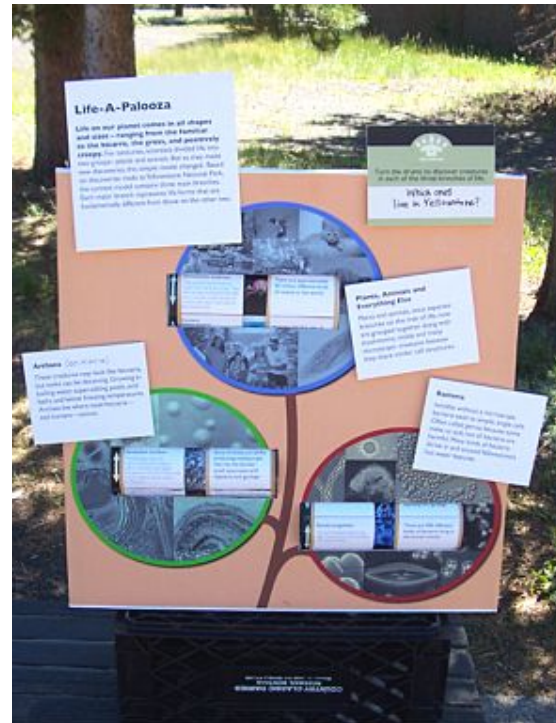


# Old Faithful Visitor Education Center Formative Evaluation

Summary of Prototype Testing  
at Old Faithful Geysers  
Yellowstone National Park  
Week of July 11, 2005

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## EXECUTIVE SUMMARY

The Old Faithful Visitor Education Center (OFVEC) in Yellowstone National Park will be comprised of a new building with a centralized welcome and visitor information center, theaters, and two stories of exhibition space. This report describes the evaluation process, findings, and recommendations for prototype testing of selected exhibits for the OFVEC.

We tested three prototype interactives at Old Faithful Geyser over a four-day period, testing them with 53 respondents in 18 visitor groups. The prototype exhibits were continually revised during testing, based on how respondents engaged with them and what they took away from their interactions. This executive summary includes brief descriptions of the major findings and recommendations for each of the three prototype exhibits. Additional findings are discussed in the main body of the report, including what we learned about (a) developing exhibits for the OFVEC, (b) visitors to the Old Faithful Geyser area, and (c) the formative evaluation process.

**The Ultimate Graphic.** The goal of this multimedia exhibit is to help visitors understand how geysers work by showing what happens below ground to make Old Faithful Geyser erupt. The Ultimate Graphic prototype was created as a series of graphic-and-text boards that stepped visitors through a simplified version of the multimedia presentation. Data indicated that the overall framework for this exhibit (i.e., a step-by-step overview of an Old Faithful Geyser eruption) is sound, and that visitors will likely be able to navigate it successfully. The inclusion of a control device (such as the slider we tested) will be essential. In addition, there was strong evidence that the effectiveness of the unit could be increased by the use of more representational graphics, similar to other diagrams visitors see elsewhere in the Park. Keeping the text simple and straightforward will be a continuing challenge with this unit. Rather than adding narrative definitions of terms such as *constriction*—a word that proved difficult for many visitors—the team should consider graphic techniques, such as labeling the constriction on the diagram. Other challenging words for visitors were *underground volcano*, *active volcano*, and *superheated water*. We encourage the team to take the relatively static graphics that are familiar to visitors and bring them to life through special lighting effects. We also recommend that the exhibit team make a few additional modifications as outlined in this document, but retain this unit’s demonstrated strengths of simplicity, visitor control, and completeness.

**The Joy of Yellowstone’s Hot Water Features.** This computer interactive is intended to help visitors understand (a) the classification of Yellowstone’s hydrothermal features into four main types and (b) the physical, geological and biological factors that help generate the four types of features. The current design is a computer database presented in a cookbook format. We tested a paper mock-up of the computer screens, arranged into a loose-leaf notebook. Of the three prototypes that we tested, the Joy of Yellowstone presented the most challenges. Data indicate that the cookbook metaphor was familiar



and comfortable to a wide range of visitors, including those of different ages. Most visitors had little trouble figuring out the physical interactions with the prototype, and the photographs and information about individual hot-water features proved very interesting to them. However, even after extensive revisions, this prototype failed to engage most respondents in ways that would achieve the exhibit's goals, mainly because it failed to focus visitors' attention on either the four types of hot-water features or the "ingredients" that produce them. We encourage the exhibit team to retain the cookbook and recipe metaphor, but to make extensive modifications as described in this report.

Recommended modifications include minimizing the amount of information on the screen at one time. We also recommend structuring the interactive so that visitors focus, first and foremost, on the four types of hot-water features and on the factors that shape them. If the project team decides to completely restructure this exhibit, we recommend developing a more open-ended computer interactive that allows visitors more decision-making and control, but that limits the number of variables that they can control at one time. If major changes are made, it will be essential that the new design undergo further formative testing.

**Life-a-Palooza.** This physical interactive is designed to explain and give examples of the scientific classification of all living things into a three-branched "tree of life." It is particularly targeted at children ages 6 to 13, as part of the Young Scientist Program at OFVEC. The prototype was essentially a foam core and paper mock-up of the planned exhibit. The prototype exhibit proved engaging for most visitors, especially the interactive rolling drums with "fun facts" about, and "living examples" of, the three groups. By including phonetic pronunciations of scientific names, the exhibit facilitated reading aloud and other social interactions. The prototype was less effective at engaging younger visitors; these pre-readers often lost interest before their parents and older siblings were done reading the labels. Also, elementary-aged children often failed to pay attention to labels that summarized basic concepts about the three-part classification of living things. Overall, these findings suggest that the completed exhibit will help visitors further their understanding of the scientific classification of living things. Most children in the target age range will discover examples of, and facts about, one or more of the three groups of living things. Many older children and adults will also gain a broader perspective on the origins and meaning of the three-part classification. We encourage the exhibit team to retain the overall design of this exhibit unit, but to increase its effectiveness in ways described in the full report. These recommendations include developing a new exhibit title, splitting the rolling drums, revising the label texts, and developing a way to keep pre-readers engaged with this exhibit.



## INTRODUCTION

This report describes prototype testing conducted at Yellowstone National Park as part of the formative evaluation of the Old Faithful Visitor Education Center (OFVEC). It summarizes our approaches to the study, findings as we tested prototypes with Park visitors, and decisions we made about revising the original prototypes in the field. The real deliverables for this study were the revised prototypes. This report explains the reasoning behind the decisions we made during prototype revisions. It also includes our recommendations about the final development and design for the exhibit prototypes.

We also describe some general lessons we learned about visitors to Old Faithful Geysers, which may be useful for the development of the rest of OFVEC.

### Background on the Study

The Old Faithful Visitor Education Center in Yellowstone National Park will be comprised of a new building with a centralized welcome and visitor information center, theaters, and two stories of exhibition space. With a primary focus on the hydrothermal features and accompanying geology of Yellowstone National Park, these exhibitions will cover the causes, mechanics, microbiology, and cultural significance of the hydrothermal features. Interpretive strategies will include video displays, computer interactives, low-tech interactives, graphics, and text panels. Development of OFVEC exhibitions and programs was supported in part by a grant from the National Science Foundation.<sup>1</sup> Plans for OFVEC include the Young Scientist Program, which is targeted at children ages 6 to 13. Through on-site and field-based activities, the Young Scientist Program seeks to provide students with an opportunity to explore and appreciate the natural wealth found in Yellowstone National Park's hydrothermal features, and to promote awareness of scientific investigation as a career path.

The OFVEC team is committed to the development of visitor-centered exhibits and has consequently invested significant resources into evaluation. This evaluation will be comprised of at least three distinct phases: front-end (during 2002), formative (during 2005), and summative (after the exhibit opens). The first phase, front-end evaluation, consisted of a review of the literature (Gyllenhaal, 2002a) as well as face-to-face depth interviews with Old Faithful visitors and staff to ascertain how visitors understand and think about Yellowstone's hydrothermal features (Gyllenhaal, 2002b).

The second phase of evaluation was formative evaluation. It was divided into two stages: an initial critical review, and subsequent prototype testing. The initial critical review stage covered the initial conceptual plans for four exhibit units, and employed two visitor studies and informal learning specialists (Gyllenhaal & Perry, 2005, a and b). The critical reviews addressed the question: "Based on what we know about how visitors learn in informal settings, what will be the likelihood that the educational goals and objectives for visitors will be met, and what particular challenges and opportunities will likely be faced?" The exhibit team revised their



initial concepts and plans for these exhibits based on the recommendations in the critical reviews.

The second stage of formative evaluation was on-site evaluation of three of the four exhibit prototypes reviewed during the critical review. The prototype testing is the subject of this report.

The research question for the on-site prototype testing was:

*By watching and talking with visitors who engage with prototypes of the three exhibit units, what can we learn that will help us maximize the educational effectiveness of these units for casual visitors to Old Faithful Geysers?*

The topical framework for this study is a list of issues or topics we explored as we answered the research question. It is included as [Appendix A](#).

### **The Prototype Exhibits**

Three prototypes were tested at Old Faithful Geysers during the week beginning July 11, 2005. They were:

- *The Ultimate Graphic*, a multi-sensory, one-minute presentation of the story of what happens below ground to make Old Faithful Geysers erupt.
- *The Joy of Yellowstone's Hot Water Features*, a computer database about Yellowstone's hydrothermal features presented in a cookbook format.
- *Life-a-Palooza*, a three-branched "tree of life" display, explains and gives examples of the scientific classification of life and includes a few interactive labels. It is one component of a larger exhibit about microbial life found in Yellowstone's hydrothermal features. (This is one of the Young Scientist Program exhibits.)

The prototypes are described and illustrated in more detail in the section of the report entitled [What We Learned about the Three Prototype Exhibits](#).



## DESCRIPTION OF THE STUDY

This evaluation project was approved by the Office of Management and Budget as OMB Approval #1024-0224 (NPS #05-054) Old Faithful Visitor Education Center at Yellowstone National Park. A copy of that approval is included as [Appendix D](#). The study was granted Research Permit #5574 by Yellowstone National Park.

### Methodology

People often confuse methodology and methods. In this study, we will refer to the methodology as the overarching paradigm or framework that will guide the study. Methods will refer to the specific data collection strategies or techniques. We used a naturalistic methodology to guide this study. Naturalistic methodology is often contrasted with positivistic or scientific methodology (Lincoln & Guba, 1985) and is based on a different set of assumptions (Rau, 1990). The topics under investigation were explored from as many angles as possible, and the findings were triangulated to ensure their trustworthiness.

### Evaluation Team

The team that conducted this evaluation included representatives from three organizations: Selinda Research Associates, Inc., Chris Chadbourne and Associates, and Yellowstone National Park.

Selinda Research Associates (SRA) of Chicago, Illinois, was contracted to complete the formative evaluation for OFVEC. Deborah L. Perry, Director of SRA, and Eric D. Gyllenhaal, Senior Research Associate at SRA and lead researcher for this project, designed the evaluation, collected and analyzed data during prototype testing, and wrote this report.

Christopher Chadbourne and Associates (CCA) of Boston, Massachusetts, was contracted to provide exhibition planning and exhibit development and design for OFVEC. Mike Biddle was the lead designer for the original prototypes; he both designed and produced revisions to these exhibits in the field. Carol Bossert did exhibit research, content development, and writing both for the original prototypes and for revisions completed in the field.

Diane Chalfant, Chief of Interpretation for Yellowstone National Park, took the lead role as designated client for this study. As client, Diane represented Yellowstone National Park, set the overall direction for the evaluation study, reviewed and signed off on the prototypes and subsequent revisions, and was the point person for logistics concerning the Park. Other representatives from Yellowstone National Park included Beth Kaeding, Linda Young, Danielle Nicholas, Jo Suderman, and Janet Ambrose. They assisted with

the logistics and the study in many ways, observed the prototype testing, and contributed their reactions and ideas during debriefings and prototype revisions.



## Rapid Prototyping

The primary framework for this study was *rapid prototyping*. During rapid prototyping, mockups of different interpretive elements are tested with visitors. As soon as it is clear that a particular interpretation strategy is not achieving the desired results—sometimes after testing with only two or three respondents—changes are immediately made, and the unit is tested again with another set of visitors. This rapidly occurring test-revise-test cycle continues until it is determined that the unit works as well as possible.

During this project, the evaluators, exhibit developers, and clients worked side-by-side. This enabled the exhibit developers and clients to see visitor responses to the exhibit units first-hand, and allowed the evaluators and exhibit developers to quickly identify necessary changes. As soon as it was clear that a particular aspect of a prototype needed to be revised, the exhibit developers were able to come up with a next iteration and prepare it for testing with the next visitor group.

Both group debriefs and prototype revisions were completed in one of the Warming Huts, just across a small plaza from the current Old Faithful Visitor Center (Figures 1 and 2).



Figure 1. The Warming Hut, where the evaluation and exhibit teams were based.



Figure 2. Warming Hut interior, with exhibit developers at work on rapid prototyping.



## Selecting Respondents

In accordance with standards for rigorous naturalistic methodology, we used a smaller sample size than one would find in many positivistic methodologies. While in some research paradigms this is cause for concern, it is one of naturalistic methodology's strengths. By studying fewer cases in more depth, we developed a more complete and meaningful understanding of the visitor experience than would be possible by collecting less information from a larger number of respondents.

In this study we used a purposive sampling technique rather than random sampling. With purposive sampling, each respondent is selected based on the results of previous data sets. As data were gathered and preliminary analysis was conducted, new questions and areas of interest emerged. Respondents were selected purposively to illuminate different types of visitor experiences around those new questions and areas of interest. This ensured that we interviewed participants with a maximum range of experiences relating to the content of the prototype exhibits.

Selinda Research Associates is committed to the ethical treatment of respondents. During all data collection, we posted signs informing visitors that we were conducting a study and that they might be approached to participate in an interview. Visitors were given instructions for how to opt out of the study if they wished to do so. Visitors were also given the option of requesting a handout with more detailed information about the study (included in [Appendix B](#)).

## Data Collection Methods

This study used three data collection strategies: unobtrusive observation, depth interview, and participant observation. Each of these three data collection methods is described below.

*Unobtrusive Observation:* After a visitor group was selected, approached, and invited to participate in an interview, we began our data collection by observing the respondents using the exhibit prototype. We defined four types of visitor engagements with the exhibit prototypes: physical, intellectual, social, and emotional. These four types of engagements are not—and are not meant to be—mutually exclusive.

Physical engagements were all the physical things visitors did with the exhibit prototype, such as turning a wheel, reading a label, spending time, etc. These were not predetermined categories of behavior. Rather, we noted the variety of things respondents did, and then during analysis these behaviors and ways of engaging were categorized and described in meaningful ways.

Intellectual engagements were all the ways in which visitors engaged in cognitive and intellectual ways with the prototype exhibitions, such as the ways visitors thought about, processed, and made meaning of their experiences. Intellectual engagements included respondents commenting aloud on their interpretation of the exhibit, being thoughtful and



reflective, or expressing frustration because they couldn't understand something.

Social engagements were the ways in which visitors engaged with each other within the context of the prototype exhibit, which included verbal exchanges as well as body language. Research indicates that most informal science learners learn not from the exhibit itself but from each other (e.g., Diamond, 1986). In addition, when they are in close physical proximity (for example touching each other as opposed to being separated by a couple of feet) visitors work harder to make sense of what they are observing (McManus, 1987; McManus, 1988). Because we are interested in the educational experience at the *Old Faithful Visitor Education Center* exhibits, we paid special attention to the extent to which, and ways in which, visitors engaged socially, paying particular attention to active meaning-making.

Emotional engagements were all the ways that visitors engaged emotionally with the prototype exhibits. We paid special attention to evidence of (for example) surprise, satisfaction, and other indicators of relevant emotional engagements, as well as evidence of frustration, intimidation, or confusion. Research indicates that the emotional content of experiences is an important aspect of how they remember, reflect on, and process their visits (Anderson, 2004).

We recorded our observations on a data collection form, which is included in [Appendix B](#).

Once the visitor group said they had completed their use of the prototype, we approached them and began the depth interview.

*Depth Interview:* The depth interviews were open-ended and free-flowing. We used a list of questions to guide our conversations with visitors ([Appendix B](#)), but not all questions were asked of all respondents. Additional questions that are not on the interview protocol were asked, depending on the issues and topics that emerged during the conversation. At the end of the interview, respondents were given a small token of appreciation and thanked for their time.

*Participant Observation.* In some cases, it seemed more appropriate to conduct a participant observation in place of the more typical observation/interview sequence described above.

In participant observations, we joined the visitor group and participated in their experience with prototype exhibit. This resulted in an even more informal and natural exchange with the respondent group than the observation/interview sequence. In a participant observation, we listened to the conversations and engagements as they were taking place, asked clarifying questions, and sometimes guided the conversation into an area of particular interest. In some of the participant observations we encouraged the respondents to “think out loud,” sharing with us, uncensored and in real-time, whatever was going through their heads. Participant observations sometimes took long periods of time. However, they enabled us to develop a close relationship with a high level of trust with the respondent group, resulting in a better understanding of the visitor experience.



## **Data Analysis Methods**

Data analysis for this study was an on-going process using a modified inductive constant comparison approach (Lincoln & Guba, 1985). The method takes each unit of data and systematically compares it to all previous units of data. Data analysis took place at three junctures. The first was during the actual observation/interview. As data were gathered in the field, preliminary understandings were developed and tested out with respondents. After the interview and/or observation was completed, the researcher then sat down with a computer and typed up a formal debrief. The debrief summarized the data collection session, recorded the researcher's interpretation of the session, and compared it to previously collected data. At the same time, the researcher also developed questions to be explored in subsequent data collection sessions, including any special areas of interest. Finally, the third interval of data analysis took place during the planning and writing of this report, as the researchers revisited the debriefs, discussed the findings and preliminary conclusions, and wrote and revised the report.

## **Description of Respondents**

Our primary unit of analysis was the respondent group. A group was defined as a naturally occurring unit that visits Old Faithful Geyser, whether that unit was a single individual or a small group of individuals. While attempts were made to include as many of the group members in the interview as possible, often not all members were willing to participate. Almost all of the respondents for this study were casual visitor groups to the Old Faithful Geyser. Data collection took place in a variety of settings as visitors approached or left the boardwalk around Old Faithful Geyser. Two of these settings are illustrated in Figures 3 and 4. For seating during the interviews, we used both the permanent benches located along the paths and additional chairs brought from the Warming Hut.

When conducting research, there is always tension between the desire to collect small amounts of information from a large number of people and the desire to collect large amounts of information from a small number of people. Because we were particularly interested in helping the project team develop a greater understanding of how visitors will use the exhibits to process, think about, and further their understandings of the hydrothermal features of Yellowstone National Park, we decided to engage with fewer selected visitor groups for longer periods of time.





Figure 3. Data collection site, along an entrance path to Old Faithful Geysers.



Figure 4. Data collection site, along an entrance path to Old Faithful Geysers.

We collected data over three and a half days with two evaluators (Eric D. Gyllenhaal and Deborah L. Perry). We observed and interviewed 53 visitors in 18 visitor groups. More information about these groups is included in [Appendix C](#). The two evaluators completed about 40 contact hours in all (which includes both time for observations and interviews with visitors, and time spent writing the debriefs.)

### **Limitations of this Study**

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. For the three prototypes tested during this study, we seem to have achieved redundancy on many of the issues listed in the topical framework. However, we received a more limited range of responses in some areas of the study. For instance, we were unable to take the rapid prototyping process as far as we would have liked with some exhibits, and we were unable to test the prototypes with visitors who did not speak English. Where appropriate in the report, we identify issues we were unable to completely resolve in the field.



# WHAT WE LEARNED ABOUT THE THREE PROTOTYPE EXHIBITS

## The Ultimate Graphic

### Description of the Prototype Exhibit

This exhibit will be the centerpiece of a larger group of OFVEC exhibits focused on Old Faithful Geyser and other geysers at Yellowstone National Park. It is intended to help visitors understand how geysers work, and why they are found in such abundance at Yellowstone National Park.

The goals, objectives, and intended messages for this unit include the following:

**Goal:** Visitors will develop a greater understanding of, and appreciation for, the sequence of events that take place below ground that are responsible for the above-ground phenomenon known as Old Faithful Geyser.

**Objectives:** Visitors will:

- Understand that distinct processes happen in sequence to produce an eruption of Old Faithful Geyser.
- Briefly describe each of the steps in an Old Faithful Geyser eruption.

**Educational Messages:**

- Much of Yellowstone, including the area around Old Faithful Geyser, lies above an active volcano.
- Because we're on top of an active volcano, the rock underlying Yellowstone is hotter than most other places.
- Water cycles through cracks in the rocks under Yellowstone.
- This water first leaks far below the surface and then heats up to very high temperatures.
- This hot water then rises upwards through a system of wider cracks that's like a natural plumbing system.
- Some water gets temporarily trapped on its upward journey.
- This trapped water is under a lot of pressure and becomes superheated—hotter than the normal boiling point.
- A slight change in pressure triggers the water to flash into steam and explode toward the surface.
- Above ground, the mixture of boiling water and steam erupts to form Old Faithful Geyser.

The Ultimate Graphic prototype was created as a series of boards that stepped visitors through a simplified version of what will eventually be a multimedia presentation about an Old Faithful



Geyser eruption (Figs. 5, 6, and 7). Visitors also read brief descriptions of special effects they would see in the completed exhibits; some of the visual effects were illustrated on the flip cards and at the base of the exhibit. In the completed exhibit, visitors will read the narration themselves. The draft label text for this narration was included on each board, which respondents read aloud or to themselves, as they pleased. Completing the entire sequence (nine boards) usually took between one and three minutes. During prototype testing, visitor groups were first briefed on their use of the exhibit and then observed as they moved through the sequence of boards. At the conclusion of the sequence, respondent groups were interviewed about their reactions to, and understandings of, the exhibit.

Based on respondents' experiences with the initial version of the prototype Ultimate Graphic, the exhibit developers made several revisions to the prototype. The most important revision was the addition of a mocked-up slider (Fig. 8), which gave visitors more control over the pace of the multimedia presentation and allowed them to move back and forth between steps as they wished.



Figure 5. The Ultimate Graphic, as displayed during prototype testing.



Figure 6. Original version of the Ultimate Graphic prototype, showing first step.





Figure 7. Original version of the Ultimate Graphic prototype, showing final step.



Figure 8. Final version of the Ultimate Graphic prototype, showing slider (on base).

## Findings

The following findings are based on observations of, and interviews with, visitor groups as they used the original and revised versions of the prototype.

Our overall findings about this exhibit can be summarized as follows:

- **Visitor engagement.** The data indicate that the overall framework for this exhibit (i.e., a step-by-step overview of Old Faithful Geyser) is sound, and visitors likely will be able to successfully navigate it. Respondents' physical, intellectual, and social engagement increased when they were given more control with the mocked-up slider. The short, clearly written narration facilitated respondents' intellectual and social engagement; however, visitors found some terms and phrases confusing.
- **Achieving goals and objectives.** The data indicated that this exhibit most likely will provide visitors with a thorough overview of an Old Faithful Geyser eruption. Most visitors will further develop their understanding of the sequence of events that take place below ground prior to an eruption of Old Faithful Geyser. We encourage the exhibit team to make the exhibit even more effective by including a few modifications as



outlined in the recommendations below, but to retain the final prototype unit's demonstrated strengths of simplicity, visitor control, and completeness.

More specific findings about this exhibit include the following:

- **Visitor control.** Giving visitors control over this exhibit (as we did with the mocked-up slider) had a positive impact on their engagement with the prototype and on their understanding of the exhibit's content. It was more fun and gave visitors more time to think and talk about what they were seeing. For instance, to clarify something they didn't understand the first time, visitors sometimes moved the slider back and forth, rather than just going through in sequence.
- **Narration.** Visitors appreciated the brief text of the narration. Even some 2<sup>nd</sup> and 3<sup>rd</sup> graders were able to read most of the words (although children that young had difficulty comprehending what they were reading as they decoded the text aloud).
- **Understanding terms and phrases.** Visitors had trouble understanding some terms and phrases in the draft narration, including *constriction* (which some children misread as “construction”), *underground volcano*, *active volcano*, and *superheated water*. Interestingly, the phrase *flash to steam* was more easily understood by most visitors, perhaps because it's so descriptive of the process.
- **Graphic representation.** Many visitors said they would prefer, and better understand, a more "realistic" representation of the geyser. By “realistic,” they meant something that looked more like the diagrams they had seen elsewhere in the Park (for the subsurface features) and more like the actual Old Faithful Geyser and its surroundings (for the above-ground features).

## Recommendations

Based on the findings discussed above, we recommend that the following features be included in the final version of this exhibit.

- **Give visitors control over the presentation.** A slider or similar interface should allow visitors to go through the nine steps at their own pace in sequential order, or to go back and forth between steps.
- **Make the graphics more diagrammatic and “realistic.”** Return to a more diagrammatic look to this exhibit, abandoning the more abstracted prototype (such as the ball-like molecules of steam and water). The graphics' look should recall diagrams that visitors will have encountered elsewhere in the Park, and in Park-related publications, and the aboveground features should look more like what visitors see from the boardwalk around Old Faithful Geyser. (We include an in-depth discussion of representational diagrams in a later section of this report entitled, “[What We Learned about Developing Exhibits for the OFVEC.](#)”)



- **Use lighting effects to “bring the diagrams to life.”** The lighting effects should be designed to take these familiar Yellowstone diagrams and "bring them to life" in ways that aren't possible with more conventional graphics. This may require a return to the use of polarized light effects in lieu of more mechanical elements.
- **Keep the narration brief and clear.** Keeping the text simple and straightforward will be a continuing challenge with this unit. The text tested during the prototype evaluation seemed to be about the right length.
- **Use the diagrams to help visitors understand unfamiliar terms and phrases.** Clarify unfamiliar terms and concepts like *constriction*, *superheated water*, *active volcano*, and *underground volcano* through the more diagrammatic representations, rather than adding narrative definitions. For instance, the team should consider graphic techniques, such as labeling the constriction on the diagram.



## The Joy of Yellowstone's Hot Water Features

### Description of the Prototype Exhibit

This computer interactive will be the centerpiece of a larger group of OFVEC exhibits focused on the variety of hot-water features at Yellowstone National Park. It is intended to help visitors understand both the classification of these features into four main types, and the factors that help generate these different types.

The goals, objectives, and intended messages for this unit include the following:

**Goal:** Visitors will develop a greater understanding of, and appreciation for, the physical, geological and biological factors that contribute to the wide variety of hot water features of Yellowstone National Park.

**Objective:** Visitors will understand that variations in underground physical, geological and biological factors produce dramatically different types of hot water features above ground.

#### Educational Messages:

- Mud pots, steam vents, hot springs, and geysers are all products of a basic “recipe” that includes water and heat.
- While each hot water feature is unique in its above ground appearance and activity, it can be categorized as one of four types of features: mud pot, steam vent, hot spring or geyser.
- Other factors – or “ingredients” – can account for the variety within each type.

The final exhibit will be a computer interactive. Developers explained the intended game play for this interactive as follows: “Visitors encounter a computer screen that has the familiar red-plaid of the cover of a *Better Homes and Gardens Cookbook*. The cookbook cover says, ‘The Joy of Yellowstone’s Hot Water Features. Over 10,000 recipes.’ Visitors touch the screen to open the cookbook. A table of contents appears, but instead of the typical list of Pies and Cakes, Meats, Vegetables, etc. this cookbook lists Hot Springs, Mud Pots, Steam Vents and Geysers. A glossary chapter will also be included. Labeled tabs along the right side repeat the chapters. Visitors touch the chapter heading or tab and another screen appears that describes the recipe for a particular hot water feature within that category. Photos, video footage, audio, spot illustrations, diagrams and/or recipe variations may be on the page. A ‘See Also...’ option might take visitors to a recipe for a related feature. A ‘Back’ option would take them back to the previous screen or the Table of Contents.”

The prototype that we tested was a paper mock-up of the computer screens for this interactive, arranged into a loose-leaf notebook (Figs. 9 to 13). Individual pages were protected by plastic sheaths, which had holes that allowed them to be inserted into the



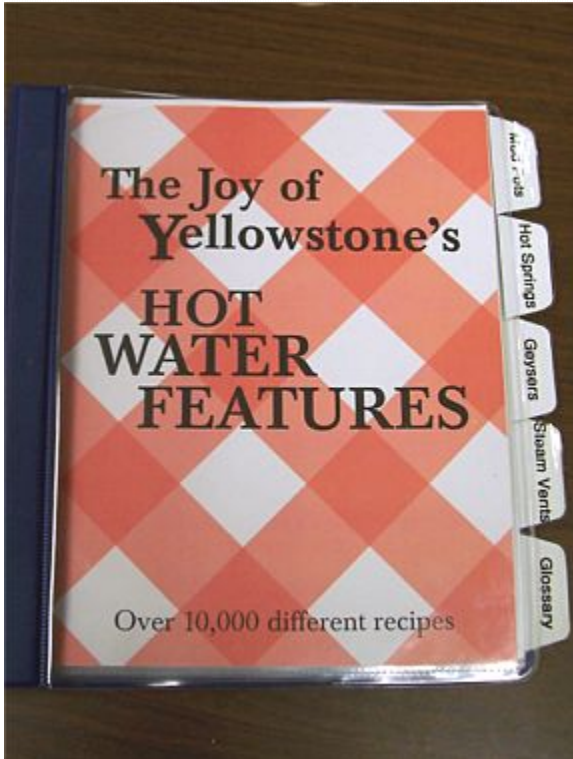


Figure 9. Cover and tabs of the “Joy of Yellowstone” cookbook prototype.

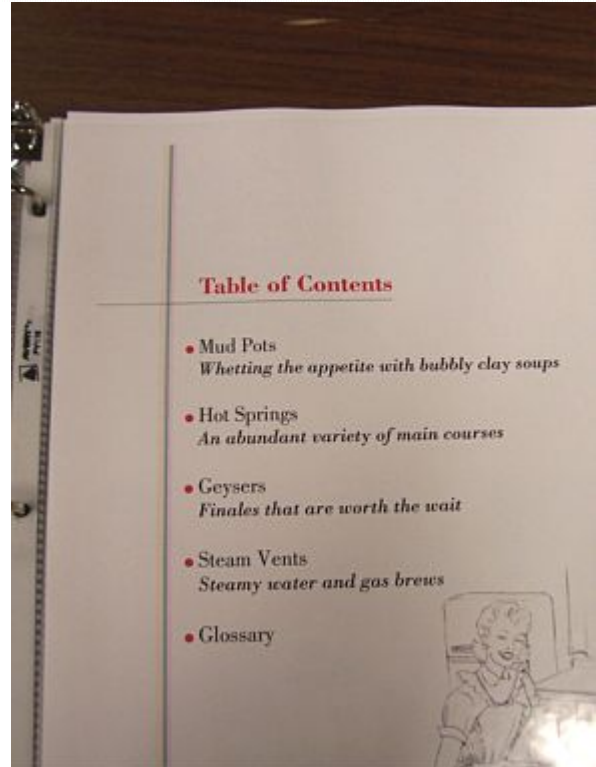


Figure 10. Original table of contents for the “Joy of Yellowstone” cookbook prototype.

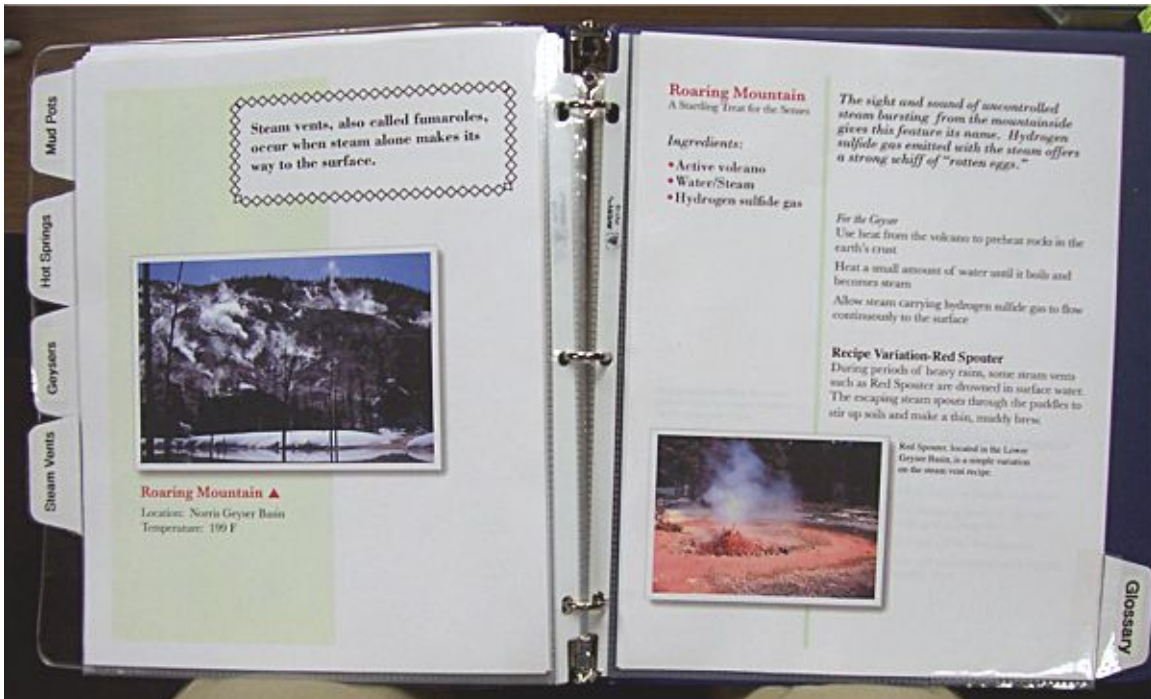


Figure 11. Two-page spread from the original “Joy of Yellowstone” cookbook prototype.



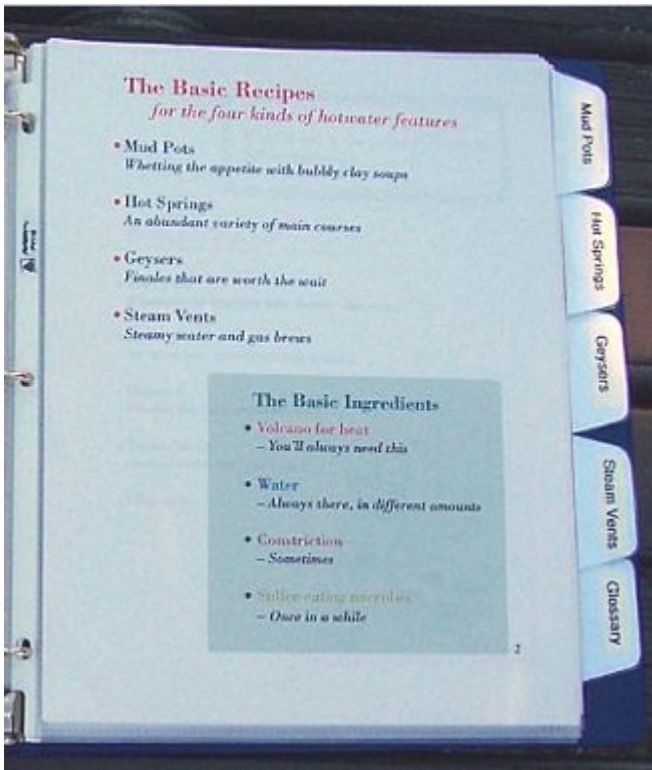


Figure 12. Table of Contents from the revised “Joy of Yellowstone” cookbook prototype.

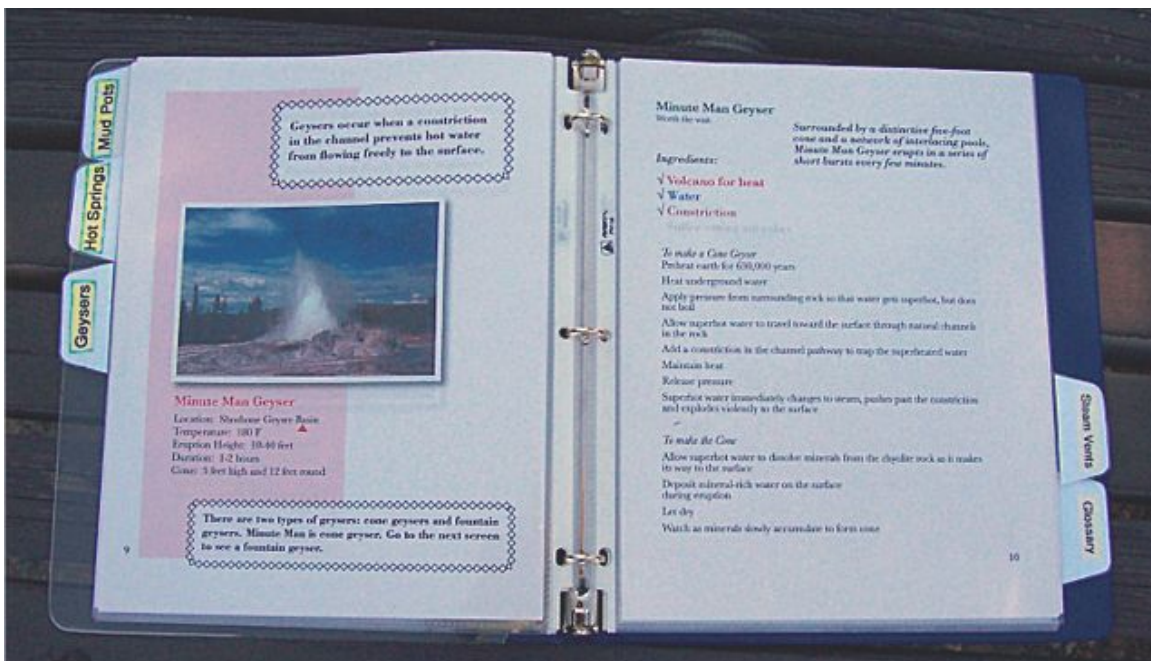


Figure 13. Two-page spread from the revised “Joy of Yellowstone” cookbook prototype.



three-ring binder. We told visitors they could navigate through the simulated computer program using either the tabs at the side of the binder (Fig. 9, on right) or by touching a recipe on the Table of Contents screen (Fig. 10). The simulated recipe screens (e.g., Fig. 11) included information about the feature they had chosen on the page (on the left) and the recipe itself, plus variations and additional features (on the right).

Based on respondents' experiences with the initial version of the prototype cookbook, the exhibit team made extensive revisions on a laptop computer, and then printed these revised pages on a color printer. The revised Table of Contents (Fig. 12) and recipe screens (e.g., Fig. 13) tried to increase visitors' attention to the messages about the four types of hot-water features and the "ingredients" that contribute to their formation.

## Findings

The following findings are based on observations of, and interviews with, visitor groups as they used the original and revised versions of the prototype.

Our overall findings about this exhibit can be summarized as follows:

- **Visitor engagement.** Of the three units that were tested, the *Joy of Yellowstone* presented the most challenges. The cookbook metaphor seemed familiar and comfortable to a wide range of visitors including those of different ages. However, even after extensive revisions this prototype failed to engage most respondents in ways that would help achieve the goals and objectives of this exhibit. Most respondents had little trouble figuring out the physical interactions with the prototype. However, when visitors engaged intellectually and socially, it was most often with the information about individual features that they had seen, or might see, in the Park.
- **Achieving goals and objectives.** The photographs and information about individual hot-water features proved very interesting to respondents. However, even after revisions, the prototype failed to focus visitors' attention on either the four types of hot-water features or the "ingredients" – the underground physical, geological and biological factors produce them.

More specific findings about this exhibit include the following:

- **Cookbook metaphor.** The cookbook metaphor seemed familiar and comfortable to respondents, and the red-and-white checker pattern on the cover was recognized by many children as well as adults. However, due to time constraints, we did not test the metaphor with international visitors, so we don't know if non-Americans would recognize it.
- **Amount of information.** Many respondents commented about the amount of information on the pages and said that might discourage them from using the computer interactive.



- **Focus on individual features.** The photographs and information about individual hot-water features proved very interesting to respondents. However, it often distracted them from learning more general concepts about the four types of hot-water features and how they are formed.
- **Interactive-savvy visitors.** Children and parents doubted that the recipe book, as presented, would hold their (or their children's) interest for long. They often complained that it did not seem particularly interactive, especially given that it was going to be on a computer. Some respondents cited examples of more interactive computer programs they had used in other visitor centers and museums, including simulations and games that they considered to be much more fun than the cookbook. We were impressed at how articulate visitors were about the role of interactivity in holding children's attention and helping them learn.

## Recommendations

Based on the findings discussed above, we recommend that the following features be included in the final version of this exhibit. The first three recommendations apply no matter how the project team decides to proceed with this interactive:

- **Retain the cookbook metaphor.** We encourage the exhibit team to retain the cookbook and recipe metaphor, especially the red-and-white checkered pattern (provided no trademarks are infringed upon).
- **Limit the amount of visible information.** We strongly recommend limiting the amount of visible information on the screen at one time.
- **Tighten the focus of the information on each screen.** We also recommend that the interactive be structured so that visitors focus first and foremost on the four types of hot-water features and on the factors that play roles in their formation. Visitors should have access to information about individual features, but only after they have focused on, and made choices about, the types of features and the factors that form them.

If the project team decides to completely restructure this interactive, then we would make the following recommendations:

- **Give visitors more control.** Develop a more open-ended computer interactive that allows visitors more decision-making and control
- **Limit the number of variables.** Limit the number of variables that visitors control at one time. Perhaps the revised interactive could include a constant heat source, but be given control over only one or two other variables on a given screen (e.g., amount of water, underground configuration, and/or microbial interactions, but not all three).



- **Continue formative testing.** Given the magnitude of this proposed change, it will be essential to conduct formative testing of the revised exhibit, possibly including critical reviews and/or testing of a paper prototype of the new approach.

Towards the end of field testing, the exhibit team developed an idea for a Hot Water Features Kitchen, where a chef would be directed by the visitor to cook up assorted hot-water feature recipes. Visitors could use a predetermined “recipe” or create their own out of a standard set of “ingredients.” We described the "Hot Water Features Kitchen" approach to a few visitors on the last day of testing, and they seemed to think it would more likely hold their attention.



## Life-a-Palooza

### Description of the Prototype Exhibit

This interactive exhibit will be part of a larger group of OFVEC exhibits focused on the Archaea, a group of single-celled organisms first described from Yellowstone's extreme hot-water environments. It is intended to help visitors understand how the Archaea are related to other, more familiar types of living things. This exhibit is part of the Young Scientist Program at OFVEC. The Young Scientist Program, through on-site and field-based activities, seeks to provide students with an opportunity to explore and appreciate the natural wealth found in Yellowstone National Park's hydrothermal features, and to promote awareness of scientific investigation as a career path.

The goals, objectives, and intended messages for this unit include the following:

**Goal:** Both general visitors and participants in the Young Scientist Program will further their understanding of the scientific classification of microorganisms, plants, and animals at Yellowstone (and elsewhere on earth).

**Objectives:** Both general visitors and participants in the Young Scientist Program will:

- Recognize the three main groups of living things: Bacteria, Archaea and a single group for everything else [Eukarya]
- Give examples of organisms from each main branch – and know which branch includes humans

**Educational Messages:**

- Scientists classify almost all familiar organisms—including animals, plants, mushrooms, and you—into a single group [called Eukarya].
- Tiny, single-celled Bacteria are so different from other living things that scientists classify them into their own separate group.
- Another type of single-celled organism found in Yellowstone hot waters is so different from Bacteria that scientists also place them in their own separate group. Scientists call these Archaea.
- Although Archaea and Bacteria are extremely tiny, they are much more abundant than plants, animals, and other members of their branch

The prototype exhibit tested at Yellowstone was essentially a foam core and paper mock-up of the planned exhibit (Fig. 14). Messages were communicated through:

- A static primary label (Fig. 15), which introduced the major themes of the exhibit.



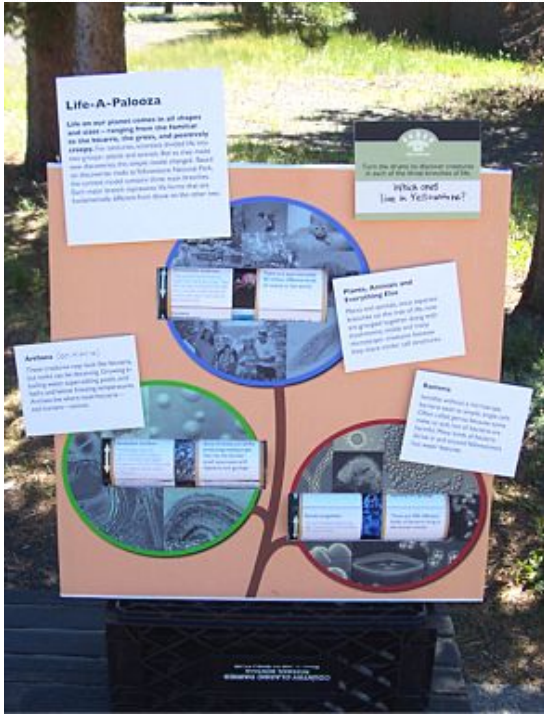


Figure 14. Overview of the Life-a-Palooza prototype exhibit.

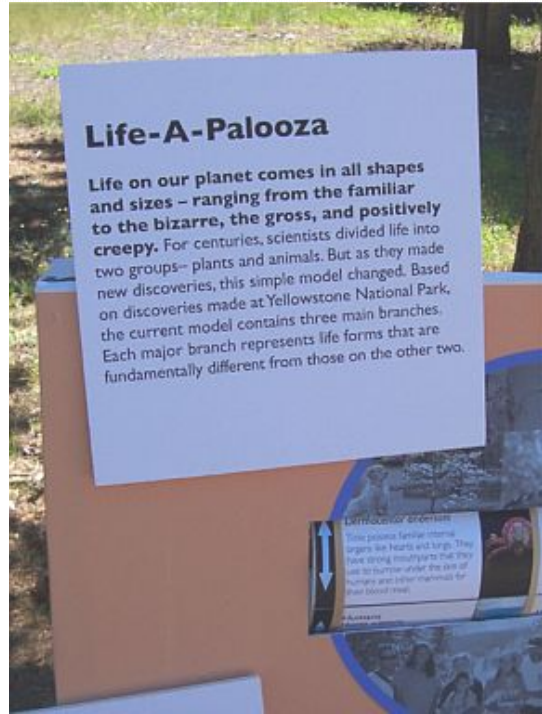


Figure 15. Close-up of original version of the Life-a-Palooza prototype exhibit.

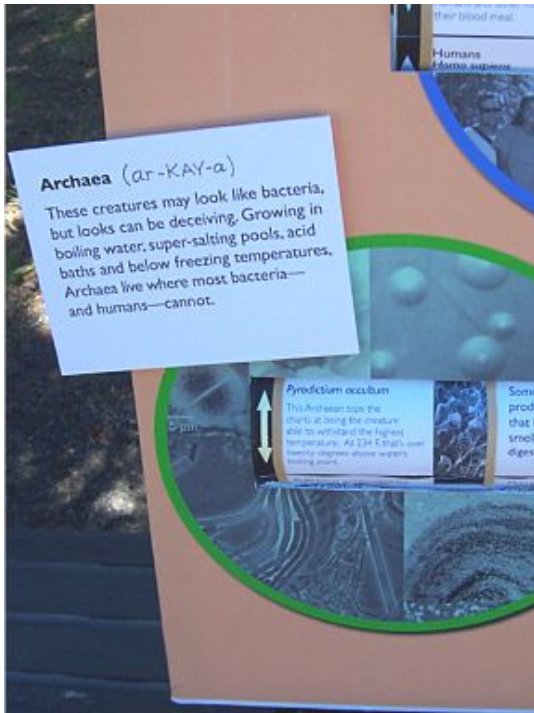


Figure 16. Close-up of original version of the Life-a-Palooza prototype exhibit.

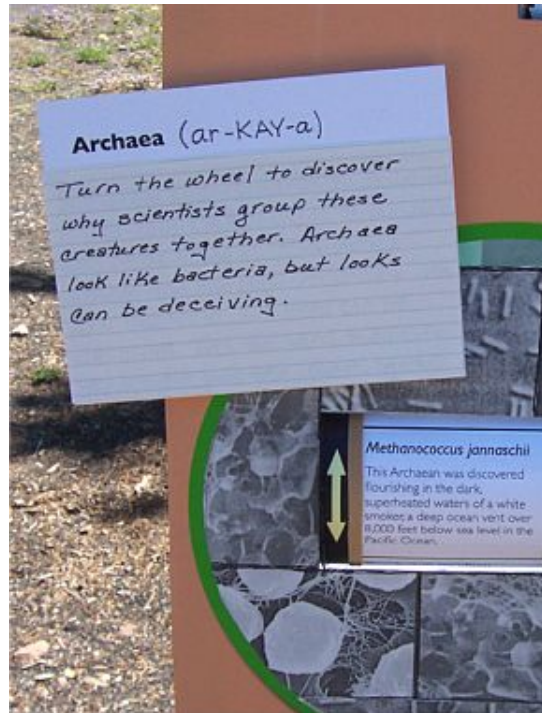


Figure 17. Close-up of an example of rapid prototyping for the Life-a-Palooza.

- Three static secondary labels (e.g., Fig. 16 and 17), which briefly described the three



major groups of living things (Archaea, Bacteria, and Eukarya) and, in two cases, showed how to pronounce the group's name. Each secondary label was accompanied by a circular arrangement of photographs showing examples of organisms in that group.

- Interactive tertiary labels on rolling drums (e.g., Fig. 16 and 17), one drum for each major group. The labels on the left side of the drum described “living examples” from that group; photos in the middle of the drum illustrated these examples; and labels on the right side provided “fun facts” about the group, such as how many bacteria may be found in a spoonful of soil. Arrows at the margins of the drums were intended to show visitors that the drums could be rotated by hand.
- An interactive instruction label located on the upper left corner of the exhibit (Fig. 14).

During rapid prototyping, we worked within the label system described above, but modified the text of all the labels one or more times. These modifications included both handwritten labels (e.g., Fig. 17) and laser-printed revisions. We also revised the photographs on the drums and circular backgrounds, changing both the selection of photographs and the use of color.

## Findings

The following findings are based on observations of, and interviews with, visitor groups as they used the original and revised versions of the prototype.

Our overall findings about this exhibit can be summarized as follows:

- **Visitor engagement.** This exhibit proved engaging for most visitors, ranging from elementary-aged independent readers through adults. The prototype engaged these older children and adults in appropriate ways, fostering physical, intellectual, social, and emotional engagements with the “fun facts” and many of the “living examples” on the interactive rolling drums. By including phonetic pronunciations of scientific names, the exhibit facilitated reading aloud and other social interactions. The prototype was less effective at engaging younger visitors; these pre-readers often lost interest before their parents and older siblings were done reading the labels. Also, children younger than middle school age usually did not engage with the primary and secondary labels, which summarized basic concepts about classification of living things.
- **Achieving goals and objectives.** This exhibit should help both general visitors and participants in the Young Scientist Program further their understanding of the scientific classification of microorganisms, plants, and animals. Most children in the target age range will discover examples of, and facts about, one or more of the three groups of living things. Many older children and adults will also gain a broader perspective on the origins and meaning of the three-part classification. We encourage the exhibit team to retain the overall design of this exhibit unit, but to increase the effectiveness of the

exhibit by developing a new exhibit title, splitting the rolling drums, revising the labels,



and developing a way to keep younger visitors engaged with this exhibit.

More specific findings about this exhibit include the following:

- **Exhibit title.** The original exhibit title, “Life-a-Palooza,” made little or no sense to most respondents. Even visitors who had heard of the term “Lala Palooza,” or who had been to a Lollapalooza concert, had difficulty relating the title to the contents of the exhibit.
- **Amount of text.** Although the rolling drums initially hid much of the label text from visitors, the overall amount of text still seemed a bit overwhelming to many respondents, especially children (who are the major target audience for this exhibit).
- **Primary and secondary labels.** Visitors who read the primary and secondary labels often expressed surprise at the new ways that scientists classify life (especially the linking of plants with animals and the distinctions between Archaea and Bacteria). However, visitors who merely skimmed the titles and first sentence of the primary and secondary labels usually missed these concepts entirely. As one “skimming” visitor said, he “got the gist of it” and didn’t read any further; as a result, as he later discovered, he missed some ideas that proved new and interesting to him.
- **Rolling drums.** Both children and adults enjoyed and learned something new from the “fun facts.” Most children paid less attention to the “living example” sides of the rolling drums (with the exception of the wapiti example). The prominence of scientific names on the “living example” labels discouraged many visitors from reading further (especially children, but also adults). Also, many visitors linked the “living example” with the adjacent “fun fact” – they thought they were both about the same creature.
- **Pronunciations.** The phonetic pronunciation guides were very successful and enabled visitors to read out loud words that were otherwise unfamiliar, like Archaea and Eukarya. When the exhibit was tested without pronunciation guides, visitors stumbled over words that previously had flowed off of respondents’ tongues when the labels were present. Genus and species names were also stumbling blocks to conversations, and if included, should be accompanied by pronunciation guides.
- **Engaging younger children.** Children who could not read initially directed their attention at the rolling drums and the images of animals and other creatures. However, they often lost interest before their parents and older siblings were done reading the labels. During rapid prototyping we attempted to engage these children with a game where they matched photos on the drums with those on the circular background mat with some success. When the interviewer showed them what to do, the matching activity held young children’s attention. However, with our limited time and resources, we were unable to develop a game that parents could easily explain to their children.



## Recommendations

Based on the findings discussed above, we recommend that the following features be included in the final version of this exhibit:

- **Revise the exhibit title.** Develop a title that better describes the contents of the exhibit.
- **Limit the amount of text.** Limit the overall amount of text to encourage social interaction among group members rather than passive reading.
- **Rewrite the primary and secondary labels.** The titles and initial sentences of the primary and secondary labels need to be written in ways that will help more visitors realize the larger concepts for this unit – that Archaea are very different from Bacteria, and that plants and animals are more similar to each other than Archaea are to Bacteria. Visitors who merely skim these labels need to realize that the ideas they explain are (most likely) new and interesting to them.
- **Split the rolling drums.** Develop separate rolling drums for the “living examples” and “fun facts,” so that visitors will realize that they are not linked (i.e., two drums for each group).
- **Rewrite the “living examples” labels.** Write the “living example” labels more like the “fun facts,” so that they will be more likely to attract and hold children’s attention. This includes diminishing the prominence of the scientific names by including them in the body of the text rather than using them as headers. The living examples can include both organisms from Yellowstone and organisms from other places, as long as they relate to the goals and objectives of the exhibit.
- **Provide pronunciation guides.** Provide phonetic pronunciation guides whenever the names *Eukarya* or *Archaea* are first used on an individual label. Include phonetic pronunciations for all scientific names of genera and species.
- **Limit the range of images.** Limit background images to depictions of the “living examples” illustrated on the drum labels
- **Engage younger children.** The exhibit team should continue to experiment with ways to keep younger children engaged at the exhibit. Keeping younger children engaged will increase the effectiveness of this exhibit for the entire family. As described above, one idea that we tried during rapid prototyping was to match the images on the drums to the images on the background. This might be more effective if the background image lights up when the “living example” drum is turned to the matching organism.



## WHAT WE LEARNED ABOUT DEVELOPING EXHIBITS FOR THE OFVEC

Based on our experience evaluating the three prototype exhibits, we have extracted some general lessons that will be useful during the continuing development of interpretive exhibits for the Old Faithful Visitor Education Center. These broader recommendations are supported by the literature on informal education and instructional design. We list and describe these lessons in this section of the report.

### Lessons Learned

**Facilitate social interactions.** Our testing of all three prototypes reinforced the vital role that social interaction plays in informal learning, especially among groups with children, but also among groups of adults. Specific features of the prototypes that helped facilitate social interaction included the following:

- Giving visitors control over their experience.
- Developing labels that are easy to read aloud. For instance, provide pronunciation guides for scientific names and other scientific terms that will be difficult for visitors to sound out on their own.
- Developing labels that help parents explain difficult concepts to their children by, for instance, defining (or illustrating) words that are likely to be new to young visitors or that have a specific-but-unfamiliar meaning in this context.

**Develop label texts that visitors will read all the way through.** When we asked visitors to read label texts, it was obvious that the *structure* of the labels mattered as much as the brevity and clarity of the text. That's because many visitors took time to skim the headings and first few words of the label, but then read further only if the label seemed to be about something new, relevant, and interesting to them. In her book, *Exhibit Labels: An Interpretive Approach*, Beverly Serrell recommends that labels should be designed to be read all the way through. That means that, in addition to being short and concise, labels should be structured to include:

- Informative paragraph titles and subtitles (as opposed to clever and catchy titles that don't advance the narrative).
- Body copy that sparingly covers the essential information, and then stops.
- A snappy ending, as "a reward for reading it all. Rewards can be in the form of closure, reinforcement, or a new insight." (Serrell, 1996, p. 90).

By following these guidelines, visitors will be less apt to skim and more apt to read the whole label, and thus more likely to achieve the goal of the exhibit.

**Limit the amount and focus of information.** When an exhibit has a specific communication goal, all the text and illustrations included in the exhibit need to support that goal. The prototypes we tested included some examples with appropriate amount and focus of text and some that needed more work. For instance, the text that accompanied the Ultimate Graphic seemed to have the right amount and focus of information—it told visitors what they wanted to



know in a way that accomplished the goals of the exhibit. On the other hand, the prototype cookbook distracted visitors from its educational goals by providing too much information about individual hot-water features. As the project team continues to develop and review OFVEC exhibits, we hope they will keep these findings in mind.

**Engage younger visitors.** As we tested the prototypes with groups that included young children, we were continually reminded of the importance of providing exhibits that engage younger children as well as their older siblings and caregivers. More specifically, exhibits should provide something obvious for younger children to do while their caregivers figure out how to talk with them about the exhibit. This can include something as simple as looking at and matching pictures, naming animals, or spinning one of the rolling drums. Because family groups are such an important component of Yellowstone’s audience, the team should strive to develop *all* OFVEC exhibit clusters with components that will engage younger children.

**Help visitors locate the hot-water features illustrated in the exhibits.** Most respondents were just beginning to figure out the names and locations of various basins and areas within the Park. Simply telling them that a geyser was in “Norris” or at “Fishing Bridge” often was not enough. Many visitors also wanted to see small maps that would help them figure out if they would be able to see a particular feature during their visit to the Park. We recommend that, whenever possible, the OFVEC exhibits provide inset maps and location names for hydrothermal features.

**Develop representational diagrams.** Our data suggested that representational diagrams do a better job of quickly conveying concepts to visitors, whereas abstract representations often require an extra cognitive leap for visitors to make sense of them. This seems especially applicable in the context of Yellowstone National Park, because many visitors have already been exposed to diagrammatic representations of the Park’s underground features through Park literature, wayside exhibits, and other forms of interpretation.

The instructional design literature suggests that, in developing diagrams that both look “real” and communicate effectively, designers must delicately balance *simplicity and complexity*, on the one hand, and *familiarity and novelty*, on the other (Fleming & Levie, 1978 and 1993). With regard to simplicity, Fleming & Levie (1993) state that:

*Since the function of interpretive pictures is to explain often complex and difficult phenomena, it is imperative that they be made as simple as possible without oversimplifying the content of what they convey....There is a tendency to use realistic pictures in an interpretive way; inevitably they do not work. Effective interpretive pictures are often line drawings or cut-aways. It is only once the irrelevant and distracting detail has been stripped away that students can see and understand the processes that are illustrated (Fleming & Levie, 1993, p. 93).*

Thus an interpretive graphic can be *too* realistic to accomplish its function well. However, what visitors perceive as real depends as much on their previous experience as it does on the complexity of the image.



*Representational pictures should be ‘true to life’ with the proviso that what is depicted is within the realm of experience of the student and that the student's experience is close enough to that of the designer for there to be common ground for the identification of the features that are illustrated...What is perceived as real depends on the similarity of the message to the learner's internal representations, not to the domain of reference (Fleming & Levie, 1993, p. 89).*

That may explain why many visitors we talked with seemed to consider more conventional diagrams to be more “real”—that was what they were familiar with from exhibits elsewhere in the Park and the Park’s literature. However, we also must be mindful of the importance of novelty in attracting and holding visitors’ attention.

*People tend to be attracted to things or events that are novel or dramatic....Studies have shown that learners are drawn to pictures that include unique or dramatic elements, different or dramatic placements or elements, and novel ways of using color, tone, and other picture qualities. Without a doubt, a designer can overdo variety and novelty in selecting illustrations. Most designers agree that too much novelty can be distracting or confusing and therefore counterproductive. There is little doubt that the illustrations...should be varied and should contain novel elements. But they must also be consistent and familiar enough to promote ease of use and to create a sense of comfort (Fleming & Levie, 1993, p. 46).*

Thus, as we said, designers need to seek a balance among all these factors.

## **Summary of Recommendations**

The following is a brief summary of the recommendations developed in this section of the report.

- **Labels.** Develop labels for OFVEC that:
  - Are focused on the topics and goals of the exhibit.
  - Are easy to read aloud.
  - Include informative headlines or titles, tightly focused body copy, and a snappy ending.
  - Provide phonetic pronunciation guides for scientific names and other scientific terms.
  - Help caregivers explain difficult concepts to their children
- **Visitor control.** Develop interactives that give visitors control over their experience.
- **Younger visitors.** Provide activities that productively engage younger visitors within each exhibit cluster.



- **Maps.** Provide inset maps and location names for hot-water features.
- **Diagrams.** Use representational diagrams rather than abstract representations. Develop diagrams that balance *simplicity and complexity*, on the one hand, and *familiarity and novelty*, on the other.



## WHAT WE LEARNED ABOUT VISITORS TO OLD FAITHFUL GEYSER

Based on our experience evaluating the three prototype exhibits, we have extracted some general lessons about visitors to the Old Faithful Geyser. Several of these broader lessons-learned are supported by data collected during the earlier front-end evaluations for this project (Gyllenhaal, 2002a and 2002b). We list and describe those lessons in this section of the report.

### Lessons Learned

**Most visitors to Old Faithful Geyser were disoriented.** Visitor orientation is a major issue at Old Faithful Geyser. We encountered many visitors who couldn't find restrooms, water, and other places and things they needed. Visitors also said they were unclear on the rules (such as where they had to stay on the paths), and they didn't know where to go to find out about predictions for the next Old Faithful Geyser eruption. Several visitors expressed their anger at the lack of orientation. A more effective map will help many visitors find what they need, but we encourage the team to consider other approaches as well, including directional signs with arrows pointing visitors to the nearest restrooms, food and water, and predictions of the next Old Faithful Geyser eruption.

**Even a short visit to Old Faithful Geyser can be a significant experience.** Between one third and one half of all visitors to Yellowstone spend less than a day in the Park (Gyllenhaal, 2002a). However, as we learned during prototype testing, even short visits may still play an important role in visitors' lives. It's important to understand and appreciate the context of peoples' visits to the Park. For instance, we met a number of families who were taking month-long trips that have been family traditions or long-standing family goals. We also talked with visitors on trips that marked major transitions in their lives, such as retirement or college graduation. They may have stayed at Old Faithful Geyser for only an hour or so, but their memories will last a lifetime. It's important to ensure that those memories are positive and are linked to an increased understanding of Yellowstone's role in natural and human systems.

**In contrast to short-term visitors, some longer-term visitors build islands—and even archipelagos—of expertise about the Park.** In the front-end report, we described visitors to Yellowstone who were developing *islands of expertise* about the Park during their multi-day visits to Yellowstone (Gyllenhaal, 2002b). Although Crowley & Jacobs (2002) first applied their concept of islands of expertise to children, in the front-end study we found that it also described how many adults were engaged in learning about the Park (Gyllenhaal, 2002b). During prototype testing, we talked with several groups who had visited a number of other national parks, either on their current long trip, or on a number of trips spread over several years' time. These visitors seemed to have developed several islands of geological expertise covering places like Grand Canyon, Dinosaur National Monument, Mt. St. Helens, and Yellowstone. When Selinda encountered this multiple-island phenomenon at Grand Canyon National Park, we termed it *archipelagos of expertise* (Gyllenhaal & Perry, 2004). Crowley & Jacobs (2002) emphasized the role that parents play in their children's development and maintenance of islands of expertise, both as mentors and as co-explorers on the road to a shared island of expertise, and



parents we talked with at Yellowstone were playing a similar role in their children's learning about the Park. It's also important to recognize the role that Park programming, such as the Young Scientist Program and ranger-lead talks and hikes, can play in visitors' development of islands of expertise about the Park. As we pointed out in the front-end evaluation, Park rangers can play a vital role in mentoring visitors during this process (Gyllenhaal, 2002b, p. 27). We suggest that the brochures and Web site being developed along with OFVEC can also contribute to visitors' growing islands of expertise about Yellowstone, and in their archipelagos of expertise about national parks of the West.

**Some visitors showed a sophisticated understanding of the role of interactivity in their children's learning.** We were surprised by the sophisticated ways in which some visitors talked about interactivity and children. Their understanding of these relationships was often based on their experiences with science museums and other visitor centers, as well as their children's use of interactive media at home and school. During front-end discussions with visitors, the common phrase we heard was "hands-on." Parents, grandparents, and even visitors without children often talked about the importance of having hands-on exhibits for children, and some adults even admitted a personal preference for that sort of exhibit (Gyllenhaal, 2002b). Based on prototype-testing, we advise that it is also important to provide visitors with exhibit experiences that they will recognize as interactive in ways that will further learning by both children and adults.

**The planned OFVEC exhibits seem likely to answer most visitor questions about the Old Faithful Geyser.** Although visitors asked questions about a range of topics during our prototype-testing interviews, it was encouraging that most questions were about topics and issues covered in the OFVEC's planned exhibits. The results of the front-end evaluation argued for a broad coverage of topics at OFVEC, including subthemes on history and culture as well as geoscience and biology (Gyllenhaal, 2002b). The results of prototype testing support the decision to include those topics in the final exhibits.

### **Summary of Recommendations**

The following is a brief summary of the recommendations developed in this section of the report:

- **Finding amenities.** Develop several ways to help visitors to Old Faithful Geyser find the amenities they are looking for.
- **Visitors' use of time.** Respect short-term visitors' decisions about how they use their time, and help them make the most of the time they have.
- **In-depth programs.** Provide in-depth programs—like the Young Scientist Program—for visitors who devote more time to the Park.
- **Interactivity.** Provide exhibit experiences that visitors will recognize are interactive in appropriate ways.



- **Range of topics.** Continue with current plans to cover a diversity of topics with OFVEC exhibits, and supplement the exhibits with brochures and a Web site.



## WHAT WE LEARNED ABOUT THE FORMATIVE EVALUATION PROCESS

Based on our experience evaluating the three prototype exhibits, we have extracted some general lessons that about the process of prototype testing, especially rapid prototyping. We list and describe those lessons in this section of the report.

### Lessons Learned

**It was essential and wonderful that so many stakeholders could take part in the formative evaluation process.** Clients, exhibit developers and designers, and evaluators were able to work together collaboratively before testing began, and to participate in prototype testing—especially rapid prototyping—in the field. This close collaboration seemed to help the project team members develop joint ownership of the exhibits. We hope that this approach can serve as a model for future work on OFVEC and other exhibits in the National Parks. Selinda will try to emulate it in our own work on other projects.

**Formative evaluation seemed most efficient when critical reviews, prototype testing, and rapid prototyping were all part of a continuing process of exhibit development.** When critical reviews resulted in well-developed initial prototypes, on-site prototype testing and rapid prototyping could proceed with small, clearly defined steps that were more about refinement than starting over from scratch. To borrow a metaphor from one of the prototypes, it was like testing out a new recipe—tasting, adding a little more salt here, raising the temperature there.

**The large, open workspace in the Warming Hut facilitated rapid prototyping.** To collaborate effectively during prototype testing, we needed a large space, with lots of table space and space for informal discussion, in which to work. The Warming Hut turned out to be an ideal resource for rapid prototyping.

**Because prototype testing put visitors “on display,” it was best done in a semi-private setting.** There was ample seating near Old Faithful Geyser, radiating out in “layers,” from the long, open benches on the boardwalk to more isolated seating areas back in the trees along the paths from the parking lots. This provided plenty of semi-private spaces within which to conduct the prototype testing. While conducting front-end interviews on the boardwalk was ideal (Gyllenhaal, 2002b), we quickly learned that the boardwalk was not appropriate for prototyping because of the public nature of the location. The seating areas along the paths from the parking lots provided an ideal location that respected visitors’ need to not be “on display,” while also not taking them into a closed building or out of view of accompanying friends or family. These locations also included shade and permanent seating, as well as chairs that could be pulled into a circle for group interviews.



## Summary of Recommendations

The following is a brief summary of the recommendations developed in this section of the report.

- **Stakeholders.** Involve all stakeholders in each phase of the formative evaluation process.
- **Formative evaluation process.** Develop formative evaluation plans that include critical reviews, prototype testing, and rapid prototyping as part of a continuing process of exhibit development.
- **Workspace.** Provide a large, open workspace to facilitate rapid prototyping.
- **Setting.** Prototype testing is best done in a semi-private setting, with both shade and movable seating.



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## ENDNOTES

1. The grant is NSF Informal Science Education Award # 0307709 to the Yellowstone Park Foundation for "Yellowstone Old Faithful Visitor Education Center." Opinions expressed in this report are those of the authors and not necessarily those of the National Science Foundation.



## APPENDIX A: TOPICAL FRAMEWORK

### Topical Framework for the Formative Evaluation for the Old Faithful Visitor Education Center

Selinda Research Associates, Inc.

== 6/30/05 ==

A topical framework is a list of issues or topics we will explore during formative evaluation. It is phrased as a series of questions we will answer by observing and talking with visitors as they use the prototypes. (Note: These are questions we will answer through observations and interviews with visitors, not the questions we will ask our interview respondents.)

**Research Question:** By watching and talking with visitors who engage with prototypes of the three exhibit units, what can we learn that will help us maximize the educational effectiveness of these units for casual visitors to Old Faithful Geysler?

#### Topical Framework:

1. **Visitors' engagement with the prototypes.** These questions will apply in different ways to the three different prototype exhibits.
  - 1.1. **Physical engagements.** In what ways did visitors engage physically with the prototype? How long did they spend interacting with the prototype? What did they do at the unit, specifically (e.g., looking, reading, pointing, touching, and manipulating things)? How did families and other social groups use this prototype? Do visitors have trouble reading any of the text or pronouncing any of the terms? In what ways did these physical engagements contribute to or hinder achieving the goals and objectives of the prototype? [As time permits:] In what ways did the prototype accommodate visitors with specific needs, such as those in wheelchairs, those with physical disabilities, those who do not speak English, those who are very young?
  - 1.2. **Intellectual engagements.** In what ways did visitors engage intellectually with the prototype, including thinking about, processing, and making meaning of their experiences? What things were going through visitors' minds as they engaged with the prototype? What were they thinking about? What mental processes were they using (observing, hypothesizing, appreciating, experimenting, comparing, contemplating, etc.)? In what ways were visitors thinking about and making connections between what they already knew and had experienced? In what ways did visitors make connections between what they saw and did at the prototype and what they had seen in the park? Do visitors have trouble understanding any of the text or terms? How do they interpret any illustrations, symbols, or other representations included with the prototype (e.g., lighting



effects, patterns, and actions at the *Ultimate Graphic*)? In what ways did these intellectual engagements contribute to or hinder achieving the goals and objectives of the prototype?

- 1.3. **Social engagements.** In what ways did visitors engage socially with the prototype? What were all the ways in which visitors engaged with each other within the context of the prototype experience, including verbal exchanges as well as body language? This could include directing attention, asking a question, coming up with an explanation together, reading a label out loud. How did visitors engage with each other? What types of teaching/learning and meaning-making interactions did they participate in? What did they talk about and how did they talk about it? What potentially useful types of social interactions did visitors **not** engage in as they looked at and used the prototype? In what ways did these social engagements contribute to or hinder achieving the goals and objectives of the prototype? [Note: We will also observe and interview visitors who are in the Park on their own.]
- 1.4. **Emotional engagements.** In what ways did visitors engage emotionally with the prototype? (Potential examples include surprise, delight, awe, satisfaction, and feelings of competence, intimidation, and frustration.) What was visitors' primary emotional connection with the exhibit? What other emotions did visitors feel while they are engaged with the exhibit? What kinds of play did visitors engage in? What kinds of emotional experiences did visitors **not** have? Do visitors feel these experiences are appropriate for Yellowstone National Park? In what ways did these emotional engagements contribute to or hinder achieving the goals and objectives of the prototype?
2. **Messages.** What messages did visitors take away from the prototype exhibit? What did they see as the theme and main message of the unit? How did these compare with the intended theme and messages? To what extent did these messages represent alternative understandings that visitors had brought with them to the experience? In what ways might these alternative understandings be modified or replaced? To what extent were visitors' misunderstandings generated by using the prototype exhibits, and in what ways can we alter the prototype to prevent that from happening? Are there ways in which the messages should be modified based on visitor reactions to this exhibit?
3. **Goals and objectives.** To what extent and in what ways does this prototype seem likely to achieve its stated goals and objectives? In what ways will it support visitors' understanding of the Big Idea for the zone in which the exhibit is located? Is it likely to be effective for some groups, but not for others? Are there ways in which the goals or objectives should be modified based on visitor reactions to this exhibit?
4. **Revisions.** In what ways could the prototype be modified to increase its effectiveness? To what extent could these modifications be made during rapid prototyping, and what were the results when these changes were made and tested with visitors? What revisions will only be possible with the final version of the exhibit, and what are their intended results?



5. **Learning more about visitors to Yellowstone.** What have we learned about visitors to Yellowstone National Park through prototype testing, and how can that knowledge be applied to other exhibits being developed for OFVEC? Based on our findings, what can we recommend for other exhibits on the same or similar topics? What can we recommend for exhibits in other parts of the Center? Based on our findings, what recommendations would apply to Yellowstone interpretation beyond the OFVEC, like other educational programs, brochures, or the Web site?



## APPENDIX B: DATA COLLECTION PROTOCOL

### Yellowstone: Old Faithful Visitor Education Center Formative Evaluation Visitor Observation/Interview Protocol

Final Revision 7/12/05

OMB Approval #1024-0224 (NPS #05-054)

Expiration Date: 01/31/2006

#### Introductory Outline

##### *Selecting/recruiting respondents:*

- working with Yellowstone
- developing exhibit for new visitor center
- describe prototyping process in general
- testing prototypes with some visitors
- willing to give us your opinion by looking at an exhibit and answering questions?
  - it'll take about 15 minutes
  - completely voluntary – you don't have to participate
  - completely anonymous and confidential – we won't ask for your name
  - approved by the National Park Service and the Office of Management and Budget. I have information on that approval if you would like [*handout is final sheet of this document*]
  - it won't hurt
- would you be willing to participate?  
*If "No," Thank you. Enjoy your visit to Yellowstone*

##### **If "Yes" continue:**

##### **Pre-Prototype Testing/Observation Review**

- process for this session
  - look at prototype exhibit and go through it
  - take as long as you want
  - then we'll ask you some questions
  - we're trying to find out if exhibit works as we want it to
  - not a test of you; we're testing the exhibit
  - we didn't make the prototype – whatever you say about it, you can't hurt our feelings
  - we're particularly interested in.....
  - take as long as you want; go back and forth or straight through; we're less interested in mechanics right now
  - if you have questions, be sure to ask them. We might hold off on answering them until after you've gone through, but we will answer them.

##### **Post-Prototype Testing / Pre-Interview Review**

We'll ask you some questions:

- no right or wrong answers
- testing exhibit not you
- stop at any time
- [chit chat to get visitors relaxed]



Date:		Time:			Interviewer:	
Name of exhibit:						

<i>respondent #</i>	<i>time</i>	<i>composition</i>	<i>PI</i>	<i>SI</i>	<i>II</i>	<i>EI</i>
05071__ -						

Why did we select this group?

*Record notes about visitor engagement with the prototype:*

Physical:

Social:

Intellectual:

Emotional:



<b>Date:</b>	<b>Time:</b>	<b>Interviewer:</b>			
<b>Name of exhibit:</b>					

respondent #	time	composition	PI	SI	II	EI
05071__ -						

*Rating scale 0 to 6 [rate the group]*

1. Did you see Old Faithful go off today?                    Y                    N  
 Have you ever visited Yellowstone before?            Y                    N  
 What about Old Faithful?                                    Y                    N  
  
 Who else is here with you today?  
 What ages are the children who are with you today?  
 May I ask where you're from?
  
2. I noticed that you were \_\_\_\_\_.  
 Can you tell me more about what you were doing and thinking?
  
3. When you finished using this exhibit, what things were going through your mind?  
  
 What unanswered questions did you have?
  
4. What is something new that you think your child found out at this exhibit that they didn't know before?  
  
 What did you find out?  
  
 [If appropriate] How would you explain this to somebody else?
  
5. Do you have any special interest or expertise in this area?
  
6. Rate this exhibit from 1-10 (1 is the worst and 10 is the best) compared to other exhibits you've seen in visitor centers. Why did you give it this rating?

7. That's all the questions I have. Do you have any questions for me?

Thank you very much for your time. Here's a small token of our appreciation. Please come back when the visitor center opens in summer 2008.

*Handout for visitors who ask for more information about the study:*

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**Old Faithful Visitor Education Center Evaluation Study, Yellowstone National Park**

Expedited OMB Approval #1024-0224 (NPS #05-054)

July 11-14, 2005

**This additional information is provided to visitors upon request.**

OMB Approval #1024-0224 (NPS #05-054)

Expiration Date: 01/31/2006

Persons Collecting and Analyzing Information: Dr. Deborah L. Perry and Dr. Eric D. Gyllenhaal, Selinda Research Associates, Inc., 801 South Plymouth Court, Suite 521, Chicago, IL, 60605. (312) 986-1134.  
DLPerry@SelindaResearch.com.

**16 U.S.C. 1a-7 authorizes collection of this information. This information will be used by park managers to better serve the public. Response to this request is voluntary. No action may be taken against you for refusing to supply the information requested. No personal data will be recorded. You may direct comments on the number of minutes required to respond, or on any other aspect of this survey to:**

Information Collection Clearance Officer,  
WASO Administrative Program Center  
National Park Service  
1849 C Street, NW  
Washington, D.C. 20240



Selinda Research Associates, Inc., Chicago, Illinois, USA

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## APPENDIX C: RESPONDENT DATA TABLE

Date	#	DC	Exhibit	Total	AF	AM	CF (age)	CM (age)	Group Type	Loc.
050711-	51	EDG/DLP	Ultimate Graphic	3		1	8	5	Fam/Ch	Mississippi
050711-	52	EDG/DLP	Ultimate Graphic	2	1			12	Fam/Ch	(unknown)
050711-	53	EDG/DLP	Ultimate Graphic	2	1	1			Adult	Montana/Michigan
050712-	51	EDG	Ultimate Graphic	1	1				T/Alone	(unknown)
050712-	52	EDG	Ultimate Graphic	5	1	1	11	13, 9	Fam/Ch	Canada
050712-	01	DLP	Ultimate Graphic	4	1	1		15, 12	Fam/Ch	New York
050712-	02	DLP	Life-a-Palooza	4	1	1	9	15	Fam/Ch	California
050712-	03	DLP	Life-a-Palooza	4	1	1	6, 5		Fam/Ch	North Dakota?
050712-	04	DLP	Cookbook	1	1				Alone	(unknown)
050713-	51	EDG	Life-a-Palooza	4	1	1	10	12	Fam/Ch	Canada
050713-	01	DLP	Ultimate Graphic	3	1	1	8		Fam/Ch	Minnesota
050713-	02	DLP	Life-a-Palooza	2	1	1			Adult	Maryland
050713-	03	DLP	Life-a-Palooza	2			6	7	Fam/Ch	(unknown)
050713-	04	DLP	Life-a-Palooza	4	1	1	11	14	Fam/Ch	Florida
050713-	05	DLP	Cookbook	2	1			7	Fam/Ch	Oklahoma
050714-	01	DLP	Cookbook	1	1				Alone	Oregon
050714-	51	EDG	Cookbook	4	1	1	13	10	Fam/Ch	Canada
050714-	52	EDG	Cookbook	4	1	1	11	5	Fam/Ch	Arizona
<b>Totals</b>		<b>18 groups</b>		<b>52</b>	<b>16</b>	<b>12</b>	<b>11</b>	<b>13</b>		

### Other summary statistics:

#### Number of interviews by exhibit

Ultimate Graphic	7
Life-a-Palooza	6
Recipe	5

#### Number of interviews by group type

Fam/Ch	13
Adult	2 (both adult groups actually had children with them but not participating in the interview)
Alone	3 (all but one of the "alones" had children with them but not participating in the interview)

### Key

Date = MM/DD

# = Interview number

DC = Data collector (EDG = Eric D. Gyllenhaal, DLP = Deborah L. Perry)

Total = Total number of respondents talked with and/or observed

AF = Record number of female adults in group

AM = Number of male adults in group



CF = Ages of female children in group  
CM = Ages of male children in group  
Group type (examples)  
Fam = Family (with younger children)  
Ad = Adult (includes adult children),  
T = Tour  
A = Alone



## **APPENDIX D: OFFICE OF MANAGEMENT AND BUDGET APPROVAL**

This evaluation project was approved OMB Approval #1024-0224 (NPS #05-054) for formative evaluation work Old Faithful Visitor Education Center in Yellowstone National Park. A copy of the completed approval form follows.





## Expedited Approval for NPS-Sponsored Public Surveys

1. Project Title | Old Faithful Visitor Education Center at Yellowstone  
Submission Date: | National Park Formative Evaluation | 6/3/05

2. Abstract: This study is a formative evaluation of three prototype geology exhibits that will be part of the Old Faithful Visitor Education Center at Yellowstone National Park. It will be comprised of observations of and interviews with the general public (not school groups) as they interact with prototypes of the exhibit units. The study is being conducted in order to determine the educational effectiveness of the three exhibit units, and determine recommendations for revisions and on-going development of the exhibits.

(not to exceed 150 words)

### 3. Principal Investigator Contact Information

First Name: Deborah Last Name: Perry

Title: Director

Affiliation: Selinda Research Associates, Inc.

Street Address: 801 South Plymouth Court, Suite 521

City: Chicago State: IL Zip code: 60605

Phone: (312) 986-1134 Fax: (312) 986-1213

Email: DLPerry@SelindaResearch.com

### 4. Park or Program Liaison Contact Information

First Name: Diane Last Name: Chalfant

Title: Chief

Park: Yellowstone National Park

Park Office/Division: Division of Interpretation

Street Address: P.O. Box 168

City: Yellowstone National Park State: WY Zip code: 82190

Phone: (307) 344-2250 Fax:

Email: Diane\_Chalfant@nps.gov

## Project Information

5. Park(s) Where Research is to be Conducted:
6. Survey Dates:  (mm/dd/yyyy) to  (mm/dd/yyyy)
7. Type of Information Collection Instrument (Check ALL that Apply)
- Mail-Back Questionnaire       On-Site Questionnaire       Face-to-Face Interview       Telephone Survey       Focus Groups
- Other (explain)
8. Survey Justification: (Use as much space as needed; if necessary include additional explanation on a separate page.)
- The National Park Service needs this information to inform ongoing development of the Old Faithful Visitor Education Center exhibits and will use information from this survey to determine which parts of the exhibits are effective and which need further refinement. The findings will also help the exhibit development team (NPS, Selinda Associates) to reach a better understanding of how visitors think about and understand the geo-hydrothermal features of Yellowstone. Formative evaluation is a required component of this NSF-funded project.
9. Survey Methodology: (Use as much space as needed; if necessary include additional explanation on a separate page.)
- (a) Respondent universe:  
The respondent universe will be all general visitors to the Old Faithful Geyser during the study period.
- (b) Sampling plan/procedures:  
The sampling plan/ procedure will utilize the technique of “maximum variation purposive sampling” which involves a brief introductory script to become acquainted with the visitor, then tailored questions that best achieve the goals of the interview for each visitor. During the study period we will contact 50 visitors, selected to encompass a wide range of visitor types. All interviews will be conducted at Old Faithful. Weather permitting, respondents will be interviewed on the boardwalk as they wait for the next eruption. A researcher will approach a potential respondent and invite them to participate in the study following the procedures outlined below. During times of inclement weather, interviews will be conducted in the existing Visitor Center or other sheltered location where visitors are waiting.
- (c) Instrument administration:  
Three exhibit prototypes will be tested during this research study:  
*Create A Hydrothermal Feature*, a computer interactive where visitors select varying amounts of water and temperature to create a hydrothermal feature.  
*The Ultimate Graphic*, a large interactive graphic that demonstrates how the water under Old Faithful Geyser becomes heated underground, and then explodes to the surface.  
*The Microbial Life Young Scientist Station*, a large display showcasing the microbial life that is found in many of Yellowstone’s hydrothermal

features.

Data gathered for this study will be used for two purposes. First, it will help the exhibit development team develop a clearer understanding of how visitors to Old Faithful Geyser understand the hydrothermal features of Yellowstone National Park, in their own words. It will not test visitors' knowledge of these features as scientists understand it, but rather will help the team develop an appreciation for how visitors think about it. The second purpose of the study is to provide solid, concrete information about which aspects of the exhibits are likely to be confusing to visitors, and which aspects further the goal of facilitating their understanding.

The study will be conducted using a naturalistic inquiry methodology (Lincoln & Guba, 1984). Respondents will be purposively selected (Miles & Huberman, 1992) and, after a brief introductory explanation of the study, will be given the option to participate. After deciding to participate in the study, respondents will be asked questions in order to get a conversation started and to help place the respondent within the constellation of Old Faithful visitors (rather than to collect demographic data as such). The exact wording and order of questions will vary based on how the conversation proceeds. Not all questions will be asked of all respondents. The choice of which questions to ask will depend on what information is given in the course of the observation/interview.

#### OPENING QUESTIONS:

*Example of contact script: We're working with Yellowstone National Park to help them develop some exhibits about geysers and hot springs for their new visitor center. This is a prototype of one of the exhibits that might go into the center. We are doing a study and would appreciate your input. This study has been approved by the National Park Service and the Office of Management and Budget. I have information on that approval if you would like.\* Responses are voluntary and anonymous. It would take about 20 minutes to participate in the study. Would you be willing to participate?*

If "NO" *Thank you. Enjoy your visit to Yellowstone National Park.*

If "YES"

Once the visitor agrees to be interviewed, we explain that we will be taking notes on paper. It will be explained that all conversations are confidential and we won't be asking any identifying information.

(Hand out Additional Information if requested)

**\*Additional Information Provided upon Request.**

OMB Approval number: (Not yet assigned)  
Expiration Date: (Not yet assigned)  
Person Collecting and Analyzing Information: Deborah Perry and Eric Gyllenhaal, Selinda Research Associates, Inc., 801 South Plymouth Court, Suite 521, Chicago, IL 60605, (312) 986-1134, DLPerry@SelindaResearch.com.

16 U.S.C. 1a-7 authorizes collection of this information. This information will be used by park managers to better serve the public. Response to this request is voluntary. No action may be taken against you for refusing to supply the information requested. No personal data will be recorded. .

You may direct comments on the number of minutes required to respond, or on any other aspect of this survey to:

Information Collection Clearance Officer,  
WASO Administrative Program Center  
National Park Service  
1849 C Street, NW  
Washington, D.C. 20240

## **Questions**

### *Questions 1-5: Topic Area 1—Individual Characteristics*

1. Where you are from? (city/state/country, etc.)
2. What type of group are you with (family, friends, tour group, with or without younger children; ages of children, etc.)?
3. What is your age?

### *Questions 6-10: Topic Area 2—Trip/Visit Characteristics*

[A log form for recording this information is included at the end of this document.]

4. How long have you been in Yellowstone National Park on this trip?
5. Is this your first visit to the Park?
6. Is this your first visit to Old Faithful?
7. Is Old Faithful your primary destination on this trip?
8. How are you getting around within the Park on this trip?

We will only ask these questions as needed (because many visitors will provide answers to them without our asking as the conversation proceeds). The interviewer will also ask and make notes about the

extent and nature of respondents' familiarity with the topics covered, but will not ask standardized questions about these topics.

#### PRIMARY INTERVIEW QUESTIONS:

Because it will be important to uncover the ways visitors think about hydrothermal features in their own words, we will begin interviews with an open-ended approach.

During the observations we will pay special attention to four types of interactions at the exhibit (Perry, 1993). We will be noting visitor *physical interactions*, recording how visitors use the exhibit, what behaviors they engage in, and how long they spend. We will be noting visitor *intellectual interactions*, those behaviors that are indicative of intellectual and cognitive involvement such as being thoughtful, pointing to something, and reading the brochure. We will be noting visitor *social interactions*, the ways respondents talk with each other and interact as a group. And finally, we will be reporting on visitor *emotional interactions*, including indications of awe, inspiration, enjoyment, and satisfaction. These four components of meaningful visitor experiences are not, and are not meant to be, mutually exclusive. They have however, been found to be a useful way to analyze visitor engagement with informal science interpretive devices.

Whenever possible, all observations will be followed by an interview which will further illuminate the ways visitors were engaging with the prototype exhibits. These interview questions will enable the researchers to identify the ways in which and the extent to which the prototypes are a) enhancing visitor understandings of hydrothermal features, b) inhibiting the development of visitor understandings, or c) having no effect.

The exact questions that are asked will emerge from 1) the observation, and 2) the conversation with the respondents as it evolves.

A typical interview might start off: "Can you tell me what you were thinking about as you were using the exhibit unit?" If the respondent mentions something about how hydrothermal features work or about the microorganisms, we will follow up with another probing question—using the respondent's words—designed to illuminate in more detail how they understand these concepts. If the respondent talks about something that has nothing to do with hydrothermal features or microorganisms, we will respond in a way to guide the conversation towards these concepts, being careful not to introduce new words or concepts of our own, but to provide opportunities for them to share with us their understandings of the exhibit content.

Throughout the conversation we will use additional questioning probes, being careful to ensure the visitor does not feel they are being tested. We have found that most interviews have a natural ebb and flow, and it becomes obvious when we have developed a clear understanding of their perspective. At this point we will close out the interview and thank them for their time. In addition, we are always sensitive to visitor timeframes and agendas and will end the interview immediately if there are indications that the respondent wishes to move on, whenever that occurs. In addition, as it gets close to the 20 minutes we mentioned at the beginning of the interview, we check in with the visitor and give them the option of terminating the conversation or continuing.

**CLOSING QUESTION:**

Do you have any questions you would like to ask us today?

**(d) Expected response rate/confidence levels:**

We will contact about 50 visitors and anticipate 90% or 45 individuals to respond. In other similar studies we have experienced a response rate of approximately 90%. In a qualitative study of this nature confidence levels are not applicable.

**(e) Strategies for dealing with potential non-response bias:**

This is a qualitative study and non-response bias is not an issue

**(f) Description of any pre-testing and peer review of the methods and/or instrument (recommended):**

We have used the conversational probes described above in many different studies and in many different settings including a recent study at the Grand Canyon, OMB Approval #1024-0224 (NPS #04-058) . These probes have been developed over twenty years of conducting visitor studies in similar settings.

10.	Total Number of Initial Contacts   Expected Respondents:	50	45	ii.	Estimated Time to Complete Initial Contact   Instrument (mins.):	1	20	12.	Total Burden Hours:	16
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13.	Reporting Plan:	<p>A final evaluation report will be submitted at the end of the project to NPS, Yellowstone National Park Interpretation Division, and a copy of the final report will be archived with NPS Social Science Office for inclusion in the Social Science Studies Collection. We are committed to wide distribution of the results of all our evaluation studies and work with our clients to ensure the findings are available to the field of informal science whenever possible.</p>
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