

## Evaluation Brief EB7

April 25, 2007

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### Off-Site Testing of the Prototype 10-Meter Markers: Large Numbers and Time Transitions

An earlier evaluation brief looked at existing studies on how best to represent large amounts of time in exhibitions: as numbers with lots of zeros, as thousands-of-millions of years, or as billions of years (Selinda Research Associates, 2006). The brief recommended that the project “conduct additional off-site testing to further determine which treatment (a) is least confusing to the public, and (b) best conveys the sense of increasing time” (p. 2). Based on the available literature, this brief also recommended that *Trail of Time* interpretation “spell out the words *million* and *billion* rather than writing them as numbers” and “use (for example) *3.5 billion* rather than *3,500 million*.” (p. 2). The purpose of this round of off-site testing was to carry out the recommended tests by comparing two approaches to expressing these really large numbers: Should the *Trail of Time* express numbers larger than 990 million as decimal *fractions-of-billions*, or as *thousands-of-millions* of years?

#### **Methods:**

This test was conducted off-site in the Chicago area. Two methods were used: (a) critical review and (b) user testing with purposively selected respondents. A total of 2.6 direct contact hours were spent with ten respondents in eight interviews between April 3, 2007 and April 15, 2007. Respondents varied in (a) age (4<sup>th</sup> grade through mature adult); (b) previous experience with the Grand Canyon (no experience to several previous visits); and (c) knowledge of geology (complete novice to amateur paleontologist).

The critical review consisted of two evaluators independently reviewing the materials for the incorporation of principles of instructional design and informal learning. The user-testing protocol included showing respondents a series of full-sized color prototype 10-meter markers (see below) in chronological order and asking them a series of open-ended questions. In some cases the markers were shown to respondents while sitting together at a table; in other cases the trail was laid out almost-to-scale on the ground. And in some cases the two alternative sequences (*thousands-of-millions*, and *fractions-of-billions*) were laid out side-by-side. Both ascending and descending chronological order were tested.

Outlined below are some of the key findings. In trying to keep this report necessarily brief, we combine both results and conclusions. When we mention *respondents* we are referring to the actual data from the people with whom we talked. When we use the term *visitors* we are interpreting findings from the critical review and user-testing and making predictions about what will or won't work for visitors at the rim. These conclusions of course will need to be tested during the May 2007 on-site evaluation.

#### **Key Findings:**

1. Each approach will likely be equally effective at communicating to visitors that the *Trail of Time* is a geology timeline that moves forward and backwards in time. Regardless of whether *thousands-of-millions* or *fractions-of-billions* were used, and regardless of whether the numbers were increasing or decreasing, all respondents were able to quickly grasp that this was a timeline, and that time was moving forwards or backwards depending on which way they moved. Although the markers still need to be tested at the rim, data so far indicates that (a) most visitors to the timeline will readily grasp that this is a geologic timeline; and (b) traveling the trail in either direction won't pose any conceptual difficulty.
2. Data indicates that the *fractions-of-billions* approach will be more familiar to most visitors and thus more comfortable, even with the decimal fractions. The *thousands-of-millions* approach was less familiar to many respondents and even confusing to some. As one respondent said, “A thousand-million years is not a real number.”
3. In contrast to most visitors, there will likely be some visitors for whom *thousands-of-millions* will feel more comfortable. Respondents who had engineering, math, and/or accounting backgrounds indicated a slight preference for the *thousands-of-millions* because it is more precise, and the transition from 990 million to 1,000 million more logical, although interestingly often their first impression was a preference for *fractions-of-billions*. It was only after thinking about it that they explained that *thousands-of-millions* made more sense.
4. There were also indications that for most visitors to the rim, the number *one billion* will be perceived as a larger number than *one-thousand-million*. As one respondent said, “One billion feels like a metaphor. A billion, a gazillion.

It's about a *way out there* number.” Only one of our respondents felt that one-thousand-million felt like a bigger number, because “people see all the zeros.”

5. Data also indicated that most visitors will be able to readily figure out that the meter markers are one million years apart, especially when entering the trail at the smaller numbers (less than 1 billion) or when entering in the *thousands-of-millions*. However, when entering the trail where *fractions-of-billions* are used, there were indications that many visitors will likely have trouble converting from the *fractions-of-billions* to the million-sized steps along the *Trail* (and vice versa). When respondents in this study started with the *fractions-of-billions* 10-meter markers, they frequently had difficulty trying to estimate how many years were between the meter-markers.
6. Saying out loud the number represented by *fractions-of-billions* will likely be slightly easier for respondents than *thousands-of-millions*, although both will present challenges. Even extremely knowledgeable respondents, some having taken numerous college courses in geology or mathematics, had difficulty saying both the number 1,010 million, and the number 1.01 billion. 1,010 million represented a slightly greater challenge because the idea of *thousands-of-millions* was less familiar to them. After stumbling over the 1,010 marker and trying numerous attempts at pronouncing it—“one million ten thousand; one thousand ten”—one respondent (a university humanities professor) became very frustrated: “Something’s wrong but I can’t figure it out. I’m not sure how to **say** it.”
7. In its interpretation and publications Grand Canyon National Park is currently inconsistent in when it uses *thousands-of-millions* and *fractions-of-billions*. However, the brand new Grand Canyon Yavapai Geology Museum uses *thousands-of-millions*, and there are indications that the Park is moving towards the overall general use of *thousands-of-millions* rather than *fractions-of-billions* (J. Hellmich-Bryan, personal communication, April 16 & 17, 2007).

### **Recommendations:**

1. Install markers for the May on-site user-testing that use *fractions-of-billions* rather than *thousands-of-millions*. These markers should be installed in two locations: (a) at the Verkamps end of the *Trail*, which begins with the oldest rocks; and (b) in both directions at the 1 billion/1,000-million transition point. However, also have available comparable laminated cardboard mockups of the *thousands-of-millions* markers for use during the evaluation so this can be tested further in context. Delay the final decision on which treatment to use until the beginning of June.
2. Regardless of which approach is used in the temporary signage and the 2007 walking guide, include easy-to-locate references to the fact that 1,000 million years = 1 billion years. If *thousands-of-millions* is used as the primary treatment, include *fractions-of-billions* in parentheses, e.g. 1,800 million years (1.8 billion years).
3. Regardless of which expression of large numbers is finally chosen, the project’s interpretative plan should include a multi-pronged approach to helping visitors understand and talk about large numbers of years as they walk the *Trail of Time*. This should include information in the walking guide, portal exhibits, and a wayside exhibit installed at the 1,000 million/1 billion 10-meter marker.

### **References**

- Gyllenhaal, E. D., & Perry, D. L. (2004). *Phase one of formative evaluation for the Trail of Time at Grand Canyon National Park*. Unpublished manuscript, University of New Mexico, Albuquerque, NM.  
<http://www.selindaresearch.com/TrailOfTimeFormativeFINAL.pdf>
- Selinda Research Associates, Inc. (2006). *Evaluation Brief #1: How should large numbers of years be expressed?*. Unpublished manuscript, University of New Mexico, Albuquerque, NM.

### **The two different versions of the 10-meter markers**

