

**Old Faithful Visitor Center
Yellowstone National Park
Front-End Evaluation
Final Report**

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EXECUTIVE SUMMARY

The Yellowstone Park Foundation is partnering with Yellowstone National Park (YNP) to develop and build a visitor education center at Old Faithful. Selinda Research Associates (SRA) worked with staff from Yellowstone's Division of Interpretation to plan and conduct a front-end evaluation of the exhibits for the new center. The evaluation was grounded in naturalistic methodology and used a variety of methods to triangulate on park visitors' understanding of and reactions to a variety of issues. These methods included in-depth interviews with visitors both before and after their visits and card sorts and drawing activities to delve deeper into visitors' understandings of the park. Here are some of the major findings of this study:

- **Why visitors came to Old Faithful.** Respondents told us that they came to Old Faithful for a variety of reasons, and the reasons often involved a complex mix of emotions and reasoning. One theme we heard repeatedly: Visitors felt they *had* to come here, and that Old Faithful was something they couldn't miss. The forces that compelled these visitors seemed to be a mix of positive forces ("It's a wonder of the world!") and less positive ones ("If my friends found out I came to Yellowstone and didn't see Old Faithful, they'd think I was crazy!")
- **Learning about Yellowstone.** Learning seemed to play at least a moderately important role in the Yellowstone experience for most of the groups we spoke with. At least one member of most groups had sought out information about the park before the visit (including watching what seemed to be a very effective special on the Discovery Channel); almost all respondents learned from a variety of sources within the park or just outside its borders; and some followed up their visit to the park with visits to the library, or by finally getting around to reading the books and brochures they obtained in the park. For those who stayed in the park for several days, learning about the park seemed to be a cumulative process. They often went through several learning experiences about the same or similar topics and came away with new information and deeper understanding each time. Some groups seemed to be on the way to developing shared "islands of expertise" about Yellowstone. Although respondents who were just passing through did less advance preparation, even they seemed interested in learning about what they saw in the park. Respondents who said they didn't want to learn scientific concepts about the park often wanted to use the visitor center to find out about where to go next, seeing wildlife in the park, or other things that would guide their exploration of the park.
- **Connecting concepts.** Based on our word sorts, it seemed that respondents had trouble connecting what they already understood about geology and the Earth's subsurface to the hydrothermal features they saw in the park. Key steps in building visitors' understanding seemed to be (1) realizing that the geyser basins of Yellowstone lie within an active volcano, and (2) understanding the "plumbing system" that circulates water from hot subsurface rocks to the park's geysers and other hydrothermal features.

- **Understanding geysers.** We challenged respondents to depict their understanding of how geysers work by making a cross-section drawing. Most of them demonstrated that they understood (or were able to figure out on-the-spot) at least a few of the basic components of the geyser's system. However, respondent's more accurate understandings were often mixed with misunderstandings about, for instance, where and how water moves underground.
- **Science behind the scenery.** Many of our Yellowstone respondents either knew about scientists working in the park or assumed they had to be somewhere, behind-the-scenery, doing their work. Many of them emphasized the importance of scientists communicating directly with the public. Some representative comments: "All of the information we know was developed by scientists....They enable us to understand," and, "You need a scientist to tell you what's really going on." Visitors seemed to want to stay informed about the intellectual adventure of understanding the park's geology and biology; however, there also seemed to be a somewhat self-centered, almost "what's in it for me" aspect to some of these comments. Our respondents seemed less knowledgeable in the role that science plays in wildlife conservation and park management.
- **Prioritizing the subthemes (or not).** Although most respondents were willing to prioritize the subthemes, this turned out to be a difficult task, with no single subtheme emerging as a top choice. Using the short phrasings of the subthemes, "Yellowstone's volcanoes-past, present, and future," and "Yellowstone's geysers, mud pots, fumaroles, and hot springs" came out slightly ahead for reasons that will be detailed in the final report. "Old Faithful-cultural icon, place of pilgrimage, and shared legacy" received a slightly overall lower priority (although this was also rated highest by some). There were indications that this slightly lower rating may have to do with an objection to the "commercialization" and crowding of the Old Faithful area. What we found vastly more interesting than the ranking of the subthemes, were the reasons behind the ratings. Our analysis of these reasons is more important than the actual ratings themselves and is covered in detail in this report.
- **Visitors' preferences for exhibits.** Another common thread that we heard from all sorts of visitors, including parents, grandparents, and those without kids: Make the exhibits interactive, hands-on, and "fun for the kids." We're wondering if the increasing prevalence of children's museums and science centers has changed many people's expectations about what a museum (or visitor center) should be like. We also got the impression that some of our adult respondents enjoyed this sort of exhibitry at least as much as their kids and grandkids.
- **What time will it erupt?** The most frequent suggestion we heard for the new visitor center: Post the predicted time of the next Old Faithful eruption in one or more places that can be seen from the boardwalk (and also within the exhibit area).

This report concludes with recommendations about prioritizing the proposed subthemes for the exhibit, simplifying the thematic outline, and developing exhibits that can excite and inspire a wide range of visitors to Old Faithful.

INTRODUCTION

The Yellowstone Park Foundation is partnering with Yellowstone National Park (YNP) to develop and build a visitor education center at Old Faithful. The new center will include approximately 8,000 square feet of exhibit space, which will interpret Yellowstone's hydrothermal features. The primary theme for the exhibition will be: "Yellowstone National Park protects the rarest collection of geysers and hot springs on Earth." Individual exhibit elements will interpret a wide range of geological, biological, and cultural subthemes related to this primary theme. Selinda Research Associates (SRA) worked with staff from Yellowstone's Division of Interpretation to plan and conduct a front-end evaluation of the exhibition.

Our overarching research question for this evaluation was:

What can we learn about actual and potential visitors' understandings, feelings, and expectations about Yellowstone's geyser basins that will help us make the new visitor center exhibits exciting, inspiring, and informative for the broadest range of visitors?

[Appendix A](#) includes a detailed topical framework outlining the specific questions addressed during the evaluation.

METHODOLOGY AND METHODS

Methodology

This evaluation was grounded in naturalistic methodology, because we have found that a naturalistic methodology works best to investigate questions that must be answered during exhibit development and design. Naturalistic inquiry is a rigorous approach to understanding experiences in the natural context in which they occur. It usually includes collecting data from a variety of sources and triangulating that data to develop a thorough understanding of the subject of investigation. The goal of naturalistic methodology is to provide a holistic understanding of an audience from a variety of perspectives.

This approach to visitor research is particularly useful in parks because these institutions have different types of visitors with varied experiences, interests, and levels of knowledge. Rather than looking for an "average" experience, naturalistic inquiry aims to describe the range of visitor experiences and understandings. As such, it is a powerful tool for interpretive planners, because they are concerned with reaching multiple audiences.

Naturalistic inquiry relies to a large extent on qualitative data. One of the strengths of naturalistic evaluation is that unanticipated findings often emerge from the data, often in visitors' own words. This type of inquiry allows for the researcher to follow up on threads and themes that characterize how visitors think about their experiences. This approach also allows the interpretive planning team to develop a rich understanding of the ways in which visitors may react to and learn from the planned exhibition.

Methods

Data collection for the front-end evaluation methods included two phases:

- **Phase One – An Analysis Of What We Already Know:** This first phase of the evaluation study focused on what was already known about the visitors to Yellowstone and their experiences within the park. It included a) interviews of selected staff at Yellowstone, and b) a review of the existing literature to investigate potential visitors' understandings of key scientific concepts behind the topics proposed for the exhibition. The product of this phase was an extensive review (Gyllenhaal, 2002), which helped us develop protocols for selecting and interviewing visitors and potential visitors during the second phase of the project. We refer to this review many times in this report.
- **Phase Two – An Analysis Of How Visitors Think And Feel:** The second phase of the front-end evaluation is the subject of this report. The goal of this phase was to develop a deeper understanding of how visitors think and feel about the park and about the main theme and sub-themes of the proposed exhibition. We felt that it was important to seek perspectives from park visitors both during their visit to Old Faithful and after they left Yellowstone. Therefore, we interviewed visitors both on site, on or near the boardwalk around Old Faithful, and by phone, about six weeks after their visit had ended and they had had some time to reflect on their experiences.

The rest of this section details the methods used in Phase Two.

Depth Interviews On Site

We made two site visits to the Old Faithful area in Yellowstone National Park. The first visit was August 2-7, 2002, by Eric Gyllenhaal, and the second site visit was September 9-12, 2002, by Linda Pulik. During these visits, we conducted depth interviews with visitors to Old Faithful. A depth interview is an open-ended and relatively unstructured conversation between a researcher and one or more respondents. Although a protocol was used to guide our depth interviews and ensure that important topics were covered, we often added additional questions and probes during an interview to follow up on interesting topics and themes introduced by the respondent.

The interviews took place at one of two locations. We initially stopped visitor groups as they were walking towards the parking lot after an eruption of Old Faithful and invited to join us for an interview in the enclosed breezeway area, a comfortable seating area between two wings of the Old Faithful Inn. The response rate to this approach was very low—perhaps one in seven groups accepted our invitation. Therefore, we began interviewing visitor groups who were seated on the benches around Old Faithful waiting for the next eruption (Fig. 1). We started approaching visitor groups about 45-60 minutes before the next predicted eruption. We emphasized in introducing ourselves that our interview would be an interesting and fun way to occupy their time before the next eruption. The response rate to this approach was

much higher—we often conducted three or four interviews in a row without a single refusal. As a result, almost all the depth interviews were conducted on the boardwalk.



Figure 1. Visitor seating on the boardwalk near Old Faithful.

Respondents were purposively selected and asked to participate in an interview. (See the [Respondents](#) subsection, below, for details about the sampling procedures.) The on-site interviews followed a protocol developed in collaboration with the client ([Appendix B](#)). We did not always follow this protocol exactly. Often we used probing questions to elicit the extent to which the respondents understood the concepts under investigation; when interesting new threads appeared, we followed up with additional probes. We tried to keep the interviews brief (20 minutes or less) and fun (concentrating on doing and discussing activities, like the sorts and drawings discussed below). We also tried to involve all children and adults in each group. When possible, we assigned each group member at least one activity (sometimes two), and we asked them to comment on other respondents' work.

At the conclusion of the interview, we gave each group one or more gifts from the National Park Service. Each group received a copy of the hardcover book, *A Yellowstone Album: A Photographic Celebration of the First National Park*. We also offered younger children a small puzzle with a photo of a wolf, bison, or other animal native to Yellowstone National Park.

For the most part, respondents seemed to enjoy the interviews. Many respondents offered a handshake at the end of the interview; three groups asked the researcher to autograph their gift book, and three groups posed the researcher for photos.

Immediately after the interview, the researchers completed a written debrief summarizing their findings and overall impressions of the interview. Most of the interviews also were tape recorded with the permission of the respondents. The tapes were transcribed, and the transcriptions were included in the later stages of data analysis.

Our on-site protocol included the use of card and word sorts, to investigate how respondents made connections among Yellowstone-related concepts, and a drawing activity, to investigate respondents' understandings of how geysers work. These techniques are discussed in the next two subsections.

Card/word sorts. Card sorts are an evaluation technique frequently used to engage visitors in a concrete activity that helps the evaluator understand how the visitors are thinking about things. Traditionally, the researcher uses words written on 3x5 cards, one to a card. Respondents are asked to sort these cards in various ways, either grouping them into categories or sometimes a hierarchical structure, depending on which words are used and the respondent's understanding of those words (Fig. 2). They are then asked to discuss their groupings with the evaluator. The ways in which they talk about the words and their groupings gives the researchers a clearer picture of how they understand the concepts. This technique is particularly useful when dealing with scientific concepts.

Although the traditional approach to card sorting worked well in the Old Faithful Inn's breezeway, we needed a different technique for the wind-blown boardwalk around Old Faithful. We developed a new technique using magnetic strips on an 11" by 14" magnetic white board (inspired, in part, by an article by Britton & Wandersee, 1997). First we laminated the strips to pastel green cardstock, which we labeled with a black Sharpie (Fig. 3). This technique was rather laborious, and the strips started to delaminate after a few uses. Therefore, starting with the second day of boardwalk interviews, we wrote the words directly on strips of light-colored magnetic sheet cut to size (Fig. 4). We also offered respondents a dry-erase pen, which some used to organize, label, and explain their work (Fig. 5)



Figure 2. Example of card sort, placed on a tabletop. (S080301A)

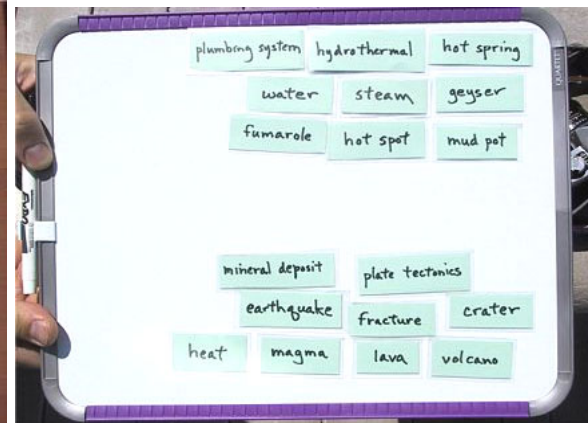


Figure 3. Example of the magnetic word-sort technique. (S080403B)

We discuss the system for analyzing and scoring the drawings later in this report in the subsection entitled [Relationship Between Park Geology and Hydrothermal Features](#).

[Appendix C](#) lists the words used for three content-area word and card sorts. [Appendix D](#) lists the sentences/phrases that describe the five subthemes proposed for the exhibit. Because there were only five subthemes, it was convenient to hand these to respondents as a set of five cards, even on the boardwalk. The respondents then arranged and discussed the cards in order of priority.

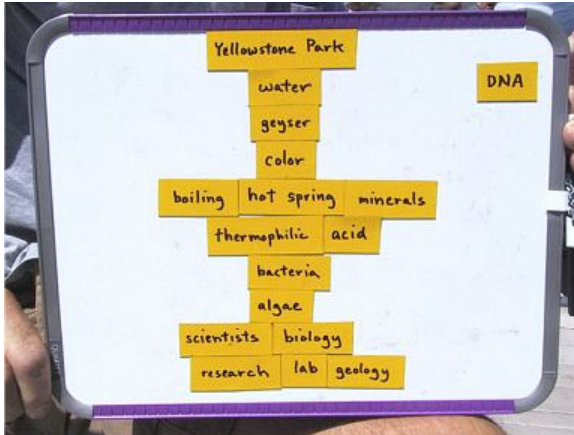


Figure 4. Word-sort technique, with words written directly on magnetic strips. (S080602B)

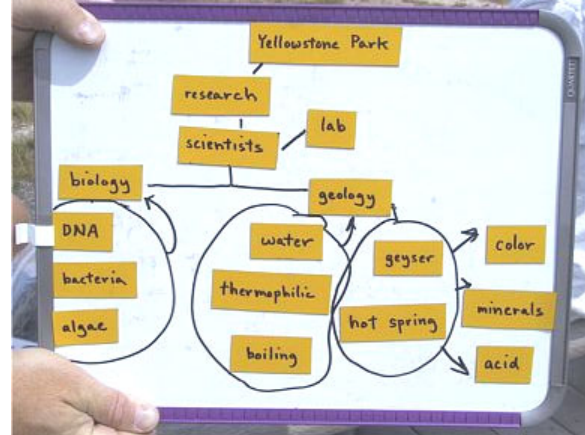


Figure 5. Word-sort technique. The respondent used a dry erase pen to organize and explain his work. (S080603A)

Visitors' drawings of Old Faithful. To aid our investigations of visitors' understandings about how geysers work, we gave selected respondents a second 11" by 14" white board and a set of dry-erase pens (black and colored). We asked them to draw a picture of Old Faithful with the surface part of the geyser at the top of the board and the underground portion below, so they could show us how a geyser works. We told respondents that, if they were unsure how a geyser works, they should use their imaginations. As seen from the examples of completed drawings are shown in Figures 6 and 7, most respondents labeled their drawings with words and/or numbers, to explain aspects of geysers that they had trouble illustrating.

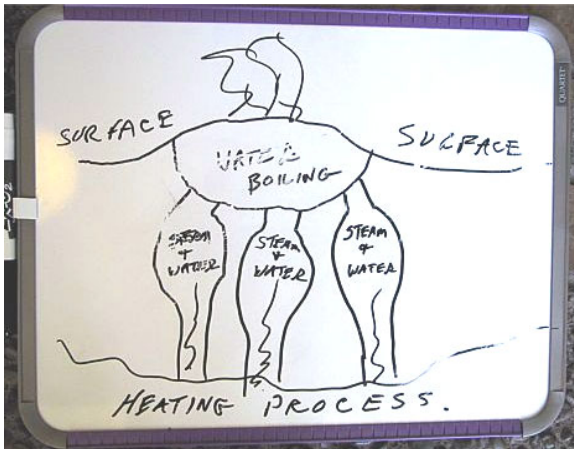


Figure 6. Example of a drawing made by a respondent. (D080502A)

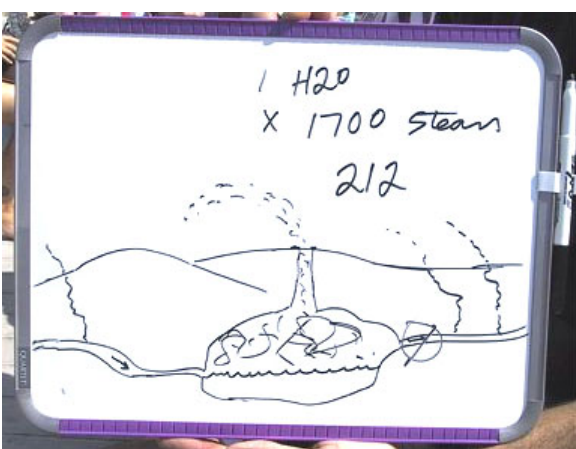


Figure 7. Example of a drawing made by a respondent. (D080504A)

Once the respondents were finished with their drawing, we discussed their efforts. If the respondents did not volunteer information about the heat source, water source, and so forth, we asked questions about these parts of the system. Our analysis of the drawings includes

both the drawings themselves and these discussions. We discuss the system for analyzing and scoring the drawings later in this report in the subsection entitled [How Geysers Work](#).

Depth Interviews by Phone

During the August site visit to Yellowstone National Park, SRA staff distributed and collected short questionnaires to visitors in the Old Faithful area. After some experimentation, we decided to both distribute questionnaires (with clipboards and pencils) and collect the completed questionnaires on the boardwalk between Old Faithful and the current Visitor Center for 10 to 15 minutes following eruptions of the geyser. (We also offered respondents the option of dropping their completed questionnaires in a drop box located in the Visitor Center.) Although the response rate was low (perhaps one in three or four groups accepted a questionnaire), this approach allowed us to purposively select groups that seemed in a hurry to leave the Old Faithful area, as well as groups who seemed to take a more leisurely approach to their visit.

The one-page questionnaire ([Appendix E](#)) elicited basic demographic information, information about the type and size of the respondent's group, mode of transportation, where they spent the previous night, how long they have been in the park, and how much longer they planned to stay. It also asked for phone numbers and e-mail addresses where the respondents were willing to be contacted during the day or evening several weeks after their visit.

The post-visit interviews were conducted by telephone by SRA staff, following a protocol developed in collaboration with the client ([Appendix F](#)). Immediately after the interview, the researcher completed a written debrief summarizing his or her findings and overall impressions of the interview. Most of the interviews were tape recorded, with the permission of the respondent. The tapes were transcribed, and these transcriptions were included in the later stages of data analysis. When the interviews were complete, each respondent was mailed a small token of appreciation (a set of Yellowstone postcards).

Respondents

Respondents for the interview phase of the study were purposively selected (Miles & Huberman, 1994). In purposive sampling, each respondent is handpicked for certain characteristics. The goal of this sampling technique is to talk with respondents who are as different from each other as possible in order to elicit the widest range of responses as possible (unlike random sampling, which looks at the average and is generally not concerned with those outside the mean). Understanding the experiences of a broad range of visitors was particularly important to this study, because the Visitor Education Center must reach multiple audiences, intergenerational groups, and traditionally underserved populations (e.g., racial minorities and lower socioeconomic groups). In addition, because of the limited resources for this study, this approach allowed us to obtain information from a broader group of respondents in a relatively short period of time. Because purposive sampling deliberately selects respondents (i.e. the sample is not randomly generated), percentages are not reported in the results.

In the on-site visitor interviews, the main characteristics that helped determine group selection included: a) group composition (including groups with children, groups of adults, and tour groups); b) age (mix of age ranges in groups, e.g., elderly visitors, teen or young adult groups, groups with children in different age ranges); c) gender; and d) apparent racial/ethnic background (as wide a range as possible). During data collection an initial group was selected, and subsequent groups were selected based on the agreed upon characteristics. Generally, the evaluator selected a group which was as different as possible from the previous group observed.

We conducted a total 31 depth interviews, 19 during the August site visit and 12 during the September visit. Since two interviews included members from more than group, we interviewed a total of 32 groups while on site at Old Faithful. Most interviews included several members of a group, so that we actually interviewed a total of 91 visitors during this part of the study. Information about these respondents is included in [Appendix G](#).

We selected groups to approach with the phone questionnaire based on the same range of characteristics as the depth interviews: group composition, age, gender, and ethnic background. Once we convinced a group member to accept a questionnaire, we selected the next group so that it would be as different as possible from the previous groups. In addition, as we collected the completed questionnaires, we made note of which subgroups seemed underrepresented in our sample. During the last two days of data collection in August, we made a special effort to approach these sorts of groups so as to broaden the diversity of our sample. We obtained about 120 completed questionnaires during our August site visit, allowing us to purposively select a range of visitors for phone interviews and to account for visitors who we were unable to contact during the phone interview study.

Respondents for telephone interviews were selected based on demographic and other informational questions that they answered on their survey forms. As we selected respondents for post-visit phone interviews with park visitors, some of the characteristics we used were the same as for the on-site interviews, including: a) group composition; b) age; c) gender; and d) apparent racial/ethnic background. In addition, we were able to select visitors to call based on characteristics related to their visit, including a) where they live (close or far from the park; USA or another country); b) how long they planned to stay in the park (day visitors, several days, or a week or more); c) where they stayed overnight (campers, park inns and cabins, or outside the park); and d) how their visit to Old Faithful fit into their overall visit to the park (early or late in their visit).

We completed 20 phone interviews, mostly during middle to late September (usually five to seven weeks after a respondent's visit to the park). Information about these respondents is included in [Appendix G](#).

Data Analysis

Interview data was ware analyzed using inductive constant comparison (Lincoln & Guba, 1985), whereby each unit of data is systematically compared with each previous unit of data. In constant comparison, concepts emerged from data units and then were elaborated or modified by the researcher as incoming data were meticulously compared to against previous

data units. This allowed us to continually identify, develop, and refine categories of data and interesting themes as they emerged.

Limitations

Due to limited resources, this study was necessarily limited in scope. For instance, when conducting an evaluation study using naturalistic methodologies, it is standard practice to continue collecting data until a *state of redundancy* is reached. Redundancy is the point at which no new information is gleaned, despite repeated attempts to elicit additional findings. We seem to have achieved redundancy on many of the issues we listed in the topical framework.

However, due to our limited time in the field, we were not able to reach a state of redundancy with all aspects of this study. In most cases this does not appear to be a major limitation, because we still have broad range of responses. For instance, we used the drawings to define a broad range of understanding about geysers, although if we had more time we probably would find even more interesting variations in respondents' alternative understandings and in their combinations of alternative and scientific understandings (which most respondents showed).

We received a more limited range of responses in some areas of the study. For instance, most respondents knew very little about thermophilic life, so we were unable to map out the ways that visitors *did* understand this subject in any detail (because most respondents barely made it onto the map). Also, some new issues came up during our investigation, and we were unable to explore them in depth. For instance, there seemed to be differences in the ways that females and males responded to the geyser drawing activity, but we lacked time to investigate this issue in satisfactory detail. Where appropriate, we identify issues that warrant further exploration, should funds be available at a later time.

We also recognize that the audience for Old Faithful is extremely broad, and our limited sampling has not done justice to its diversity. Our sample of visitors seems to under represent the following groups:

- Visitors who were in such a hurry to move on that they would not stop to be interviewed or to complete a questionnaire.
- Ethnic and racial minorities.
- Visitors from Asia and many other parts of the world. (We interviewed some visitors from Canada and Europe.)
- Visitors who came mainly for recreational activities, such as fishing.
- Local residents.
- True off-season visitors, who come in late fall, winter, or early spring.
- Visitors who disliked the development and crowding near Old Faithful and avoided that part of the park.

Where appropriate, we identify issues that seem particularly vulnerable to the biases in our sample.

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VISITORS AND OLD FAITHFUL

As we talked with visitors in the park and over the phone, we were surprised at their broad range of emotional responses to Old Faithful, and at the mixed feelings that some respondents expressed about their Old Faithful experience. This became clear as we discussed the reasons they came to Old Faithful and their expectations about the geyser.

Why They Come

Respondents told us that they came to Old Faithful for a variety of reasons, often involving a complex mix of emotions and reasoning. One theme we heard repeatedly was that visitors felt they *had* to come here; Old Faithful was something they could not miss. The forces that compelled these visitors seemed to be a mix of positive forces ("It's one of the wonders of the world!") and less positive ones ("If my friends found out that I came to Yellowstone and didn't see Old Faithful, they'd think I was crazy!")

In discussing their motivations, some respondents talked about how Old Faithful fit into their trip:

- **It's why they were there.** Some respondents said they came to the Yellowstone to see Old Faithful.

It's the main reason why we're coming to Yellowstone National Park. I mean, Old Faithful!
(0909024)

It was my primary destination. (0910027)

- **It was on the way.** Some respondents said Old Faithful was not their major destination—it was just on the way to a destination outside the park.

It was an attraction on the way to where we're going. (0910026)

Yellowstone wasn't our main destination on this trip. We were going to Jackson for some fishing. So, passing through Yellowstone was just a way to kind of see Old Faithful. (P0926021)

- **It was on the loop.** Some respondents said Old Faithful was one of a series of features that they visited during a prescribed journey through the park.

We made the loop....We came up through the south entrance and made the loop, and we wanted to definitely see Old Faithful. (0805025)

It's part of the park circuit and all those geysers and everything else that there is to see.
(0910021)

- **It's predictable.** Some respondents who were pressed for time talked about the practical aspects of Old Faithful's predictability.

There is another geyser in the park that erupts much higher than Old Faithful. But it's very unpredictable....They would say any time between seven and eleven PM it might erupt, and it could go up to 200 feet, or so. I don't think Old Faithful quite goes up that high. But Old Faithful is just so predictable. (P0922021)

Respondents also discussed the significance of Old Faithful in a number of different ways:

- **Personal significance.** Many repeat visitors discussed their personal connections to the geyser. Some respondents said they had fond memories of visiting as adults, and many others spoke fondly (and sometimes not so fondly) of childhood visits to Old Faithful.

It was our honeymoon here. We had the honeymoon suite [at Old Faithful Inn]. (0803022)

I grew up in Boise, Idaho, and my grandmother, my Dad's mother, lived east of the park, east of the east entrance, about 100 miles. So, as a child, we drove through the park a couple times a year to go see grandma. And sometimes we'd just zoom right through, because we were in a hurry. And other times, we'd get to stop and see different things. And sometimes, we'd actually spend the night or stay a couple days. So, as a child, I remember coming. (0804025)

My very first time that I saw it, I puked afterwards. (P0914021)

- **Significance within Yellowstone Park.** Some respondents described the strong association between Old Faithful and Yellowstone National Park; they saw the geyser as a symbol of the park.

When I think of Yellowstone, I think of Old Faithful. (0805024)

It's the premier attraction at Yellowstone. (0910022)

It's quintessential to Yellowstone. That's what everyone thinks of when you think of Yellowstone, you think of Old Faithful and bears. (P0918022)

- **National and international significance.** Others talked about Old Faithful's national and international reputation.

It's like a national monument. It's like going to the Statue of Liberty. (0910025)

Just the fact that it's so famous, too. We didn't want to come all the way out here and not see it. (0910024)

It's one of the wonders of the world! (0805023)

Some respondents said they visited Old Faithful for someone else, and some said they visited just for themselves.

- **For the children.** We heard this from many parents.

[I came here] probably primarily because I have two children, you know. (P0914021)

My wife and I had been out there, eight or ten years ago. And now, we have a seven and nine-year-old child, and we wanted them to go up there and have the experience, too. So, we stopped there mainly because we wanted our kids to see it. (P0922022)

- **For out-of-town guests.** We sometimes heard this from local residents showing the park to guests or from respondents playing host to foreign visitors.

We had a visitor from Europe, to be quite honest, and this was probably the only time she would ever see this in her life, and it looks bad if you go back and you didn't see Old Faithful. (P0902021)

- **For themselves.** Some respondents made it clear that they, personally, wanted to experience Old Faithful.

Just to see the magnificent geyser erupting. It's a beautiful view. (P0917022)

As predicted by the staff members interviewed for the earlier report (Gyllenhaal, 2002), many respondents seemed very sincere in their affection for the geyser, and they really connected with the subtheme that described Old Faithful as a “cultural icon, place of pilgrimage, and shared legacy.” However, other respondents were not as sentimental about Old Faithful, and some outright rejected the “cultural icon” subtheme.

We also were a bit surprised to find that some respondents visited the geyser out of what seemed to be almost a sense of obligation. They said things like:

That's just what you are supposed to do when you go to Yellowstone. (P0919022)

Once you go to Yellowstone, you have to see that, you know? (P0918021)

Why Old Faithful? It's required. (P0920021)

Although many respondents seemed to be saying this in jest, we think there's some truth to it. Some respondents suggested that people who knew they had been to Yellowstone would ask about Old Faithful. If they had not seen it, their friends would be disappointed in them.

If you say, “We went to Yellowstone,” and somebody asks you, “Did you see Old Faithful?”, you can say, “Yes.” Because that's what most people think of when they think of Yellowstone. (0803024)

Based on responses like these, we developed a “reverse status” hypothesis for why some people come to Old Faithful: “People do not gain much status with their friends and family

by going to Old Faithful—after all, everybody does it, right? On the other hand, if they go to Yellowstone and don't go to Old Faithful, they will lose status." Some older children and teens articulated something like this hypothesis in their own words. With adults, we had to seek confirmation by asking, "If your friends back home found out that you went to Yellowstone and didn't see Old Faithful, what would they say?" One respondent replied, "They'd say we were crazy!" We asked this respondent, "Would they be right? She answered, "Yes!" and laughed.

However, the "reverse status" hypothesis did not apply to all visitors. As mentioned above, some visitors seemed very sincere in their interest in the geyser. At the other extreme, a 14-year-old respondent said that her friends "don't care if I don't come," and that she did not particularly want to be here. This respondent seemed beyond the reverse status hypothesis—she was so negative about her whole trip that this theory did not apply to her. However, we detected some degree of obligation in many respondents' answers. For many, it was an obligation they happily fulfilled, but it also seemed like something they could not afford to miss.

A few respondents did not seem to have thought much about why they came to Old Faithful—they were just on vacation, or they "wanted to get out of the house."

So, although many visitors seemed to feel a strong emotional attachment to the geyser, exhibit developers cannot assume that all visitors feel this way. This conclusion should be kept in mind later in this report, when we discuss prioritizing the subthemes.

Meeting (and Failing to Meet) Visitors' Expectations

The visitors who we talked to expressed a broad range of expectations about Old Faithful—even broader than the range of expectations discussed in the first report (Gyllenhaal, 2002). Some respondents said that they had no expectations for the geyser to meet, but many others admitted to expecting something and told us how their Old Faithful experience met, or failed to meet, their expectations.

Some respondents told us about the range of ways in which Old Faithful met or exceeded their expectations.

- **Met their high expectations.** Even visitors who arrived with high expectations sometimes found them met or exceeded.

You know, my Dad would tell me as a kid that he'd gone to the park and seen it, and how it was so hard to describe when it erupts, to see the height and the magnitude of that water bubble and burst out of there. And until you're standing right there in front of it and see it just build up and build up and build up, and then, to be able to stay erupting at that height for that length of time. And then, it just kind of slowly disseminates. You can sit there and time them. And it's kind of unique that how long it erupts will depend on the time before the next eruption—it was really, really, remarkable. (P0917022)

- **Exceeded their low expectations.** Some respondents said they had relatively low expectations but that they were exceeded by the actual experience of Old Faithful.

I didn't expect much of Old Faithful. I was just expecting another geyser. But actually, it was—despite the fact that we were not very close to the geyser, it was really—well, as it was the first geyser I was actually seeing erupting, it was amazing. And I wasn't disappointed by what I was seeing. (P0918021)

- **It was as faithful—or more faithful—than they expected.** Some respondents were impressed that Old Faithful erupted as predicted. Others had not expected it to be quite that predictable.

I guess, the thing that meets your expectations, it always shoots up. It's Old Faithful, it's reliable. (P0902021)

I don't think it matters whether it's big or small, it's just incredible that it does go off in a timely fashion. (0909021)

I was pleased with the fact that it erupts almost consistently, where they can kind of predict the time. I wasn't aware that that was possible. I just thought you had to go and take your chances to see if it erupts or not. So, it was kind of nice that they had the approximate times posted. (P0919022)

- **Other aspects of the experience contributed to their satisfaction.** Some respondents said they were impressed by the geyser, but they also felt that the wait, the crowds, and other aspects of the setting helped set up the experience.

Old Faithful, itself, was a big, spectacular geyser. And I think the effect is built by waiting for it and by having so many people from so many countries joining together. (P0920021)

I like the fact that they provide seats around it, because it's such a big draw, a crowd pleaser. There were so many people. It was nice that you had the tiered seats so everybody could see it. (P0922021)

Old Faithful also failed to meet some respondents' expectations, again for a range of reasons:

- **Expected a bigger eruption.** Some respondents said they expected the geyser to be larger, higher, louder, and so forth, and they were disappointed when Old Faithful failed to meet their expectations.

I was disappointed. I thought it was going to be huge. (0910025)

I expected it to be really, really a lot higher for a longer time than—maybe 30 seconds—because it was only high for a little while. Then, it got really low. (0803024)

Old Faithful, itself, was kind of—I don't know. Kind of a fizzle, I think. It just didn't geyser up as far and high as I thought it would. I thought somewhere along the line, seeing all these pictures, it kind of looks like it's shooting hundreds of feet in the air...I guess it's anticlimactic. That's the word I'm looking for. (P0917021)

- **It did not live up to their previous experiences.** As our staff informants had warned us during interviews earlier in the summer (Gyllenhaal, 2002), repeat visitors sometimes said Old Faithful did not live up to their expectations. Although some respondents said Old Faithful was as they remembered it from previous visits, others were less satisfied with their repeat experience.

I think it's like anything in the world. The memory is usually better than reality. (P0919025)

I can remember as a kid it seemed like it was huge and then when I was back here working, it didn't seem quite as huge. I guess that's the way it goes. As you get older things don't seem quite as big as they were. (0909021)

- **The wait was “too long.”** Some respondents said they had to wait too long or wished the geyser erupted more often.

The wait was kind of a bummer, because we missed it twice, because we were in the gift shop, or whatever. (P0926021)

I thought it went off little more often...But I read something there, I believe, that indicated earth tremors, earthquakes, or something had changed the timing a few years ago. So, I understood. (P0919025)

- **The weather interfered.** Some respondents complained that it was too windy or cloudy, and Old Faithful did not live up to the photos they had seen, photos taken in calm, sunny weather.

I think the fact that it rained, probably, and the sky was gray, was a little disappointing. It wasn't that spectacular with the gray sky in the background. (0803024)

It was a windy day. So, it wasn't like it just shot up. You know, the beautiful pictures you see with the blue, pristine (inaudible). So, it was a little windy. So, the mist was carried. So, it didn't look as grand, I think. (P0919024)

- **Other aspects of the experience decreased their satisfaction.** Some respondents said they were disappointed because of the developments in the Old Faithful area, or because of other factors not directly attributable to the geyser.

It was the only thing in the park that reminded me a little of Atlantic City. You know, the boardwalk and all the people...I guess it's because it's been there so long and you've got the lodge and all that. I mean, Old Faithful isn't natural—isn't in a natural setting. (P091302)

It's almost like going to a concert or something. (0910026)

I wish we had known a little bit more about the timing, how long had been since the last [eruption]. I wish there had been somebody to ask that, so we would not have spent quite so much time there. Or else had walked down through the other areas of the park where the geysers [were], instead of sitting there. (P0923021)

I was here many years ago, probably twenty-five years ago, and this has all changed. I remember the boardwalk, [but] I don't remember this being open....I liked the intimacy of how it used to be. And I think there was actually a railing, you could actually walk up and just stand a little more back in there. (0910026)

Whether or not Old Faithful met their expectations, many respondents said that they were pleasantly surprised at how many geysers there were in the Old Faithful area, and in the park.

I think we enjoyed all the geysers around Old Faithful as much, if not more. It was just fun to—each one was a different experience. And we enjoyed walking on all the boardwalks and seeing all the different shapes and sizes. (P0920021)

Once they made this discovery, some respondents said they wished that had planned more time for their visit.

I wish I had known a little bit more about the number of geysers that are there, and the pathways that go around to the other geysers. We didn't know anything about that until we got to the visitor center. And we were a little pressed for time, so all that we did get to see was Old Faithful. (P0926021)

During phone interviews six weeks after their visits to the park, we asked respondents what they remembered as the highlights of their trip. Many mentioned Artists' Point, the Grand Canyon of the Yellowstone, or encounters with wildlife. However, no one mentioned Old Faithful as the high point of his or her visit. Was this because expectations for Old Faithful were high relative to the rest of the park, putting the geyser at a disadvantage for this sort of question? Or is this evidence that visitors think of Old Faithful as discrete from the rest of the park, a site unto itself—ask visitors about Yellowstone, and they think of everything but Old Faithful. If this second hypothesis is true, it implies that Old Faithful somehow represents Yellowstone National Park in the public's mind but does not exemplify the park's features to those who have actually been there. Unfortunately, we discovered this phenomenon too late in the study and were unable to investigate it in depth.

The take-home point for this section seems to be that the potential audience for the new visitor education center will have a range of emotional attachments and reactions to Old Faithful, and that some will have mixed emotions about their experiences to that point. Although exhibit developers may feel that Old Faithful is a “cultural icon, place of pilgrimage, and shared legacy,” some visitors may think of Old Faithful as an icon of tourism that they are visiting because of a vague feeling of obligation. We may all share the legacy of Old Faithful, but our expectations of and reactions to the geyser are not universally shared.

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LEARNING ABOUT YELLOWSTONE

Learning seemed to play an important part in the Yellowstone experience for most of the people to whom we spoke. Many visitors said they started learning about the park long before their visit, and some were still learning about the park when we spoke with them six weeks after they left.

The Importance of Learning to Park Visitors

Most respondents told us that learning was at least a somewhat important part of their visit to the park, and some said that it was the reason they came to Yellowstone. For many of these respondents, learning seemed as enjoyable as any other part of their Yellowstone experience.

[Why is learning important?] Oh, I guess—I don't know. I think it's enjoyable. (P0920021)

Some respondents seemed to feel that learning was as important or more important than the experience itself.

Sitting here watching [Old Faithful] doesn't explain anything. I'd like to understand more, along with watching. (0910021)

Even respondents who said they did not want to learn scientific concepts about geysers and volcanoes still wanted to learn up-to-the-minute information about fishing regulations or viewing wildlife in the park.

With all the emphasis on learning, we were interested in the reasons that some respondents gave for making it a lower priority:

- **Just here to relax.** Some respondents said they were just here on vacation—they wanted to relax and take in the scenery, and that did not imply any learning to them.

I'm a student. So, this trip was supposed to be relaxing. So, I didn't expect to learn something, really. (P091802)

- **Just exploring.** Some respondents said they just were exploring the park, so learning about what they were seeing was not their first priority.

It was our first trip there. We definitely will go back....We were trying to get the lay of the land. You know, trying to figure out what was there. So, I wasn't really paying attention to the geological history. (P0919024)

- **“We grew up here.”** We spoke with some local residents who placed a low priority on learning in the park because they had learned about the park while they were growing up.

We grew up here. It's kind of a backyard. (0803022)

- **Do not have enough time.** Some respondents complained that they had so little time in the park that they could not make learning a priority, even if they wanted to.

I think if I had been there longer, I would have really wanted to do that. But that's why I bought the book, so I could read about it after the fact....I knew I didn't have time to ask and read and research without missing some of the things I wanted to see. (P0923021)

- **Enough is enough.** This respondent, whose husband is a hydrogeologist, reached a point where she had learned enough.

I always got more than I really wanted to. By the end of the trip, I was telling my husband, "Can we just be here and look?"...I said, can we just say, "Oh, it's beautiful?" I was more interested in the diversity of the park, the colors. (P0922021)

Many parents said that the focus of their family's learning was on their children, although that did not necessarily preclude the parents from learning something, too.

Everything I do with my kids is a learning experience. I'm a teacher and I want them to learn, I want them to know how the geysers work; I want them to know that these are living hot beds with algae and bacteria. I want them to know those things. So the more information I have to share, or I know, then [the more] they can learn. (P0902021)

It was kind of important for my children to learn about it, but not me so much. That was the whole point of the trip, cross country with three children. (P0926021)

I think it's important from my daughter's perspective that I'm capable of explaining to her what she's seeing in simple terms that she understands. So, I certainly want to learn and understand it. [But] do I need to walk away with a term-paper feeling and all of that? The formation of hot spots, etcetera? No. But it's always nice to have information that you can not bother with, as opposed to the other way around. (0919023)

At least one member of most groups said that she or he had sought information about the park before the visit. Almost all respondents learned from a variety of sources within the park or just outside its borders, and some followed their park visits with visits to the library, or by reading the books and brochures they obtained in the park. The following subsections give some details about learning before, during, and after a visit to Yellowstone.

Learning Before Their Visit

Before visiting the park, respondents obtained reading materials from a variety of sources.

I had an old book from Yellowstone Park, you see it on the stands there.... [and] I also had [another] little booklet that talked about the park. My mom had been the year before [and bought

them, so] they were about a year old. And then I just got some stuff from my [motor club], and that was new. You can get a visitor's guide for Montana and Wyoming, free to members. (P0902021)

Frommers, and AAA, [and] the park map, [off] the Internet. I just wanted to see what exactly there was here. I mean, you hear about Yellowstone just like Yosemite. You hear about all these national parks. But what, you know, what is there, besides just nature? And here, it's famous for the geysers. (0804022)

Probably the only ones [I read] were articles from National Geographic and stuff that I had read in the past. (P0917021)

When we were in Rocky Mountain National, I picked up a Yellowstone National Park book that has a lot of photographs in order to get the kids somewhat prepped to know what they'd been seeing at Yellowstone. (P0914021)

We were surprised at how many respondents told us they had seen a special shown on the Discovery Channel. Many of them recalled specific scenes from the show, and almost all of them used the term “supervolcano” as they talked about the park

I've heard that this was the supervolcano. Or that Yellowstone's considered a supervolcano....We saw something on the Discovery Channel....We watched a special six months ago about Yellowstone being a supervolcano. (0805023)

There were three [supervolcanoes]. They just didn't realize it till you got photo from NASA taken from outer space, and then he was able to kind of define what happened, and that this was a supervolcano. (0910021)

Most respondents said they did some advance preparation for their trips to Yellowstone. However, other respondents said they did not try to learn about the park’s natural history ahead of time. These respondents fit into several categories. Visitors in the first three categories often made learning a priority, but they did not feel the need to learn about the park in advance.

- **Repeat visitors.** Some respondents who had visited Yellowstone several times said that they did not do much planning for the current trip.

I had a good idea of what I was going to see, and I had read up quite a bit. I was pretty aware about the background of the thermal activity. (P0902021)

We didn't do a lot of pre stuff, because I was there when I was a child and [again] about eight years before [this visit]. So, I kind of knew a little bit about where I had to go. (P0922022)

[Because I had been here before,] I knew that, when I did go into the visitor center there by Old Faithful, there was a lot to read and materials to buy and take home. (P0919025)

- **Already knew a lot about the park.** Scientists and other respondents who knew about the park sometimes said they did not read much in advance.

The only reason is both my wife and I are scientists. So, we just wanted to go see what happened after the [park] burned and how it's transformed Yellowstone since then. We kind of have a pretty good idea of what we we're going to do. (P0919026)

- **Traveling with someone who knew about the park.** Some respondents were traveling with scientists and other experienced Yellowstone visitors. The following quote is from the wife of a hydrogeologist:

I didn't need to know anything, because I had my tour guide. I didn't even know when we went there that we were going to be inside of an old volcano. I had no idea. I just hadn't really done that much in the way of research, because we plan lots of places to go. I didn't really study Yellowstone before we got there. (P0922021)

Some respondents in the next two categories made learning a priority once they reached the park, and others did not.

- **Constant travelers.** Some respondents who are retired and spend much of their time on the road did not plan far in advance.

We didn't plan. We're retired. And we just kind of drive and we just ended up there. (P0919022)

- **Just passing through.** Some respondents said they were on their way to somewhere else.

Yellowstone wasn't our main destination on this trip. We were going to Jackson for some fishing....Really, we didn't do any significant literature reading or anything like that prior to our trip. (P0926021)

Learning During The Visit

For many respondents, the towns adjacent to the park served as the beginning of a Yellowstone learning experience. Several respondents mentioned an IMAX film and museum in West Yellowstone, and others said they had been to the natural history museum in Cody. These institutions seemed to provide relatively powerful learning experiences for our respondents. In fact, most of the non-scientist respondents who knew something about the biotechnological aspects of life in hot springs said they learned it by visiting these nearby attractions.

Remember, Dad, you were reading about that million dollar industry that comes from the microorganisms that live in this hot water, and how it's used for DNA....We learned that at Cody. They have a natural history museum at Cody, so they were talking about a lot of these things. (0803021)

We had seen an IMAX at [West] Yellowstone, before going in, and that's where a lot of it was explained. (P0902021)

Almost every respondent could cite a variety of sources of information that they encountered within the park.

There seemed to be really good information in the little map that you could buy or that you could pick up for the hike around the geyser basins, as well as the plaques and signs and stuff. I feel like they probably do the best job of all of explaining geysers over other park features. (P0918022)

They give you a pretty good detailed map and what's happening, going on for the day, or for the week, or for the whole summer there. And that was pretty good information. And there was plenty places to stop and talk to rangers along the way. (P0926021)

I find all of the natural facts that we've been given so far really great. Like the ranger over here was talking, and the tour guide. It's nice to have informative people around. ...We're finding out so much more by taking the tour, having informed people. (0910023)

Even when information was available, some respondents admitted they didn't take the time to read the whole thing—and sometimes they seemed to feel a bit guilty about it.

I've got the roadside geology books that are very informative. I need to read harder. But I usually bring one when we're traveling somewhere so I refer to the area. I haven't really read them. It's scanning through and finding something that is in relationship to the area that you're going through. (0910021)

We will not spend more time discussing these inside-the-park sources of information, as they have been discussed in a number of surveys mentioned in the literature review (Gyllenhaal, 2002), such as Littlejohn et al. (1990) and Littlejohn (1996). It's enough to say that the statistical data in these studies supports the idea that most park visitors use more than one source of information within the park.

One point that we want to discuss is the importance of word-of-mouth communication. When we asked respondents how they learned particular ideas or concepts, many said they heard them from other members of their groups, other visitors, or Yellowstone staff members.

How did I find out? Someone told me. So it must have been somewhere along the line that somebody was giving an interpretation, some kind of park person. I just remember hearing that. (P0902021)

Of course, respondents also used visitors as a source of information about where to go next, and what to see there.

When we did stop, and we were walking, we would always meet somebody and they'd say, oh, you need to look over here at whatever it was, whatever they had found to look at. (P0923021)

We will come back to this point when we discuss our recommendations for the new Visitor Education Center.

Learning After The Visit

Although some respondents told us that they managed to read more about Yellowstone during their trips home, many of the phone respondents said they had not had time to read anything more since they returned from the park.

I guess we got back, school started, and we have to deal with that. We haven't had the chance.
(P0917022)

Other respondents said they finally had a chance to read publications they had obtained in the park.

I had a chance to sit down and I read more of the brochures and the book we bought, a little book. But we just kind of glanced through it as we were going to the park. (P0917021)

A few respondents said they sought information from other sources after they returned home.

I was searching by myself [in the library in Paris] and I [found] a little bit more of information about the chemistry about sulfur. (P0918021)

In summary, learning about Yellowstone National Park seemed to be a cumulative process for many respondents. They went through several learning experiences about the same or similar topics and came away with new information each time. Here's an example:

A lot of the hydrothermal stuff, we learned from going to Mammoth and other places...That movie [at Old Faithful Visitor Center], though, was interesting. One thing that I noticed from the movie is how there's a hot spot that remains stationary and the crust moves....I think I'd seen that somewhere, but it wasn't illustrated as well as in that cross section I saw in the movie. (0803024)

For many respondents the cumulative learning started outside the park, and for some it continued after their visit. Because many people return to the park several times during their lives, cumulative learning can also be a cyclic process in which each visit builds on previous visits. Because of the possibility for cumulative learning, big parks like Yellowstone seem to have an extraordinary opportunity to shape visitors' understanding through multiple learning experiences. We need to think about what this implies about the overall approach to interpretation in the new visitor center.

Here are some other characteristics of learning in Yellowstone that impressed us:

- **Many sources for learning.** There is so much information available, inside and outside the park, and much of it is presented in forms most people can understand.

- **Cycle between experience and learning.** The opportunity exists to alternate between experiencing the real thing and having experiences that help visitors learn more about it.
- **Repeated exposure.** The opportunity exists for repeated exposure to the same ideas in slightly different forms.
- **One-on-one help.** Those who persist have an opportunity for one-on-one help from a ranger.
- **Accessible concepts.** People who do not have college degrees can understand many concepts about the park. College or high school courses do help, but so does growing up in an area with volcanoes and earthquakes (including the Yellowstone area) or having a job that exposes you to some of the processes at work in the park's subsurface (e.g., being a fireman or a chemical engineer). Even when the concepts are more abstract and difficult, park interpreters try to make them more accessible by, for instance, developing different ways to teach them to different sorts of learners (Gyllenhaal, 2002).
- **Visitors as experts.** Some respondents, young and old, learned a lot about Yellowstone in a relatively short amount of time. To use a term introduced by Crowley & Jacobs (2002), they developed an "island of expertise" about Yellowstone, an area of relatively deep and rich knowledge that people develop when they are passionately interested in a topic. Although Crowley & Jacobs apply this concept to children, it also seems to describe many of the adults we talked to during this study.

Crowley & Jacobs (2002) emphasize the role that parents play in their children's development and maintenance of knowledge, both as mentors and as co-explorers on the road to a shared island of expertise. In the case of Yellowstone, we found parents who definitely were playing a similar role in their children's learning about the park. We also found examples of adults mentoring other adults as they learned about the park and of adults sharing as they explored the park together. Park rangers also seemed to take on a mentoring role for some visitors.

Here are some other ideas from Crowley & Jacobs (2002) that seem to apply to learning in the park.

- **Learning is spontaneous.** On islands of expertise, the learning is not planned and programmed. A child or parent notices something and asks a question, and the island grows. Similar spontaneous events can happen on the trails and boardwalks of Yellowstone.
- **Learning from simple explanations.** The explanations parents give their children are often simple and incomplete. The important thing is that parents talk about causes, offer simple analogies, define a new word, or suggest ways to think about the evidence. Crowley & Jacobs call these partial explanations "explanatoids." Because explanatoids accumulate over time, they can be just what it takes to launch a child to a higher level of understanding. The explanations visitors take away from any individual

park experiences may also be incomplete, but for those who devote several days to the park (plus time before and after), there can be repeated exposure and gradual refinement of an understanding that was initially incomplete.

- **Learning links to what they know.** Perhaps the most important kind of explanation takes place when a parent connects something new to what a child already knows. Crowley & Jacobs (2002) studied families talking about fossils in a museum. They found that beyond just saying what the fossil was, the best way for parents to support their children's learning was to help them remember what they'd learned before from books, computer games or life. In Yellowstone, we have seen evidence that parents, adult mentors, and park interpreters have learned that lesson (Gyllenhaal, 2002), and it certainly seems worth applying in the visitor-center exhibits.
- **Learning leads to increasingly sophisticated conversations.** Because of their growing island of shared knowledge, parents and children can talk in ever more sophisticated ways about the subject. Parents can explain at deeper levels because they trust their child will understand (Crowley & Jacobs, 2002). Similarly, groups of visitors to Yellowstone can learn and eventually converse about the park in more sophisticated ways.
- **Linked to the location.** Crowley & Jacobs (2002) suggest that things children learn on museum visits may be easier to remember because they are strongly linked to or “marked” by the special places where they were learned. Based on our conversations with visitors both during and after a visit, it seems likely that learning in the park may be “marked” in similar ways.

Of course, some visitors arrive at the park with well-developed islands of expertise that help determine what they take away from their park experiences. Humans are, by nature and by nurture, specialists. For many adults, occupational roles are based on and help develop islands of expertise. These occupational islands can, in turn, shape the ways people approach their recreational experiences. A case in point was the way our respondents approached their developing understandings of geysers. A chemical engineer, a fireman, and landscape architect all found ways to use their expertise to build their explanations of how a geyser works.

Like children, adults also build islands of expertise as a hobby or special interest apart from school or work. We talked with several respondents about their interest in history and how that determined what they wanted from the visitor center's exhibits.

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WHAT VISITORS KNOW ABOUT GEOLOGY AND HYDROTHERMAL FEATURES

This section presents our results for Content Area 1 in the Topical Framework ([Appendix A](#)). Much of our data for Content Area 1 came from the [word/card sorts](#) described in the Methods section, including the word sort for Content Area 1 (see [Appendix C](#) for a list of words) and the Subthemes Sort (see [Appendix D](#) for a list of the subthemes). We also learned about this content area with the [drawing technique](#) discussed in the Methods section.

As we analyzed the card and word sorts, we realized that this technique was revealing several important aspects of respondents' understanding of these topics. These included:

- **Terminology.** Respondents' understanding of the terms and the concepts behind the individual terms.
- **Classification.** Respondents' general classification of the terms and concepts—which terms/concepts they seemed to feel were related in some way, based on their understanding of the scientific uses of these words or on their feelings about and preferences for the ideas.
- **Specific relationships.** Respondents' understandings of the specific relationships between individual terms/concepts, including causal relationships.

We discuss these aspects of visitors understanding in the following subsections.

Relationship Between Park Geology and Hydrothermal Features

The following sections are based on our discussions with 14 respondents who completed card or word searches for Content Area 1 and on more general discussions with many other respondents.

Terminology

Respondents varied in their understanding of the terms used in the word sort. (See [Appendix C](#) for a list of terms).

- **Hydrothermal.** Many respondents did not initially recognize this term but were able to figure it out by breaking down the word (“water” and “hot”). “Geothermal” was a term that seemed to come more naturally to many respondents, apparently because they were had heard or read about geothermal energy sources.
- **Mud Pot and Fumarole.** Some respondents had not yet encountered the term “mud pot,” but it made sense to them once we explained it. Many respondents didn't recognize the term “fumarole,” and those who tried to break down the word couldn't do it (“could be fumes?”). Everyone knew what a geyser was, and almost all

respondents had heard of hot springs, although a few said they were surprised to find them at Yellowstone.

- **Hot spot.** Only a few respondents really seemed to understand “hot spot” the way geologists use the term. Here are some examples of the range of understandings we heard from some of our more informed respondents.

The hot spot? That's just a thin spot in the crust. And so, the magma has a chance to kind of creep up through. (0804025)

You would have these hydrothermal areas or volcanoes that occur above this hot spot. But it's moving. So, you have the extinct volcanoes are kind of moving past, and you have the current volcano. (0803024)

In the movie we watched at the visitor center at Old Faithful, they just showed how this thick plate of fire underneath is moving—land is moving along on top of it, and there's marks stretching all the way into Nevada and Arizona from just this area. That was kind of surprising. (P0926021)

Several of these respondents had been to visitor centers elsewhere in Yellowstone, at Craters of the Moon, or in Hawaii, and a few had just seen the film at Old Faithful visitor center.

One respondent, who lived near the park, told us that “hot spot” reminded her of the local pastime called “hot potting.”

You get to know places to go where the hot water hits the rivers, and it's not always in the park. It's all over the place. You have to kind of gauge it a little bit... The real, real cold water will flow in with the hot water, and you have pockets [to soak in that transition] from hotter water into the cooler water. In the winter, it's fun. (0803022)

- **Volcano and “Supervolcano.”** Some respondents had just recently learned about the huge volcanic explosions that helped shape the park. They seemed very excited about the whole concept, and they wanted to learn more about it. A few respondents talked about volcanoes as something in the past and perhaps the future of Yellowstone, but they didn’t seem to think that Yellowstone was still a volcano. Respondents who had seen the Discovery Channel special on Yellowstone seemed to enjoy using the term “supervolcano.”
- **Lava and Magma.** Most respondents knew lava and magma were similar, but many didn’t seem clear about the differences. Some respondents incorporated magma into their understanding of how geysers function. Others seemed to have a more general feeling that it was hot down below for unspecified reasons, and that heat somehow fueled the geysers. One respondent claimed that magma at the Earth’s core was driving both plate tectonics and hot spots. (In a sense that’s true, but molten core material is very different from the magma closer to the Earth’s surface.)

- **Plate tectonics.** Most respondents seemed to recognize the term and realize it was linked to earthquakes, volcanoes, and other aspects of geology. However, as suggested in our earlier report (Gyllenhaal, 2002), most respondents' understandings of the concept didn't seem very deep or sophisticated.

Plates are the plates in the earth, right? That come together that lift and that crap when you have an earthquake. When you have the earthquake, it moves the plate, it makes the volcano, and it forms lava and the magma. (0803021)

Many respondents also linked plate tectonics to Yellowstone's geology, although they weren't very clear about how the connections worked. Only a few respondents gave detailed, scientifically correct descriptions of the link between plate motion, hot spots, and the shifting pattern of volcanism in the Yellowstone region.

- **Earthquakes.** Most respondents did not talk much (and perhaps weren't aware of) earthquakes at Yellowstone, although residents of nearby states seemed much more aware of local earthquakes. A few respondents seemed genuinely surprised to discover the seismograph at the visitor center.

The thing I was surprised about was the earthquake. For whatever reason, I hadn't thought about it. I don't know why. It's pretty obvious. And then, it was almost mentioned as an afterthought in the [visitor center] movie, too. I think that was probably the biggest thing that I needed to put together. (0803024)

Later in the interview she said that earthquakes were what she most wanted to learn more about.

Most respondents seemed to make links between plate tectonics and earthquakes. Several respondents said that plate tectonics caused the earthquakes at Yellowstone, although they were not clear about why that happens. Here's an example from a thirteen-year-old respondent's explanation of his Content Area 1 word sort.

I guess this is like the plates in the ground. And when the plates move, it causes an earthquake. And that sometimes happens when there's a volcano. So, I have earthquake and volcano [together]. (0804021)

Earthquakes and volcano were sorted into in the same group by many respondents, and like the previous respondent, some of them implied that there might be a causal link between the two. Their explanations of the link were usually vague or naïve (like similar explanations by students described in our earlier report, Gyllenhaal, 2002).

- **Plumbing System.** The term "plumbing system" initially confused some groups. Although some respondents immediately understood the metaphoric use of the term, and others accepted the metaphor after some thought, several respondents never got beyond a literal interpretation.

This is like their ongoing issue in the park. The plumbing. And the sewer, it's an ongoing debate with the park, as far as the number of tourists that are coming through is outgrowing the capacity. (0803022)

Of those who understood the metaphoric use of the term, some had relatively accurate mental models of the system, and others did not. For instance, one respondent said the plumbing was cracks from fractures, and that rainwater filtered down from the surface through cracks. Another respondent seemed to think the plumbing system was ancient buried lava tubes, like the ones he had seen near the surface in Hawaii.

When respondents did not understand the meaning of terms, they had trouble with the other aspects of the word sorting activity, like classification and describing relationships between terms. We give examples of these problems in the next two sections.

Classification

We saw a number of common patterns in the card/word sorts (see examples, Figures 8 to 11, below). The most common pattern was to separate aboveground hydrothermal features from belowground volcanoes/earthquakes/plate tectonics.

For instance, some respondents (Figs. 8 and 9) split the cards or words into just two groups. One group included the aboveground hydrothermal features (“hydrothermal” or “geyser” group), and one included belowground features and geological forces like plate tectonics and earthquakes (“rock” or “plate tectonics” group). Some respondents said they saw no links between these two groups (e.g., Fig. 8). Other respondents said the groups were linked by either the term “hydrothermal” (because hot water came up from below) or the term “plumbing system” (because it carried the hot water) (e.g., Fig. 9). In some ways, these two groups seemed to parallel two of the proposed subthemes: “Yellowstone's geysers, mud pots, fumaroles, and hot springs,” and “Yellowstone's volcanoes—past, present, and future.” Most respondents seemed to better understand the aboveground group, and their descriptions of the belowground group sometimes seemed naïve.

Other respondents made four or more groups by, for instance, splitting the aboveground group into geyser and hot-spring groups and splitting the belowground group into an earthquake-plate tectonics group and a group for the volcanic terms. Some distinguished hot springs from geysers/fumaroles/mud pots in various ways. For instance, one respondent talked about hot springs as something you could go to in many parts of the region to soak in, and another emphasized the minerals deposited by hot springs (perhaps because they had recently been to Mammoth).

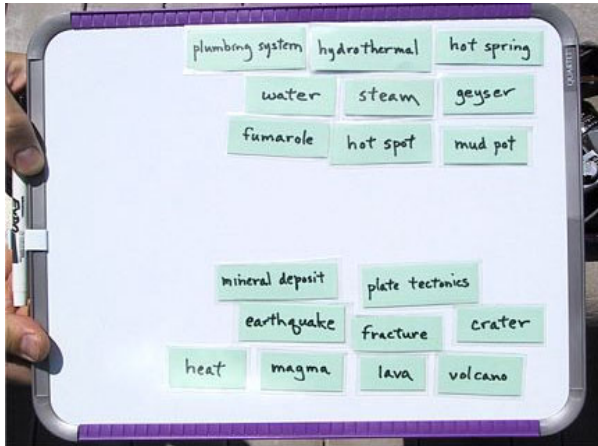


Figure 8. Word sort with two unconnected groups: “Stone or geological system” below and “water system” above. (S080403B)

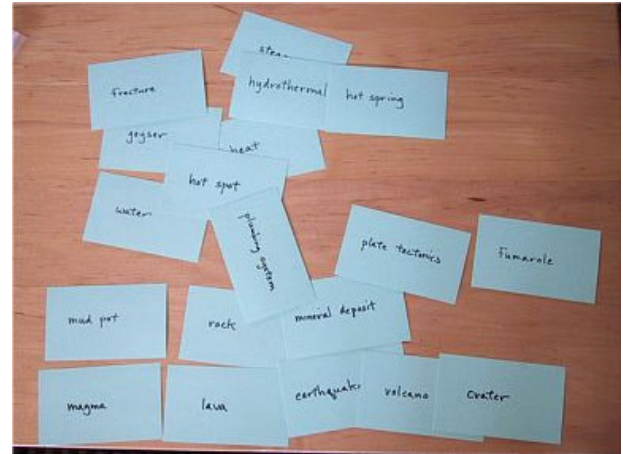


Figure 9. Card sort with two connected groups: Rock group below and geyser group above, connected by the plumbing system. (S080301A)

Some respondents had trouble deciding where to put certain terms. For instance, they said that some terms could fit in either the geology or hydrothermal group. Examples include “fracture” (underground, but water travels up through it), “steam” (given off by many things), and “water” (moves between the two systems). Some respondents put terms like “hot spot” and “mud pot” into groups where they didn’t seem to fit, because they did not understand them.

Based on our word/card sorts, it seemed that many respondents had trouble connecting what they already understood about geology and the Earth's subsurface to the hydrothermal features they saw in the park. Key steps in building visitors' understanding seemed to be (1) realizing that the geyser basins of Yellowstone lie within an active volcano, and (2) understanding the “plumbing system” that circulates water from hot subsurface rocks to the park's geysers and other hydrothermal features.

Specific Relationships

The next two photos (Figs. 10 and 11) are examples of respondents who emphasized connections between words rather than groupings of words. (We added the blue arrows and text, based on what the respondents told us during the interviews.) The sort in Figure 10 seems to exemplify a novice approach to these relationships by showing a long, unbranched chain of connections. The Figure 11 sort seems to be approaching expert status—it looks more like a concept map than a card sort. (A concept map is a graphical representation consisting of nodes and connecting lines. The nodes represent ideas or concepts—or in this case the word-sort terms—and the lines indicate that there is a relationship between the concepts.)

Looking at our whole collection of card and word sorts from Content Area 1, here are some patterns that seemed to emerge about the differences between novice and expert sorts. We saw two forms of novice sorts:

- **Classification dominates.** These novices split the terms into two or more groups and do not emphasize the connections either between groups or within groups (e.g., Fig. 8).
- **Long causal chains.** These novices showed lots of connections between words in the form of long, unbranched sequences of causes (e.g., Fig. 10). The respondent who made the sort in Figure 10 explained it as follows:

Volcano erupts; it's going to have lava. And with a volcano, an earthquake would come, and you're going to have a lot of water and your streams are going to heat up. And you're going to have a plumbing system that's going to cause hot springs and hot spots and geysers and mud pots and mineral deposits and plates. (0804024)

There are two other characteristics of novice's sorts. Novices don't understand the meanings of some terms very well, if at all, and novice explanations of connections are superficial, naïve, or demonstrably incorrect.

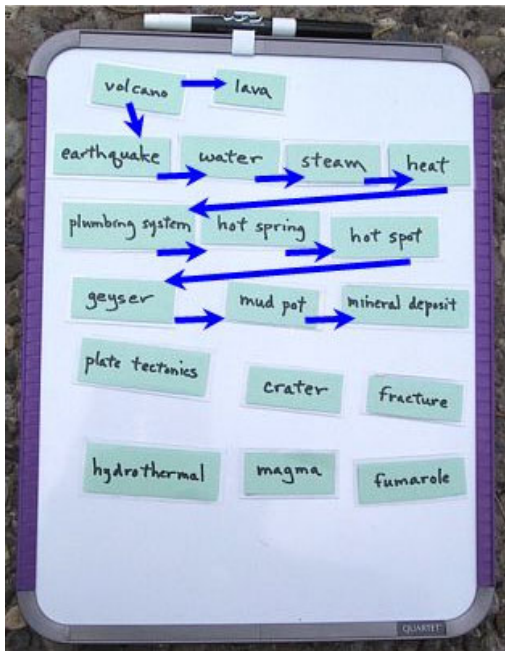


Figure 10. This respondent made a word sort with a long causal chain with one short branch. (We added the blue arrows based on the respondent's oral explanation.) (S080404A)

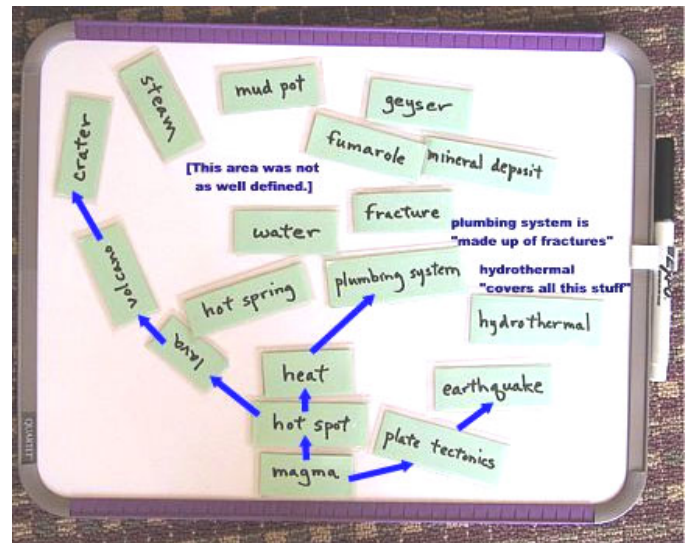


Figure 11. This respondent made a word sort that almost looks like a concept map, because of the many branching connections. (We added the blue arrows and text based on the respondent's oral explanation.) (S080405A)

More expert sorts seemed to share these characteristics:

- **Connections dominate.** The emphasis was on connections, sometimes to the exclusion of categories or groups. An expert knows what the terms mean, but emphasizes the connections between them.
- **Terms at an angle.** Experts often put cards at an angle to connect things—part of the overall emphasis on connections.
- **Shorter causal chains.** The causal chains were also shorter and more branched, because many terms were connected to two or more other terms.
- **More like a concept map.** The result looked like a concept map rather than a tradition card sort.

Of course, more expert respondents also understood the meanings of most of the terms, and their explanations of the connections between terms were relatively deep, sophisticated, and accurate.

What does the shift from novice to expert look like?

- **Appropriate categories.** To make an expert sort, it helped to first sort the terms into an appropriate group. More expert sorters often started with categories of terms, and then developed them into a concept map as the sort developed
- **From categories to connections.** The novice-to-expert shift seemed to be paralleled by a shift from a category sort towards a concept map. That's because both experts and concept maps emphasize connections.

If you start with a category sort, there are two ways to move towards a concept map:

- **Add structure within groups.** Structure develops as respondents add and clarify connections between individual terms/concepts. A novice's first attempts to connect ideas may be unsophisticated, but they are a step in the right direction.
- **Add connections between major groups.** Again, the first attempts to connect major groups may be vague and unsophisticated. Here's one respondent's attempt to link his volcano group with his geyser group:

But I know both geysers [and volcanoes] emit heat, give out mineral deposits. They both have to do with plate tectonics. They're both hydrothermal. I'm guessing before a geyser erupts, there's a slight quake in the ground. They both, you know, come from craters. They're both hot spots. And they both have fractures, deep inside the earth. (0804022)

Although an expert needs to recognize and understand connections both within and between groups, we suspect that, for most visitors, the key to understanding Yellowstone is to

recognize and understand the connections between the two major subgroups that can be seen in most of novice sorts. That means clearly demonstrating and explaining two big ideas:

- **Volcanoes.** Hot rock is especially close to the surface in this area, because Yellowstone is a giant volcanic crater.
- **Plumbing.** Yellowstone’s “plumbing system” moves hot water from underground to the surface to form geysers, hot springs, and so forth.

Other parts of the exhibit can clarify other relationships—between earthquakes and the volcano, between the hot spot and plate tectonics, and so forth—for both interested novices and budding experts. However, the main thrust of the geological exhibits should be to help novice visitors understand the connections between the subsurface and surface features of Yellowstone.

How Geysers Work

When we challenged visitors to draw a cross-section of Old Faithful, most demonstrated that they understood—or were able to figure out—several of the basic components of the system. However, respondents’ more accurate understandings were often mixed with misunderstandings about, for instance, where and how water moves underground.

Many respondents willingly participated in the drawing activity, although some protested at first and others outright refused. We collected 14 drawings showing a range of levels of understanding of how geysers function. The five drawings illustrated in this report (Figs. 12 to 16) show a range from novice to near expert. The entire collection of 14 drawings is included as [Appendix H](#).

As we analyzed and scored the drawings, we counted both the drawing and the oral explanations given by the respondents. We also gave credit for realizing that something needed to be explained and then trying to explain it, even if the respondent used a metaphor or gave an explanation that differed from the accepted science. One way to show the results of our analysis is to use a chart like Table 1. Based on this chart, it’s clear that even novices had at least the beginnings of a scientific understanding of geysers—in other words, they had something that park interpreters can build on. Some major steps in the move from novice towards an expert scientific understanding included:

- **Learn the output.** Learn that geysers output steam, not smoke.
- **Learn the heat source.** Learn that magma causes heating.
- **Learn about groundwater flow.** The movement of underground water seemed a mystery to even those who knew a bit about geology. (Many respondents said water moved through cavernous tunnels.)
- **Account for all the water.** Include a source for recharge of groundwater.



Figure 12. This drawing, by a 7- or 8-year old, shows “smoke” rising from a pool of boiling water, with a layer of “hot mud” below. (D080504B)

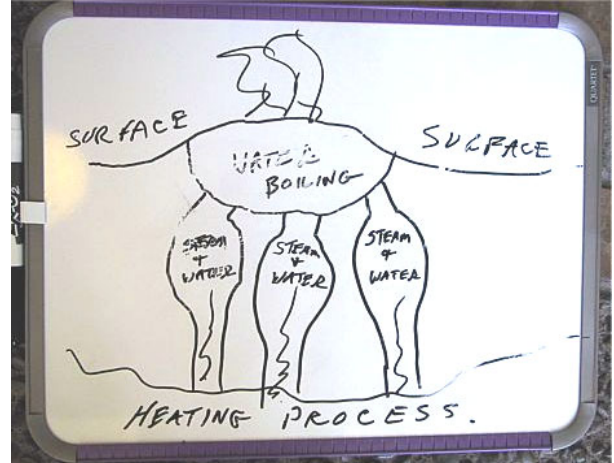


Figure 13. This respondent apparently made it up his ideas on the spot. He wasn't certain what heated the water, and he took a metaphorical approach to the physics. (He said the geyser was like a “pressure cooker with a fuse”). (D080502A)



Figure 14. This respondent's drawing included many of the basic ideas about how geysers work. He had magma heating the water, and he talked about rainwater water (recharge) seeping or absorbing into the ground. (D080503A)

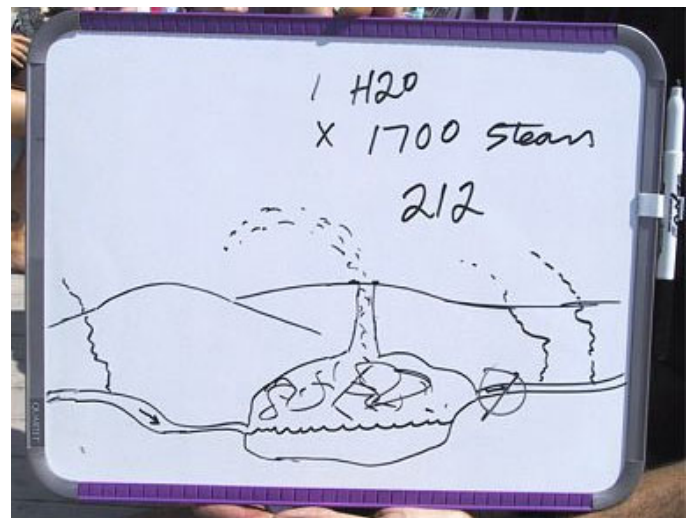


Figure 15. This respondent discussed a mechanism for building up pressure (the constriction with the circle around it) and for the sudden discharge as steam (see numbers for the ratio of water to the steam it generates at 212 degrees F, above the drawing). He said he knew this because he was a fireman. (D080504A)

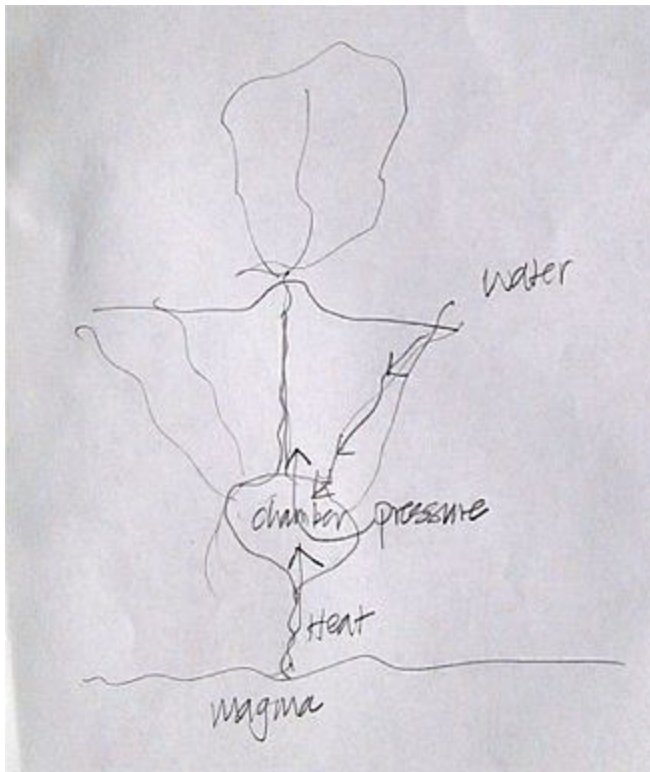


Figure 16. In one of the few drawings done on paper, this respondent drew one of the more complete examples of a geyser's subsurface. He showed magma below making heat, a chamber, and a narrow opening to the surface. He illustrated the constriction without talking about it, and he explained the pressure-building mechanism in very general terms. He had recharge water flowing down from the ground surface directly into the chamber through narrow fractures. He had heat coming up directly from the magma, not as circulating water. He didn't seem to see the entire plumbing system as open chambers, but he also missed the point of permeable sedimentary layers. (D080304A)

- **Understand groundwater movement.** Replace alternative understandings of the size and positions of underground cavities and feeder channels, the makeup of the output, and so forth, with scientific understandings.
- **Understand pressurized steam and the reasons for its explosive discharge.** Start with metaphors, and then move towards an understanding of the physics.
- **Account for periodicity.** Learn why Old Faithful is predictable.
- **Understand relative and absolute depths.** Learn scientists' best estimates of the true depths to the chamber, heat source, and so forth.

Even the most sophisticated respondents still held minor misconceptions and failed to account all aspects of the geyser system.

Exhibit developers can use this information to develop and evaluate strategies for helping visitors build a more scientific understanding of how geysers work.

	Drawing numbers:				
	Figure 12 D080504B	Figure 13 D080502A	Figure 14 D080503A	Figure 15 D080504A	Figure 16 D080304A
Characteristics of the drawings:					
Alternative understandings					
Output is smoke	X				
Exaggerates size of main cavity	X	X	X	X	x
Main cavity shown within cone	X	X			
Exaggerates size of feeder cavities		X		X	
Shallow "hot mud"	X				
Scientific understandings					
Output is steam and hot water		X	X	X	X
Shows a "plumbing system"		X	X	X	X
shows main cavity at appropriate depth			X	X	X
shows feeder channels as small			X		X
Shows heat source		X	X		X
specifies source as magma			X		X
Shows subsurface water	X	X	X	X	X
water moving upwards		X	X	X	X
source for recharge			X	X	X
Shows water boiling	X	X	X	X	X
Explains role of pressure		X		X	X
expansion as steam forms		X		X	
Accounts for pressure build-up		X		X	X
specifies as constriction				X	X
Accounts for pressure release		X		X	X
relates to superheated water					
Accounts for periodicity				X	
specifies as constant flow				X	

Table 1. Analysis of selected drawings discussed in this report.

We were interested to discover that children’s understanding of what comes out of geysers seemed to vary somewhat with age, but that even older children sometimes used the term “smoke” when describing Old Faithful. When we asked children what erupts from Old Faithful, we heard the following descriptions.

It's got to look like a big fire. Like a big smoke, some big smoke. (First grader, 0804022)

Smoke? Water vapor, I guess. It's kind of like water and gas. Evaporated water. (8 year old, 0804021)

Hot water and calcium and minerals and stuff. Because that's what builds up the stuff around there, as the water comes out, and then, it comes down. (12 year old, 0804025)

A tall stream of water coming up from the hole. [There's] smoke in front of the bottom of the hole. (High school senior, 0804022)

Children seem to need help understanding exactly what comes out of geysers and with understanding the difference between smoke and steam.

In order to triangulate the findings of the drawing study, during the September site visit we asked respondents to tell us, in their own words, what they knew about the workings of geysers. As we found in the drawing study, most respondents seemed to understand at least some of the key factors involved in a geyser eruption. The following novice explanations seem unsophisticated and rather vague, but they include some key ideas about, for instance, the role of pressure:

I think that there are several chambers underneath [Old Faithful], and the pressure builds up in the lower chamber or something and then it shoots it out. (0909023)

There's a force from underground that builds up and when it gets to a certain level it has to spout. It seems to be constant, so it must be running off pressure at a time that keeps stuff underground for so long that it has to let off a big spout. (0909021)

As with the drawing activity, we found a broad range of explanations, from novice to more sophisticated. In their oral explanations, respondents often demonstrated their developing expertise by placing geysers to the larger picture of Yellowstone geology—something we didn’t see during the drawing activity.

I know enough geology to know that most of the geology around here is considered new rather than old. And that new is usually associated with more recent volcanic action. And geysers typically are fissures or cracks in the surface that lead down to the volcanic, or the mantle or the lava that's close underground. And that the water basically leaks down there and is turned into steam and forced back out from the pressure. (0910026)

I've seen in the past NASA's taken satellite pictures of this place. I don't know what you'd call the type picture they take, but it senses thermal activity. It seems like eighty per cent of the park is sitting on a huge volcano with the magma down there, and the water is getting heated up by pressure and heat that's coming up out of the ground. (0910024)

Thus the oral explanations provided a nice complement to the more specific understandings demonstrated in the drawing activity. They tended to support the overall findings discussed above, but provided much less detail about the structure and function of individual geysers.

There were indications that many drawing respondents hadn't seen much interpretation about geysers or thought much about this subject before we asked them to draw. However, some of them still developed credible explanations by, more-or-less, figuring it out as they went along. It seems that geysers have an aspect of "garage-style physics" (or perhaps "kitchen physics") that help some people figure them out on their own.

Some respondents' drawings suggest that they had seen and remembered images displayed in wayside exhibits. Two examples are shown below. The respondent who drew Figure 18 seemed directly inspired by an exhibit panel displayed along the walkway to Old Faithful (Fig. 17). The child who drew Figure 20 seemed to have developed a mental model that included pools of water just below the surface under geysers and "hot mud" below the pools. We suspect that this child's ideas were influenced by either an exhibit panel displayed along the walkway to Old Faithful (Fig. 19); by warnings about what could happen if he walked near geysers; or by discussions with his cousin, who helped work on this drawing and then made a very similar drawing of his own (see [Appendix H](#)).

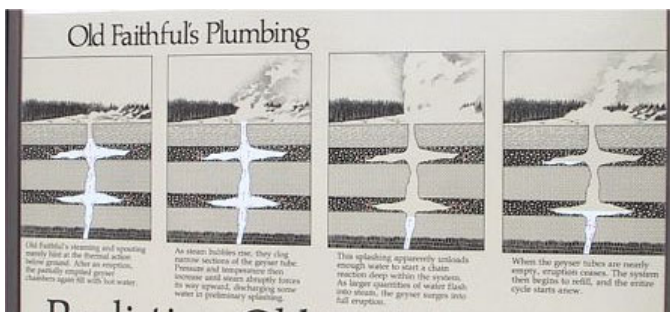


Figure 17. Graphic from "Predicting Old Faithful" label panel in a wayside exhibit near the Old Faithful Visitor Center.

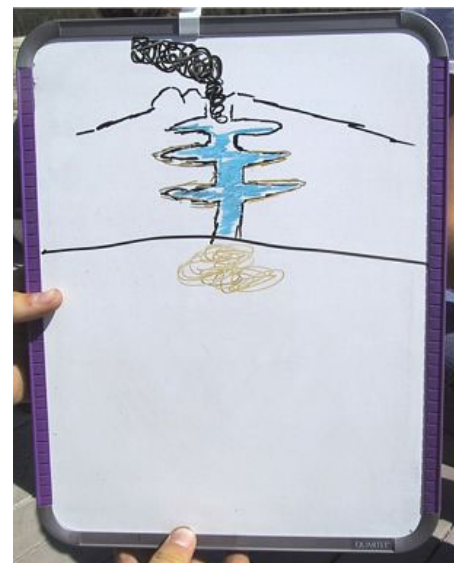


Figure 18. This respondent's drawing seems to have been inspired by the panel on the left.



Figure 19. Graphic from “Dangerous Ground” label panel in a wayside exhibit near Old Faithful Inn.



Figure 20. This child’s drawing that seems to have been inspired by this panel, or by conversations with adults about related topics.

A few respondents produced playful drawings of how geysers worked, with heat supplied by the “Fires of Hell” (Fig. 21) or by smaller fires tended by human-like figures (Fig. 22).

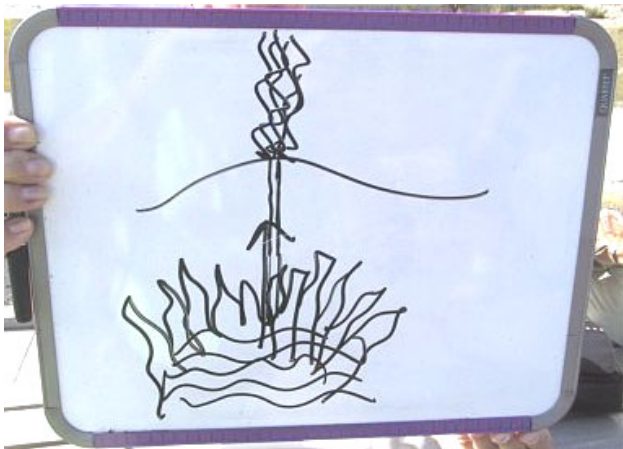


Figure 21. This respondent said that “the fires of hell” were powering the geyser. (D080505A)

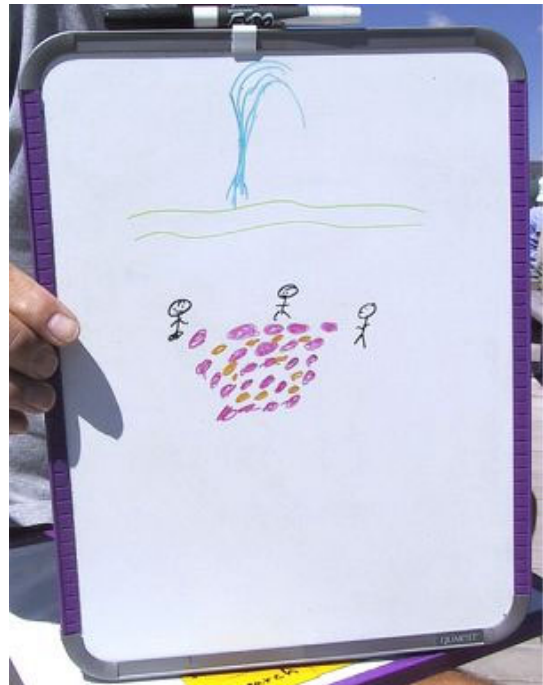


Figure 22. This respondent said the little people were tending the fires that kept this all going. (D080602A)

The examples we have of this approach were drawn by women, and we also noted that respondents who declined our opportunity to draw a geyser were more often female than male. Could this be evidence of gender differences in willingness to approach learning about geysers in this manner? Unfortunately, we ran out of time before we were unable to pursue this inquiry.

Our first report listed eight different ways that park interpreters explained geyser to the public (Gyllenhaal, 2002). The drawing technique was based on one of these approaches—“show a graphic of a geyser’s subsurface workings.” Here are some of the other interpretive approaches that were reflected in respondent’s drawings or oral explanations:

- **Discuss a familiar analogy.** Some respondents used analogies, such as teapot or pressure cooker, in their drawings or explanations.
- **Explain the physics of a geyser eruption.** A few respondents tried to explain some aspects of the physics of pressure, for instance, although others used analogies to substitute for this sort of explanation.
- **Explain the geology behind the hydrothermal features, especially the volcanic history of Yellowstone.** Some drawings included magma as the heat source, and some respondents demonstrated their developing expertise by explaining the larger geologic context of geysers.

The following interpretative approaches were not found in the drawings or explanations, perhaps because most of these respondents had not interacted with park interpreters:

- **List the factors that are necessary for geysers to function as ingredients in a recipe.** Although many explanations included most or all of the ingredients, no one specifically listed them one-by-one.
- **Categorize the types of hydrothermal features.** None of the explanations compared geysers to hot springs, fumaroles, or mud pots.

The next two interpretive approaches were not included in the drawings or explanations, but some respondents said they wanted to see them in the new visitor center exhibits.

- **Quantify the timing, duration, and flow of geyser eruptions.** As one respondent said:

I'm a statistical freak. It's how like how far down does that waterfall go? And you know, how many gallons of water are coming up with that at once? (0805025)

- **Demonstrate a working model.** Several respondents mentioned that they hoped to see a working model of a geyser in the new visitor center.

Why don't we have a model and actually pump the water and they can watch? (0910022)

Some respondents said that the park needed to use a range of methods to explain how geysers work.

If you explained in simple language, but [not too] technical. And another way could be metaphorically....I think you need both, and I think you need graphics as well. I think that the best way is to have all of those. (0910027)

With so many people visiting, [and] everybody is different; it requires something different to help them learn. You kind of tap into several of those three or four different aspects or mode of communication. (0910024)

We would have to agree with them, for the following reasons:

- **Range of learning styles.** Different visitors learn best in different ways.
- **Learning is cumulative.** As discussed earlier in this report, exposure to a range of explanations seemed to have a cumulative effect on respondents, adding both detail and context to their initial understandings of a concept and clarifying some of their initial misunderstandings.

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WHAT VISITORS KNOW ABOUT SCIENCE IN THE PARK

This section and the next on thermophilic life present our results for Content Area 2 in the Topical Framework ([Appendix A](#)). Much of our data for this content area came from the [word/card sorts](#) described in the Methods section, including the word sort for Content Area 2 (see [Appendix C](#) for a list of words) and the Subthemes Sort (see [Appendix D](#) for a list of the subthemes). We provide examples and a preliminary analysis in the next subsection.

Word Sort for Science in the Park and Life in Hot Waters

We include a range of examples of word sorts produced for this content area as Figures 23 to 28. The captions are based on respondents' explanations of their sorts. Some sorts included a number of discrete categories, often linked by the term, "Yellowstone Park" (e.g., Fig. 23). Other sorts included a mix of categories and elements arranged more like concept maps (e.g., Fig. 24). Concept-map like sorts (Figs. 25-28) seemed more prevalent than in the Content Area 1 sorts; however, the relationships portrayed in the maps were often based on rather simple classifications ("a bunch of things you see at Yellowstone," Fig. 24) or on personal connections (Fig. 26).



Figure 23. This respondent made four groups, all centered around Yellowstone Park. She called the groups "geology," "university," "biology," and no title (the hydrothermal terms). (S080501A)



Figure 24. This respondent placed Yellowstone in the center, with "a bunch of things you see at Yellowstone" radiating out from it. On the left she had a stack of science/university terms that she called the "intellectual" group. Lined up along the bottom she had a "biology" group. (S080502A)

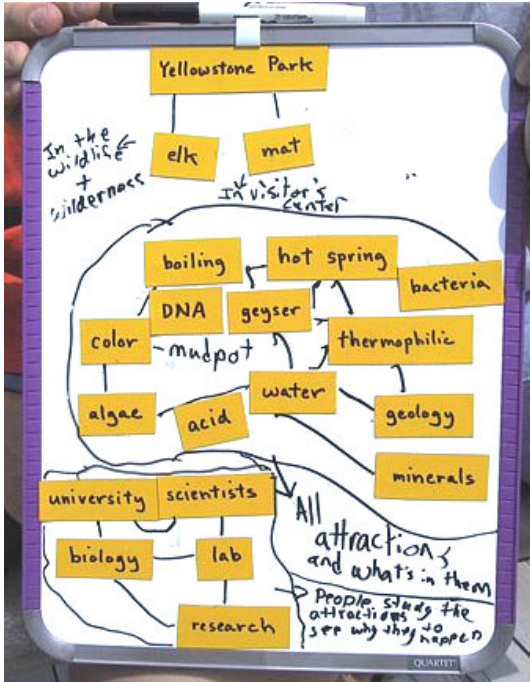


Figure 25. A 15-year-old brother and his 12-year old sister completed this word sort, which seem to be self-explanatory. (S080503B)

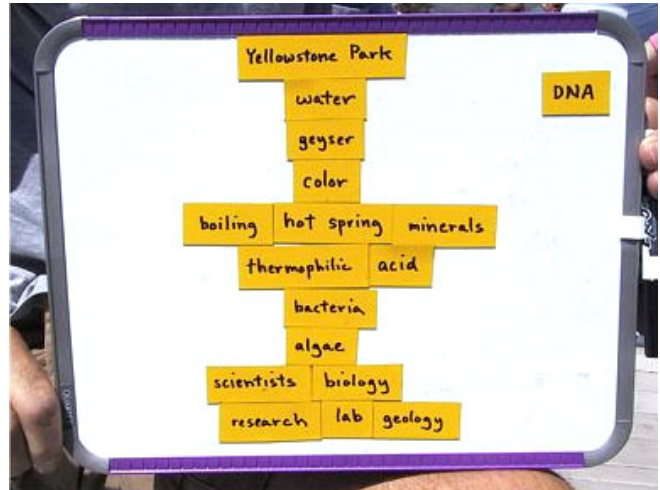


Figure 26. This word sort is an interrelated group with lots of personalized connections flowing downwards from “Yellowstone Park,” like a long, complex sentence. The respondent said “water” came first because he’s interested in fishing. (S080602A)

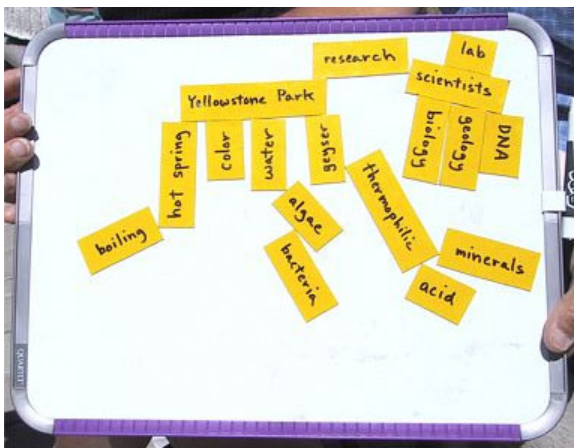


Figure 27. This respondent made a concept map, emphasizing connections, even though she wasn’t an expert on the subject matter. The sort even has short, branching chains with the words at an angle. Note that “research” is immediately adjacent to “Yellowstone Park.” (S080602B)

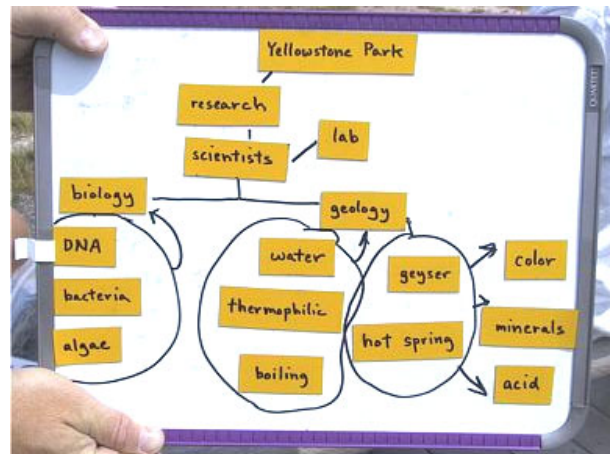


Figure 28. This respondent’s word sort also looked like a concept map. There was a single research branch off Yellowstone because “science is the mainstay of the mission of Yellowstone.” He also described the park as a lab. He said he didn’t know where DNA fit in. (S080603A)

Are Scientists in the Park?

In contrast to what we found out about visitors' knowledge of behind-the-scenes science in museums (Gyllenhaal, 2002), many of our Yellowstone respondents either knew about scientists working in the park or assumed they had to be somewhere, behind-the-scenery, doing their work.

Many word-sort respondents separated out “Yellowstone” and “science/university” groups in various ways (e.g., Fig. 23 and 24). However, even when their sorts didn’t show direct connections between these groups, when we asked if there were connections—if scientists ever worked in the park—almost everyone said yes. Other respondents showed more direct links between “scientists,” “research,” and “Yellowstone Park” (e.g., Fig. 25, 27, and 28).

How did respondents find out about scientists in the park? Some said they had read about them, seen pictures of scientists in visitor centers, or remembered seeing scientists in a Discovery Channel special about Yellowstone. Others said they just assumed that scientists were present.

We should note that respondents who had not participated in the word sort seemed less likely to understand that scientists were working at Yellowstone. Once they started thinking about the topic, respondents seemed to readily accept the idea that scientists were working in the park—it made sense to them. But they didn’t necessarily think about or wonder about scientists on their own.

Where Do the Scientists Come From?

The word sorts suggested that respondents strongly associated “scientists” and “research” with universities (Figs. 23, 24, and 25.) We eventually dropped the term “university” from the sort, so we could get a better idea of how respondents linked these concepts to Yellowstone National Park (Figs. 26, 27, and 28).

In discussions about the word sorts, respondents readily accepted the idea that university professors and their students might visit Yellowstone to conduct research.

I'm seeing Yellowstone Park as a sort of field research laboratory. We have university scientists, geological scientists, that are part of it. We've got the geysers and the hot springs, and the aquatic side of it here that also is in the park, and we have the biological part of it, the biological [scientists] working in the park. It's...just sort of rolled into Yellowstone. (0910022)

Again, this may be a concept that most visitors do not wonder about on their own, but the idea that university scientists visit Yellowstone seemed to make sense to our respondents once we brought up the subject.

A few respondents said that scientists also worked *for* the National Park Service and that there were research labs in the Old Faithful area, but we did not have time to pursue this issue in depth.

Scientists' Responsibility to the Public

We were surprised to hear respondents' comments about the role of scientists and their work. Many emphasized the importance of scientists communicating directly with the public.

All of the information that's known about all the features [was] explored by scientists. They enable us to understand, and I'm sure that that's ongoing. (0805021F)

They monitor what's going on in the area...and what those changes are, [and then] update for tourists. (0805021M)

The scientists have to tell you about it. (0805023)

I like the scientists to display it all for me so I learn more. (0803021)

You need a scientist to tell you what's really going on. (0806022)

Some respondents seemed to feel that discovering—and especially disseminating—new knowledge were the primary goals of scientists working in the park. Visitors wanted to stay informed about the intellectual adventure of understanding the park's geology and biology; however, there also seemed to be a somewhat self-centered, almost "what's in it for me" aspect to some responses.

Most respondents seemed less knowledgeable (and perhaps less interested) in the role that science plays in wildlife conservation and park management. A few respondents seemed to understand that scientists' had an impact on how the park's resources were managed (e.g., studying the effects of the 1988 fire). Very few respondents mentioned the economic impact of scientists' work, perhaps that's because most respondents were unaware of the economic benefits of scientific work with thermophilic microorganisms.

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WHAT VISITORS KNOW ABOUT LIFE IN HOT WATER

This section discusses visitors' understandings of thermophilic life based on the word/card sort for Content Area 2, described in the [previous section](#). See [Appendix C](#) for a list of words used in this sort. Some results are also based on respondents' discussions of the Subthemes Sort (see [Appendix D](#) for a list of the subthemes).

As we conducted the word sort, one thing quickly became obvious. Very few respondents understood the term “thermophilic.” They could figure out the “thermo-“ part (“heat” or “hot”), but they needed coaching to figure out “-philic.” Respondents who recognized the term often lived in nearby states or had been to museums and the IMAX show outside the park.

What Lives in Hot Water

Many respondents seemed to have at least a basic understanding about the life forms that lived in hot-spring waters. In the word sort for Content Area 2, some respondents categorized “bacteria” and “algae” in a biology group (Figs. 24 and 28); others placed them with terms like “hot spring” and “water” (Figs. 25 and 27); and others split them between groups. In other discussions about the park, many respondents came up with the terms “bacteria” and “algae” on their own when we brought up the possibility of life in hot water.

For many respondents, the strongest hook for this topic—and perhaps the only thing that turned their attentions to microscopic life forms—was the colors they saw in hot-spring waters. When we asked respondents what most surprised them about the park, many of them said things like this:

Hot springs, the color of them. I didn't think it would be truly that color, although it said it was in the book. And I know I was surprised it was from the algae, [and from] the sulfur that comes up. (P0923021)

As respondents tried to make sense of life in Yellowstone's hot waters, they sometimes drew parallels with life near deep-sea vents and other places with extreme conditions. They knew something about these organisms and assumed that knowledge would help them understand life in hot springs.

I've watched a lot of [shows] on the [life] in the deep ocean...like the bacteria and stuff that's growing there. But I don't think I've seen very much or learned very much about the stuff that we see here at the park. (0909023)

I know that under the oceans where there's volcanic action, there's many, many creatures that live near the hot zone, so I assume there are probably creatures here somewhere.... It seems like we all presuppose that we can kill organisms by boiling water, and yet we hear we have organisms under the sea that survive. (0910026)

I did just see an Imax show in Denver... on scientists who go to various caves, ice caves and other kinds of caves, collecting organisms that live in these extreme conditions. (0910027)

Word-sort respondents seemed confused by the term “mat.” Most respondents put it by itself (Fig. 23 and 24) or made a joke about it (“In the visitor’s center,” Fig. 25). They were not linking “algae” and “mat” on their own, but instead were wondering why we included a term that just didn’t fit. Eventually we dropped the term from the sort (Figs. 26-28).

The Science and Technology of Thermophilic Life

We talked with very few visitors who knew of the links between Yellowstone’s thermophilic life and the science and technology of genetics. Most word-sort respondents linked “DNA” with “bacteria,” “biology,” “research,” or “lab.” A few respondents placed “DNA” in a category by itself (Fig. 26) and admitted they did not know what to do with it. The one respondent who placed “DNA” with hydrothermal features said he didn’t know where else to put it (Fig. 25).

The one group that discussed biotechnology in depth had just learned about it at a natural history museum in Cody.

Remember, Dad, you were reading about that million dollar industry that comes from the microorganisms that live in this hot water, and how it's used for DNA....We learned that at Cody. They have a natural history museum at Cody, so they were talking about a lot of these things. (0803021)

When we told respondents about the relationships between the biotechnology industry and Yellowstone, some seemed interested in learning more about it, and some did not.

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WHAT VISITORS KNOW AND FEEL ABOUT HISTORY AND PRESERVATION AT OLD FAITHFUL

This section focuses on visitors' understandings of the historical aspects of the Old Faithful and on their understanding of the park's efforts to preserve Yellowstone's hydrothermal resources. The results are based mainly on the word/card sort for Content Area 3, described in the [Methods](#) section. See [Appendix C](#) for a list of words used in this sort. Although some results are also based on respondents' discussions of the Subthemes Sort, most of the discussion of the "cultural icon" subtheme is presented below under [Prioritizing the Subthemes](#). (See [Appendix D](#) for a list of the subthemes.)

Thinking About the Past

Most of the adult visitors we spoke with seemed to have a basic understanding of the sequence of historical events in the region. Sometimes this understanding was directly expressed in the word sorting activity (Figs. 29 and 30).

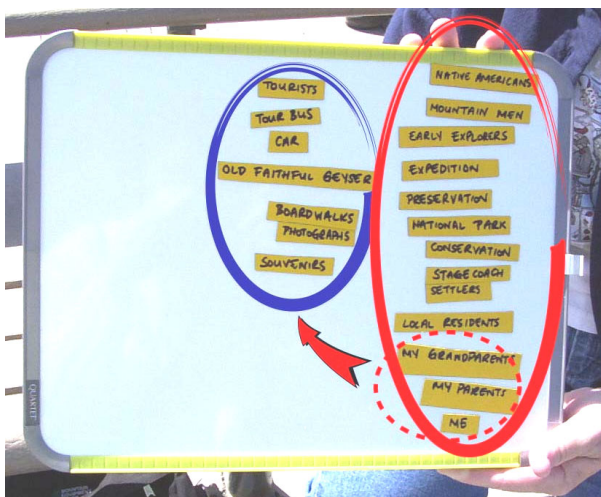


Figure 29. Content Area 3 sort with a strong chronological component (large oval). The group circled with a small oval represents aspects of the park relevant to the respondent's immediate family. (S0909021)

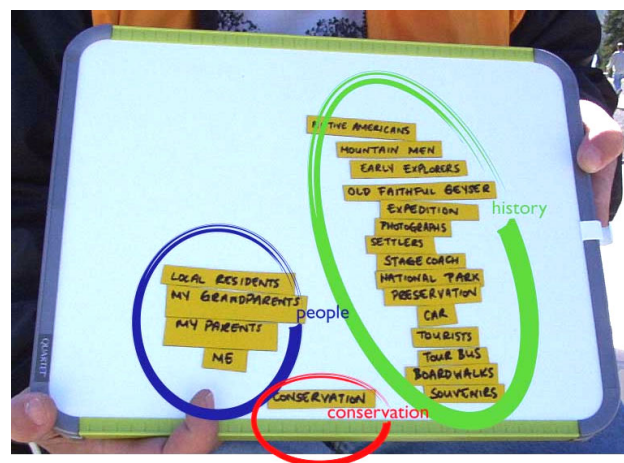


Figure 30. Content Area 3 sort with categories for history, people, and conservation. Note that the history theme is arranged chronologically, and that the respondent grouped preservation with history instead of with conservation. (S0909022)

More often the terms were sorted into categories that were personally meaningful to the respondents, and then respondents' understanding of chronology was expressed as they talked about the sort

Native Americans were here first, then you have your expeditions, your early explorers, the mountain men, the different people that finally settled here, and now you've got your local residents. (0910024)

Most respondents seemed to have limited interest in the history of Native populations in the area. However, we talked with a vocal minority who considered this one of the most interesting aspects of the park, and who were disappointed they couldn't find out more about it.

I was very disappointed that there was a lack of information on the Indians and how the Indians perceived the geysers. There was basic information about where the Indians were and how they treated, and sort of what they did. But no information about how the geysers were perceived. I think we just don't know. (P0920021)

We also encountered a small-but-committed minority who expressed strong interest in the early European history of the park.

I want to know more about the early explorers, Native Americans, mountain men, settlers, and expeditions into the park. Which includes early photography, drawing, and diaries. (0910021)

We encountered even fewer respondents who expressed a strong interest in the more recent history of the park, although a few respondents seemed interested in the history of the Old Faithful Inn.

Although the number of respondents with a strong interest in park history was relatively small, it is important to note that some of these people seemed much more interested in the human history of the park than its natural history.

Preservation and Conservation at Yellowstone

We found that many respondents were aware that Yellowstone was the first national park, and that it was established in large part to protect the region's hydrothermal features. Most respondents also seemed aware of the park's efforts to preserve geysers by keeping people on the boardwalks and by preventing them from throwing things into the hydrothermal features.

They're trying very hard to keep people from throwing things in them. Somewhat successfully, I think. They're doing much better than they did in the past. The visitors are well behaved; they're on the path. Except for one item I saw this morning in one of the hot springs of Biscuit Basin, that's the only thing I've seen human-made [objects] in one of them. (0910022)

They strongly discourage it. They did say that it wasn't really going to be feasible to fix it because they'd have to move heavy equipment in and it could do a lot of damage. We did see [a photograph] at some geyser they were cleaning out debris. I forget which one in particular it was, but they were showing like coins they were taking out. (0910024)

Many respondents approached this subject on a personal level—they talked about their own responsibility to follow the park’s rules. Some respondents also linked their personal safety with geyser preservation.

I can see it's a good idea not to walk on this fragile ground because you might fall in and get boiled to death. It probably wouldn't be too good for the feature either. (0910027)

We were interested to note that some respondents were curious about whether the park’s hydrothermal resources could or would be used as an alternative energy supply.

[Yellowstone Park is] clearly the largest hydrothermal area in the world. It's a premiere area for preservation of resources....There's always questions of hydrothermal development. I haven't heard anything lately that's imminent. (0910022)

Some respondents admitted they didn’t know the difference between preservation and conservations.

I think they're important things, I'm just not quite sure of the difference between the two. (0910027)

We talked with a number of other respondents seemed less aware of the park’s role in protecting hydrothermal features from economic exploitation both inside and outside the boundaries of the park. For instance, many visitors did not seem to understand why tapping geothermal energy outside the park might have negative affects of the geysers of Yellowstone, and why mining mineral resources inside the park violates the mandate of a national park.

We were surprised at the number of respondents who wanted to know more about the number of visitors to the park, and what the Park Service was doing to control them.

I'd be more curious on how many visitors than the actual dynamics behind the geysers. (0910025)

This seemed like a preservation issue because most of these respondents wondered how the park was managing the large numbers of visitors in an effort to keep the area pristine.

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VISITORS' PRIORITIES FOR THE NEW VISITOR CENTER

Prioritizing the Subthemes

Although most respondents were willing to prioritize the subthemes, this turned out to be a difficult task, with no single subtheme emerging as a top choice. In fact, many respondents emphasized that they wanted to see all the subthemes represented in the exhibit, and they would only rate the subthemes in terms of the order in which they wanted to encounter them.

Using the short phrasings of the subthemes, "Yellowstone's volcanoes—past, present, and future," and "Yellowstone's geysers, mud pots, fumaroles, and hot springs" came out slightly ahead for reasons that are detailed below. "Old Faithful-cultural icon, place of pilgrimage, and shared legacy" received a slightly lower overall priority (although this was also rated highest by some). There were indications that this slightly lower rating may have to do with many respondents mixed feelings about their experiences at Old Faithful and to some respondents' objections to what they saw as the "commercialization" and crowding of the Old Faithful area.

What we found vastly more interesting than the ranking of the subthemes were the reasons behind the ratings. Our analysis of these reasons seems more important than the actual ratings themselves and is covered in detail in the rest of this subsection.

“Yellowstone’s volcanoes—past, present, and future”

Many respondents seemed especially interested in ideas they were just finding out about for the first time—and many respondents had just learned about the volcanoes of Yellowstone (sometimes during our interview).

Respondents who rated this subtopic highly gave reasons such as, “That’s the interesting thing that links it together,” and it’s “the bigger picture—why it’s here.” Respondents who gave this theme a lower priority either didn’t seem to know about or understand the concept or had strong personal interests in other aspects of the park, like its human history and cultural meaning

“Yellowstone’s geysers, mud pots, fumaroles, and hot springs”

Many respondents considered this to be the most accessible of the subtopics—the one that would “reach the most people.” Respondents rated this subtopic highly because, “That’s what we came to see,” or because their kids had the most questions about geysers and such, and they weren’t able to answer them. Some respondents emphasized the link between this subtopic and the volcano subtopic; one respondent rated this theme second because “it goes along from volcanoes in a progression.”

The full wording of this subtopic was, “At Yellowstone, hot water helps shape an extraordinary landscape of rare hydrothermal features—geysers, mud pots, fumaroles, and hot springs.” A few respondents objected to the phrasing of this sentence, either because it seemed like an overly narrow use of the term “landscape” or because shaping the landscape wasn’t important to them, because, “You can shape terrain with a plow or Caterpillar.”

“Yellowstone—scientists at work in a living laboratory”

This subtheme received a mix of positive and negative reactions, with most falling somewhere in between. Some respondents seemed to have very positive feelings about science and scientists, especially at Yellowstone. They wanted to learn more about what scientists had discovered and how they had discovered it. As discussed earlier, many respondents considered dissemination of results to be a major role for scientists in the park.

Other respondents seemed to have generally negative feelings about science and preferred to learn about other aspects of the park.

You can just say the word "Science", and it will turn me off. (P0919025)

The wording of this subtheme seemed to confuse or distract some respondents. To a few respondents, “Scientists at work in a living laboratory” implied that the new visitor center would include a working lab:

This would be the one that I would find most interesting, is to have scientists in a working laboratory that you could watch and ask questions and find out just exactly what is going on out there, underneath. (0805025)

A few respondents reacted negatively to the full wording of this theme: “Yellowstone is a rare living laboratory that draws scientists who want to explore the interplay between the volcano, the hydrothermal features, and the diversity of life found here.” Their first reactions to this version were:

It should be drawing people, not scientists. (0804024)

I'm not a scientist. The majority of the people who come here aren't scientists. (0804022)

They seemed to feel that the wording emphasized what’s in it for scientists, not what’s in it for the public.

“Life in Yellowstone’s hot waters”

This subtheme also received a mix of positive and negative reactions, with most in between. Some respondents had just learned about the topic during our interview, and they wanted to learn more. The few respondents who had heard about the “million dollar industry” based on Yellowstone discoveries also rated this topic highly.

Many respondents seemed to rate “life in hot waters” near the middle either because they didn’t know enough about it to make up their minds, or because they didn’t have strong reactions for or against the subtopic.

Some respondents who gave this subtopic a low rating were concerned about the small size of bacteria and algae. There seemed to be less interest in smaller organisms because people cannot see or watch them without a microscope.

I think life in Yellowstone's hot water probably are microscopic, so you probably won't be able to visually see it or experience it. (0910026)

Other respondents pointed out that it made more sense to talk about this subject at Mammoth, where you could get closer to the pools.

Respondents showed a mix of reactions to the idea that scientists don’t fully understand life in hot water. Some respondents said they were attracted to this idea, but others were concerned that the exhibits might state facts that would soon be proven wrong.

We're only beginning to understand it. I don't know. Maybe they should wait until they get more information before they start sharing it with us and confusing us. (0804025)

“Old Faithful—cultural icon, place of pilgrimage, and shared legacy”

This subtheme received a mix of strong positive and strong negative reactions, with not as many in between as some of the other subtopics. Some respondents said they identified with one of more aspects of “cultural icon, place of pilgrimage, and shared legacy.”

The pilgrimage, you know, that really bit. Because you do see people from not only across our country - we were just kind of looking, you know. Did you see a Pennsylvania? Yes, we saw a Pennsylvania. Did you see a Massachusetts? Yes, we saw Massachusetts. (0804025)

I went to this place the first time with my fiancée at the time, and now we're bringing our son back, and I want him to see it. So, it's a place of pilgrimage. (0806023)

The shared legacy pretty much tells everyone they've got a piece in keeping it going. (0803022)

Other respondents expressed negative reactions to these same ideas.

I think that cultural icon should rest in the gift shop and no place else. (0805026)

I don't see Old Faithful as a cultural icon or a place of pilgrimage. I don't think either one of those things is, particularly for most people. (0910022)

Some respondents also questioned the claim of a “shared legacy.” One foreign-born Hispanic visitor said he doubted that different cultural groups would want to see the same ideas expressed in the exhibit:

What the Hispanic cultures want to see is going to be different than what the Indian cultures want to see, or different than what the Asian cultures want to see. And I really don't want to read what others said. (0804022)

A few respondents thought this theme expressed some important ideas, but they figured most people already understood that so it didn't have to be emphasized in the exhibit.

Even though that is important to America and everybody else with it. Yes, we're proud of it. As far as learning-wise, to show people and teach them [the other subtopics] is more important. (0804026)

Other respondents said they thought these ideas were important and interesting, but they gave the subtheme a low rating because they wanted visitors to be exposed to the other ideas first.

I'd like to put Old Faithful last, because it's the culmination of all of this knowledge. If we would learn all this before we came here, I'd appreciate it a little more. (0805022)

We'll complete our discussion of this issue in the [RECOMMENDATIONS: Prioritizing the Subthemes](#) section of this report.

Other Themes of Interest to Visitors

After discussing the five subthemes with respondents, we asked them if any topics seemed to be missing from the list. Many mentioned one or more additional topics that they would like to see included in the exhibits.

Wildlife. Many respondents said they wanted to see exhibits about wildlife in the park. Some specifically wanted to find out how wildlife use and are affected by hydrothermal features, especially in winter. Some of these respondents said they wondered if large mammals warmed themselves in the hot springs; others wondered how hot-water runoff affected fish in Yellowstone's rivers.

Other respondents wanted more general information about wildlife in the park, such as what lived in the park, and where they could go to see large mammals.

What I guess I see missing out of some of these is the wildlife. That's a big, big part of the park, as well.... Our feel of the park is [that it's] not here for the people. It should be here for the wildlife, and we're just visiting. (0803022)

Short-term visitors in particular said Old Faithful would be the only center they saw in the park, so this would be their only opportunity to view exhibits about wildlife.

History. Some respondents said they wanted to learn more about the human history of the park, including the discovery and use of hydrothermal and other features by Native Americans and Europeans.

Like the history of Yellowstone, a compilation of who explored it, discovered it. Who found all these geysers? [It] has to be here. (0804022)

Those who requested this topic were adamant about the need to include it. Some of them seemed to relate more strongly to the human history of the park than to the natural history topics that dominated the subthemes.

We should note that, although history wasn't specifically mentioned in the "cultural icon" subtheme, the detailed outline discusses the history of the park in some detail. It seems that there will be a relatively small but very receptive audience for this part of the exhibit.

Economic uses of Yellowstone's resources. Some respondents said they were wondering about the practical uses of Yellowstone's resources. Some of them brought up the issue of geothermal power; others wondered about whether hot springs were used for bathing, either recreationally or for health purposes; a few asked about hydrothermal mineral deposits as resources; and one respondent even brought up the issue of the mud in mud pots.

I think [they need] more to do with the mineral things—what is actually coming out of the earth. The mineral deposits that are coming out of the mud pots....Are any of them being used as resources for us today? Do they do anything with the mud? Like in Israel, certain places, they take the mud and use it for facial crèmes and all this kind of stuff. (0803021)

Sometimes as they discussed these economic aspects of Yellowstone, respondents recalled that Yellowstone was a national park and remembered what that meant in terms of the protection of natural resources. Other respondents didn't seem to think about conservation and preservation aspects of Yellowstone resources, at least not in the context of our conversation.

The 1988 Fires. Many respondents brought up the issue of the 1988 fires. Some commented about how much the vegetation had recovered since the fires; others seemed concerned about the many dead trees they saw and what they considered to be the low height of the new growth. As we asked about potential exhibit topics, some respondents said they thought this would be a good topic for the Old Faithful visitor center.

The other thing is the big fire in '88, there was really nothing about that anywhere. How many acres? I think it was a lightning strike that started it, but I can't remember exactly. (0910021)

Some respondents said they wanted information specifically about the fires' effects in the Old Faithful area; others seemed to want a more complete discussion of the Yellowstone fires. A few respondents expressed concern about the effects of fire on hydrothermal features in the park.

Controversies. A few respondents brought up various controversies that they had read about in the papers or heard about on TV news. These respondents were interested in finding out more about issues such as the affects of the 1988 fires on the park and how the current drought might affect hydrothermal features. Although the newsworthiness of any individual issue will likely change with time, one respondent argued that controversy in-and-of-itself should be a topic in the new Visitor Education Center:

Put [controversies] out there in front. I mean, you can't hide it...It's part of the park. It's part of that ongoing, living thing...You have to put those controversial things out there and get people to understand why. (0803022)

Other aspects of Yellowstone geology. As discussed earlier, respondents often expressed strong interest in seeing exhibits about topics they had just recently encountered for the first time. A few respondents said they wanted to see more in-depth information about specific aspects of Yellowstone geology that had aroused their curiosity, but did not seem adequately covered by the five subtopics. These included respondents who had just learned about the affects of glaciers on the landscape and the prevalence of earthquakes in Yellowstone.

The one thing that I would be interested in finding out more about would be the whole earthquake thing....You know, the idea of there being earthquakes in Yellowstone every day was fascinating to me. (0803024)

We should note that, although earthquakes weren't specifically mentioned in the volcano subtheme, the detailed outline discusses earthquakes in some detail. It seems that there will be at least a small but receptive audience for this part of the exhibit.

Some of the take-home messages from this section and the previous discussion of the subthemes seem rather obvious:

- **Broad interests.** Visitors as a group have a wide range of interests—broader than could possibly be satisfied in a single exhibit.
- **Deep passions.** Some visitors are deeply passionate about their interests—deeper than could be satisfied in a single exhibit.
- **Old Faithful area *and* Yellowstone.** As a group, visitors want to find both specifics about the Old Faithful area and more general information about Yellowstone in the new center's exhibits.
- **The excitement of the new.** Visitors can get caught up in the excitement of learning something new—and once they get started with a new topic or new idea, they want to learn more about it.
- **Lack of consensus within groups.** Within most of the groups we talked with, there was a range of interests and passions. Groups rarely achieved consensus on prioritizing the subthemes, and there were often differences on what additional topics should be included in the exhibits.

Satisfying such an audience may seem like an impossible task for exhibit developers and designers. However, we still think it is worth considering our respondents' suggestions. We'll complete our discussion of this issue in the [RECOMMENDATIONS: Prioritizing the Subthemes](#) section of this report.

What Visitors Said About Exhibits

As we discussed specific ideas for exhibits for the new Visitor Education Center, several threads emerged. In this section we discuss two threads that seemed specific to the major theme and subthemes proposed for the exhibits. In the section entitled, [Experiencing the Park](#), we discuss some additional threads dealing with respondents' desires for exhibits that would help them better experience the park as a whole.

The first theme that we heard from all sorts of visitors, including parents, grandparents, and those without kids: Make the exhibits interactive, hands-on, and "fun for the kids." When we asked respondents about their preferences for exhibits in the new center, we were surprised how many discussed the needs of children.

[I want] more hands-on type things...Someplace where the kids can do a lot of discovery. Something for the kids. (P0917022)

[I want] interactive displays where kids could hands-on see how the geysers work, how the water goes down and comes out....Even hands-on ways of showing how the water comes out in these different colors and showing why they have the vibrant hues. (P0902021)

These last two quotes were from parents who were also elementary school teachers, who we would expect to use terms like "hands-on" and "discovery." However, many non-educators also seemed to have learned the museum jargon for these sorts of exhibits, and even made it their own.

A little bit more on-hand showing how it works would be more dramatic for kids, a little more interactive would get kids involved. Just showing information is really quite boring to kids, right? A lever to push or something to show, you know, it helps. (P0902021)

I would like to see lots of hands-on. Children, when they see all those walls of posters or artifacts up on the wall, it's boring. They walk by it; they couldn't be bothered. (0909025)

We heard this theme from more than just educators and parents; even grandparents spoke up for the kids.

We have two grandchildren. We've seen how they get involved in stuff like that. Movies don't hold the attention at all. And these kids would have something to do. Just for them, they need something a little bit more hands-on, sometimes. They get tired of having their parents push them around. (0804023)

Although we believe that many respondents were indeed concerned about the needs of children, we began to suspect that some respondents had a more personal interest in this type of exhibitry. Eventually we spoke with adults who admitted that they also preferred these types of displays.

I like hands-on, interactive displays.... I'm a touchy feely person.... I like to touch them, feel them, you know. [And that's for you, too. Not just for your kids?] Exactly. Oh, yes. For me, too. I love that. (P0919024)

We were interested to note that some respondents discussed various types of informal educational institutions that the park should try to emulate.

Like Monterey Aquarium, they have things a kid can play with and see it. Why don't we have a model and actually pump the water and they can watch? (0910022)

The dinosaur exhibit at the Natural History Museum in Denver is pretty good. It used some hands-on things and questions for kids to lift up things in order to see the answers below. Hands-on stuff. All that helped. (0910027)

Like children's museum type of thing, where they could do something with it. And really get them involved in what's really going on. (0804023)

We're wondering if the prevalence of interactive and hands-on exhibits in children's museums, other museums and science centers, and even aquaria and zoos has changed many people's expectations about what an exhibit can and should be. If so, it seems logical that many people will come to the new Old Faithful Visitor Education Center with similar expectations.

However, as we listened to these visitors, several points about interactive exhibits came to mind:

- **Labor-intensive.** Maintenance of interactive exhibits is a labor-intensive activity, which can be difficult even at science centers and museums with on-site interactive shops.
- **Negative impact of broken exhibits.** Even a few broken exhibits can have a negative impact on the perceived quality of a visit. When exhibits are crowded, visitors seem even more likely to encounter broken exhibits (because other visitors are crowded around the functioning exhibits), leading to the perception that "everything is broken." (Wageman, 2001).
- **Isolated setting.** The staff informants interviewed for our first report (Gyllenhaal, 2002) told us several stories about how difficult it had been to maintain various audiovisual displays at Old Faithful, especially given the limited staff and isolation of the park.

We'll return to this thread in the [RECOMMENDATIONS: Creating Exhibits that Excite and Inspire Visitors](#) section of this report.

The second notable thread related to exhibits seemed to be inspired by respondents' desire to experience geysers and other geologic features in ways they couldn't experience the real thing. Some respondents described exhibits that could take them closer to geysers.

I would expect some visual aids [that show] where we can't be but other people can go. In other words, park rangers could actually go and maybe film around there to show what's going on right near there so we could actually see it. (0910026)

Other respondents wanted to get a better understanding of what was going on in the subsurface.

I think it would be really neat to have some ground penetrating radar. Start talking about the geological formations underneath, what the fault lines look like under here. I'm sure a lot of that observation is available already. What would be really fun is for somebody to put a slit trench across a fault line and make an exhibit. (0910022)

Others asked for hands-on or up-close looks at other aspects of hydrothermal features.

Even just showing displays of bacteria that grow in there....I presume they could make a culture that people [could] see up close, because you don't get that close to them. (P0902021)

Visitors' experiences of the "real thing" at Yellowstone are necessarily limited to protect hydrothermal features, visitors, and other living things. Therefore it seemed appropriate that our respondents sought alternative ways to experience the park's features through the new visitor center's exhibits.

Experiencing the Park

The previous section dealt with respondents' ideas for exhibits specific to the themes and subthemes proposed for the new visitor center. However, many respondents also told us that they wanted the new visitor center's exhibits to help them better explore the park.

Where to go, what to see, what programs the rangers are having, the different activities that people can do throughout the park, when's the best time to see the different big animals around the park, where's the best places to see them? (0910024)

Although many respondents said they got that sort of information from rangers, others said they had a hard time finding a ranger to talk to during the peak season.

There were so many people, like it was almost impossible to talk to a ranger. We were there in the beginning of August, end of July.... There's just no way. (P0917021)

When we asked respondents whether they would prefer to talk to a ranger or see exhibits about exploring the park, many said they preferred to talk with rangers when possible. However, others said they preferred an exhibit.

I'd rather see an exhibit just having information that you can read. That way, if there were a bunch of people there, you wouldn't have to wait. (0804023)

Of course, similar information is available through park publications, guidebooks, and many other sources, but many respondents also wanted to see exhibits in the visitor center.

Another frequent suggestion for an exhibit seemed to be an expression of respondents' desires to gain perspective on the park and its major features. Respondents often suggested that the new visitor center include a large relief model of Yellowstone National Park, much like similar landscape models they had seen at other parks.

We went through the Grand Tetons, and in their ranger center they have a three-dimensional map of the park laid out on this big, huge table. On it, the rangers give a talk and place wildlife in areas where they can be seen. They also touch on highlights in the park at those places. (P0917022)

I like those big, huge topographic maps....[They] show all the different features and the topography. It's got little labels, and you can walk around it. It's a big table. You've seen them. You push a button and it says, "Old Faithful." It's a hands-on. You can really get a perspective. It's like flying over. You can see where everything is. (0804025)

Some respondents wanted to use the landscape model to help plan the rest of their visit, in part by helping them get a handle on the immensity of Yellowstone National Park.

[The most important thing for the new visitor center is] probably a map or a replica of the park. I know it can't show distances [in miles], but you ...could group things together. And that way, you could learn and not miss anything. (P0923021)

Although some respondents pointed out that a landscape model could help interpret that park's geology (e.g., by showing the boundaries of the caldera), most respondents seemed to think of the model as an orientation device rather than as a tool for learning science.

We heard many other suggestions of ways the visitor center could help improve visitors' experiences of the park. Some of these were discussed earlier in the section entitled, [Other Themes of Interest to Visitors](#). These suggestions could either be viewed as proposed exhibits about the Old Faithful area's hydrothermal features or as suggestions for separate, independent exhibits about exploring the park. For instance, exhibits on wildlife either could be closely related to the proposed themes for the exhibit (e.g., how wildlife use and are affected by hydrothermal features) or could be designed to orient visitors to wildlife found throughout the park. Exhibits on the 1988 fires similarly could be closely focused on the Old Faithful area or could deal with fires throughout the park.

We encountered two other categories of suggestions that seemed to fall under the general category of exploring the park. One category included suggestions for exhibits that would encourage visitors to change the way in which they explore the park. Several respondents wanted to encourage other visitors to get out of their cars and explore the park.

In at least my Yellowstone experience, it was extremely hard to find anything about hiking or getting outside your car. It seemed like hiking was really discouraged. There were many signs that said, "Don't go off the trails. It's dangerous. You'll fall in hot spring waters or a bear will get you." So, I guess I would like to see in the visitor center a display [that] asked what sort of hike you'd like to go on and then suggested hikes that fit those parameters. (P0920021)

A second category was for exhibits that would help visitors gain some of the practical skills that it takes to survive in a more or less natural environment. Some of these suggestions dealt with visitor safety, but others dealt with more mundane aspects of wilderness life.

How to do your dishes while we were camping. People are camping. And there are many signs that tell you how not to do dishes, but there's nothing that tells you how to do them. And it's quite challenging, you know. (P0920021)

As pointed out by our staff respondents (Gyllenhaal 2002), visitors who grew up in cities and suburbs are often ill prepared for life in Yellowstone National Park—and at least some of them want the Park Service to help them make it in the wild.

Finally, as we tried to discuss exhibit ideas for the new visitor center, many respondents turned the discussion towards the interpretation they encountered along Yellowstone's trails. Some respondents complained about a general lack of interpretation along the trails.

[At] the mud pots and things we visited, there just wasn't all that much information. I'd like to see signs and more information about them. There was only one place we stopped at that [the signs] tell you how hot it was. And I would just like to have a lot more information at each of the locations....A lot of places you go, they have a lot of information. You can stop and read it all, and you can learn about it. You can't really do that here. (0805025)

Others made specific suggestions about the sorts of interpretation they would want to encounter along a particular trail or at a particular type of hydrothermal feature.

I'm a statistical freak. How far down does that waterfall go? How many gallons of water are coming up with that at once? I'm a question gal. I ask a lot of them. And none of that got answered. (0805025)

Responses like these suggested that visitors want to use a variety of information sources within the park, and that they are looking for different sorts of information from the different sources. They also reinforced our earlier findings that learning within the park can be cumulative, based on repeated exposure to similar ideas and cycling back-and-forth from experiencing the real thing first-hand to learning about it at a distance.

Although most of the respondents quoted in this section suggested ideas for visitor-center exhibits, there might be other ways to accommodate the needs and desires that inspired their suggestions. We will complete our discussion of this topic in the section entitled, [Additional Recommendations](#).

Amenities

As we expected, our respondents made many suggestions about restrooms and other amenities that will be associated with the new visitor center. Most suggestions would be pretty obvious to those who have spent time at Old Faithful in the summer. Perhaps the most frequent

suggestion about traditional amenities was to build more women’s restrooms. The most surprising suggestion was to build Old Faithful’s restrooms without walls (so that late-comers and parents dealing with last-minute emergencies could both use the facilities and see Old Faithful erupt).

As evaluators who often work in museum settings, another common suggestion rang true.

I think more chairs...Just being able to sit and look outside. (P0919021)

Some respondents talked about seating in the visitor center itself, and others discussed the need for more seating along the paths from the buildings to the boardwalk. Several respondents discussed seating as a need for older visitors in particular; however, based on our museum experiences, increased seating improves the experience for all ages.

Finally, the most frequent suggestion we heard overall was to post the predicted time of the next Old Faithful eruption in one or more places where it would be obvious and easily read from the boardwalk.

One thing I wanted to get at the visitor center at Old Faithful was try to get an understanding about the semi-predictable eruptions, when they were going to erupt.... And you know, as far as doing a service for visitors, I think that's probably the most important service they can give. (P0913021)

Some respondents also suggested posting the predicted times within the new center’s exhibit area, and others suggested posting times near the walkways from the parking lots.

This suggestion also rang true with us. As we collected data on the boardwalk, visitors were continually asking us when the next Old Faithful eruption would be—and once they found out how much time they had, they often decided to do something other than sit and wait. Some decided to take a hike, go to the bathroom, get ice cream, or even stop by the visitor center to see the film or check out the bookstore. We tend to agree that, given the priorities of most visitors to Old Faithful, a more prominent posting of the predicted eruption times would be, “the most important service they can give.”

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RECOMMENDATIONS

In this section we translate our findings into concrete suggestions for the new Old Faithful Visitor Education Center. These recommendations should be regarded as preliminary—as a starting point as we negotiate the meaning of our findings with the exhibit developers and designers and with other folks who have a stake in the outcomes of this process. This negotiation begins with the comments we receive from Yellowstone National Park staff on this draft report, and can continue during the design charette, when a representative from Selinda Research Associates will meet with the exhibit team to reformulate and shape these recommendations until they fit the needs of the Park Service as well as visitors to Yellowstone National Park.

Before we discuss our other recommendations, we would like to address the primary theme proposed for the exhibit: **“Yellowstone National Park protects the rarest collection of geysers and hot springs on Earth.”** We make the following recommendations with regards to this theme:

- **Keep the focus on the wealth of hydrothermal features at Yellowstone.** As we discussed several times in this report, many respondents expressed mixed or even negative emotions about their experiences with Old Faithful, but first-time visitors in particular seemed enthusiastic about their discovery of the wealth of hydrothermal features that surround the best-known feature in the park. The primary theme seems to capitalize on this enthusiasm in appropriate ways.
- **Help visitors understand why Yellowstone’s geysers and hot springs are unique.** Achieving this goal will require an understanding of each of the five subthemes, because the uniqueness of Yellowstone depends on the combined geological, biological, and human history of the park. We suspect that visitors will find this understanding to be emotionally satisfying for a range of reasons. For instance, visitors have invested time and money on their trip to Yellowstone, and they deserve to understand why their efforts were well spent.
- **Help visitors better understand the meaning of “protect.”** As we discussed elsewhere, most respondents understood protection of hydrothermal features on a personal level—what they could do to protect the geysers, and what the park was doing to prevent visitors from harming these resources. However, our respondents seemed less aware of the park’s role in protecting hydrothermal features from economic exploitation both inside and outside the boundaries of the park.

Prioritizing the Subthemes

Based on our findings, we make the following recommendations about the five subthemes.

- **Include all five subthemes.** We agree with those respondents who said that all five subthemes needed to be in the exhibit. Our results—especially our findings about the diverse interests of our respondents—argue for a broader coverage of hydrothermal features and related topics, rather than a more specialized treatment of just a few aspects of science or humanities of Old Faithful. We do not suggest that the five subthemes be arranged in a particular sequence, although (in the points below) we make suggestions about the prominence and interrelationships among the subthemes.
- **“Yellowstone’s geysers, mud pots, fumaroles, and hot springs” and “Yellowstone’s volcanoes—past, present, and future.” Give equal priority to the subthemes on hydrothermal features and volcanoes.** We recommend that the main educational goal of the exhibits should be to help visitors forge stronger and deeper conceptual links between the hydrothermal features they see on the surface and the Yellowstone “supervolcano.” Remember that some visitors will be developing these links for the first time, and others will be elaborating on pre-existing understandings. Based on the results of our word sort and drawing activities with visitors, we recommend:

- (1) **Scientific terminology should be used with care.** Although many respondents recognized or figured out many scientific terms, like “magma,” “plate tectonics,” and “hydrothermal,” their understandings of these terms were often shallow and incomplete. Other terms, like “hot spot” and “fumarole,” were unfamiliar to most respondents.
- (2) **Help novice visitors make critical links between major concepts.** Perhaps the most critical step for novice visitors will be to understand that surface hydrothermal features are directly linked to Yellowstone’s huge volcano.
- (3) **Help visitors who have begun to develop an expertise about Yellowstone to refine their understandings** of key ideas and relationships (e.g., the relationship between the hot spot and plate tectonics, and the connections between earthquakes and volcanoes) and to learn the scientific explanations for their alternative understandings (e.g., how water moves in the subsurface).

Because visitors learn in so many different ways, these concepts should be explained and illustrated using a range of methods, including illustrations, animations, and static and working models, as well as a range of verbal explanations, including analogies.

The exhibits about these subthemes should be placed so that everyone who enters the exhibit area—even for a brief visit—at least walks past them, because they are critical to visitors’ understanding of the main theme of the exhibit.

- **“Yellowstone—scientists at work in a living laboratory.” Examples of scientists at work in the park should be placed in many parts of the exhibit.** To quote one

of our respondents, “You need a scientist to tell you what’s really going on,” and scientists have things to tell visitors about every aspect of the park. Many respondents expected scientists to inform the public about their work, and some seemed to consider public education to be an important responsibility for scientists. It will also be important to inform visitors of some of applications of scientists’ work that they seem less aware of, such as park management, resource preservation, and biotechnology.

We recommend that examples of scientists-at-work be placed throughout the exhibit, rather than confined to a single, isolated section about the “science in the park” subtheme. When possible, scientists should “speak directly to visitors” in the exhibit through recorded conversations, partial transcripts, and images of them engaged in research.

- **“Life in Yellowstone’s hot waters.” Assume that visitors know very little about life in hot water.** Many visitors will have a rudimentary understanding of the role of bacteria and algae in coloring hot-spring waters, and we recommend developing exhibits that build on these understandings in three ways:
 - (1) **Give details about the interacting roles of microorganisms, minerals, and temperatures in coloring hot-spring waters.** Most visitors will have a basic understanding that the exhibit can build on.
 - (2) **Introduce visitors to a few basic ecological and evolutionary ideas about thermophilic organisms.** Much of this will be new information to most visitors, although the ideas may link to what some of them already know about life in deep-sea vents and other extreme environments.
 - (3) **Introduce visitors to a few basic ideas about the role of thermophilic organisms in genetic science and biotechnology.** This also will be new information to most visitors, but it can be linked to things they’ve heard or read about biotechnology. A careful treatment of this topic can also challenge and expand visitors’ understanding of what it means to protect a natural resource in a national park.

This should be a separate section of the exhibit hall, because it is not directly related to the most important subthemes. Although this subtheme is an important elaboration of the main theme of the exhibit, but it is not as critical that every visitor be exposed to these ideas. The strongest hook for this subtheme seems to be the colors in hot-spring waters, and that should be used to draw visitors into the other aspects of the subtheme. It’s important that labels use specialized terminology with care, especially the word “thermophilic.”

- **“Old Faithful—cultural icon, place of pilgrimage, and shared legacy.” Recognize the range of visitors’ feelings about Old Faithful.** Although Old Faithful may seem like a “cultural icon, place of pilgrimage, and shared legacy” to some visitors, others have more complex feelings about this geyser. These feelings should be recognized and even validated by the exhibit, and no one’s feelings should be dismissed. It seems appropriate to develop an exhibit that encourages discussion

within groups, because so many of the groups we spoke with demonstrated a range of reactions to Old Faithful. *People* seem to be the hook here, rather than artifacts, and that should be recognized in the design of the exhibit.

We suggest that the exhibits on the cultural aspects of Old Faithful should be a separate section of the exhibit hall, because they are not directly related to the most important subthemes. Although this subtheme is an important elaboration of the main theme of the exhibit, but it is not as critical that every visitor be exposed to these ideas. However, because some visitors will be seeking exhibits on the human aspects of Yellowstone, it should be clearly visible to all who enter the exhibit area.

Evaluating the Thematic Outline

In the topical framework, we promised to try to answer the question, “To what extent is the scope and breadth of the current thematic outline realistic, appropriate, and achievable?” For reasons already discussed, the breadth of the thematic outline seems appropriate in many ways. We agree that all five subthemes should be included in the exhibits.

We are concerned, however, about the depth of information and level of detail included under some of the subthemes, particularly “Yellowstone’s geysers, mud pots, fumaroles, and hot springs.” Much of the detailed information about mineral deposits, individual hot springs, and the various geyser basins reminded us of the information that respondents said they were looking for as signs along the park’s trails. When detailed information is closely connected to experiencing the actual feature, it seems compelling and memorable. When details are catalogued in the name of completeness, they seem dry and forgettable.

Details, however, can be important in many sorts of exhibits. Details are vitally important in multimedia presentations that tell a story about a specific time, place, or feature. Some types of models gain interest because of their details (although other types function by stripping away detail until “how it works” becomes clear). Appropriate places for detailed textual information might include photo captions and specimen labels, especially when the details help visitors understand the what ever they are looking at.

We recommend that exhibit developers and designers take care as they select which detailed information to include in the exhibits and how to include it.

Creating Exhibits that Excite and Inspire Visitors

A second question we promised to answer is, “How can the new visitor education center’s exhibits be made exciting and inspiring for the broadest range of visitors?” Our respondents’ answers to that question emphasized two points:

- Many respondents seemed excited about exhibits that would clearly answer their questions about topics that excite them.

- Many respondents seemed excited about exhibits that were hands-on and interactive—more like a children’s museum than like a traditional visitor center.

The section on prioritizing the subthemes discussed which topics excited, or at least interested, our respondents. Accommodating visitors’ apparent preferences for hands-on and interactive exhibits may be a more difficult proposition, for reasons discussed earlier in this report.

Here are our suggestions for meeting this challenge:

- **More than hands-on.** We recommend that exhibit developers and designers consider the whole range of features that make a modern children’s museum or science center seem welcoming to visitors. In our experience, it is more than just the hands-on or interactive nature of the exhibits. Deborah Perry's research has identified six important components that help institutions make learning fun, satisfying, and successful for visitors (Perry, 1992, 1993a, 1993b):
 - **Curiosity:** Exhibits should surprise and intrigue the visitor.
 - **Confidence:** Exhibits should help visitors feel safe and smart.
 - **Challenge:** Exhibits should encourage visitors to do or learn something new.
 - **Control:** Exhibits should help visitors feel "in charge."
 - **Play:** Exhibits should encourage playfulness and sensory exploration.
 - **Communication:** Exhibits should stimulate meaningful conversations among visitor groups.

Some hands-on and interactive exhibits include all these components; however, we have evaluated many interactives that fail visitors on one or more criteria. We have also evaluated a range of relatively static exhibits that engage visitors through well-written labels and well-chosen specimens or graphics.

- **What’s best at Yellowstone?** We recommend that Yellowstone staff consider the resources that are available in the park, and then develop a philosophy for visitor-friendly exhibits that fits the opportunities and limitations of a visitor center located in Yellowstone. Perhaps that would minimize exhibits with moving parts; make creative use of exhibits that visitors can touch or climb on; emphasize connections to the fantastic resources that lie just outside the door; clearly answer questions that visitors are wondering about; and make good use of the knowledgeable staff and volunteers. It wouldn’t be a children’s museum, but if the concept is well executed, visitors will leave with a new standard by which to judge visitor centers in national parks.
- **Well-tested and designed for ease of maintenance.** When interactives are included in an exhibit, they should be:

- o Prototyped and then iteratively tested both for functionality and for educational effectiveness.
- o Designed for ease of maintenance in a remote location. Perhaps exhibit designers can make use of lessons learned about exhibit maintenance by museums like the Science Museum of Minnesota that successfully develop and maintain traveling exhibits (e.g., Gyllenhaal, 1998).
- **Reserve funding for remediation of the exhibits.** Many museums set aside a certain percentage of the budget for remediation after the exhibit opens.

Additional Recommendations

Here are several recommendations that didn't seem to fit the other categories:

- **Build exhibits that help visitors create their Yellowstone experience.** If the building design allows it, create a separate exhibit area in the lobby or elsewhere that will help visitors to orient themselves to the Old Faithful area, gain some perspective on Yellowstone National Park as a whole, and answer some of their basic questions about park wildlife, fire damage, and other topics of general interest to Yellowstone visitors. Short-term visitors should be able to stop at these exhibits for a few minutes to answer their most basic questions, such as “Where do I go next?” when a ranger is not available. We do not suggest including these elements in the main exhibit about the park’s hydrothermal features.
- **Let them know when Old Faithful is predicted to erupt.** Post the predicted time of the next eruption in large numbers at one or more places that can be seen from the boardwalk. As some visitors suggested, we also recommend posting predicted times in the new exhibit hall in clearly visible places.
- **Help Old Faithful visitors understand their options.** Near the predicted times for the next eruption, post a sign with suggested short hikes that can be completed if visitors have, say, 20, 40, or 60 minutes before the next eruption.
- **Include ample seating within and just outside the exhibit area.**
- **Evaluate interpretive signage along park trails.** Ideally, signage along the trails should both support and extend the theme and subthemes of the exhibits in the new Old Faithful Visitor Education Center.

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APPENDIX A: Topical Framework

Old Faithful Visitor Education Center Exhibits Front-End Evaluation Plan Topical Framework Yellowstone Park Foundation

Submitted by Selinda Research Associates
July 8, 2002

Visitor expectations about the park's hydrothermal features

- **Why do visitors come to Old Faithful?** What factors help shape visitors' decision to come here, and what to see once they come? What role do the park's geysers, hot springs, and other hydrothermal features play in their decisions?
- **Expectations about hydrothermal features.** What are visitors' expectations about the park's hydrothermal features, especially the ones in the Old Faithful area? What do they expect to see, feel, hear, smell, and learn about the features? How do they form their expectations?
- **Meeting expectations.** Do visitors' experiences of the park's hydrothermal features meet their expectations? Are the features as big, colorful, hot, loud, and smelly as they expect? Do visitors experience what they expect to experience, feel what they expect to feel, and learn what they expect to learn?
- **Role of the visitor center.** From the visitors' point of view, what role should the visitor center play in their experience of the Old Faithful area? What do visitors expect to experience and learn within a visitor center?
- **What's next?** Where do visitors expect to go next, and why? What are they hoping to see, do, and experience? Does Old Faithful satisfy their desire to see hydrothermal features, or whet their appetite for more?

Visitor understandings and learning about the park's hydrothermal features

- **Underlying concepts.** What do visitors understand about key scientific concepts that underlie the Interpretive Themes outlined for the exhibit, such as the Earth's subsurface, volcanoes, earthquakes, and plate tectonics? In what ways can visitors' prior understandings support or interfere with their understanding of Yellowstone's hydrothermal features?
- **Before their visit.** What do visitors know about Yellowstone's hydrothermal features when they arrived at the park? How do they gain their initial understandings about hydrothermal and related features? What sorts of resources do they consult before their visit—books, Web sites, friends, and so forth?
- **During their visit.** What do visitors learn about hydrothermal features once they arrive at the park? What do they learn about geysers, hot springs, and other hydrothermal features? What do they find out about the bigger picture of park geology: Collapsed volcanoes, hot

spots, moving continents, earthquakes, and heated ground water? What interpretive sources do visitors use during their visit? From which source do they learn the most?

- **After their visit.** Do visitors continue to learn about the park's hydrothermal features once they return home? If so, what do they learn, and how do they learn it? Do they continue to discuss the park's hydrothermal features with members of their group—or with other family and friends—once their visit is over? If so, what did they talk about?
- **Visitors' questions.** What questions are raised as they visit the park's hydrothermal features—and how do they seek to answer these questions? What questions are they still curious about once their visit is complete? What do they wish they had known about the park's hydrothermal features *before* they visited them?
- **Biology and hydrothermal features.** What do visitors understand about the interplay of the park's biological and hydrothermal features? What do they already know about relevant concepts in biology and microbiology, and how can their prior understandings support or interfere with their understanding of Yellowstone's unique biology?
- **History and hydrothermal features.** What do visitors know about the history of Yellowstone, especially as it relates to the park's hydrothermal features? How important is it to them to learn more? What role does Yellowstone play in visitors' personal or family histories? If they've visited Yellowstone before, what did they take away from their experience of the park's hydrothermal features?
- **Conservation of hydrothermal features.** What do visitors know about the role that Yellowstone plays in the conservation of hydrothermal resources? How important is it to them to learn more? What do they understand about the ways that individual visitors can help preserve the park's hydrothermal features?
- **Science in the park.** What do visitors know about the science being done in Yellowstone National Park? What aspects of park science are most interesting to them? What would they want to learn more about?
- **Importance of learning.** How important is learning about hydrothermal features to visitors' overall Yellowstone experience? What aspects of the park's hydrothermal resources seem to have the most meaning to visitors, and why?
- **Visitor interests.** What do visitors most want to learn about the park's hydrothermal features? How do they rank their interest in the five main subthemes listed in the Request for Quotes? *

Larger questions to be addressed in our recommendations

- **Thematic outline.** To what extent is the scope and breadth of the current thematic outline realistic, appropriate, and achievable? How should the subthemes be prioritized?
 - **Exhibits.** How can the new visitor education center's exhibits be made exciting and inspiring for the broadest range of visitors?
-

- * The five main subthemes listed in the request for quotes:
- At Yellowstone, hot water helps shape an extraordinary landscape of rare hydrothermal features—geysers, mud pots, fumaroles, and hot springs.
 - Yellowstone’s hydrothermal features exist here because of past and ongoing volcanic activity.
 - Yellowstone’s heated waters are habitat for diverse thermophilic life forms that we are only beginning to understand.
 - Americans’ fascination with and pride in Old Faithful has transformed it into a cultural icon, a place of pilgrimage, and a shared legacy.
 - Yellowstone is a rare living laboratory that draws scientists who want to explore the interplay between the volcano, the hydrothermal features, and the diversity of life found here.

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APPENDIX B: Protocol for On-Site Interviews with Visitors

Old Faithful Visitor Education Center Front-end Evaluation

On-site Visitor Interview Protocol (short version)

July 30, 2002

1. Introduction

- Introduce yourself—what you're doing, why it's important to talk to them, etc.; explain that you're an independent consultant and don't work for the park.
- Explain that most interviews take 15 minutes or so
- Explain the process—go to a shady spot by the Inn, there are no right or wrong answers, promise of confidentiality.
- Get their permission to tape record. Ask if they have any questions before getting started

2. Introductory questions

- Where are they from?
- How long have they been here?
- Who are they with?
- How did they get here?

3. Initial Discussion: We will engage visitors in a discussion that seeks answers to the following overall questions. The actual questions we ask the visitors will vary.

- Why do visitors come to Old Faithful?
- How does their visit to Old Faithful fit into their overall park experience?
- What do visitors expect about the park's geysers and other hydrothermal features, especially the ones in the Old Faithful area?

4. Content-Area Discussions: We will engage most visitors in a card sort activity and discussion about one (and perhaps more) of the following content areas. (See the following pages for more detailed breakdowns of each content area.)

- Content Area 1. Hydrothermal features and the geology of Yellowstone
- Content Area 2. Life in hot water and park science
- Content Area 3. Cultural aspects of Old Faithful and geyser preservation

5. Priorities for the New Visitor Center: This may also involve a five-card sort and discussion.

6. Closing

- Do they have any questions for us?
- Thanks
- Token of our appreciation

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APPENDIX C: Word Sets for Word/Card Sorts

We selected terms from these long lists. Each respondent sorted no more than one content area.

Content Area 1: Hydrothermal features and the geology of Yellowstone

hydrothermal	heat	earthquake
geyser	plumbing system	hot spot
hot spring	rock	plate tectonics
fumarole	fracture	volcano
mud pot	mineral deposit	magma
water	silica	lava
steam	acid	crater

Content Area 2: Life in hot water and park science

hydrothermal		
hot spring		
water	algae	research
heat	mat	biology
boiling	color	geology
thermophilic	minerals	Yellowstone Park
microorganism	acid	university
bacteria	DNA	laboratory
	scientists	

Content Area 3: Cultural aspects of Old Faithful and geyser preservation

Native Americans	conservation	stagecoach
early explorers	preservation	tour bus
mountain men	national park	car
settlers	boardwalks	my grandparents
tourists	Old Faithful Geyser	my parents
local residents	photographs	me
expedition	souvenirs	

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APPENDIX D: Proposed Subthemes for the New Visitor Center

We used both full-text and short versions of the subthemes, depending on the circumstances.

Full-text version: “Here are some themes they may include in the exhibit...”

At Yellowstone, hot water helps shape an extraordinary landscape of rare hydrothermal features—geysers, mud pots, fumaroles, and hot springs.

Yellowstone’s hydrothermal features exist here because of past and ongoing volcanic activity.

Yellowstone’s heated waters are habitat for diverse thermophilic life forms that we are only beginning to understand.

Americans’ fascination with and pride in Old Faithful has transformed it into a cultural icon, a place of pilgrimage, and a shared legacy.

Yellowstone is a rare living laboratory that draws scientists who want to explore the interplay between the volcano, the hydrothermal features, and the diversity of life found here.

Short Version: “Here are some topics they might include in the exhibit...”

Yellowstone’s geysers, mud pots, fumaroles, and hot springs.

Yellowstone’s volcanoes—past, present, and future.

Life in Yellowstone’s hot waters.

Old Faithful—cultural icon, place of pilgrimage, and shared legacy.

Yellowstone—scientists at work in a living laboratory.

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APPENDIX E: Questionnaire to Collect Visitor Phone Numbers

[Note: The actual questionnaire fit on a single sheet of paper.]



selinda research associates

Would you be willing to be interviewed by phone about your visit to Yellowstone National Park?

If so—and if you will be available for an interview between August 15 and September 15—please complete this survey.

Selinda Research Associates of Chicago, Illinois, is conducting a study of visitors to Old Faithful. The results will help Yellowstone National Park plan the new Old Faithful Visitor Education Center. We promise to keep the following information confidential. We won't release your name, phone, or e-mail to anyone—not even the National Park Service!

Your name: _____ Your age: _____ M___ or F___

Your home: City _____ State/Province _____

Country _____ Postal Code _____

Your phone numbers: Day _____ Evening _____

Your e-mail address: _____

How long have you been in the park so far? _____

How much longer are you planning to stay? _____

How did you get here (by car, bus, on foot, etc.)? _____

How many people are in your group? _____

Check if you came with: Family _____ Friends _____ Larger group _____

Check if your group includes children: 5 and under _____ 6 to 12 _____ Teens _____

Please tell us what you think we should know about your ethnic, racial, and/or national identity:

Check how you spent last night: Camped____ Hotel/cabin____ At home____

Check how many times you have been to Yellowstone (including this visit):

 First time____ 2-4 times____ 5-9 times____ 10 times or more____

If there's anything else you'd like to tell us, please write it on the back of this sheet.

Please drop this in the box labeled "Surveys" in the Old Faithful Visitor Center.

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Appendix F: Protocol for Phone Interviews with Visitors

Old Faithful Visitor Education Center Front-end Evaluation Phone Interview Protocol August, 2002 Draft 2

1. Introduction

- Introduce yourself—what you're doing, why it's important to talk to them, etc.; explain that you're an independent consultant and don't work for the park.
 - Explain that most interviews take 15 minutes or so
 - Explain the process—there are no right or wrong answers, promise of confidentiality.
 - Get their permission to tape record. Ask if they have any questions.
-

2. Introductory questions

- What else did you visit in Yellowstone National Park? Did you go to any visitor centers in the park? If so, which ones?
- What was the highlight of your visit to the park? What was the low point of your visit?

3. Initial Discussion: Engage visitors in a discussion:

- While you were planning and preparing for your visit to Yellowstone, did you see or read anything that helped you understand the natural features that you saw in the park? [If yes] Please tell me about it.
- Do you remember why you decided to go to Old Faithful?
- In what ways did Old Faithful meet your expectations? In what ways did it fail to meet your expectations?
- Is there anything that you wish you had known about the park's geysers and hot springs *before* you visited them?

4. Questions that Occurred to Them

- Can you tell me some questions that occurred to you as you were traveling through the park?
- [If so] Which questions were you able to answer by reading pamphlets or seeing exhibits or asking rangers?
- What questions have you not yet found answers for?
- Have you seen or read anything since you visit that helped you better understand what you saw in the park?

5. Learning in the Park

- At some point during your trip, did you find out anything about geysers or hot springs that really surprised you? [If so, ask how and where they learned it.]
- Did you find out anything that helped you understand how geysers work? [If so, ask how and where they learned it.]
- Did you find out anything surprising about the things that live in hot spring waters? [If so, ask how and where they learned it.]
- Did you find out anything surprising about the ancient history of the park? [If so, ask how and where they learned it.]

- [*If they didn't find out much of anything....* Try to find out how important learning was to their park experience.]

6. Priorities for the New Visitor Center:

- If you were going to visit the new visitor center at Old Faithful in a few years, what would you like to find there? What's the most important thing they should include (besides bathrooms)?
- I'm going to read you some topics that could be included in the exhibits in the new visitor center. I'd like you to rate them 1, 2 or 3. Topics that you rate as 1 are the most important topics to you, the ones they should devote the most space and effort to explaining. Topics that you rate as 2 are not quite as important. Topics that you rate as 3 are the least important topics—ones that wouldn't be of much interest to you. [List of shorted subthemes is on the next page.]

7. Closing Do they have any questions for us? Thanks We'll send a token of our appreciation (if they're willing to give us an address we can send it). The token is a packet of Yellowstone postcards.

We used the short version of the subthemes: “Here are some topics they might include in the exhibit....” [vary the order]

Yellowstone's geysers,
mud pots, fumaroles,
and hot springs.

Yellowstone's volcanoes—
past, present, and future.

Life in Yellowstone's
hot waters.

Old Faithful—cultural icon,
place of pilgrimage, and
shared legacy.

Yellowstone—scientists at
work in a living laboratory.

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APPENDIX G: Information About the Respondents

Table G-1, Part 1. Respondents for On-site Interviews in August.

Group Code	Resp. Code	Approx. Age	M/F	State, Country	Days in Park so Far	Group Size	Group Types	Child < 20	Times in Park	Race
0803021	1A03	70's	M	MN, USA	< 1	4	Family		4-5	Caucasian
0803021	1B03	70's	F	MN, USA	< 1	4	Family		4-5	Caucasian
0803021	1C03	40's	F	MN, USA	< 1	4	Family		> 2	Caucasian
0803021	1D03	40's	F	TX, USA	< 1	4	Family		> 2	Caucasian
0803022	2A03	mid 30's	F	MT, USA	?	2	Family		> 2	Caucasian
0803022	2B03	mid 30's	M	MT, USA	?	2	Family		> 2	Caucasian
0803023	3A03	50's	M	MT, USA	?	2	Couple		> 5	Caucasian
0803023	3B03	50's	F	Germany	?	2	Couple		1	Caucasian
0803024	4A03	late 30's	F	IN, USA	5	4	Family	Yes	1	Caucasian
0803024	4B03	late 30's	M	IN, USA	5	4	Family	Yes	1	Caucasian
0803024	4C03	11	F	IN, USA	5	4	Family	Yes	1	Caucasian
0803024	4D03	7	F	IN, USA	5	4	Family	Yes	1	Caucasian
0804021	1A04	40's	M	FL, USA	2	5	Family	Yes	1	Hispanic
0804021	1B04	40's	F	FL, USA	2	5	Family	Yes	1	Caucasian
0804021	1C04	13	M	FL, USA	2	5	Family	Yes	1	Hispanic
0804021	1D04	13	M	FL, USA	2	5	Family	Yes	1	Hispanic
0804021	1A04	8	M	FL, USA	2	5	Family	Yes	1	Hispanic
0804022	2A04	40's	F	CA, USA	2	4	Family	Yes	1	Caucasian
0804022	2B04	40's	M	CA, USA	2	4	Family	Yes	1	Caucasian
0804022	2C04	17	M	CA, USA	2	4	Family	Yes	1	Caucasian
0804022	2D04	6	M	CA, USA	2	4	Family	Yes	1	Caucasian
0804023	3A04	50's	M	OH, USA	< 0.25	4	Family		2	Caucasian
0804023	3B04	50's	F	OH, USA	< 0.25	4	Family		2	Caucasian
0804023	3C04	early 20's	F	CO, USA	< 0.25	4	Family		2	Caucasian
0804023	3D04	early 20's	M	CO, USA	< 0.25	4	Friend		1	Caucasian
0804024	4A04	60's	M	TX?, USA	< 0.5	2	Friends		1	Caucasian
0804024	4B04	60's	M	TX?, USA	< 0.5	2	Friends		1	Caucasian
0804025	5A04	late 30's	M	WA, USA	< 0.5	4	Family	Yes	2	Caucasian
0804025	5B04	late 30's	F	WA, USA	< 0.5	4	Family	Yes	3	Caucasian
0804025	5C04	12	F	WA, USA	< 0.5	4	Family	Yes	1	Caucasian
0804025	5D04	10	F	WA, USA	< 0.5	4	Family	Yes	1	Caucasian
0804026	6A04	50's	F	IA, USA	2?	6-8	Family	Yes	2	Nat. Am.
0804026	6B04	50's	M	IA, USA	2?	6-8	Family	Yes	1	Nat. Am.
0804026	6C04	late 20's	M	IA, USA	2?	6-8	Family	Yes	1	Nat. Am.

Continued next page

Table G-1, Part 2. Respondents for On-site Interviews in August, continued.

Group Code	Resp. Code	Approx. Age	M/F	State, Country	Days in Park so Far	Group Size	Group Types	Child < 20	Times in Park	Race
0805021	1A05	30's	M	CO, USA	2	4	Family	Yes	2	Caucasian
0805021	1B05	30's	F	CO, USA	2	4	Family	Yes	2	Caucasian
0805021	1C05	8	M	CO, USA	2	4	Family	Yes	1	Caucasian
0805021	1D05	5	M	CO, USA	2	4	Family	Yes	1	Caucasian
0805022	2A05	50's	F	WI, USA	< 0.5	2	Family		1	Caucasian
0805022	2B05	50's	M	WI, USA	< 0.5	2	Family		2	Caucasian
0805023	3A05	late 30's	M	CO, USA	< 0.5	4	Family	Yes	1	Caucasian
0805023	3B05	late 30's	F	CO, USA	< 0.5	4	Family	Yes	2	Caucasian
0805023	3C05	15	M	CO, USA	< 0.5	4	Family	Yes	1	Caucasian
0805023	3D05	12	F	CO, USA	< 0.5	4	Family	Yes	1	Caucasian
0805024	4A05	50's	F	CA, USA	?	2	Family1		1	Caucasian
0805024	4B05	50's	M	CA, USA	?	2	Family1		2	Caucasian
0805024	4C05	30's	M	ID, USA	?	8+	Family2	Yes	1	Caucasian
0805024	4D05	60's	M	AZ, USA	?	8+	Family2	Yes	2	Caucasian
0805024	4E05	30's	M	AZ, USA	?	8+	Family2	Yes	1	Caucasian
0805024	4F05	8	M	AZ, USA	?	8+	Family2	Yes	1	Caucasian
0805024	4G05	8	M	ID, USA	?	8+	Family2	Yes	1	Caucasian
0805025	5A05	60's	F	ID, USA	< 0.5	3	Family		5+	Caucasian
0805025	5B05	40's	F	AZ, USA	< 0.5	3	Family		3	Caucasian
0805025	5C05	20's	F	ID, USA	< 0.5	3	Family		3?	Caucasian
0805026	6A05	50's	F	Quebec, CA	< 0.5	3	Family		1	Caucasian
0805026	6B05	20's	M	Quebec, CA	< 0.5	3	Family		1	Caucasian
0805026	6C05	20's	F	Quebec, CA	< 0.5	3	Friend		1	Caucasian
0806021	1A06	40's	M	KS, USA	< 0.25	3	Family1	Yes	1	Caucasian
0806021	1B06	40's	F	KS, USA	< 0.25	3	Family1	Yes	1	Caucasian
0806021	1C06	14	F	KS, USA	< 0.25	3	Family1	Yes	1	Caucasian
0806021	1D06	17	M	IA, USA	?	3?	Family2	Yes	1	Caucasian
0806022	2A06	late 40's	F	WI, USA	< 0.5	2	Family		4	Caucasian
0806022	2B06	late 40's	M	WI, USA	< 0.5	2	Family		4	Caucasian
0806023	3A06	late 30's	M	ND, USA	< 0.5	3	Family	Yes	5	Caucasian
0806023	3B06	late 30's	F	ND, USA	< 0.5	3	Family	Yes	2	Caucasian
0806023	3C06	10	M	ND, USA	< 0.5	3	Family	Yes	1	Caucasian

Table G-2. Respondents for On-site Interviews in September.

Group Code	Resp. Code	Approx. Age	M/F	State, Country	Days in Park so Far	Group Size	Group Types	Child < 18	Times in Park	Race
0909021	1A09	50's	F	WA, USA	2	2	Friends		> 2	Caucasian
0909021	1B09	50's	F	WA, USA	2	2	Friends		2	Caucasian
0909022	2A09	late 50's	F	IL, USA	< 0.5	2	Family		1	Caucasian
0909022	2B09	late 50's	M	IL, USA	< 0.5	2	Family		1	Caucasian
0909023	3A09	mid 20s	M	KS, USA	< 0.25	2	Couple		3	Caucasian
0909023	3B09	mid 20s	F	KS, USA	< 0.25	2	Couple		1	Caucasian
0909024	4A09	mid 40s	F	IL, USA	< 0.25	3	Family		2	Asian
0909024	4B09	early 40s	F	IL, USA	< 0.25	3	Family		2	Asian
0909024	4C09	late 60s	F	IL, USA	< 0.25	3	Family		2	Asian
0909025	5A09	mid 40s	F	NJ, USA	< 0.25	5	Family	Yes	2	Caucasian
0909025	5B09	mid 40s	M	NJ, USA	< 0.25	5	Family	Yes	2	Eurasian
0910021	1A10	mid 40s	M	CO, USA	3	5	Family		2	Caucasian
0910021	1B10	mid 40s	F	CO, USA	3	5	Family		1	Caucasian
0910022	2A10	late 30s	F	CO, USA	5	2	Couple		1	Asian
0910022	2B10	late 30s	M	CO, USA	5	2	Couple		1	Caucasian
0910023	3A10	late 60s	F	CA, USA	2	2	Tour		1	Caucasian
0910024	4A10	mid 30s	M	NC, USA	3	4	Friends		1	Caucasian
0910024	4B10	mid 30s	M	NC, USA	3	4	Friends		1	Caucasian
0910024	4C10	mid 30s	M	NC, USA	3	4	Friends		1	Caucasian
0910024	4D10	mid 30s	M	NC, USA	3	4	Friends		2	Caucasian
0910025	5A10	early 20s	F	WA, USA	< 0.25	14	Work/Tour		1	Caucasian
0910025	5B10	early 20s	M	WA, USA	< 0.25	14	Work/Tour		1	Caucasian
0910026	6A10	late 30s	M	CA, USA	< 0.25	2	Couple		1	Caucasian
0910026	6B10	late 30s	F	CA, USA	< 0.25	2	Couple		1	Caucasian
0910027	7A10	mid 40s	F	CO, USA	< 0.5	1	Alone		1	Caucasian

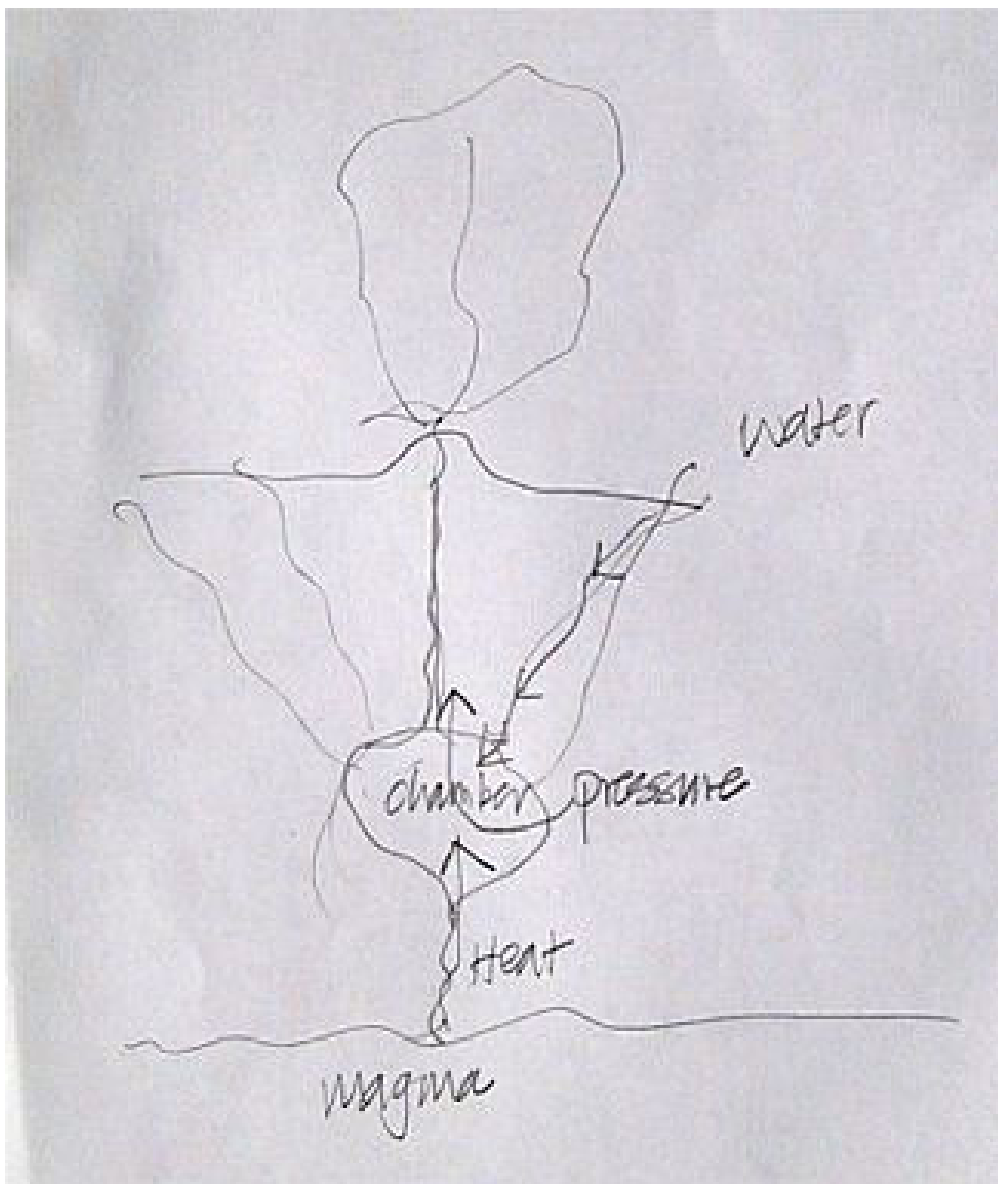
Table G-3. Respondents for Phone Interviews.

Code	Age	M/F	State, Country	Days in Park	Group Size	Group Type	Child < 18	Spent night	Times in Park	Self- Identity	Int.
P0902021	37	F	Alberta, CA	3	7	Family	Yes	Hotel	2	French/Engl.	LP
P0913021	48	M	VA, USA	8	4	Family	Yes	Hotel	1	WASP	LB
P0914021	48	F	NE, USA	5	3	Family	Yes	Camp	2	Latino kids	LB
P0915021	24	M	UT, USA	4	7	Family	Yes	Camp	2	American	LB
P0917021	46	M	Alberta, CA	2	4	Family	Yes	Hotel	1	(blank)	LP
P0917022	33	F	MO, USA	7	4	Family	Yes	Camp	1	(blank)	EF
P0918021	19	F	France	8	3	Family		Hotel	1	(blank)	LP
P0918022	37	M	Alberta, CA	3	2	Family		Hotel	30	White	LP
P0919021	29	F	Holland	2	4	Friends	Yes	Camp	1	(blank)	LP
P0919022	55	F	CO, USA	1.5	2	Family	Yes	Camp	1	American	LP
P0919023	41	M	NJ, USA	0.5	4	Family	Yes	Hotel	3	(blank)	LP
P0919024	44	F	CO, USA	4	8	Fam/Frd	Yes	Camp	1	WASP	EF
P0919025	29	M	OR, USA	2	2	Family		Hotel	2	White	EF
P0919026	65	F	TX, USA	1	2	Family		Hotel	3	Caucasian	EF
P0920021	51	M	CA, USA	7	4	Family	Yes	Camp	2	Caucasian	EF
P0922021	46	F	PA, USA	2	5	Family	Yes	Hotel	1	Caucasian	EF
P0922022	36	M	WI, USA	3	4	Family	Yes	Camp	3	White	EF
P0923021	54	F	NC, USA	0.75	5	Family		Hotel	2	(blank)	EF
P0923022	29	M	MN, USA	1	5	Family	Yes	Hotel	1	White	EF
P0926021	46	M	SD, USA	0.5	5	Family	Yes	Hotel	2	(blank)	LP

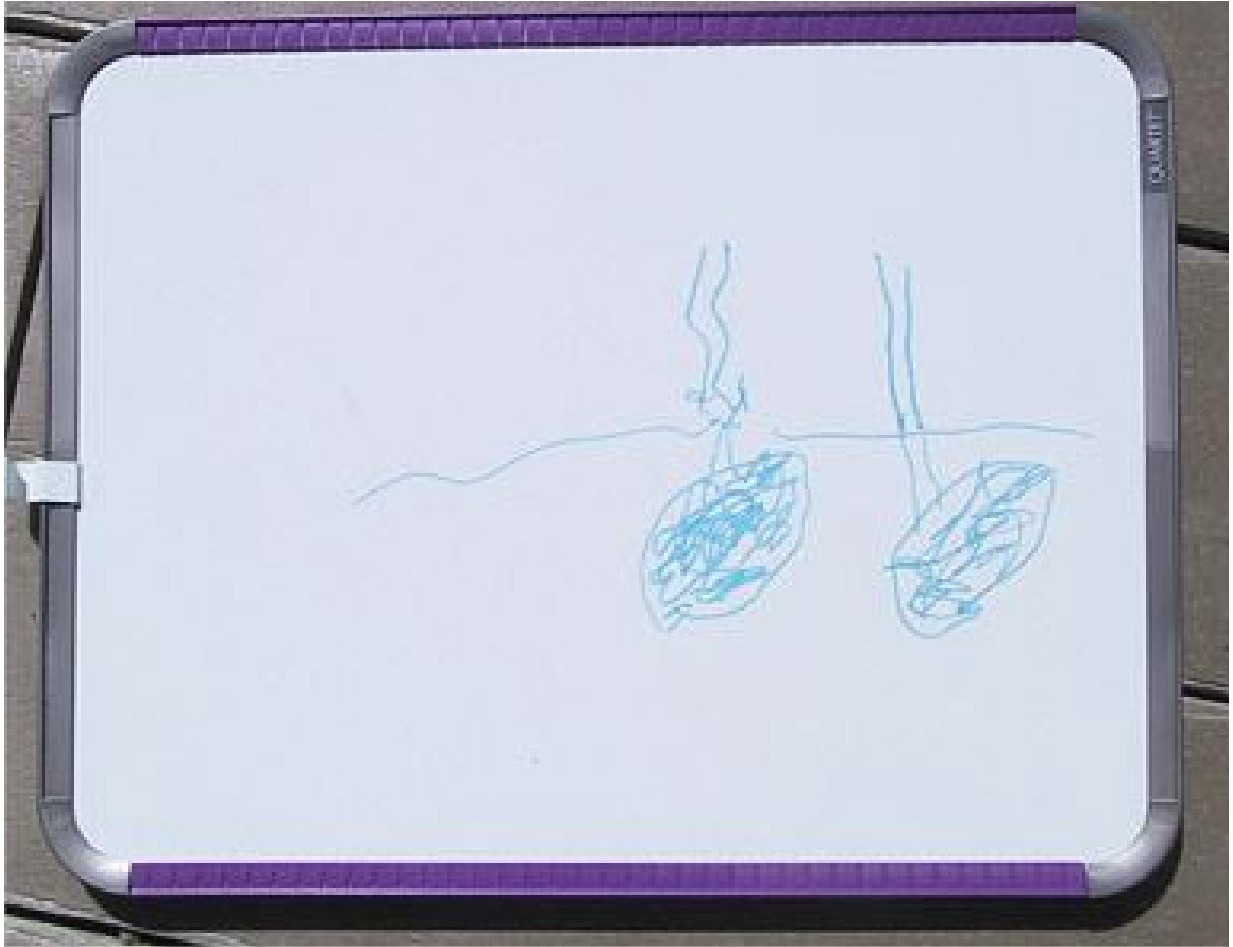
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APPENDIX H. Respondents' Drawings of Old Faithful

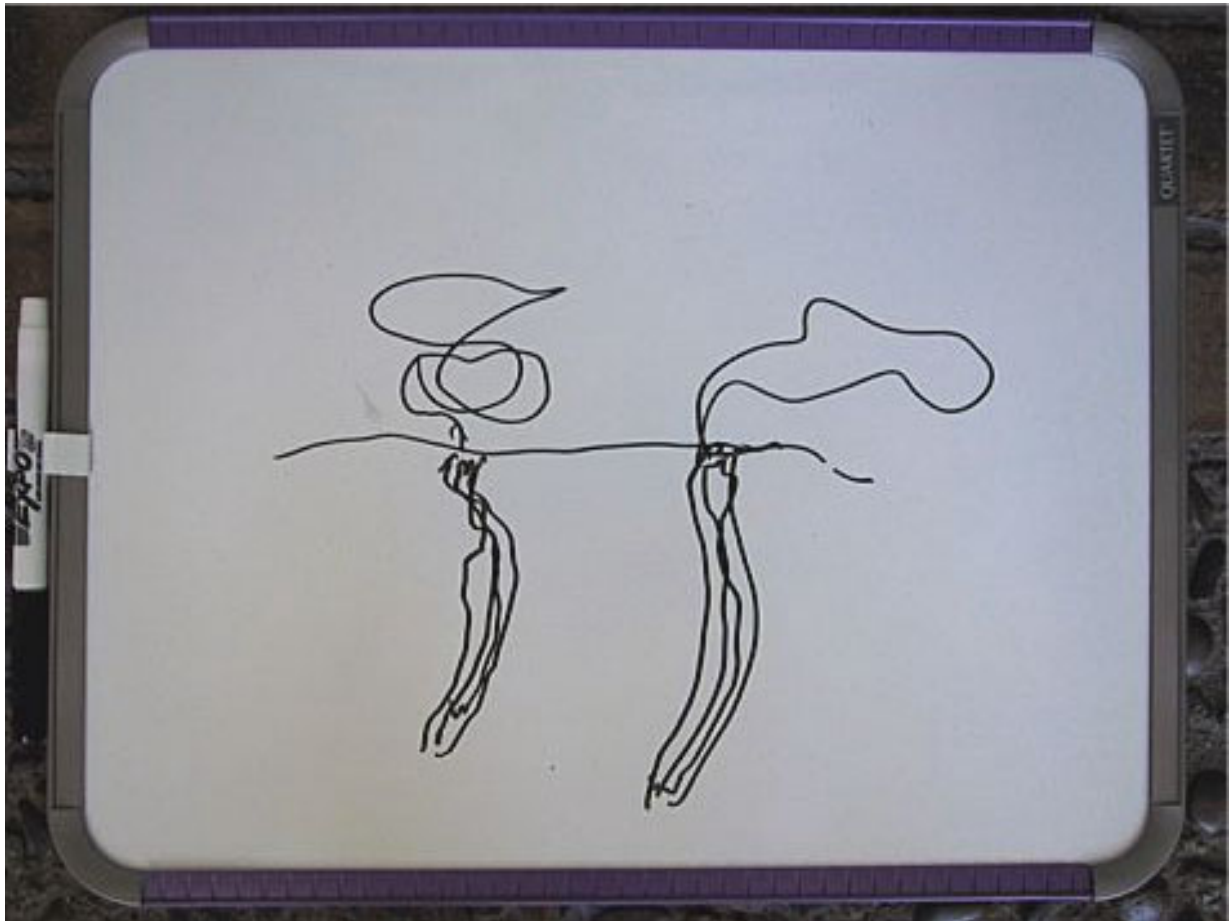
D080304A. Respondent 4B03. Male, late 30's, landscape architect. In one of the few drawings done on paper, this respondent drew one of the more complete examples of a geyser's subsurface workings. He showed magma below making heat, a chamber, and a narrow opening to the surface. He illustrated the constriction without talking about it, and he explained the pressure-building mechanism in very general terms. He had recharge water flowing down from the ground surface directly into the chamber through narrow fractures. He had heat coming up directly from the magma, not as circulating water. He didn't seem to see the entire plumbing system as open chambers, but he also missed the point of permeable sedimentary layers. This drawing is also included as Figure 16 in the main report.



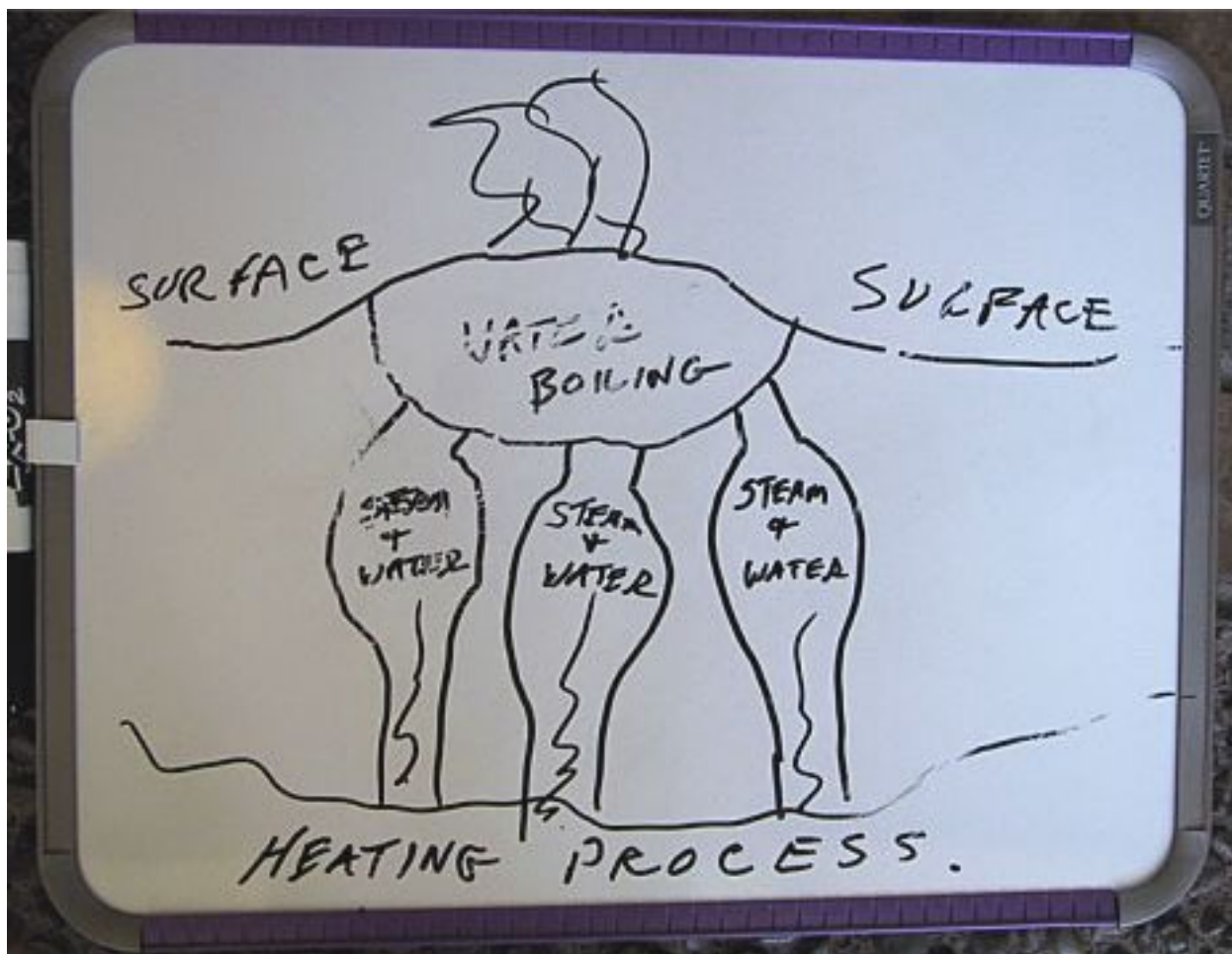
D080501A. Respondent 1D05. 5-year-old male. His father worked closely with him, especially to get him to draw a cross-section view. The parents seemed to have been talking to both their sons about what geysers are and how they work, and some of what they said had gotten through. However, the boys still had to work hard to remember that the geyser's output was steam instead of smoke.



D080501B. Respondent 1C05. 8-year-old male. He worked partly with his father, partly on his own, and partly copied his brother. The parents seemed to have been talking to both their sons about what geysers are and how they work, and some of what they said had gotten through. However, the boys still had to work hard to remember that the geyser's output was steam instead of smoke.



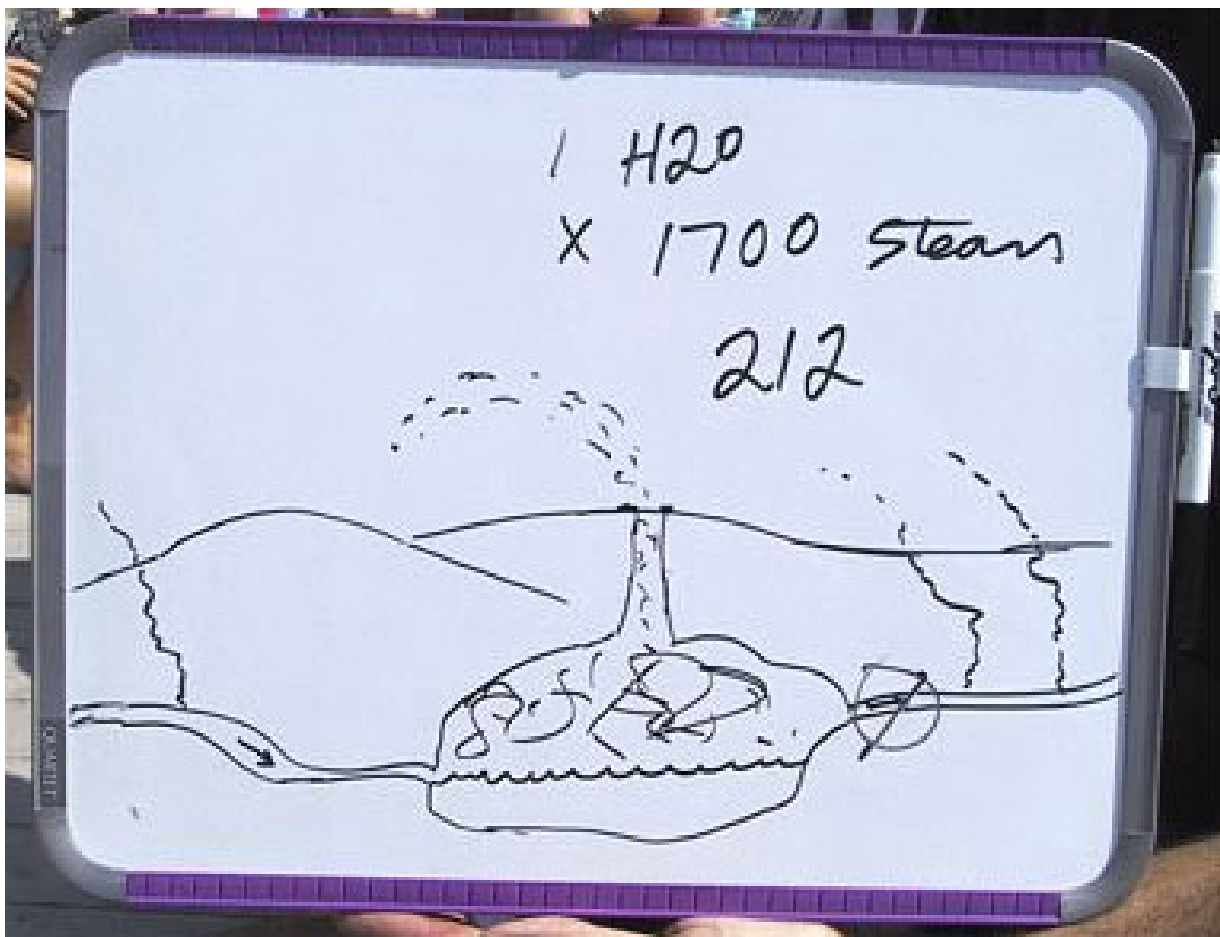
D080502A. Respondent 2B05. Male, 50's. This respondent apparently made it up his ideas on the spot. He wasn't certain what heated the water, and he took a metaphorical approach to the physics. (He said the geyser was like a "pressure cooker with a fuse"). This drawing is also included as Figures 6 and 13 in the main report.



D080503A. Respondent 3C05. 15-year-old male. This respondent's drawing included many of the basic ideas about how geysers work. He had magma heating the water, with bubbles and boiling water at depth, and he talked about rainwater water (recharge) seeping or absorbing into the ground. This drawing is also included as Figure 14 in the main report.



S080504A. Respondent 4C05. Male, 30's. This respondent discussed a mechanism for building up pressure (the constriction with the circle around it) and for the sudden discharge as steam (see numbers for the ratio of water to the steam it generates at 212 degrees F, above the drawing). He said he knew this because he was a fireman. This drawing is also included as Figures 7 and 15 in the main report.



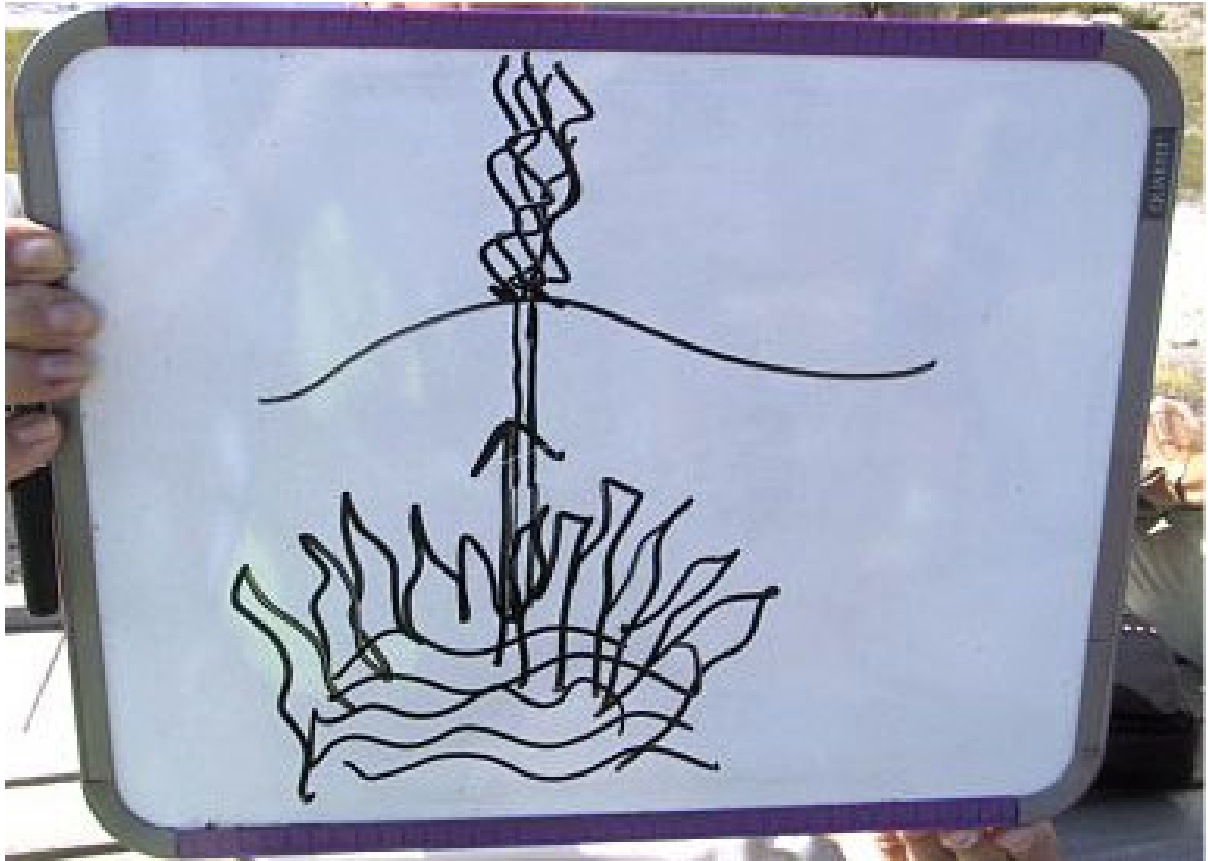
D080504B. Respondent 4F05. A 7- or 8-year-old boy made this drawing. He said it showed “smoke” rising from a pool of boiling water, with a layer of “hot mud” below. The respondent described the black shapes near the top of the drawing as “trees.” This drawing is also included as Figures 12 and 20 in the main report. Figure 19 in the main text shows a graphics panel that may have inspired this young respondent.



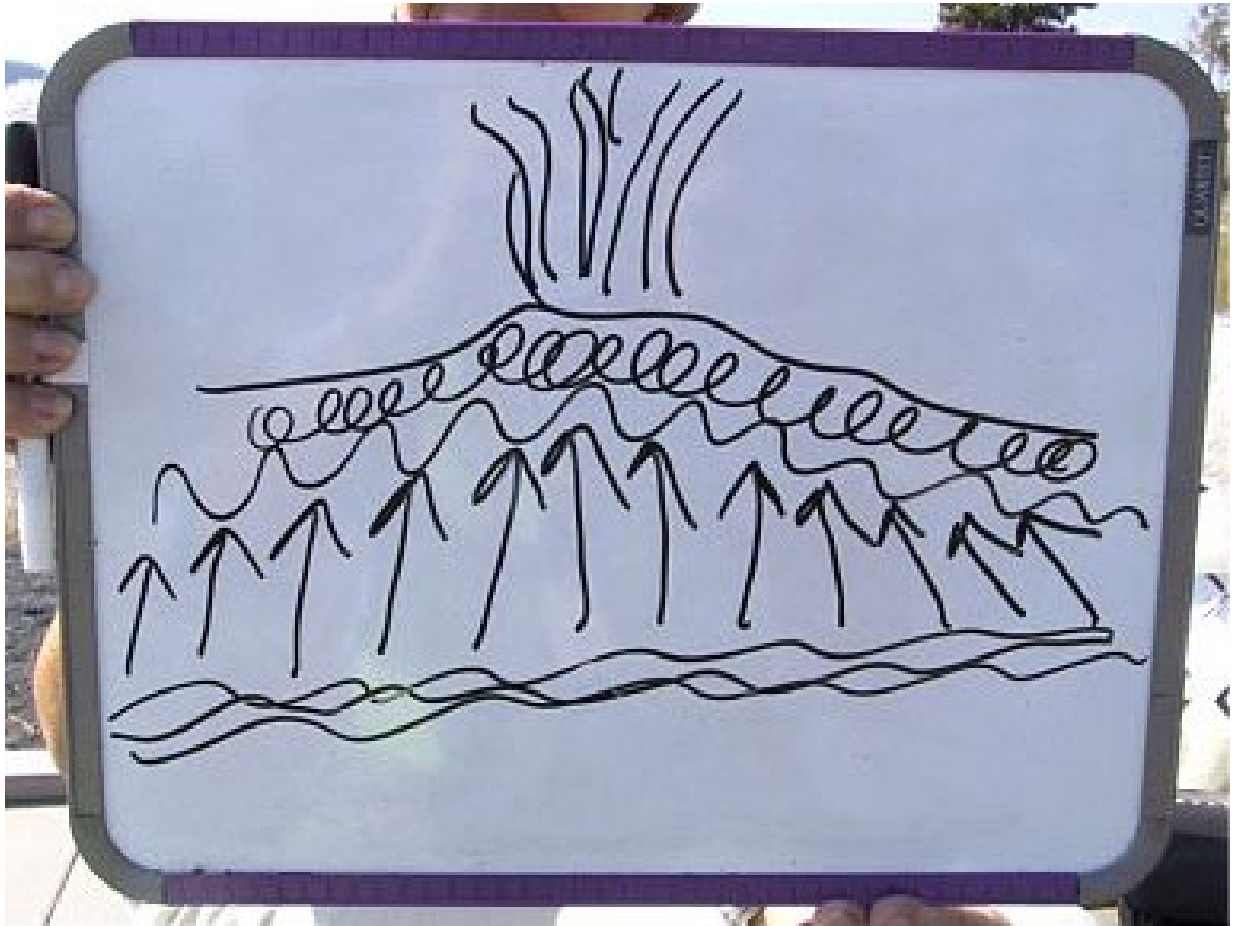
D080504C. Respondent 4G05. This respondent was the cousin of Respondent 4F05, just above, and also about 7- or 8-years old. He worked with and largely copied his cousin, adding a few more trees above what he called the “smoke” from the geyser.



D080505A. Respondent 5C05. Female, 20's. This respondent said that “the fires of hell” were powering the geyser (so you can guess how serious she was at first—then she got more serious.) She also said there was a big aquifer under here, which she explained was an underground reservoir. She said when it builds up enough pressure, it's got to release. She said it's like a volcano with water. She couldn't really explain why it was predictable. (She said something about geothermal and location.)



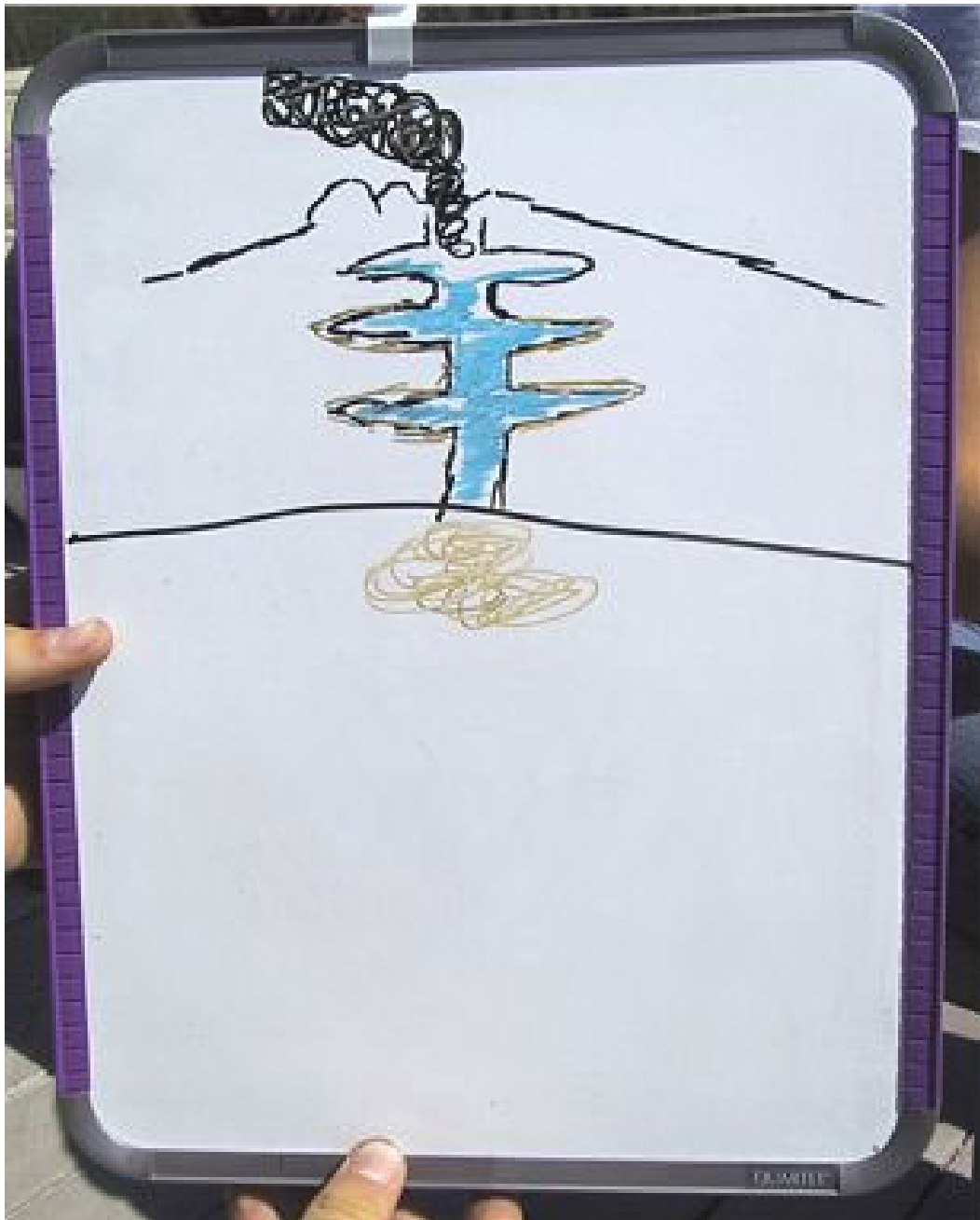
D080505B. Respondent 5B05. Female, 40's, mother of respondent 5C05 just above. She said her drawing showed pressure (arrows) and water (wavy and curly lines), but it had no visible plumbing system. She said that the pressure increased and the water got more active (from wavy to curly lines) closer to the surface.



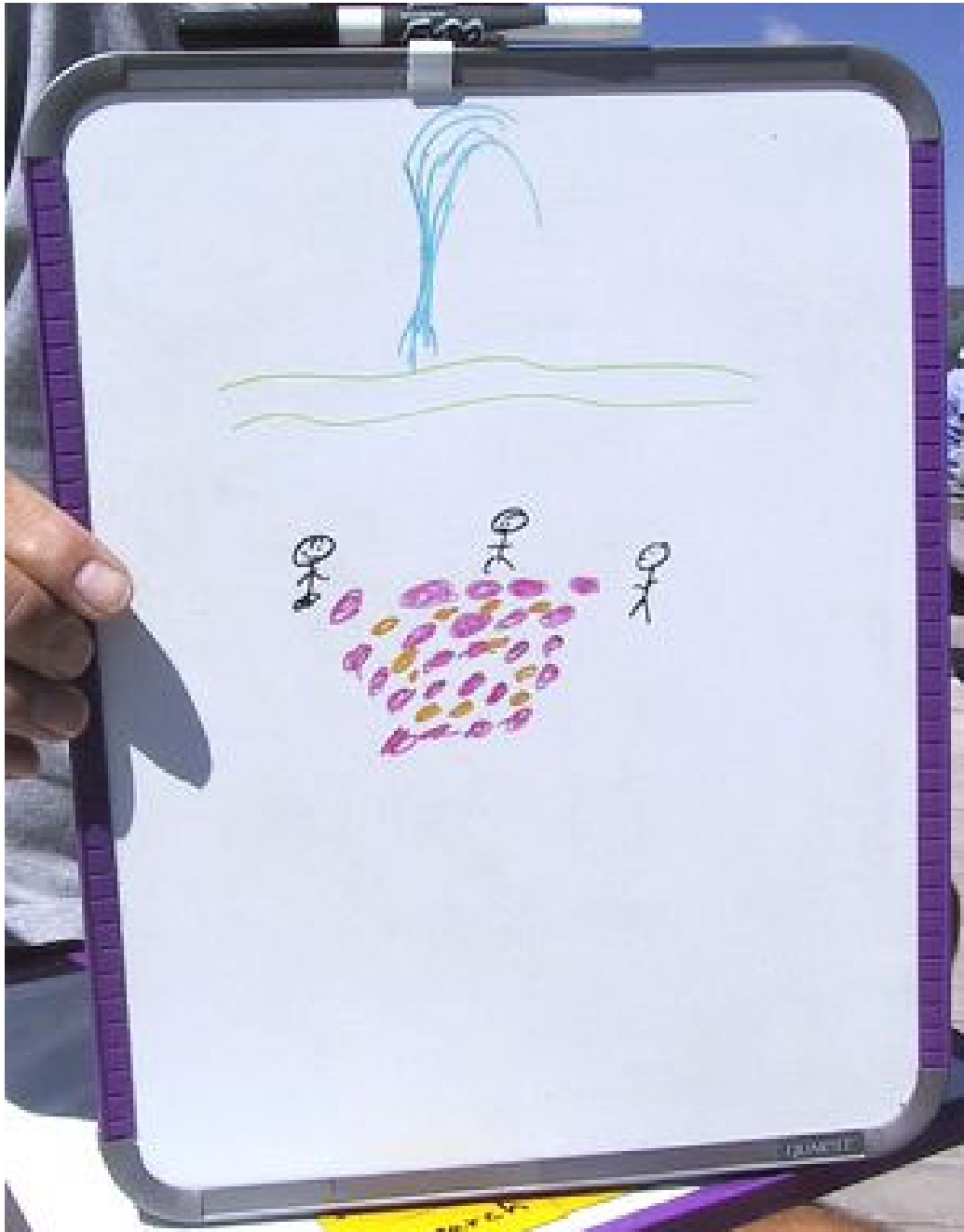
D080506A. Respondent 6C05. Female, 20's, from Quebec, spoke halting English. She showed and underground chamber with magma as the heat source, but it was all very close to the surface.



D080601A. Respondent 1D06. 17-year-old male, in high school. His explanation included his estimate of the volume of water (10,000 gal.); height of the eruption (106-150 ft.); and depth to “lava” (3-7 miles down). He said the “lava” provided heat; ground water filled the cavities, and then water “clogged” in some areas, creating pressure. He said the pressure builds up and gusts out. He said the water then goes in again, fills up, and it cycles again. This drawing is also included as Figure 18 in the main report. Figure 17 in the main text shows a graphics panel that may have inspired this respondent.



D080602A. Respondent 2A06. Female, late 40's. This respondent said her drawing showed the little people who were tending the fires that kept this all going. This drawing is also included as Figure 22 in the main report.



D80603A. Respondent 3C06. 10-year-old male. He said his drawing had a large opening deep (“near the center of the Earth”), with a narrow channel to the surface. The cavity had magma on the bottom, and boiling water on top. He showed a channel off to the side where “water gets in.” He said the water makes steam. His mother said her son was “into science,” and that he was participating in the Junior Ranger program. His father was a forester, and he showed a strong interest in and knowledge of science.



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