



Evaluation report Isotope Investigators: Unraveling Water's Wild Journey *Headwaters hands on activity*

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Project background

The Headwaters Project was a collaboration between the Oregon Museum of Science and Industry (OMSI) and Dr. Catalina Segura, PhD, a professor, and Zach Perry, PhD candidate in the Forest Engineering, Resources & Management Department at Oregon State University (OSU). The collaboration between OSU and MSI resulted in the production of a hands-on activity that was facilitated at the museum by professional museum educators for at least 100 hours during the summer 2025. Concurrently, MSI led a summative evaluation of the demo at the museum to assess the public audience impacts of the hands-on activities in alignment with the evaluation objectives.

Evaluation objectives

The activity's theme was: "A Dynamic water cycle: Learn where water comes from and how water movement is affected by the changing landscape and climate". The activity had the following learning objectives:

- Visitors will learn how hydrologic tracers help us to understand patterns of water movement.
- Visitors will learn about the role of topography in patterns of water movement.
- Visitors will understand the importance of water to human and ecosystem health.
- Visitors will leave with an understanding of how climate change affects water availability and how we can address this.

While the activity was designed to address all of the objectives above, the MSI program team encouraged the OSU team to focus on the one objective that they hoped everyone would take away. The first objective above became the primary objective while the rest of the objectives were considered secondary objectives.

In addition to examining visitors' explicit conceptual connections to the learning objectives, the evaluation also documented visitor engagement with the demonstration. As exemplified by Stocklmayer and Gilbert (2002), Rennie et al. (2003), and Barriault and Pearson (2010), the level to which a visitor is engaged by an exhibit through participating in the activity, repeating actions and making connections to their lives, is a direct indicator of the learning taking place.

Ultimately, the evaluation goal was to assess in what ways and to what extent the demo achieved its intended impacts by exploring the following evaluation questions:

- 1) How does participation in the facilitated activity contribute to visitors' understanding of the ideas corresponding to the activity's learning objectives?
 - a) Water begins as precipitation (rain and/or snow) in the mountains and then

- travels downstream . Scientists can use isotopes to trace the path of water.
- b) Water travels both on the surface and underground. How quickly water moves depends on the steepness and the type of ground material.
- c) A significant portion of our summer water comes from snowmelt, but as climate change progresses, more of our winter precipitation will fall as rain instead of snow. In order to predict water availability, we need to understand how climate change affects water traveling downstream.
- d) Water availability and quality is important to human and ecosystem health.

The item a) above, is the first priority regarding the learning objectives for the facilitated demo. The other objectives are secondary and were pursued if visitors were engaged and willing to explore the activity further. As such, these objectives are considered a plus if achieved during the interaction.

- 2) How do visitors engage with the activity?
 - a) Ask questions
 - b) Complete the activity - once or multiple times
 - c) Stay for follow up activities
 - d) Talk to others in their group
 - e) Time at exhibit
 - f) Skills practiced
 - g) Interactions with facilitator - independent exploration (how much of the time the facilitator was actively involved vs. the time the group did it on their own)
- 3) How do visitors rate and report their experience with the activity? This in reference to the constructs of engaging, interesting, and fun.

Context

The interactive hands-on experience, from now on referred to as Headwaters, consisted of a 3D landscape model that depicts rivers and streams in a watershed (see Figure 1). Different colors were used to display different water levels and flow. The interactive part of this experience consisted of buttons that could be pressed to generate a printout of elevation, weather conditions, and isotope values at specific locations. Visitors could collect samples from three precipitation sites, three river sites and three stream sites, as well as under three weather conditions: normal, heavy snowfall and drought.

Once the Headwaters demo was built, two OMSI museum educators were trained by an experienced OMSI staff who co-developed the facilitation script with the OSU team. The training took place in two sessions in April of 2025. The area where the training happened (and later data collection occurred) was a corner of the Natural Sciences Hall where the

temporary exhibition *Knowing Nature: Stories of the Boreal Forest* was hosted (see Figure 1). After the training sessions, the museum educators selected Wednesdays and Thursdays for each one of them to facilitate the demo. Visitorship varied during the facilitation timeline. In May and the first weeks in June, visitorship consisted mostly of organized programs (such as schools) and caregivers with younger children visiting the museum. From mid June and into the summer season, visitorship consisted of families and groups, both local and from out of town visiting the museum.

Interactions with the demonstration often followed a similar pattern based on the facilitation guide. Interactions often began with inquiries around water and the fact that isotopes of water can be used as tracers. Visitors then explored isotope values at precipitation sites, then in rivers and streams. If groups were still engaged, interactions moved on to look at how different weather conditions affected water flow and connectivity.

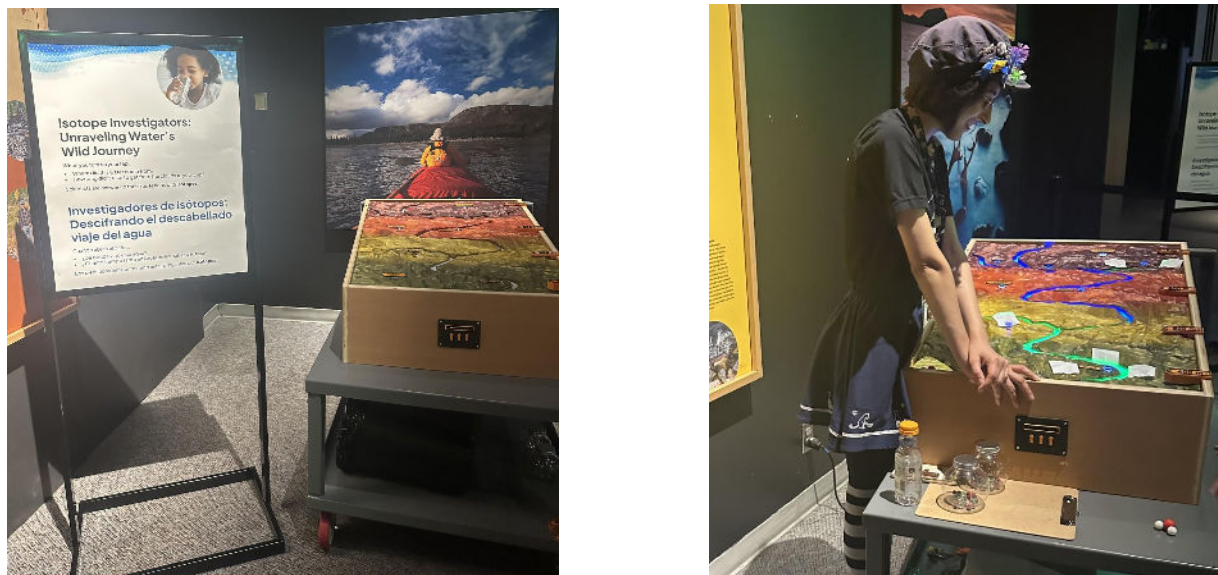


Figure 1. Demo set up (left image) and OMSI museum educator facilitating the demo (right image).

Methods

A mixed methods approach was utilized for the evaluation and included observations as well as survey and interview data. Data are reported in the form of descriptive statistics (counts and frequencies) as well as emergent themes from qualitative coding.

Data collection

Data collection occurred in May through July 2025 with general OMSI visitors. While the preferred audience was family groups, this did occasionally include those attending as school or camp groups. Data collection included naturalistic observations of visitors engaging with the demo (facilitated by one of two OMSI museum educators). A stopwatch was used to determine the total time that a group spent with the demonstration. This was followed by data collectors requesting participants to complete a short survey and participate in a structured exit interview (See Appendices A, C, D for instruments). The target sample was initially set at 50 individuals/groups per data collection method. Because not all the participants and their groups had the time to stay in to fill in the survey and answer the interviews, this led to variability in the numbers of data collected per method.

Consent

Adhering to the Gutwill method (Gutwill, 2003), consent for observations was immediately provided upon entering the observation area (as indicated by posted signage), informing visitors and groups of OMSI staff observations. Signage was visible and posted in three places, within the demo area on the stanchions that surrounded the demo and the facilitator.

Prior to distributing the survey or asking to answer the interview questions, the data collectors outlined the purpose of the study to potential participants, how the information would be used, and asked an individual from their group if they consented to participate. Those who verbally agreed received the survey and were asked the interview questions. Participants had the option of skipping any question they did not feel comfortable answering. Demographic information about the group was documented on the observation form only. Personal information, such as the name or address of the visitors was not collected.

Data analysis

Data analysis varied by method. Observations, surveys, and interviews were scanned and data entered in a Google spreadsheet by the OMSI staff who collected that data. Data entered in the spreadsheets were reviewed to ensure entry reflected what was collected in the paper instruments. Descriptives, such as counts, were run on the observation and survey data spreadsheets when pertinent, meaning observable behaviours that were noted by the data collector were counted. Interview notes and notes from the observations were analyzed using thematic analysis which allowed OMSI staff to identify themes and patterns associated with the goals of this summative evaluation. Data were analyzed per instrument and by evaluation objectives and questions.

Sample size

Methods included observations, surveys, and interviews. All of these methods were conducted during the facilitated demo with an original target of 50 individuals/groups per method.

Method	Total Sample
Observations	86
Surveys	74
Interviews	56

Figure 2. Sample by method

As seen in Figure 2, 86 groups were observed at the facilitated demo; from those, 74 individuals from the groups agreed to complete the survey and 56 agreed to be interviewed after filling out the survey. According to data collectors, participants who chose to not participate beyond observations, were usually in a hurry to leave the museum or engage with another experience immediately after engaging with the demo.

Results

The results from the evaluation are organized by the methods and objectives stated in this report (see evaluation questions on page 4) that account for participants' engagement, and experience (including interest).

Observation data

Observation data were collected from 86 groups. Groups to be observed were selected based on the following priority: 1) intergenerational families with children 10 years or older; 2) intergenerational families with children 6 to 10 years old; 3) groups of adults only (18+); 4) individual adult visitors. Observers recorded the date, group number and their initials on the observation form. They made their best guess for the ages and genders of individuals in the group and made notes about the group.

Observers noted what parts of the activity were completed by the group as well as whether any of those parts were done multiple times (repeated). They also recorded behaviors in several categories including *Emotional response*, *Seeks information*, *Shares information*, and *Makes meaning*. The observation instrument can be seen in Appendix A and operational definitions for engagement indicators in Appendix B. A summary of the observation data is below; for several of the sections, multiple codes could be recorded, so counts may add up to more than 86 in the charts.

Groups ranged from one to eight people with an average of 3.5 people per group.

Perceived gender by age group

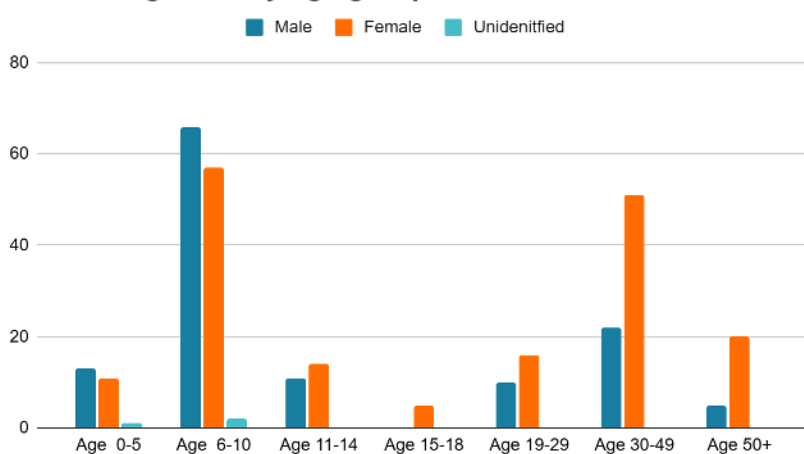


Figure 3. Gender perceived and reported by data collectors

A total of 127 perceived male, 174 perceived female and three of unidentified gender were observed. The greatest number of individuals were in the age categories of 6 to 10 years and 30 to 49 years (see Figure 3).

Engagement

The total time engaged with the demonstration was collected from 75 groups and ranged from about a minute and a half to almost 25 minutes with an average of 11 minutes 54 seconds.

Interactions with the demonstration often followed a similar pattern based on the facilitation guide, though facilitators often altered the order of activities based on the learners' interest and questions. Generally speaking, parts of the activity that were introduced later in an interaction were engaged in fewer times than those typically introduced at the beginning. Early in most (96%) interactions, groups engaged with isotope models. This is the one part of the activity that was never repeated. All of the groups observed engaged in collecting precipitation samples with two thirds (67%) collecting samples multiple times. Over 75% of groups went on to discuss the precipitation samples collected. A fewer number of groups went past precipitation site sampling; over half (54%) collected and discussed river or stream samples while nearly a quarter (23%) explored and discussed different snowpack conditions.

Completed Activities

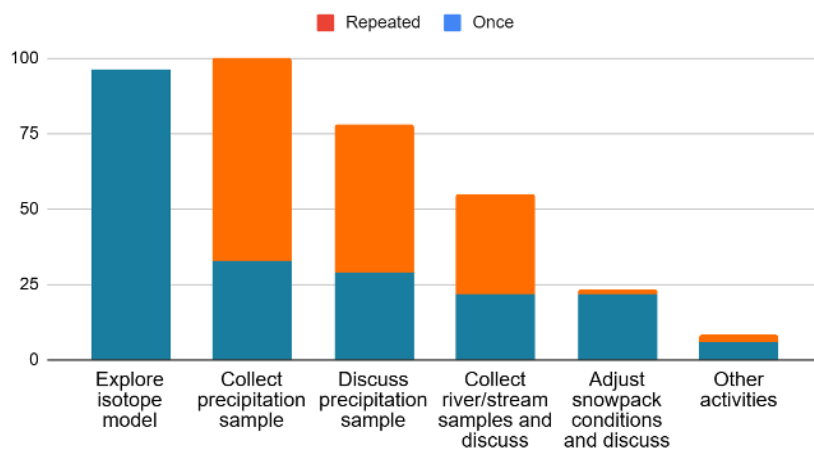


Figure 4. Observed counts of participants who completed activities in the demo

Almost half (41) of the interactions observed were described as being a balanced mix between the facilitator and members of the group. This means that the learners were speaking and contributing to the interaction at about the same level as the facilitator. Many (37) were described as primarily led by the facilitator. Only two of the interactions were primarily between members of the group without involving the facilitator.

Interaction Type

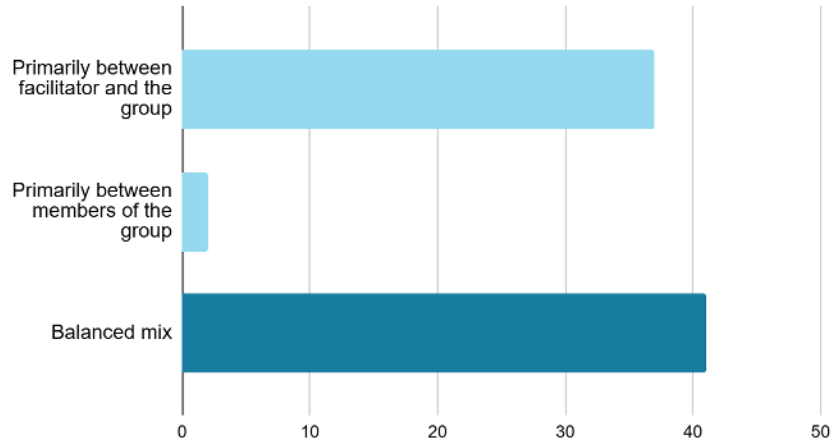


Figure 5. Observed counts of types of interactions

A majority of groups exhibited indications of high energy, positive emotional responses (Brackett, 2020) including *Curiosity* (62) and *Excitement* (23). Very few groups showed negative emotional responses (*Boredom*, $n=4$; *Annoyed* $n=2$), while *Relaxed*, a low energy, positive response was noted in about a third (31) of the groups. Other emotions noted included *Attentive* (1), *Eager* (2), and *Interested* (4).

Emotional Responses

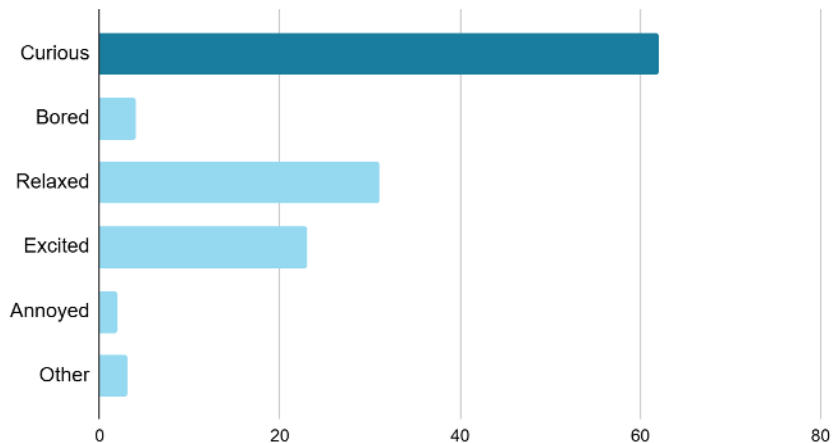


Figure 6. Observed counts of emotions

Groups were observed seeking information by examining the landscape model (n=45) and asking questions (n=30). Reading signage (n=7) was seen less frequently, which is not surprising as this was a facilitated experience where learners tend to engage more with the staff than with written text.

Seeks Information

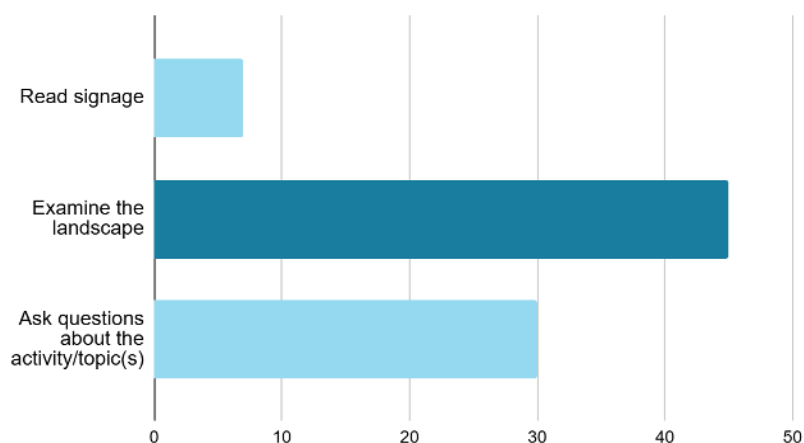


Figure 7. Observed counts of seeking information

Nearly all groups (80 out of 86) were observed sharing information by responding to facilitators' questions. In over half of the interactions, learners led the sharing of information by describing their observations (n=34) and/or explaining their ideas (n=29) about the content.

Shares Information

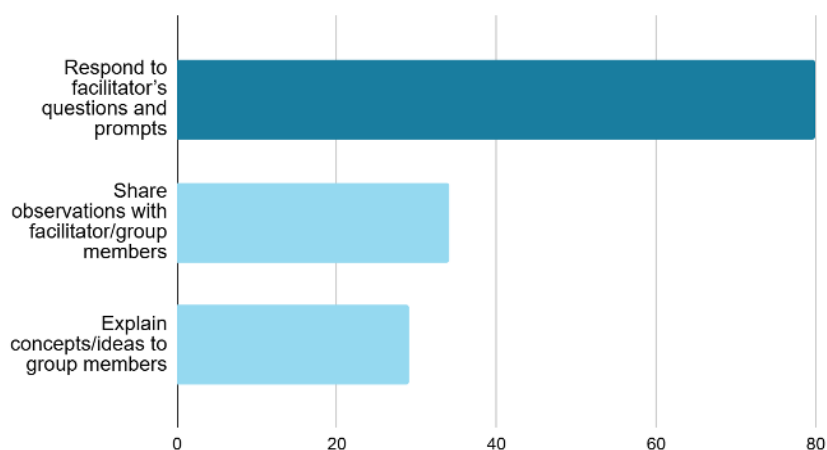


Figure 8. Observed counts of sharing information

Some of the deeper cognitive engagement occurred as learners made meaning about the content such as making connections and identifying patterns. About half of the groups (n=42) identified patterns or insights during the activity; this might include noting the decrease in isotope numbers as elevation increases ("The Isotope changes to small numbers as you go up") or the idea that heavier isotopes fall out first. Thirty-seven groups made connections to past knowledge or experiences. Examples include

- So this is like the snow from Mt. Hood coming down the river?
- Precipitation is another word for rain
- We live close to the Willamette river- this can be the Willamette too?

Eleven of the groups talked about impacts on larger systems. This typically involved discussions of local water sources and how droughts can affect water availability.

Makes Meaning of Topic(s)

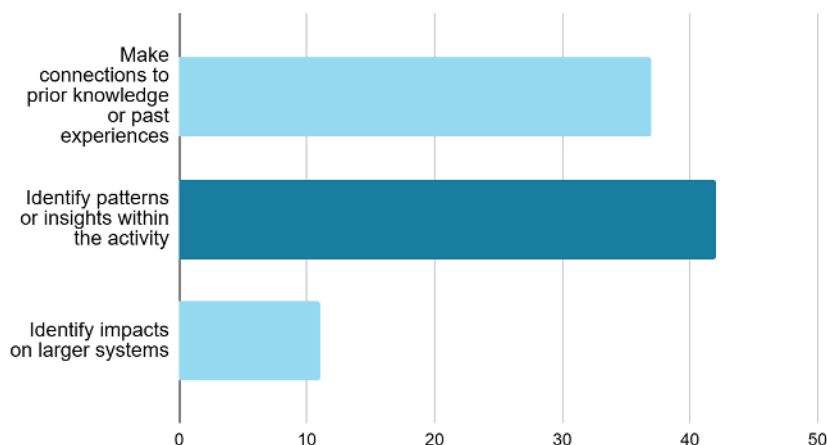


Figure 9. Observed counts of meaning making

Survey data

Experience with the demo

Questions aiming to capture participants' experience with the demo were included in the survey and in the interview. Participants were asked to rate how new the information from the demo was to them. This was followed by rating how interesting, fun, easy to understand, and engaging the demo was for them. When pertinent in the presentation below, interview responses that proved additional insights with respect to the experience at the demo are included to better describe it from the participants' perspectives.

Newness of the information

Participants were asked to rate their experience of the facilitated demo with respect to how new the information in the activity was for them ranging from *Already knew it all* to *Mostly or entirely new and I learned a lot* (see Appendix C for survey instrument questions).

How new was the information in the activity

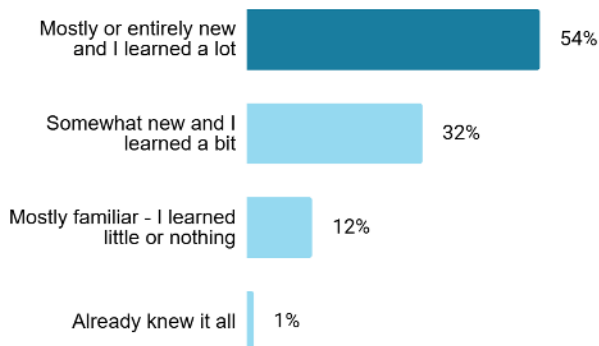


Figure 10. Percentage of self-reported newness of the information

Slightly more than half (40 out of 74) of the participants reported that the information in the demo was mostly or entirely new for them (see Figure 10).

When asked about what they learned from the demo, participants' responses in the interview mentioned that they learned about isotopes in general (as a concept) and as part of the water as atoms, elements and so on. Some participants referred to isotope counts or levels. One participant, on this matter responded:

"They are Isotopes in the water to help scientists know where the water comes from depending on the elevation."

Other responses mentioned that participants learned about isotopes with respect to precipitation (such as rain), streams and rivers, and elevation (altitude of a location).

The responses suggest that the facilitated demo met the first learning objective: *Water begins as precipitation (rain and/or snow) in the mountains and then travels downstream. Scientists can use isotopes to trace the path of water.* Responses also suggest that the activity somewhat met the second objective regarding the awareness that water travels on the surface and that steepness matters. There were minimal mentions regarding water traveling underground.

The objective that refers to water availability and where water comes from, was hinted at in participants' responses when in the interview they were asked what they would want to learn more about. The responses varied and themes that emerged were:

- Content related to isotopes, measurement, ways of collecting data, how the data is used in real life
- Climate and weather patterns, meaning from precipitation variability in clouds, droughts, to climate change impacts on water
- Some connections to potable water and local landscapes for example

Experience: interesting

All of the participants found the demo to be *Very interesting* or *Somewhat interesting*. Of those, about three quarters (55 out of 73) of the participants selected that the demo was very interesting for them.

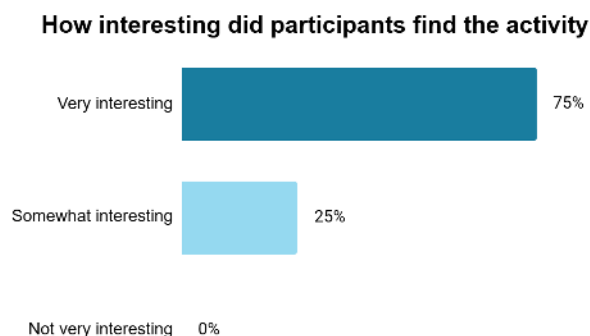


Figure 11. Percentage of self-reported interest in the demo

In their interview responses, the majority of the participants mentioned aspects of the facilitated demo that captured their attention and they found interesting. The majority of the responses mentioned the activity characteristics including:

- **Interactives** : the buttons that could be pressed and the readout in the form of a printed paper with the data.
- **Content**: such as science information (molecules, gravity), content related to water (its elements), isotopes, rainwater and some connections to their use.
- **Look and feel**: the way the streams (river) model and lights looked in the demo, the whole finished look.

Other respondents referred to the novelty of the demo, the facilitation, and mentioned their experience as enjoyable.

Experience: fun

When asked the extent to which they agree with the statement that the activity was fun, an overwhelming majority (66 out of 73) selected they *Strongly agree* or *Agree* (Figure 12).

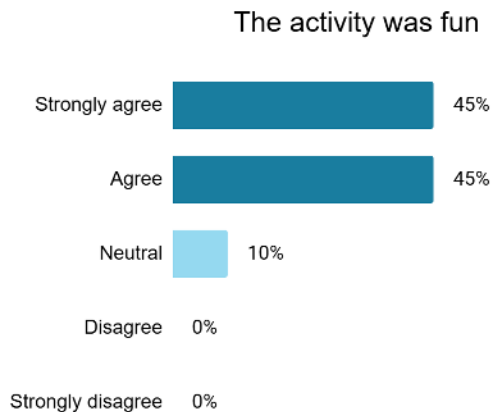


Figure 12. Percentage of self-reported extent of fun

None of the respondents reported finding that the activity was not fun for them .

Experience: easy to understand

Similarly to the construct of fun (Figure 13), the overwhelming majority (66 out of 73) of the participants reported that they *Strongly agree* or *Agree* that the demo was easy to understand.

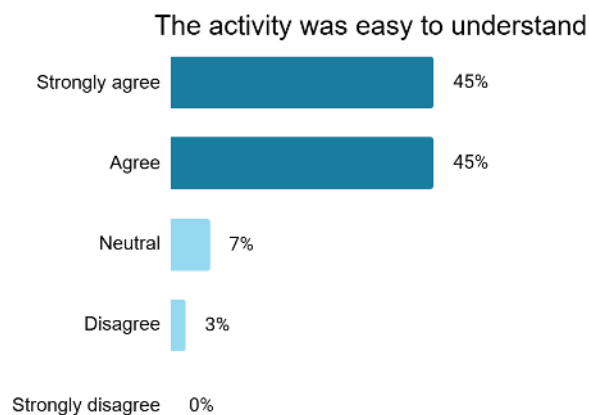


Figure 13. Percentage of self-reported extent of easiness to understand

Experience: engaging

More than half (42 out of 73) of the participants stated that they *Strongly agree* that the demo was engaging for them (Figure 14).

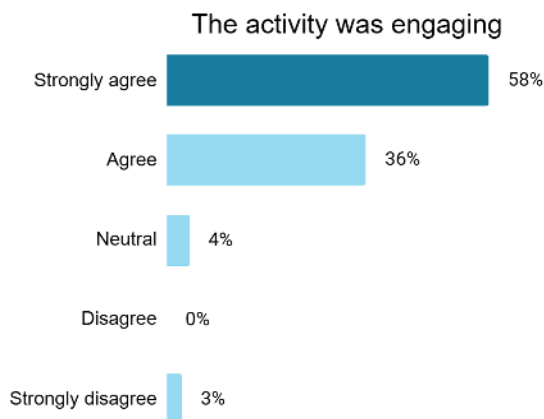


Figure 14. Percentage of self-reported extent of engagement

Interview data

Awareness of the demo objectives

After filling in the surveys, visitors who agreed to participate in the interview provided their insights in relation to the awareness of the facilitated demo objectives and the connections and relevance the activity had for them.

Learning objectives

Participants' interview responses to what the activity was about and what they learned were connected to the main ideas of the learning objectives, in particular, that water begins as precipitation in the mountains and then travels downstream, and that scientists can use isotopes to trace the path of water. About two thirds of the respondents mentioned that the activity was about water in relation to three interrelated emergent themes: composition, origin and movement.

- **Composition:** a theme mentioned often by participants was the composition of water. This included both mention of the elements within water (hydrogen and oxygen), the number of those elements, the shape of the molecule, and the presence of isotopes. Isotopes in particular were included in responses related to the next two themes.

- **Origin:** participants referred to the origin of water in streams and rivers being precipitation, such as the rain. While the terms rain and precipitation were used frequently, there was less mention specifically of snow as a source of water.
- **Travel (how water moves):** respondents frequently stated that water flows. specifically from streams to rivers, and often mentioned factors that influence the movement of the water such as gravity (downhill), elevation (of a place), and levels (of the rain).

Some examples include:

“About where water comes from. Finger prints of water”

“Understanding of rain, distribution of rain water, analyzing Isotopes distribution”

“Measuring Isotopes and rain in various elevations of the Willamette Valley”

“They [sic] are Isotopes in the water to help scientist know where the water comes from depending on the elevation.”

“Rain from lower has more isotopes than up high water molecules are made of 3 things.”

Connections and importance

When asked about how the information in the activity might be important to them or people around them, many respondents noted the role of water in their lives. For example:

“We live in the valley and knowing about rain is important”

“It is good to learn where our water comes from”

“When there is different weather, drought+water. Helpful for [the] ecosystem- to learn how we're connected to water.”

Findings

The evaluation goal was to examine how visitor groups engaged with the facilitated demonstration and how their participation in the activity contributed to their understanding of the learning objectives. In this regard, evidence from the evaluation results suggest that the facilitated demo overall did an excellent job engaging participants with an average dwell time of almost twelve minutes, and that visitors found the experience to be interesting, fun, and easy to understand. Visitors particularly enjoyed the interactive aspects of the activity, pushing the buttons, and collecting and interpreting the printouts. The colors and textures of the exhibit itself were also mentioned as high points of the demo. Regarding the learning objectives, the demo did meet the first objective: *Water begins as precipitation (rain and/or snow) in the mountains and then travels downstream. Scientists can use isotopes to trace the path of water.* Isotopes and precipitation in the form of rain were mentioned by the majority of the participants during their interviews.

This study made no effort to evaluate the facilitators themselves, though inevitably, the facilitator has a great influence on the visitor experience. The order and pace that they present material affects how much can be covered and at what level of detail. While the demo was largely successful in engaging visitors and communicating the primary learning objective, there is potential for greater learning outcomes. The demo itself was designed to provide opportunities to explore different weather conditions (drought, normal and high snow pack conditions) as well as discussions around ground water, and connectivity of rivers and streams. However, the time groups spent at the demo is already at the higher end of what can be expected for a drop in floor experience, so simply expecting visitors to spend more time with the exhibit may not be a viable option. This leads to at least three potential approaches to covering more content.

- 1) Facilitators spend less time on isotopes and precipitation sites, and move more quickly onto other topics,
- 2) Re-order the activities (either based on facilitator choice or visitor preference) so that more groups experience different aspects of the demonstration, or
- 3) Change the venue of the demonstration so that learners have the expectation for a more in depth (longer) experience.

Each of these options has benefits and drawbacks. Perhaps spending less time on isotopes would provide opportunity to explore weather conditions, but would it jeopardise learning about tracing water with isotopes? Rotating the order of the activities would mean that more groups would see different aspects of the demo, but not contribute more to any single group.

The *Isotope Investigators* facilitated demonstration achieved its primary learning objective and provided a fun and engaging experience for visitors. While there are opportunities for improving the approach and context such that more of the demo's potential can be reached, the demo delivered a colorful and interactive opportunity for learners to explore where water comes from and how water movement is affected by the changing landscape and climate. Several educators at OMSI have been trained on the demo and it will be available for use on the floor at their discretion. Furthermore, there have been conversations regarding installing the demo as a permanent feature in the natural sciences lab when it reopens next year. OMSI looks forward to continuing to use this as a resource.

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Appendix A: Observation instrument

Headwater Streams Summative_Observation form

Group #:

Total time spent:

Date:	Observer:	Notes about the group:
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Group ages (circle your focal individual): 0-5___ 6-10___ 11-14___ 15-18___ 19-29___ 30-49___ 50+___

(↑ Write M for each male, F for each female, X when no guess is made) How does the group engage with the activity?

Engagement indicators	Description	Notes (Give examples of what they say or do)
Emotional response (check all that apply at any point of the activity)	☐ Bored ☐ Annoyed ☐ Relaxed ☐ Curious ☐ Excited Other (your suggestions):	Make notes about how they express curiosity, excitement, etc., e.g. "Wow, that looks cool!"
Seeks information about the topic(s)	☐ Read signage ☐ Examine the landscape (e.g. touch, walk around) ☐ Ask questions about the activity/topic(s) (e.g. What do these colors mean?)	
Shares information about the topic(s)	☐ Respond to facilitator's questions and prompts ☐ Share observations with facilitator/group members ☐ Explain concepts/ideas to group members	
Makes meaning of topic(s)	☐ Make connections to prior knowledge or past experiences (e.g. I studied this at school; It was snowing when we went skiing) ☐ Identify patterns or insights within the activity (e.g. patterns between elevation and isotope levels; color of the streams and elevation) ☐ Identify impacts on larger systems (e.g. impacts of drought years on agriculture, ecology, etc.)	
Completes the activities	Explore isotope model and discuss isotopes in water: ☐ Once (leave blank if didn't complete) Collect precipitation sample: ☐ Once ☐ Repeat Discuss/interpret precipitation sample: ☐ Once ☐ Repeat Adjust snowpack conditions and discuss: ☐ Once ☐ Repeat Collect samples from rivers/streams and discuss: ☐ Once ☐ Repeat Other activities (e.g. discussing colors): ☐ Once ☐ Repeat	
Most of the interaction was...	☐ Primarily between facilitator and the group (one person talking, many listening) ☐ Primarily between members of the group (participants discussing among themselves with minimal facilitator involvement) ☐ Balanced mix	

Appendix B: Operational definitions

For the observation instrument, Complete the activities:

Activity	Once	Repeat
Explore isotope model and discuss isotopes in water	Interact with the model (jars with beads inside), respond to facilitator's questions and prompts, share what they (individual) already knew about water composition and isotopes (e.g. talking about hydrogen and oxygen; isotopes are same elements, but with a different weight), etc.	N/A
Collect precipitation sample	Press the button next to one of the Precipitation Zones and print the receipt	Complete the process once more/ multiple times with different precipitation site(s) (e.g. first time did Zone 1, then repeated with Zone 2)
Discuss/interpret precipitation sample	Read the numbers on the receipt that show elevation and isotope values. Discuss what these numbers might mean (e.g. identifying patterns between elevation and isotope values.)	Complete the process once more/ multiple times with different precipitation site(s) (e.g. first time did Zone 1, then repeated with Zone 2)
Adjust snowpack conditions and discuss	Select one snowpack condition by turning the knob on the side panel (heavy snowpack year, moderate, and drought years) and interpret the precipitation patterns and isotope trends	Complete the process once more/ multiple times with different snowpack condition(s) (e.g. first time did heavy snowpack year, then repeated with moderate year, then - with a drought year)
Collect samples from rivers/streams and discuss	Collect river/stream samples from various elevations and discuss the differences in isotopes and what they might mean	Complete the process once more/ multiple times with different river/stream sites from different elevations (e.g. first time did river C at 400m, then repeated with Stream 3 at 600m)
Other activities	Any extension activities following collecting samples from rivers/streams, such as discussing the colors on the rivers and streams	

Appendix C: Survey instrument

Headwater Streams Summative evaluation_Survey

Date:
Group
number:
Interviewer:

Please select what best describes your experience with this activity.

1. How new was the information in this activity to you?

- a. Mostly or entirely new and I learned a lot
- b. Somewhat new and I learned a bit
- c. Mostly familiar - I learned little or nothing
- d. Already knew it all

2. How interesting did you find it?

- a. Very interesting
- b. Somewhat interesting
- c. Not very interesting

3. To what extent do you agree with the following statements: "The activity was..."

<i>Fun</i>	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
<i>Easy to understand</i>	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
<i>Engaging</i>	Strongly agree	Agree	Neutral	Disagree	Strongly disagree

Appendix D: Interview instrument

Headwater Streams Summative evaluation_Interview guide

Date:
Group
number:
Interviewer:

Mark who is responding: ____ Youth ____ Adult(s) ____ Everyone in the group chimes in

- 1) **If you told your friend about this activity, what would you say it is about?**

- 2) *If selected “learned a lot” or “learned a bit” in question 1 of the survey:* **Can you tell me more about what you learned in this activity?**

Follow up: **Was there anything in this activity that you’d like to learn more about?**

- 3) **Can you think of how any of the information here may be important to you or people around you?**

- 4) **What was the most interesting or exciting thing you did or discovered during this activity?**