objects/examples provided to contextualize
No tech patterns (e.g., ASCII)
Started instructions with questions (e.g., "Can you construct a shelter using shapes?")

3rd iteration (photo)

Added "Try Out a New Exhibit" attractor signage to front of table
Added Ute photos/examples to contextualize, with additional questions/prompts
Added plastic sign holders to make instructions more prominent/easy to read
Instructions changed to clarify beading shape should be red
Added plastic bin to hold rows of red/blue patterns
(See slides of materials used)

4th iteration (photo)

Added additional attractor signage to middle of tabletop, calling attention to STEM
Simplified to have one instruction sign per interactive
Started each instruction sign with statement/fact, followed by questions
Removed "make a square" prompt from wickiup signage
Added shape outlines (e.g., triangles) to Ute examples on beading and wickiup signs
Experimented with flip-ups (see photo)

Key findings:

- Good collaboration between youth and intergenerationally (youth and adults)
- "STEM" was picked up on and noticed (especially geometry, math)
- Visitors talked about "testing," "trying," "trial and error," and "experimenting"
- Bead activity (with pattern rows) led many visitors to count squares out loud
- Most visitors did not compare/contrast shapes of structures; most just built triangle
- Many visitors (over about 8yo) seem to know "triangle is stronger" from school
- Even without prompting, many visitors iterated (i.e., made more than one pattern)
- Beading interactive often led to more iterations (4+) than wickiup interactive (1-2)
- Some frustration at materials not all being the same (e.g., missing velcro)
- Some frustration at not enough materials for multiple people to engage at once
- Many visitors wanted to use all of the materials at once (i.e., all of the wickiup poles)
- Many visitors started with activity (i.e., jumped right in) and read signage second (if at all)
- Visitors naturally got competitive; some asked for extra element of challenge/competition
- Curiosity about why HCC chose not to use natural materials (e.g., sticks and real beads)
- Younger children (under 4) want to be able to touch/grab/play with materials
- Table height added to accessibility for younger visitors
- While some adult visitors were reluctant to engage in interactives, many adults engaged
- Curiosity around why shapes, patterns were/are meaningful to Ute people
- Visitors utilized the images to prompt design/building ideas (i.e., built what they saw)
- Many visitors made connections to their own lives, the outdoors, school, and science
- Many visitors got creative (e.g., one youth put an extra pole on wickiup "to catch water")
- Many visitors looked at, touched, and read the flip-ups, but didn't often discuss them

September 26-30, 2018: Plants (Science) and Baskets (Technology)

100 ppl observed: 21 solo and 29 groups (from 2-6 ppl/group)
All ages (~2 to 70+)
Several speaking languages other than English (prototyping overlapped with new citizen/naturalization ceremony)
~12 of above were HCC staff
In addition to above ~40 4th grade students in groups

- All visitors who approached/engaged in prototypes were offered same IRB-approved information sheet

- Evaluators used this new observation form, updated with science and tech teaching points and simplified list of questions

1st iteration (photo1, photo 2, and photo 3)

Labeled photos of plants with of "Ute Elders say" and "Scientists say" cards for matching
Started each instruction sign with statement/fact, followed by questions
Simple labels (e.g., loose weave, tight weave, etc.) on one side of basket boxes
Included flip-up with basket interactive

(See slides of materials used)

2nd iteration (photo)

Stopped prototyping plant matching (after agreeing not working for visitors as intended)
Considered puzzle activity for plant interactive, but ended up not prototyping it
Decided to instead do some topic testing re: possible plant topics and activities
Re-created basket signage to more clearly show coating of sap and woven plant fibers
Re-worded flip-up question to indicate to visitors that there was not one correct answer
Clarified instructions on 2 sides of basket boxes, including “turn the box”
Experimented with basket prompts to spark thinking/conversation about found materials
(See slides of materials used)

3rd iteration (photo)

Clarified basket prompts; 2 versions: “Solve a Problem” and “Technology”
Did topic testing re: possible plant topics and activities
Prototyped beading and wickiup interactives (as above) with 4th graders in school groups
(See slides of materials used)

4th iteration (photo)

Prototyped baskets and wickiup (see August prototyping) at El Pueblo farmers market
Included flip-ups for wickiup interactive
Alternated testing “Solve a Problem” and “Technology” basket prompts
Did topic testing re: possible plant topics and activities

5th iteration (photo 1 and photo 2)

Prototyped baskets and wickiup alongside video segment on wickups (on iPad)
Did topic testing re: possible plant topics and activities

Key findings:

- Many visitors started with activity (i.e., jumped right in) and read signage second (if at all)
- Many visitors were confused by plant matching activity instructions
- When visitors did read Ute elders/scientists say cards, appear more interested in Ute elders
- Matching plant activity proved too easy for many visitors; they missed connections/content
- Some visitors indicated the plant matching activity felt like a “quiz” or “homework”
- Some visitors looking for a “pay off” upon completing plant matching activity (e.g., “Did I get it right?”)
- Many visitors interested in experiencing plants as food in some way (e.g., tasting, smelling)
- Many visitors in plant use (e.g., seeing a grinder, how to make pudding)
- Observed challenges for English language learners with reading signage, but not with engaging in the activities
- Curiosity around what plants were edible/safe and what uses there were for local plants
- Before basket boxes were clearly labeled, many visitors were reluctant to pick them up
- Basket boxes need labels about the weave/sap, or visitors don’t make the connection

- Most visitors understood the clear beads in the basket boxes represented water
- Several visitors made a guess/hypothesis about basket boxes before “testing”
- Basket activity goes pretty fast; not iterative (especially compared to beading and wickiup)
- Many visitors made connection to engineering or technology/material science with baskets
- Curiosity about why HCC chose not to use natural materials (e.g., ceramic, wood)
- Many visitors made connections to their own lives, the outdoors, mountains, gardening, etc.
- Some visitors expected the answers on the flip-ups to match/relate to the pictures shown
- Many visitors expected one “right” answer on the flip-ups
- School groups/youth competed for materials when there weren’t enough to go around
- School groups/youth more likely than general visitors to assume there was a “right” way
- School groups/youth collaborated (e.g., one student build wickiup while another read aloud)
- School groups/youth made content connections (e.g., “like a teepee,” “triangles are strong”)
- Card sorting for plant topic/activity testing worked well; results here
- Newer basket prompts (“Solve a Problem” and “Technology”) both worked well
- Many visitors referenced Ute people in the past only; not making present connection
- Adding video did help visitors to understand that Ute people are past and present

Ute STEM Summative Evaluation Observations and Exit Interviews

History Colorado Center

23 July 2019

Prepared by Beth Kaminsky and Kate Livingston

Overview and Methods

As part of the National Science Foundation supported Ute STEM (science, technology, engineering, math) project, ExposeYourMuseum LLC conducted a summative evaluation of the *Written on the Land* exhibition at the History Colorado Center (HCC), focusing in large part on the Ute STEM interactive area of the gallery.

The summative study was designed to evaluate the overall visitor experience within *Written on the Land*, as well as to assess if and how learning outcomes related to Ute STEM were achieved through STEM interactives. Specifically, the evaluation investigated:

- Visitors' key take-aways, or "big ideas" within the exhibition
- What visitors perceived as the most compelling elements of the exhibition
- If and how the exhibition conveyed the Ute peoples' relationship to the land and to Colorado
    - The long history of the Ute people in what is now Colorado
    - Ute culture, language, and ongoing influence in Colorado
    - The extreme loss and displacement Ute people have faced
    - Ute adaptation and perseverance despite adversity
    - Contemporary Ute life and carrying traditions into the future

Formative evaluation and prototyping undertaken in the development and design phase of the exhibition informed the process. This summative evaluation assesses visitors' learning and/or reinforced learning as a result of the exhibition. Specifically:

- Visitors' perception of the Ute STEM interactive components/exhibits
- Visitors' use and exploration of the Ute STEM interactive components/exhibits
- If key STEM concepts were understood
- If and how the exhibition helped visitors understand connections between western science concepts (i.e., STEM) and the Ute peoples' traditional ecological knowledge (TEK)

The summative evaluation highlights—from visitors' points of view—which areas of the exhibition were successful, and which may need remediation. Findings will also inform the development of traveling exhibits and school-based programs as part of the Ute STEM project.

The evaluation utilized two primary methods:

- Ute STEM Observation and Interview
    - Sixty-six visitors were observed in the Ute STEM interactive area of the exhibition
    - Sixty people agreed to participate in intercept interviews as they exited the Ute STEM area
- *Written on the Land* Exit Interview
    - Sixty-six people were interviewed as they exited the full exhibition

After piloting and finalizing the instruments, visitor observations and interviews were conducted in March and April of 2019, approximately three to four months after the exhibition opened. (Evaluation instruments are attached as Appendix A and Appendix B.)

Initial Highlights

In early May of 2019, while the analysis of observation and interview data was getting underway, significant preliminary discoveries emerged:

100% of visitors interviewed indicated that they were impressed by or enjoyed the exhibition.
"This is the history of Colorado that most people don't know."
Visitors called the experience "immersive," beautiful," interactive," and "family-friendly."

92% of visitors spoke about the Ute people's relationship to Colorado or to the land.
"Land doesn't belong to a single person; it can't be bought or sold."
Kids said, "They were here first and they didn't want to leave."

55% commented on the Ute as a living people, present and vibrant in Colorado.
"I didn't realize how much the current culture mirrors the ancient culture.
Cradleboards are still used today!"

Key Findings

- Visitors made the connection between TEK and STEM.
  - Visitors linked their own knowledge and familiarity with STEM concepts to traditional Ute knowledge and activities.

  When asked to describe the Ute STEM interactive area of the exhibit, one visitor said, "Integration of native knowledge and modern science."

- Visitors recognized knowledge and skills embedded in Ute culture.
  - Visitors were able to articulate a variety of top-of-mind examples of Ute knowledge and skills.

  A visitor stated, "Making a teepee is engineering. Patterns are math [beadwork]."

- Visitors appreciated the long history of Ute people in what's now Colorado.
  - Many visitors commented on the length of time Ute people and their culture have been part of the fabric of this place; they mentioned the vast region that was home to Ute people; and they recognized that the land where Ute people and culture thrived for generations was taken away from them.

  One visitor realized, "The scale of their territory in the beginning to now, being on the reservations. The Utes have lost a lot of land through history."

  When asked about the Ute people's relationship to the land, a visitor responded, "I knew they had relationship to the land. Makes me feel we are the ones who don't know anything about the land."

- Visitors grasped that Ute people continue to live and thrive today.

  - Though many respondents referred to the Ute people in the past tense when reflecting on Ute history and culture, several visitors used the present tense—especially when making connections with the state of Colorado.

When asked about Colorado specifically, a visitor said, "We were looking at the maps, how it's charged with violence. The oral history. People are still here, working on in Denver. An active, living culture."

- Visitors expressed that the content of *Written on the Land* should be shared widely.
  - Several visitors mentioned that it's a story people should know—a story that contains important lessons.

When asked to describe the exhibit to a friend or family member, visitors said, "It's necessary to know this if you live in Colorado" and "Important for people to know and feel empathy."

- Visitors appreciated the variety of opportunities available to them in the exhibit.
  - The assortment of artifacts, interactives, media, and other content-carrying methods came up in visitor responses; messages were carried in ways to appeal to a range of learning and visiting styles.

When sharing what they would tell someone not to miss, one visitor said, "Videos; STEM science project; artifacts and clothing."

A Thoroughly-Used Exhibit

The Ute STEM interactive area of *Written on the Land* ranks as a "thoroughly-used" exhibit when considered within the framework of a commonly-accepted evaluation measurement system[1]. The system assumes that longer stay times and more attention and interaction with exhibit components signify engaging visitor experiences. The framework plots an exhibit's sweep rate and percentage of diligent visitors to ascertain its success—how thoroughly used by visitors it is.

Dividing the square footage of the space by the average stay time of people who enter results in the sweep rate. Exhibits with lower sweep rates are considered more thoroughly used; a lower sweep rate signifies that visitors stay longer—they linger rather than rush through.

The sweep rate of 43.75 for the Ute STEM area of *Written on the Land* falls far below the threshold of 300 as established within the framework, meaning visitors stay much longer than is typical for many exhibitions.

The percentage of diligent visitors is the number of people who stop and use various exhibit components. Because more than 25% of visitors stopped at more than 50% of the Ute STEM interactive area components, the section of the exhibit falls solidly among thoroughly-used exhibits within the framework.

[1] See, for example, https://www.informalscience.org/news-views/paying-more-attention-paying-attention. The collection of observational data for this report differed from the timing and tracking model established by Beverly Serrell; the Ute STEM area represents a portion of a larger exhibition; and, results for time spent and stops made at Ute STEM exhibit components clearly indicate that visitors thoroughly used the area.

UTE STEM OBSERVATION

Observations of 66 visitors to the *Written on the Land* exhibition during March and April of 2019 focused on their experience in the STEM interactive area.

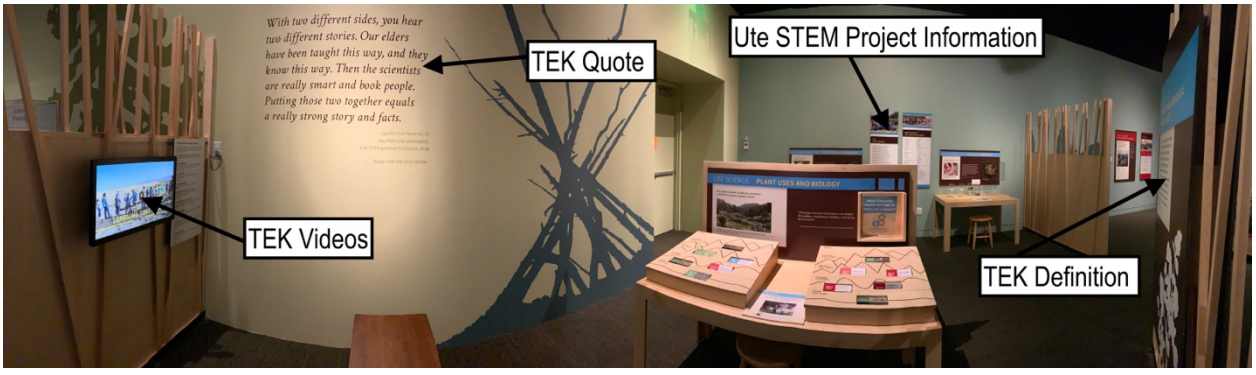
Of the 66 visitors observed, 61 entered the STEM interactive area; five bypassed the area.

Visitors who entered the area spent an average of eight minutes in the STEM interactive area. The minimum time recorded in the area was one minute and the maximum time was 32 minutes.

Observers often noted the condition—level of busyness—of *Written on the Land* during times observations were conducted. The area had low or no visitor traffic during almost all (60) of the observations. In the four instances that observers noted "medium" visitor traffic, stay times were close to average and above average: two visitors stayed for 21 minutes, one for 15 minutes, and one for seven minutes.

STEM and TEK General Content

Of the visitors who entered the STEM interactive area of the exhibition, a third (33%) noticed or spoke about the TEK quotes featured (n=12/61); 20% noticed or spoke about the TEK definition (n=12/61); and 15% noticed or spoke about the Ute STEM project information (n=9/61). (See labeled photo below.)



Ute STEM Videos

Nearly a quarter (23%) of the visitors observed in the STEM interactive area noticed or spoke about one or more of the videos recorded during Ute STEM fieldwork sessions (summers of 2017 and 2018) that highlight the Ute STEM project (n=14/61). Nine people watched one video, two people watched two videos,

and one visitor was observed watching 5 videos. People who watched spent an average of six minutes at the videos—three minutes was the minimum amount of time spent watching videos, 27 the maximum.

STEM Interactive Stations

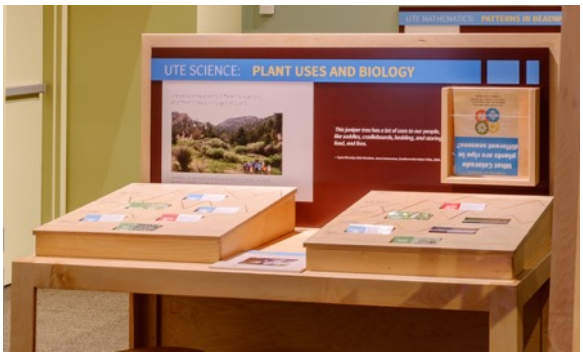
The STEM area featured four interactive exhibit stations—one for each letter of STEM: science, technology, engineering, and math. The interactive exhibits featured four Ute-specific topics and activities, each with the same basic construction and general organization (see labeled photo below):

1. Ute Science: Plant Uses and Biology
2. Ute Technology: Weaving Solutions
3. Ute Engineering: Building Shelter
4. Ute Mathematics: Patterns and Beadwork

Of the visitors who entered the STEM interactive area of the exhibition, 80% looked at or used the back panels (n=49/61), 62% looked at or used the instructions (n=38/61), and 5% looked at or used the supplemental "more info" elements (n=3/61) at one or more of the four stations.

Ute Science: Plant Uses and Biology Interactive

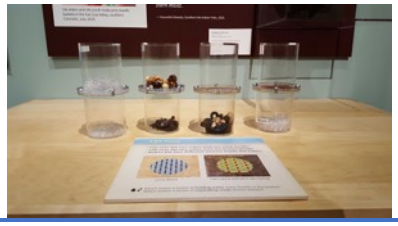
A quarter (25%) of visitors manipulated—flipped over—the blocks at the Science / Plants station (13/52). Observers noted 12% of visitors reading the labels (n=6/52).



Nearly half of visitors talked about seasons (48%; n=29/61) and/or landscape or elevation (46%; n=28/61) at the Science / Plants station.

Ute Technology: Weaving Solutions Interactive

Over half (56%) of visitors compared the materials at the Technology / Weaving station (n=34/61). Observers noted over a third (35%) of visitors reading (n=18/52).

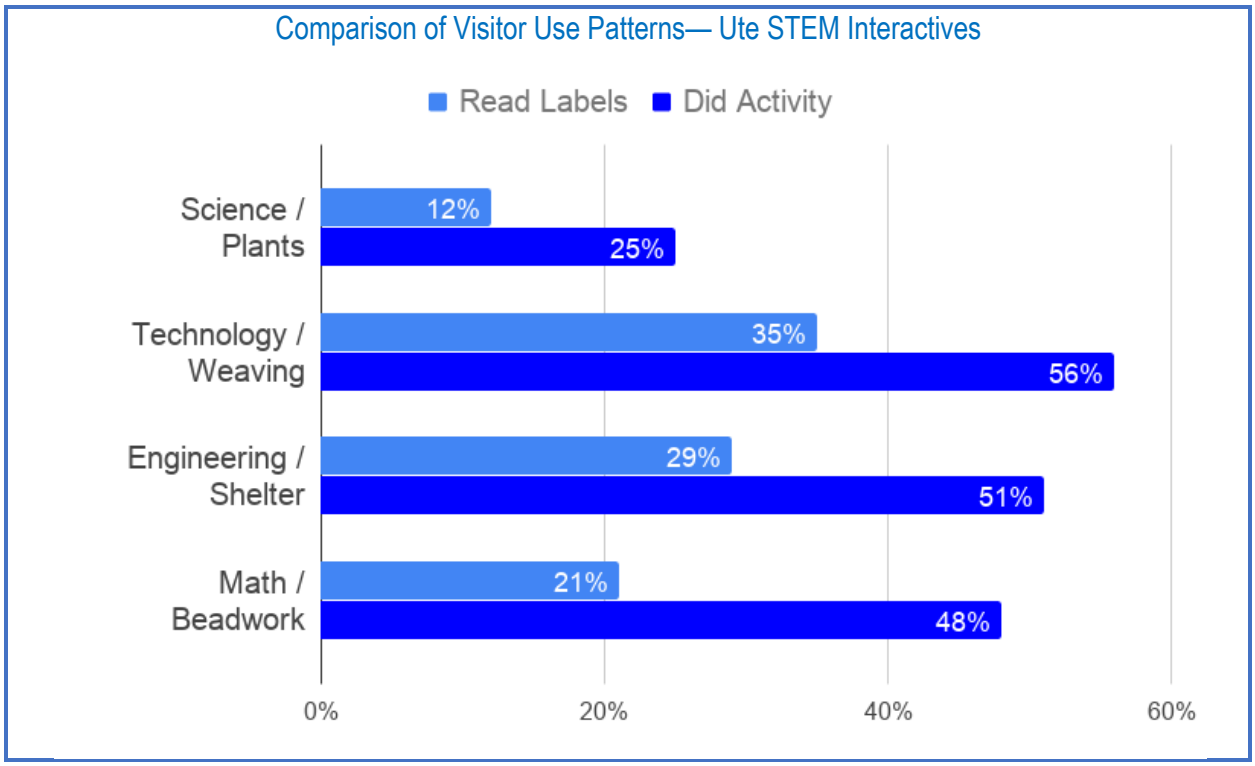


Ute Engineering: Building Shelter Interactive

Over half (51%) of visitors tested building materials at the Engineering / Building station (n=31/61). Observers noted nearly a third (29%) of visitors reading (n=15/52).

Ute Mathematics: Patterns and Beadwork Interactive

Nearly half (48%) of visitors explored or created patterns at the Math / Beadwork station (n=29/61). Observers noted a fifth (21%) of visitors reading the labels (n=11/52).



Of the visitors who entered the STEM interactive area of the exhibition, 15% didn't interact with any of the interactive stations (n=8/52).

UTE STEM INTERVIEW

Out of the sixty-six visitors observed, sixty visitors agreed to be interviewed about their experiences in the STEM interactive area of *Written on the Land* as they exited the STEM area. The qualitative interview data was cleaned, organized, analyzed, and coded using a pre-defined coding scheme (deductive; informed by Ute STEM project desired outcomes and goals); emergent categories and themes also were added (inductive coding) during the process. Findings are summarized below; for each question, the most frequently mentioned themes are listed with sample responses[2] and occurrence rates.

What's this area all about?

Theme	Sample Responses	% (n)
Land/Natural Resources	"Working with Ute tribe, how the Utes used the land and plants for survival." "Natural resources available to the Utes." "Uses of different plants. How to use plants for food and medicine."	28.3% (n=17/60)
Specific Ute STEM Exhibit(s)	"Fundamentally putting things together, teepees, basket weaving." "Beadwork. I was interested in plants so I was drawn to the elevation and plant guides."	23.3% (n=14/60)
Ute Culture	"Ute culture in Colorado." "Modern understanding of the Ute Culture and their survival." "Looking at cultural practices."	21.67% (n=13/60)
Interactivity	"Interacting with history, learning about Native American daily life." "Participation, problem solving, working."	21.67% (n=13/60)

10% of visitors mentioned Ute STEM project goals (n=10/60).

"My background is in engineering and geometry. … STEM is very critical to our survival. We've fallen behind. [This exhibit] showed me how to construct a sturdy shelter with teepee beams."

"Practicing things; testing ideas."

"I was learning about materials they used to make baskets, how they use math to bead stuff; early education."

"Their ecosystem—they have the plants; they show why and how they grow them. Trying to figure out the stick thing, water storage, mathematics."

How would you describe this area to a friend or family member (who had never visited)?

Theme	Sample Responses	% (n)
Interactive/ Hands-On	"Best place if you have kids and want hands on." "Interactive. Labels are well done, easy to understand." "Hands on area, good for kids of all ages. We tried some of it and we are in our 60s and 70s."	44% (n=26/59)
Educational/ Informative	"Really neat. If you want to learn more about the Ute culture, come here." "Cool learning place where you can learn how they built teepees and baskets." "Reminds people of local wisdom, just because things have been around for a long time, they are still relevant today."	35.6% (n=21/59)

[2] Interviewers wrote visitors' answers on forms, recording as precisely as possible their words. Sample responses in this report include relevant and revealing excerpts and are occasionally modified with bracketed information for clarity. Please note: several visitors mentioned "teepees," although Ute people do not use the term and it doesn't appear in the exhibition.

Ute Culture	"Glimpse into their lives, how they built houses, collected food." "Learned how Indians lived, how it was important to keep the culture alive."	25.4% (n=15/59)

"[The Ute STEM exhibits are a…] way to touch and feel a part of Native American culture, to feel connected to some things behind the glass."

"A family-friendly introduction to Native knowledge"

"If you're interested in learning more about
Native American history, check it out.
Native American history gets lost.
Native American culture gets lost."

Did you see/notice examples of how Ute people use STEM (science, technology, engineering, and math)?

Theme	Sample Responses	% (n)
Visitor Answered, "Yes"	"Past and present connections in STEM; building baskets, weaving." "The jewelry making. They had unit-based jewelry making. We use units in other things. They also used it in how they got water and plants." "Engineering the triangles. Beads. Water went through at different rates depending on the weave." "The engineering mind; geometry is critical thinking plus problem solving." "Beadwork. She [referring to young person in visitor group] hates math. It's math in everyday life. They were experimenting." "Think about how STEM is used/taught at a very young age. The beading is computer science. Finding food to eat is science."	88% (n=50/57)

Those who said yes noticed and recalled examples of how Ute people use STEM; 92% gave examples from specific exhibits/interactives (n=46/50).

Please complete this sentence: "Before my time in this area today, I never realized…"

Theme	Sample Responses	% (n)
Land/Natural Resources	"How many uses of aspen and cedar there are." "The number of plants I see hiking and are still around. I should learn more about the plants I see in case I have an emergency in the wild and need medicine." "They moved up and down the mountains to follow food sources."	53.5% (n=31/58)
STEM	"Didn't know the UTES practiced STEM." "How modern engineering concepts were prevalent in a simpler time in our history." "Culture is built on so many aspects—physics, language, art, math."	32.8% (n=19/58)
Materials and Material Use	"The materials they used for basket weaving--needles." "Different plant uses and how water was carried in baskets." "They used lines of beads; I thought they put them together but didn't know they used lines."	27.6% (n=16/58)

What questions, if any, do you still have?

Theme	Sample Responses	% (n)
Questions from Visitors	"How did they make the beads?" "Wondering if the patterns meant anything. Do the colors mean anything?" "Do they rely on resources outside of where they are?" "I wonder how they keep the sap off their hands and clothes." "Are you (the Museum) going to do more?"	14% (n=8/56)
86% of respondents didn't have questions (n=48/56).		
Visitor Suggestions for Improvements	"I don't know where they get their beads or steel. I was trying to figure out with the triangles—it feels like the concept is there but the Velcro doesn't work, Maybe use magnets or forks? Fun for 30 seconds." "My kids have made bracelets before and if someone, like a volunteer, was in there [the STEM area] it would be helpful for kids to learn."	3.6% (n=2/56)

Additional feedback visitors provided about the Ute STEM area included:

> "There is no definition of STEM in the area. I think you are assuming everyone knows what STEM is in America. My parents are visiting from Denmark and didn't make/understand the STEM meaning or idea of STEM."
>
> "Didn't spend enough time. As you can see, with this wheelchair I can't get around well in that area. I was concerned I was going to get stuck if I couldn't turn around. I realize you can't tear down walls to accommodate wheelchairs."

What else did you experience in the exhibition (not in this area) that helped you make sense of this area?

Themes	Sample Responses	% (n)
Artifacts	"I looked at the beadwork on the dresses and over here I can see how the beading is done." "Clothing patterns gave me a better appreciation for how made in STEM area." "Basket weaving was throughout the entire area; in the STEM area it all came together, how to basket weave was shown and explained." "The baskets over there [referring to artifacts in exhibition] and then seeing how baskets are waterproof [in STEM area]."	32.5% (n=13/40)
Land/Natural Resources	"They hunt and gather plants for use." "The Utes were in touch with nature; they started to move around the land based on weather." "Resources that Colorado has (like water) and how the uses of [basket] weaving made water transportation possible." "How they used bark and roots and used them for food. Seeing the maps of Colorado and why movement/travel was necessary for Utes."	20% (n=8/40)
Videos	"Some videos in other parts of the exhibition helped. 'Traditions' video explained the drums."	12.5% (n=5/40)

	"We watched the videos at the beginning of the exhibition so that explained a lot. I didn't want to watch more videos because I didn't want to sit any longer." "I saw the videos at the start of the exhibition about the bear dance and Ute creation story, so these videos explained more."

WRITTEN ON THE LAND INTERVIEW

Sixty-six visitors to *Written on the Land* agreed to participate in intercept interviews as they exited the exhibition during March and April of 2019. Visitors were asked questions related to their experience in the full exhibition and questions specific to the Ute STEM interactive area. As with the Ute STEM area interviews, qualitative data was cleaned, organized, analyzed, and coded using a pre-defined coding scheme (deductive; informed by Ute STEM project desired outcomes and goals); emergent categories and themes were added (inductive coding) during the process. Findings are summarized below; for each question, the most frequently mentioned themes are listed with sample responses and occurrence rates.

If you were to give me three "headlines" that capture the big ideas or main takeaways from this exhibition, what would you say?

43.8% mentioned Ute culture (n=28/64)

"How Utes have developed and maintained culture"

37.5% included something about Ute history (n=24/64)

"The Ute tribe and their history."

34.4% brought up loss of land and/or displacement (n=22/64)

"Their land was taken away from them."

21.9% mentioned Colorado (n=14/64)

"How long they have been in Colorado. That they have been here so long."

20.3% brought up the unfair treatment of and/or adversity faced by the Ute people (n=13/64)

"We stole all their land. All treaties were broken by the U.S. government."

How would you describe this exhibition to a friend or family member (who had never visited)?

44.6% said something about the quality of the exhibition overall (n=29/65)

"Informative. Go see it."

43.1% mentioned history (n=28/65)

"Historically enlightening."

26.2% called attention to the artifacts on display (n=17/65)

"Artifacts of culture."

21.5% mentioned Colorado (n=14/65)

"History of Colorado that most people don't know."

15.4% said the experience was accessible to a variety of visitors and audiences (n=10/65)

"Very educational. Well put together. Very visual. Multisensory."

What is one thing in the exhibition you would tell someone not to miss?

38.5% mentioned artifacts (n=25/65)

"Artifacts. The bead work, garments." "Beaded stuff, beautiful, water baskets."

26.2% said the videos (n=17/65)

"All the videos were good. I like that we got to pick our own videos."

24.6% shared a specific element or component of the exhibition (n=16/65)

"Bear dance video. What they wore was really interesting."

"Pay attention to the details; read it. ... Boarding school stuff."

15.4% said the interactive exhibits—both in the Ute STEM area and outside of it (n=10/65)

"Interactive tables."

"Dressing the horse."

15.4% said all of it or the whole thing (n=10/65)

"If you go, you can't miss anything."

"The whole thing was good."

What, if anything, did you learn about the Ute people's relationship to the land?

36.8% mentioned the Ute people's relationship with the land and/or natural resources (n=21/57)

"They utilized everything and loved the land."

24.6% said something related to Ute culture (n=14/65)

"Took care of the land; their culture depended on it."

19.3 brought up how Ute people's loss of land and/or displacement (n=11/65)

"How [the land was] drastically minimized in 1800s."

"We took all their land. Their land was taken away from them by the new, white people."

15.8% said something about the unfair treatment of and/or adversity faced by the Ute people (n=9/65)

"How whites stopped their trading networks."

What, if anything, did you learn about the Ute people's relationship to Colorado specifically?

26.4% said something about the land and/or natural resources (n=14/57)

"They knew how to use plants available to them."

"All different areas—they lived in mountains and plains. Adapted to all of them."

15.1% mentioned the mountains (n=8/57)

"How they moved to the mountains in the summer."

"Being able to make use of mountains, valley, plains, food, plants."

Please complete this sentence: Before my time here today, I never realized…

25.4% mentioned Colorado (n=16/63)

"How long Utes have been here—at least 10,000, maybe 20,000 years."

"How intertwined the history of the Ute people is with the areas we all enjoy. Central mountains, Southwest corner of the state."

22.2% spoke about loss of land and/or displacement (n=14/63)

"How the indigenous people were dispossessed in this area. Treaties and how it all happened."

"How unfair Utes were treated; to learn each decade they were treated worse, year to year. I never knew the specifics of how the land was taken away."

15.9% referred to the expansiveness of Ute territory (n=10/63)

"How big a region they occupied."

15.9% mentioned Ute culture or something specific about the way Ute people live(d) (n=10/63)

"I didn't realize how much the current culture mirrors the ancient culture. Cradleboards are still used today!"

"How they softened hide with deer brains; soaked for hours."

12.7 % said something about contemporary Ute people and culture (n=8/63)

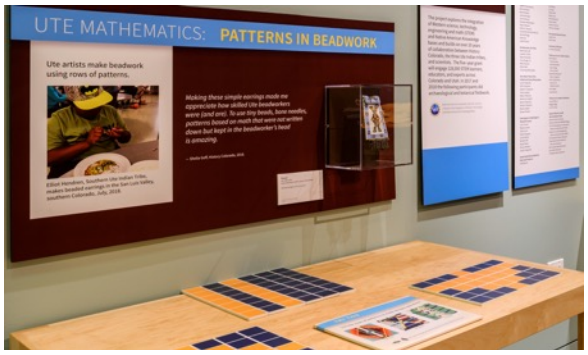
"How the culture still flourishes. People are still here and living. Interesting to see them in modern clothes, baseball caps."

"They are still around today. Their history in the state of Colorado."

"Extensive, ongoing losses of the Utes in today's world."

"What a big part of our current roads and water and names of water came from the Utes, like Pagosa Springs."

Visitors were shown pictures of the Ute STEM interactive area of the gallery and asked, "Did you visit this area of the exhibition?"



76.32% said they went into the area (n=48/63).

Of the 15 people who didn't enter the STEM interactive area of the exhibit, nine (60%) said it was because they perceived it as being for kids and therefore not for them. Four (26.7%) said it didn't look interesting to them and four (26.7%) said they lacked time and/or were going through the exhibit quickly.

Please tell me a little bit about your experience in that part of the exhibition.

Of the visitors who responded about their experiences in the STEM interactive area of the gallery, more than half mentioned STEM (52%; n=25/48) and nearly half said something positive about their experience (48%; n=23/48). About a fifth of respondents mentioned that the area appeals to kids (21%; n=10/48) and that it's full of interactive opportunities (19%; 9/48).

> "[Adult] That was fun. Nice to have for him to touch. [Youth] Really liked patterns and making teepees."
>
> "'Do it yourself' section; like that you can include kids."
>
> "Wickups: built a lot of triangles. Plants: read about plants, took pictures of Ute side—want to do more research later. Weaving: spent time on pattern. Baskets: used to separate seeds; different weaves for different things."
>
> "Read TEK quote; I noticed STEM was mentioned"
>
> "More hands-on. Great for kids. Interactive. Really liked. Always needed for kids."
>
> "Wickiup: Velcro bad; didn't work. Baskets: Weave of water baskets kept water in. Plants: Loved the plant interactive."
>
> "Interested in plants with different altitudes. We live at a high altitude--8000 ft plus. Shadow of wickiup (on wall) was interesting to me; shows the size."
>
> "We built teepee. It's cool. Bead work is cool. Teach young kids. She worked with patterns and tried options."
>
> "Built teepee, made patterns, about weaves letting water through"
>
> "It's a kids' area. There were kids in there that were really having fun."
>
> "I liked how they made patterns and sorted seeds. Liked how you could build your teepee and how hard survival was for the Utes."
>
> "Made a triangle. Beadwork. Plant interactive. Interacted with all of them."
>
> "Couldn't make teepee work. Interesting weaves/baskets. Different weaves were more or less permeable."
>
> "Tried to do teepee; didn't stick. Weave-and-water was interesting. Did look at plant interactive. Very interesting."

50% mentioned the Ute Engineering: Building Shelter interactive exhibit specifically (n=24/48)

> "Building teepee: extra hard; made it fun for the kids. Easy to take down and build real ones. Fun because you got to try different "techniques." Important to balance."
>
> "Teepees: triangular structures for housing/architecture."

"My grandson built a teepee."

33% mentioned the Ute Technology: Weaving Solutions interactive exhibit specifically (n=16/48)

"I realize the basket making was possible only with skills taught by others."

"Cool to be able to see how basket weaving connects to Puebloan baskets."

29.2% mentioned Ute Science: Plant Uses and Biology interactive exhibit specifically (n=14/48)

"I played with the plant thing and learned about their food sources."

"Used plant interactive. Looked at how they used plants."

29.2% mentioned Ute Mathematics: Patterns and Beadwork interactive exhibit specifically (n=14/48)

"Liked all of it. Made my own pattern with the bead boards."

"Beads: designed patterns for beads."

"Tried to make patterns."

Did you notice examples of how Ute people use STEM (science, technology, engineering, and math)?

85% of visitors who visited the Ute STEM area correctly provided an example of Ute people using STEM (n=33/39).

"Yes; I noticed references to the connection between TEK and modern science."

"Yes—especially the weaving. Tight weave versus loose is engineering. Shapes and designs. Teepee. Different elevations. Seasons. Timing is about science."

"We use STREM in school, because we go to Catholic school, so yeah."

44% called out Ute Engineering: Building Shelter (n=17/39)

"Building shelters is engineering."

"The teepees are architecture, against pressure."

35% specified Ute Mathematics: Patterns and Beadwork (n=14/39)

"Had to use geometry in beadwork."

"Spatial relations with beads."

"Beadwork: patterns, symmetry."

28% mentioned Ute Technology: Weaving Solutions (n=11/39)

"Baskets: white beads went faster; loose weave was faster."

"Basket weave--how they wove differently depending on use."

23% recalled Ute Science: Plant Uses and Biology (n=9/39)

"Medicinal uses of plants."

"Plants and their use."

12.82% mentioned Ute STEM Videos (n-5/39)

"Yes; when we listened to the videos, like where they said they were scientists before there were

scientists."

"Yes; the video talked about Ute men and scientists' combined efforts."

Is there anything else you want to say or ask about this exhibition?

51.5% reflected on something positive about the exhibition (n=17/33)

"Like idea of interactives. Want more of this in other spaces."

"Engaged the kids."

"Liked the feeling when I walked in—welcoming. Could see through poles to rest of the exhibit."

"It was really fun, interactive. It's fun to be able to learn without having to sit at a desk and read."

"It's well done. People need to see to help them learn more details."

"Gives great appreciation of Native people. We didn't hold up our end of negotiations/treaties."

"Glad we have it. Love Indian history."

"Didn't realize it would be so interesting!"

"Nice hands-on for kids. Artifacts are great. Reading isn't good for kids. Nice flow to it."

"Exhibit is very informative; like artifacts"

"Appreciated having artifacts on display. Cherished 'walls of stuff' from old museum."

30.3% had exhibition-specific feedback or suggestions (n=10/33)

"Wanted to smell. Wanted to use human senses. Not easy to do."

"Looks like something is missing from the teepees. No coverings/buckskin."

21.2% asked a question (n=7/33)

"Do they still hunt in Rocky Mountain National Park?"

"Questions did arise. Map didn't show exactly where they are now. Traditional roles of family--questions about what is applicable/true now; took picture."

"[Youth] What's a choke berry? Why does it look like a Captain America badge in there? [Adult] Or, you should say, why does Captain America's badge look like their badge?"

"Was that a real baby shoe?" [Talking about doll moccasins.]

"Were Ute people involved in making the exhibit?" [Shown label by door and explained many quotes, information, artifacts came from Ute people.]

"Is it a kids' area?"

"Interested in finding out how reservation…"

DEMOGRAPHICS

Optional demographic data was gathered after formal interviews were complete. To protect visitor privacy, interviewers handed them the form and asked them to record information about themselves and their visitor groups.

	Ute STEM Interviews	Full Exhibition Interview	Full Data Set/ Combined
Visiting From	53% Denver Metro (n=34/64) 9% Other CO (n=6/64) 30% Other US (n=19/64) 8% Other Country (n=5/64)	50% Denver Metro (n=29/58) 7% Other CO (n=4/58) 40% Other US (n=23/58) 3% Other Country (n=2/58)	52% Denver Metro (n=63/122) 8% Other CO (n=10/122) 34% Other US (n=42/122) 6% Other Country (n=7/122)
Visiting With	15 Visiting Alone 21 Adult-Only Groups 25 Youth/Adult Groups	14 Visiting Alone 26 Adult-Only Groups 24 Youth/Adult Groups	29 Visiting Alone 47 Adult-Only Groups 49 Youth/Adult Groups
Age	36—Average Age 8—Youngest 75—Oldest	43—Average Age 8—Youngest 85—Oldest	40—Average Age 8—Youngest 85—Oldest
Race/Ethnicity	73% White (n=43/59) 10% Latinx (n=6/59) 10% Asian (n=6/59) 3% Native (n=2/59) 3% Multiracial (n=2/59)	76% White (n=47/62) 11% Latinx (n=7/62) 8% Multiracial (n=5/62) 3% Asian (n=2/62) 2% Black (n=1/62)	74% White (n=90/121) 11% Latinx (n=13/121) 6% Asian (n=8/121) 6% Multiracial (n=7/121) 2% Native (n=2/121) 1% Black (n=1/121)
School in CO	53.1% some/all school in CO (n=26/59) 45.3% never went to school in CO (n=33/59)	53.1% some/all school in CO (n=34/64) 45.3% never went to school in CO (n=30/64) Note: The 5 visitors who indicated they had never heard of the Ute people were not educated in Colorado.	48% some/all school in CO (n=60/123) 52% never went to school in CO (n=63/123)
Live(d) in CO	49% Live(d) in CO (n=29/59) 51% Never lived in CO (n=30/59)	66% Live(d) in CO (n=41/62) 34% Never lived in CO (n=21/62)	58% Live(d) in CO (n=70/121) 42% Never lived in CO (n=51/121)

APPENDIX A—Ute STEM Observation and Interview Instrument

UTE STEM OBSERVATION In:_____ Out: _____ STEM area: ❑ Empty/Quiet ❑ Medium ❑ Busy/Packed

DATE: _____

*Noticed/spoke about:

❑ TEK definition ❑ TEK quote(s)

❑ Ute STEM project sign(s)

*❑ TEK video(s)

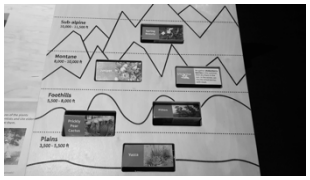
If applicable:

# of videos watched: _____

time spent on videos: _____

***Note: 1) dialogue and/or reactions, 2) connections to full exhibition, 3) personal connection**

*PLANTS



Talked about:

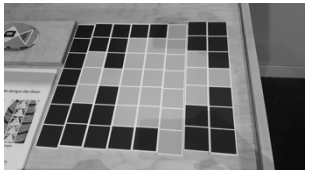
❑ seasons

❑ landscape/elevation

*BASKETS

❑ Compared materials

*BEADING



❑ Created/explored patterns

*STRUCTURES

❑ Tested building methods

***LOOKED AT/USED: ❑ BACK PANEL ❑ INSTRUCTIONS ❑ "MORE INFO"**

UTE STEM INTERVIEW

*1. What's this area all about?

*2. How would you describe this area to a friend or family member (who had never visited)?

*3. Did you see/notice examples of how Ute people use STEM (science, technology, engineering, and math)?

4. Please complete this sentence: "Before my time in this area today, I never realized…"

5. What questions, if any, do you still have?

*6. What else did you experience in the exhibition (not in this area) that helped you make sense of this area?

FOR VISITOR TO COMPLETE:

Your zip code or country, if non-U.S (I.e., where you live all/most of the year) _____
If you live (or used to live) in Colorado, how long have you lived (or did you live) here? _____

Have you ever gone to school in Colorado? ❑ YES ❑ NO
If so, for what grade level(s)? (E.g., 1st-5th grade) _____

Your age _____
Ages of others in your group (if applicable) _____

Your race and/or ethnicity _____

APPENDIX B—Written on the Land Exit Interview Instrument

WRITTEN ON THE LAND INTERVIEW **DATE: _____**

Opening line: *"This is a new exhibition…. We're getting feedback from visitors…"*

*1. If you were to give me three "headlines" that capture the big ideas or main takeaways from this exhibition, what would you say?

*2a. How would you describe this exhibition to a friend or family member (who had never visited)?

2b. What is one thing in the exhibition you would tell someone not to miss?

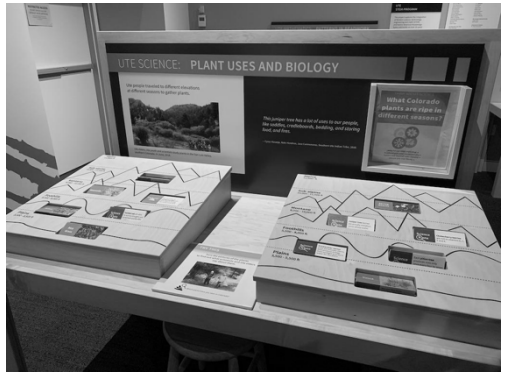
*3a. What, if anything, did you learn about the Ute people's relationship to the land?

*3b. What about Colorado specifically?

4. Please complete this sentence: "Before my time here today, I never realized…"

*5. Did you visit this area of the exhibition? ❑ YES ❑ NO ❑ NOT SURE/UNKNOWN

[If no: any reason given?]



[If yes] *Please tell me a little bit about your experience in that part of the exhibition.

*Did you notice examples of how Ute people use STEM (science, technology, engineering, and math)?

6. Is there anything else you want to say or ask about this exhibition?

FOR VISITOR TO COMPLETE:

Your zip code or country, if non-U.S (I.e., where you live all/most of the year) _____

If you live (or used to live) in Colorado, how long have you lived (or did you live) here? _____

Have you ever gone to school in Colorado? ❑ YES ❑ NO

If so, for what grade level(s)? (E.g., 1st-5th grade) _____

Your age _____

Ages of others in your group (if applicable) _____

Your race and/or ethnicity _____

Ute STEM
Traveling Exhibition Evaluation

History Colorado
January 18, 2023
Prepared by Kate Livingston, ExposeYourMuseum LLC

Traveling Ute STEM Exhibition
(Photo credit: Lorely Sanchez, Red Rocks Community College)

Introduction and Methodology

To assess project outcomes related to the National Science Foundation-supported Ute STEM project's traveling exhibition, external evaluator Kate Livingston (ExposeYourMuseum) relied on self-report data from community college educators and administrators after the exhibition was installed at the Red Rocks Community College Arvada campus (October 1-October 31, 2021) and Lakewood (main) campus (November 1-December 15, 2021). Educators and administrators shared approximate attendance numbers, photos of students and visitors interacting with the exhibition, visitor comments, and student reviews/write-ups of their experiences. Additionally, two Red Rocks Community College staff members completed an online survey about their experiences hosting the traveling exhibition.

The purpose of the traveling exhibition evaluation was to assess the desired learning outcomes articulated for the "Family and Adult STEM learners in rural and underserved communities in Colorado and surrounding states" audience of Ute STEM; specifically:

Museum visitors and public programs attendees (including traveling exhibition visitors) will:

- Increase their interest in Ute STEM, Ute culture, and archaeological research methods and tools; they will be curious about STEM connections to their own lives.
- Understand TEK concepts and modern archaeological explanations.
- Test building methods, explore patterns, and observe plants to make sense of the natural and physical world.
- Reflect on how TEK and archaeology inform one another, and will view Ute science, technology, engineering and math as contemporary STEM practice.

The following sections highlight key themes from the traveling exhibition evaluation, pointing to progress toward the desired outcomes bulleted above.

Attendance and Community College Student Feedback

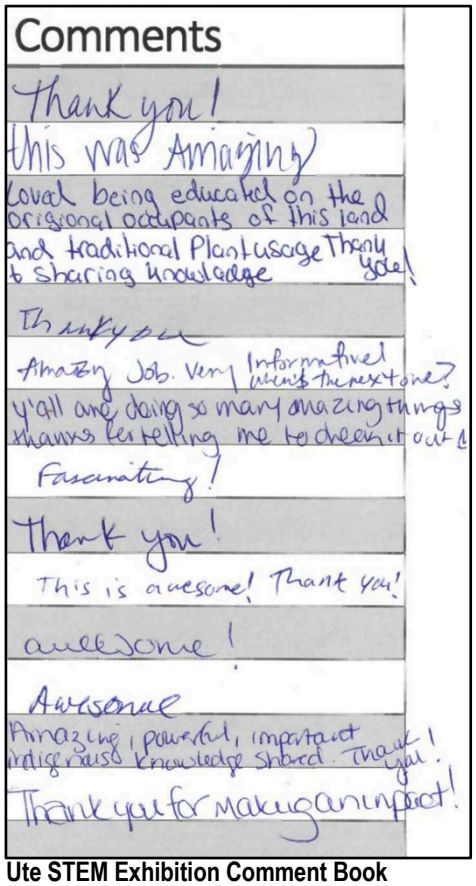
According to records kept by Red Rocks Community College, approximately 400 visitors experienced the traveling version of Ute STEM between the two campuses. Student comments included:

- *I've always been curious about the science that was lost during colonization, and it was really interesting to learn not just about that but about the differences in the ways knowledge of the world around them was shared from generation to generation for the Ute people. I loved the exhibit, and I would love to see more like it in the future!*
- *The interactive activities like the beadwork patterns and the weaving solutions were fun to see how the Ute people did their daily rituals. The questions on the board* [accompanying labels] *of these activities made it more active, so we get to use our brains. It was very satisfying seeing the connections of science to the ones of the environment. I hope we can do something like this every year.*
- *As a student, the Ute STEM exhibit is very important to me. It gave me a perspective of indigenous life I did not get in public schools or my adult life. I hope more students get the opportunity to interact with the Ute STEM exhibit like I did.*
- *I often think of the Ute STEM exhibit when I am in my Honors class, talking about climate change. I have a hunch that Indigenous knowledge may end up saving our planet. Thanks for the opportunity to see this information in a way that honors indigenous origins and current knowledge and applications.*

Community College Staff Feedback

Two Red Rocks Community College staff members completed an online survey about their experiences hosting the traveling exhibition. Survey responses included:

- *I loved this exhibit and was so happy to add to our campus experience with this wonderful exhibit. The process was straightforward and simple, the people that we worked with at History Colorado were awesome in making this available to our students. Visually, it was very engaging.*
- *The opportunity to hear, touch and manipulate the items was great because what I watched on the videos I then got to "try out" and that made it fun.*
- *The hands-on tables helped with the examples of the STEM skills involved in the daily life of the Ute peoples. LOVED the quote that said, "We were astronomers before there was astronomy." So impactful.*
- *Faculty and staff members are still mentioning how interesting and engaging the exhibit was. A colleague from a neighboring school contacted me, sad that she had missed the exhibit. I was happy to tell her that she could still see this in the "Written on the Land" exhibit at the History Colorado museum.*
- *It is an exemplary opportunity to point out the significant knowledge base that indigenous communities bring to the table. The exhibit impacted my understanding about the depth of Ute knowledge. I have increased appreciation for this contribution.*



Ute STEM Exhibition Comment Book
(Credit: Red Rocks Community College)

Ute STEM
History Take-Out Evaluation

History Colorado
January 16, 2023
Prepared by Kate Livingston, ExposeYourMuseum LLC

Early Version of Ute STEM kit plant activity

Revised Version of Ute STEM kit plant activity

Introduction and Methodology

To assess project outcomes related to the National Science Foundation-supported Ute STEM project's K–12 education programs, "Ute Knowledge: Colorado's Original Scientists" History Take-Out Program was evaluated by external evaluator Kate Livingston (ExposeYourMuseum). History Take-Out is a kit-based education program designed for preschool through 5th grade students. According to History Colorado's website: *Through facilitated hands-on programs… students use objects, photographs and a large walk-on map of the state to explore the stories of people, places, and industries throughout Colorado's history.* History Take-Out is offered as a facilitated program by History Colorado's museum educators 1) at the museum as part of school field trips, or 2) at schools as a visiting program; alternatively, teachers/educators can acquire a History Take-Out kit and facilitate the program themselves (supported by online/virtual training).

Ute STEM History Take-Out evaluation consisted of:

1. observing five lessons facilitated by History Colorado Center museum educators at Denver-area schools and two at the museum (including observing more than 120 students, 7 teachers, and several chaperones);
2. online surveys completed by seven teachers whose classrooms had the History Take-Out program at their schools (facilitated by History Colorado Center museum educators);
3. online surveys and/or one-on-one interviews with 19 educators (both school teachers and community-based education program providers) who had completed all modules of the virtual training and facilitated the lessons themselves with students around Colorado;
4. online surveys with 84 partners provided with access to History Take-Out kits and virtual training (both school teachers and community-based education program providers) for future facilitation of lessons themselves with students around Colorado;
5. two phone interviews with History Colorado staff members who created, expanded, facilitated, and created training related to the "Ute Knowledge: Colorado's Original Scientists" History Take-Out Program.

The purpose of the History Take-Out evaluation was to assess the desired learning outcomes articulated for the K-12 "Learners and Educators" audience of Ute STEM; specifically:

Outreach program participants and educators will:

- Develop an interest in Ute STEM approaches to engineering, technology, botany, geography, climate, and weather, and will be curious about STEM connections to STEM in their own lives.
- Understand TEK concepts and modern archaeological explanations.
- Explore and generate scientific questions and hypotheses about construction, ecosystems, and patterns.
- Test building methods, explore patterns, and observe plants to make sense of the natural and physical world.
- Reflect on how TEK and archaeology inform one another, and will view Ute science, technology, engineering and math as contemporary STEM practice.

Educator training participants will:

- Be motivated to incorporate Ute STEM knowledge in their classrooms and/or informal science settings.
- Apply Ute STEM content and skills in their classrooms and other settings.
- Explore scientific practices, scientific explanation, and argument in Ute STEM and archaeology that can be used in learning settings.
- Reflect on how TEK and archaeology inform one another and view Ute science, technology, engineering and math as contemporary STEM practice.

The following sections highlight key themes from History Take-Out evaluation, pointing to progress toward all of the desired outcomes bulleted above.

Observation of History Colorado Educators' Program Facilitation

ExposeYourMuseum/Kate Livingston observed five lessons facilitated by History Colorado Center museum educators at Denver-area schools and two at the museum (including observing more than 120 students, 7 teachers, and several chaperones).

Students made connections directly related to Ute STEM desired outcomes (i.e., developing interest, curiosity about connections, understanding TEK concepts, etc.) during the program, as observed by their engagement, behavior, comments, and questions. For example, one student asked the question, "Does this mean we're in Ute territory?" when seeing the map depicting where Ute people once resided and currently reside today. Another student shared: "The animals come down to the foothills in the fall. Because of the higher altitude, the weather gets cooler."

Teachers also reflected on TEK and STEM during program observations. For example, one teacher shared at the close of the program: "We've done a lot of geography, so this map is good…. They loved it. It really reinforces everything."

Observations documented students testing building methods, exploring patterns, observing plants, and calculating distances through the hands-on History Take-Out activities. Additionally, History Colorado educators utilized ongoing evaluation and their own experiences with students and educators to make adjustments and improvements to the activities, structure, and materials used within the program throughout the grant period (see photos on Page 1).

Teacher Feedback on History Colorado's Program Facilitation

ExposeYourMuseum/Kate Livingston followed up with teachers whose classrooms had the History Take-Out program at their schools, facilitated by History Colorado Center museum educators. Seven teachers completed an online survey.

Teachers appreciated the direct links between the program and the standards and curricula they were teaching students about Colorado. Related, teachers recognized that History Take-Out extended and expanded what youth might usually be exposed to about Indigenous peoples. One teacher commented, "I appreciated the respect towards the Utes. This program modeled for the students how to respect the knowledge and wisdom of the Utes and their innovative approach to life even before we had STEM as a class."

Teachers indicated that the program influenced how they might approach teaching about the Ute people and other Native people in the future. It also encouraged teachers to include more participatory and interactive teaching techniques. As one teacher commented, "I will try to make my teaching more interactive and not so general."

Teachers appreciated the History Colorado Center's museum educators and applauded their facilitation of the program. For example, one teacher shared, "It is such a delight to have a well-informed, patient, and kind facilitator here on campus talking about the Ute people. I am so thankful for this program and the materials were used in a really age-appropriate way. Thank you!!" Another teacher commented, "I really appreciated the teaching of the Utes as a contemporary people and not just a historical perspective."

Six out of seven teachers reported that their students continued to talk about the program afterward. For example, one teacher shared, "The students loved the huge map and the hands-on materials. They felt successful because they were able to answer many of the questions."

All teachers reported either some or a substantial increase in their students' and their own interest in Ute people.

Educator Feedback on Virtual Training

ExposeYourMuseum/Kate Livingston distributed online surveys to 19 educators (both school teachers and community-based education program providers) who had completed all modules of the virtual training and facilitated the lessons themselves with students around Colorado. Additionally, four of these educators participated in one-on-one phone interviews; these interviews provided the most robust and nuanced feedback on the Ute STEM History Take-Out program.

At the beginning of the online training modules, educators were asked via an online survey, "What motivated you to do this training? What are your hopes and expectations at this stage?" Common responses included wanting to teach a more accurate and complete history of Colorado to students, their own interest in the Ute people (i.e., wanting to learn the history themselves), feeling more confident talking about and teaching local Indigenous history, making connections between Native history and STEM, and incorporating inclusive histories, stories, and viewpoints into their lessons. One educator explained, "I'm motivated by my desire to help accurately teach American history because my own education in elementary and high school was very white-washed and didn't tell the whole story." Another commented: "I recognize the value of understanding the Native American way of connecting with nature. Learning their culture and traditions is a gateway to understanding how we too can live in balance with the natural world." Additionally, an educator wrote, "I want to better represent the history of Colorado with my students, as well as help my students connect to the land that we teach on by exploring Ute culture, STEM, and more!" Another shared: "I wanted to learn more about the Ute people. I am a native [i.e., born in Colorado, not Native American] and I do not know a lot about them, which is sad. I think it should have been taught to us in greater depth when I was in school. I hope to learn more about the Ute, learn how to effectively teach the topic to students, and to come out of this feeling comfortable and ready to teach." Similarly, a teacher elaborated: "I believe in teaching the full history from a multitude of perspectives, and the Ute's have played an important role in the history of Colorado. My expectations are to learn more about the culture and impact of the Ute people."

Several educators (n=9) completed an second online survey approximately midway through the online training program. They were asked: "At this stage in the training program, what is working well for you? What could be changed or improved?" The videos received positive feedback from educators, however it was noted that the museum-made videos demonstrating how to facilitate the kits were lower-quality and harder to understand than the

professionally-produced videos (e.g., those made by PBS or during Ute STEM fieldwork). One educator reflected: "I love the videos. I am a very visual learner and it helps to be able to watch how to do the activities and challenges without having to sit and observe a program and take notes as we go." Another shared: "I find the videos in this section very informative. I watched several of them and plan to go back to watch the remainder. I look forward to the in-person training to discuss with other educators how they plan to use these videos. Hearing the native people talk is invaluable." The teacher guide was appreciated by teachers as a potentially useful resource, though educators commented on its length and admitted they had skimmed it rather than reading it completely.

At the conclusion of the training modules, educators were again asked an evaluative question via online survey (6 responded): "Now that you have completed the training, how do you plan to use it in your classroom(s)? When do you think you will introduce Ute Knowledge History Take-Out to your students?" Educators shared their intentions to utilize the kit; for example: "We will be using this first at a field trip at a state park, actually, this spring. We may be able to pilot it as an in class program this spring as well. This would be very successful in the future as an in class program. We work with 4th graders, who are learning about Colorado history, so this is a huge area of potential growth for us. Thank you so much for including us in this pilot program. We love having History Colorado as a partner!"

Four educators also agreed to participate in phone interviews. During the interviews, educators were asked how they would describe the training to an educator who hadn't heard about it before. One shared: I think I would focus on how timely this is in terms of STEM and how thorough the training was. And I'd probably tell people I took nine pages of notes! That's how valuable to me it was—not just watching, but taking notes as I watched, and then reviewing my notes before I presented the content." Another shared this comprehensive description of Ute STEM: "The objective of this program is to provide an opportunity for 4th grade students to learn about the Ute history in the Rocky Mountains, gain an understanding of STEM—science technology, engineering, and math vocabulary—and explore the Ute uses of science in conjunction with traditional knowledge to solve problems. Then, through the use of the Colorado map, along with photos and icons, students will be introduced to the historic Ute people where they lived. The students will learn that the Ute people still live in Colorado today. Students will be divided into six groups to participate in matching and challenge activities to understand the problems Utes have been solving for centuries. Through the use of the Ute STEM kits, students will use their STEM skills to build structures, evaluate baskets or water holders, identify plants, create beading designs, and calculate horseback travel times. At the conclusion, students will solidify their STEM knowledge with a group discussion in which they will share examples of what they learn during their activities, investigating Ute people, and how they use science, technology, engineering, and math."

Several educators mentioned another History Colorado/History Take-Out kit, "Moving Day," and how it served as an important introduction or bridge to Ute STEM content. For example, an educator shared: "I would first also talk about the moving day program. I would start off with that because I think it's really important. It's a program that we have facilitated for four years to 4th graders in Summit County. It's a hands on educational program that introduces 4th grade students to the Colorado map, Colorado geography map features, and the important part is that six groups migrated to Colorado over a thousand years ago. Then after they explore the Colorado map, the students break into groups, just like the Ute program. They break into six groups to learn and to explore these six people groups and then they share their artifacts, photographs, and information on the different groups during the conclusion or debrief. So it follows a similar flow as, as the Ute STEM, but it provides that original history of Colorado and of the Utes."

Additionally, one interviewee focused on the virtual training itself: "We have this great online version—a virtual training program that allows a teacher who is new to the program to visualize how to prepare and present the material from the beginning of the program to the conclusion. Included in the training videos are videos for each section, including the introduction or overview of the map, the six STEM challenge activity kits, and the wrap up and conclusion. And there are training videos for the teacher to watch an actual class set-up for each section. In addition, there are numerous links to additional resources for teachers to expand their knowledge and understanding of the Ute people."

Educators who participated in phone interviews were asked about their expectations coming into the virtual training, and whether those expectations were met. Similarly to the online surveys, these educators commented on the varying video and audio quality of the training videos. Though the videos as visual aids were greatly appreciated, some struggled to hear and understand the content. This seemed particularly related to speakers in the videos wearing masks (due to COVID). While the use of masks was valued for accurately depicting current pandemic-related health and safety concerns, speakers' mouths being covered presented difficulties for educators trying to understand the words. One educator shared: "I don't know if they're going to redo it, but it would help to remove the masks. In some of the cases they had captioning or subtitles down below, but I feel like the masks don't help with sound. I wish they somehow could have done it without the masks." Similarly, an educator commented: "I'm 69 years old and so I realize some of this is my hearing, but there were times when I think the masks muffled the sound. And it wasn't the volume. It was the articulation. I had to back up and listen to it again and again. I didn't mind doing it, but obviously if you do this again it would be something to improve."

Educators also noted that the training videos utilized adult learners instead of youth and, as such, were not representative of typical classrooms or student behavior. One educator shared: "The people in the video with the example boxes were well-behaved. That's not always the case. You didn't show kids that were tearing apart the boxes' foam liners and things like that!" Another agreed: "It's a different scenario when you have 15 kids around and they all have these different ideas and they come up with these really spontaneous responses…. You can't compare the online video training to that." Similarly, an educator noted, "It would be great to have a video of it in a real classroom." One educator further elaborated on this theme, requesting help with classroom management:

> I don't know if there's, especially for me as a non-teacher, an opportunity for you guys to add some things about how to manage students. I don't have a good answer of that, but it's something that I've thought about. I think especially because I have not just this content, but "Moving Day" as well, I've had such different experiences in presenting it. I've presented it in a classroom where the teacher literally left. I don't know, may have gone to run an errand. I have no idea where they went; they just disappeared. And so here I am managing a classroom of kids who just met me and, and are not very compliant with the instructions. But then I've also had groups like a group of homeschoolers where all the parents stayed. They were sitting up straight and all but saluted me. It was the complete opposite. And so I think perhaps letting people know at some point—maybe at the end of it—some tips or, you know, "Expect the unexpected." The groups of kids you're teaching this to will all be different. It's not going to be homogeneous and not everybody behaves the same all the time.

One educator commented on the videos featuring adults, rather than youth:

> It would be awesome if you could actually have kids being interviewed more [in the program videos]. There were a lot of adults of course, and tribal leaders, but it would be awesome if PBS or History Colorado would do one just on the kids. To have one right on that 4th grade level would be awesome for our students. And maybe having them recreate some of the activities, like peeling a tree or doing some beading or something. Making a wickiup. I mean, what did kids do back then? What were there roles? That would be good to see.

Transitioning between program segments posed difficulties for some educators. For example, one shared: "I think there's Ute history and then there's how the Ute people used STEM. And I found that my transition was clunky…. It didn't naturally flow to me. It was not a natural transition. I had to watch the videos and I had to learn something to say. I had to practice what I was going to say to make that move there. The video was useful to me for that, because even though I had seen [the program] presented in person [by History Colorado staff], I didn't appreciate what I was seeing when I saw it. So seeing how those transitions worked I found very helpful." Related, another educator commented on the potential utility of seeing the full program as part of the training videos, from start to end, in addition to the shorter clips included currently: "I don't know if you could ever do the whole thing, from the beginning

to the end. I'd be watching it for about an hour, something like that, but watching it firsthand all the way through would be really valuable."

Educators interviewed noted that some STEM activities/boxes took students longer to complete than others, making it difficult to manage time with rotating students through activities. For example, one educator recommended: "Two challenges take way longer than the others. Either shorten those two or lengthen the others. I would imagine shortening would be the better fit." Another shared: "We tried to clock everything at every 10 minutes for changing stations and that didn't work well because some of the kids got through their station faster than others. Like, for instance, the transportation one and the plant one take longer than the others, and so trying to do that timing, the kids are sitting and waiting to move because the other kids aren't finished yet."

Similarly to the online surveys, the educators interviewed noted that the training guide/manual was useful and appreciated. One said: "There's the script in case you need to read it. I think the guide has been done very well. They give you an idea of how many minutes per section. They help us learn how to pronounce Ute words." Another educator shared: "It's really very well done. And everybody I've showed it to has felt the same way. They all feel like it was very well thought out and very usable, very hands-on and very user-friendly. It is so great with all the props that they included and all the cards and the guide." That said, it was also noted that the guide is long and, for some, overwhelming. One educator shared: "It is all good information, but that was a lot."

Educators interviewed were also asked what from the training or from facilitating the program continued to resonate with them—anything else that stayed "sticky." Frequently, the fact that the Ute STEM History Take-Out kit has been developed and offered to Colorado educators resonated and mattered most to educators. Educators readily noted the importance of teaching local Native history, and saw it as enhancing their students and their own learning. For example: "I was really impressed and surprised—pleased with all the additional information. And the videos that were provided. I felt like that helped to enrich my knowledge of the Ute people." Another shared: "I just really love these programs—the fact that they're hands-on and that thee students are experiencing this. I think it has to help their learning and retention so much better than going into the classroom and seeing a PowerPoint or something." For one educator, the introduction of STEM to their teaching was impactful: "STEM is sort of a new thing for me. My child is 40 years old, so I don't know anything about STEM. I had to make sure that I understood the difference between what's considered science and what's considered technology and what's considered engineering and what's considered math because that that's new content that doesn't come naturally to me."

Two educators noted the advantage of supplementing the kits with onsite visits to History Colorado museums. One shared:

> I am kind of at an advantage because I actually went to Montrose and went to the Ute Museum. I will confess that I went on a day where they weren't very busy and they realized at one point that I had been in there a really long time and they came and checked on me, which I thought was cute. But I did spend a whole lot of time there and so I had done the boxes myself—the same activities that are in the kit. I realized when I was there that this was geared toward kids, but I thought, "Oh, I'm a big kid. I want to do all of this!" And so I had done all of the activities before I even got the training. I did have that advantage. I did have that experience under my belt.

Similarly, another educator noted how impactful their museum visit (to History Colorado Center's "Written on the Land" exhibition) was to their facilitation of the program:

> I do have to say that being at the museum and seeing all the displays at the museum that are replicated in the kit was awesome. I'm going to spend a whole lot more time at the museum than we had time to spend sometime soon! I don't think an in-person training is necessary, but I do think that every person who comes to pick up a kit should be strongly encouraged to go through that online training they put together, and also encouraged to

take some time at the museum and go through the exhibition and see the original exhibits that have to do with Ute STEM. It really solidified a lot of the pieces for me.

Partner Feedback on Kits and Virtual Training

History Colorado sent an online survey to partners who had been provided with kits. These were both school teachers and community-based education program providers who had access to the virtual training/online modules and planned to facilitate the program themselves with students around Colorado in the future. The survey received 84 responses, which were analyzed by ExposeYourMuseum/Kate Livingston.

Ninety-four percent of partners who received the survey (n=77) indicated that they had received their Ute STEM History Take-Out kits. The in-person kit pick up was well-received, with 96% of partners selecting this was "useful" or "very useful." The educator manual and videos were also highly appreciated, with just one partner selecting that each was "not useful" to them.

At the time the survey was sent to and completed by partners, approximately 30% (n=24) of partners had already used the kit with learners, with another 37% (n=30) planning to use the kit with learners within the following two months. Partners indicated they were most likely to use the kits in a program for a class or group at a school or in a program for a class or group at their site. Almost 50% (n=40) of partners also indicated the kits would be utilized as part of informal programs—for example festivals or tables at events. Over 40% (n=36) planned to check the kits out to local teachers.

When asked for suggestions or changes that would make the kit or the experience better, partners shared suggestions for improving the training manual, making kit materials stronger and more robust, extending or enhancing the kit activities, and how to expand and enhance training overall. Most of the recommendations related to wanting additional information related to the logistics of facilitating the program. For example: "I think the educator manual needs more work, it doesn't really have the logistics of how this program works in a classroom. It has a lot of great information but not necessarily how to communicate that information to children or a realistic timeline of how the program will flow." Another partner shared: "It would be great to find a better way to attach the poles in the shelter building activity. The Velcro pieces do not seem very sustainable for continued use over a long period of time. Include more materials for each station for larger groups." Frequently, partners utilized this question to comment that the kits and programmatic elements were working well for them as-is. For example: "I like that you've already made changes to make things more durable. I also like that you've provided multiple resources to learn more." Another partner shared: "I just want to say that I think the map is one of the most incredible parts of the kit. You can do so much with it and the kids really enjoy gathering around the giant map!"

Most partners indicated they felt comfortable training future staff, volunteers, and/or teachers on how to use the kit. For example, one partner shared, "Yes; I am actually working on aligning the activities with Cub Scout and Scouts BSA activities to help other Scout leaders use them effectively." Another shared: "Yes because we can show them how we present the kit and refer back to the videos. There are also many resources to be able to dive deeper so that each educator can put their own spin on it." A third indicated, "Yes, the lessons and two guides are amazing resources that make understanding how to use the kits very doable." For those partners who were unsure that they were comfortable, many indicated they would like to have more experience facilitating the program themselves first. For example, one wrote, "I'd like to use mine more before training others."

When asked what would help partners market the kit to their communities, written copy describing the program (e.g., standardized email language, a one-pager, copy for paper and digital flyers, etc.), photos and digital assets, posters, an FAQ, a short introductory video, and a centralized website containing all relevant Ute STEM and History Take-Out information were often requested. For example: "Marketing flyers for teachers specifically that show what standards it meets and with some concise info on it. We created and passed out a flyer at new teacher orientation and that seemed to be helpful. We need to do some more emails to the school district. Maybe an FAQ about the take out kit?"

Additionally, partners were asked what they felt the most important thing was from the Ute STEM History Take-Out program to share with students, lifelong learners, and others. The fact that Ute people are still alive and present in Colorado today was frequently cited. For example: "The most important thing that we want to share with students is just more information about the Ute people and how they are still here today." Another partner shared: "I love that this kit emphasizes the fact that the Ute are still here. That they are a living tribe that continues to leave a legacy and a history to teach." The importance of the Ute people as STEM practitioners, especially on the Colorado landscape, was also emphasized. For example: "Ute knowledge is extremely valuable in society today. Indigenous wisdom can teach us unique ways to deal with challenges put in front of us and foster a deep respect for the outdoor world that has taught and given us so much." Another partner commented: "I really like how it illustrates how there is more to STEM than what we think of traditionally, such as lab experiments, robots/modern technology, or space exploration. I love being able to related STEM back to nature and using it in daily life to survive." Partners also commented on the connections between history and today, the hands-on activities, and the link to History Colorado's museum exhibitions (e.g., "Written on the Land").

History Colorado Staff Feedback

ExposeYourMuseum/Kate Livingston interviewed two History Colorado staff members who created and expanded the kits, facilitated museum and school-based programs, and generated in-person and virtual training related to the "Ute Knowledge: Colorado's Original Scientists" History Take-Out Program. In particular, staff members noted how COVID changed the way History Take-Out was facilitated, as well as History Colorado's overall approach to K-12 program facilitation statewide museums and in schools:

> Originally the History Takeout [kit program] was primarily facilitated by [museum] staff—trained staff. And we were thinking about how we could make it something teachers could check out. Our comfort with doing that had increased. I think those were the COVID impacts. I think that was when we were like, "Okay, we're just going to get it out to everybody." And we may not see the numbers during the grant, but we know the numbers will continue and we've trained a hundred-some people on how to do the kit and hope that it will have that impact.
>
> We were looking for ways to get [History Takeout] kits out, as opposed to the original idea of making 40 kits and paying for their facilitation [by History Colorado staff] across the state. COVID obviously altered all that. So the new task was to make as many kits as we could and get them into as many hands as we possibly could…. I'm happy with where it's gotten, because even had we done 40 kits and gotten facilitators out, I don't think we would've hit the possible scope that we have now. I think getting them into educators' hands, even if that wasn't the original intent, allows the kits more opportunity for use. And hopefully allows more students across Colorado access to them.
>
> Because of the way things turned out with COVID and the switch to like making a ton of [History Takeout] kits… they're able to give them to people with very minimal obligation. Their obligation is to be trained on the kit, use the kit, tell us if you use the kit. I just think it's so much less stressful for all of them. They're happy to have it and see [in the training videos provided], "Here's how we're going to use it"…. It's so much more freeing. I actually think the kits are going to reach 50 times more [youth/students] than they would have in the other model.
>
> I'm finding more teachers are using kits and teachers are excited. The kits give them something, because it was always on them. They were always sort of like, "Am I'm going to say the right thing?" These kits are put together with the blessings from and the information we have from the Ute [people], so I think the kits are a much simpler teaching tool for the teachers, which they really appreciate.

> I know a lot of the folks that we reached out to who have eventually ended up taking kits were super excited that it was material that had been collaborated on with the tribes. So they had a tribal voice, they had a tribal backing. That was incredibly important to a lot of folks, because with new awareness there comes an understanding that when you're teaching things, if you don't have an authentic voice, are you actually teaching it? Or are you just paying lip service to somebody else's understanding of how things have happened?

Finally, a staff member shared the potential sustainability of what was learned through Ute STEM's History Take-Out kits and related evaluation:

> I think it's just a really good resource. If other kits want to follow suit, I think it would be well-received and I think it would aid in the longevity of the other kits as well in the long run. I think this project allowed us a window into what's possible in kits and what's desirable in kits. I think this is a really good starting point to diversify our kits. If [History Colorado] follows this model, it's laid out in a way that they could copy for the other kits quite simply. It's a workable system for them to explore and expand upon. We've created a huge network of Colorado educators that now have access to our kits and that now History Colorado has access to, so they can continue to develop those programs and relationships across the state. I know part of the goal of education at History Colorado is to reach as many students as possible. We've just laid down a path to make that possible.

Ute STEM Project Logic Model

Inputs	Outputs		Outcomes – Impact		
	Activities	*Participation*	*Short*	*Medium*	*Long*
History Colorado: -staff time and expertise to support partnerships, create exhibits and educational outreach -Ute Indian Museum, Montrose -Community museums in Pueblo, Fort Garland -infrastructure for digital outreach -networks and locations for outreach, educator training **Three Ute Tribes:** -Cultural Resource & Education staff -tribal elders and youth **DARG and Ethnobotanist** -staff time and expertise to implement fieldwork. **-STEM advisors** **-Education advisors** **-Evaluator** **-Videographer** **-web designer** **-graphic designers**	**I**ncrease interest in Ute STEM knowledge and STEM learning in rural communities: <u>1.Conduct collaborative fieldwork</u> -generate ethnobotany & archaeology knowledge - inform exhibits & programs <u>2 & 3. Create STEM exhibits</u> -wickiup engineering -mathematics of beading - ethnobotany - sound physics and engineering <u>4. & 5. Deliver Public Programs and Education Outreach</u> -public programs -outreach programs to 30+ network partners -online content and activities -9 educator workshops <u>6. Communication</u> -share findings with wider informal STEM education and tribal communities	Over 5 years the Ute STEM project will reach **128,000 people:** <u>1. Ute field work and workshop participants (Yr 1-4) 302 people</u> - Ute youth, elders, experts, and extended Ute community members. <u>2 & 3. Museum Visitors (Yr 2-5) 64,549 people</u> -residents (families, adults, students) in rural western Colorado. -visitors and tourists <u>4 & 5 Public Program and Education Outreach participants (Yr 2-5) 56,100 people</u> -families, adults -K-12 educators & learners -informal educators & learners <u>5. Professionals from tribes, museums, science organizations (Yr 3-5) 7050 people</u>	Engagement in learning about Ute STEM: <u>1.Ute Participants</u> -increased interest and understanding of Ute STEM and archaeology <u>2 & 3. Museum visitors</u> -increased interest and understanding of Ute STEM and archaeology <u>4 &5. Education Program participants and educators</u> -increased interest and understanding of Ute STEM and archaeology -increased engagement in activities using scientific tools and skills <u>6. Professional peers</u> -increased interest in informal STEM collaboration	Increased involvement in STEM: <u>1. Ute Participants</u> -Reflect on Ute practice as STEM -identify selves as science learners <u>2, 3,4,5. Museum visitors and Program participants:</u> -Reflect on STEM practice -make connections between STEM in Ute practice and their lives <u>5. Educators</u> - increase ability and motivation to teach Ute content and STEM skills <u>6. Professional peers</u> **-**apply models and "how to" guides to create and strengthen collaborations	Improved STEM opportunities for Ute and rural communities: -increased academic and workforce STEM participation by Ute people - respect and understanding for Ute STEM knowledge and expertise -culturally appropriate Ute content taught in Colorado schools -increased opportunities for STEM learning and workforce participation in rural communities -more local history museums as STEM learning leaders -more collaborations between native people, museums and scientists

Assumptions
HC the Ute Tribes, DARG and partners have a strong collaborative foundation.
HC has experience creating innovative STEM-based exhibits and programs.
HC an established partner network to serve rural learners
Ute STEM is valuable, history museums can support informal STEM learning.

External Factors
Fuel costs and weather may impact timeline of deliverables.
Changing technology may impact implementation of exhibits, online exhibits and programs.

Ute STEM learning outcomes to aligned to Informal STEM learning strands

Learning Science in Informal Environments: People, Places, and Pursuits (Bell et al. 2009)

ISL Strands	Ute STEM Measurable Outcome by Deliverable/Audience
Strand 1: Sparking and Developing Interest and Excitement	**Ute field work/workshop participants** will be motivated to learn about traditional Ute approaches to engineering, technology, botany, geography, climate and weather and will be interested in archaeological research methods and tools. **Museum visitors** will increase their interest in Ute STEM, Ute culture, and archaeological research methods and tools; they will be curious about STEM connections to their own lives. **Public program and education outreach participants** will develop an interest in Ute STEM approaches to engineering, technology, botany, geography, climate, and weather, and will be curious about STEM connections to STEM in their own lives. **Educator training participants** will be motivated incorporate Ute STEM knowledge in their classrooms and/or informal science settings.
Strand 2: Understanding Scientific Knowledge	**Ute field work/workshop** will understand TEK and archaeology field practices through studying wickiup sites and regional ecology. **Museum visitors** will understand TEK concepts and modern archaeological explanations. **Public program and education outreach participants** will increase their understanding of Ute STEM concepts and modern archaeological explanations. **Educator training participants** will apply Ute STEM content and skills in their classrooms and other settings.
Strand 3: Engaging in Scientific Explanation and Argument	**Ute field work participants** will observe, gather and analyze data to answer questions, and formulate their own research questions and hypotheses to test and explore as part of the research team. **Museum visitors** will test building methods, explore patterns, and observe plants to make sense of the natural and physical world. **Public program and education outreach participants** will explore and generate scientific questions and hypotheses about construction, ecosystems, and patterns. **Educator training participants** will explore scientific practices, scientific explanation, and argument in Ute STEM and archaeology that can be used in learning settings.
Strand 4: Understanding the Scientific Enterprise	**Ute field work participants** will reflect on how TEK and archaeology inform one another, and will view Ute science, technology, engineering and math as a contemporary STEM process. **Museum and online exhibit visitors** will reflect on how TEK and archaeology inform one another, and will view Ute science, technology, engineering and math as contemporary STEM practice. **Education program participants** will reflect on how TEK and archaeology inform one another, and will view Ute science, technology, engineering and math as contemporary STEM practice. **Educator workshop participants** will reflect on how TEK and archaeology inform one another, and will view Ute science, technology, engineering and math as contemporary STEM practice
Strand 5: Engaging in Scientific Practices	**Ute field work participants** will participate in scientific activity, use the tools of archaeological surveying and site field work, engage in scientific inquiry, and use STEM findings to inform exhibits and programs.
Strand 6: Identifying with the Scientific Enterprise	**Ute field work participants** will begin to identify themselves as someone who uses and contributes to traditional Ute STEM knowledge, archaeology, engineering, and science.