

Evaluation Brief EB21
Selinda Research Associates, Inc.
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== DRAFT ==

**Spring 2009 Off-Site Test
of MYT & DTT Wayside Panels**

These waysides were tested during this round of off-site evaluation:

20ya	It's about time
10,000ya	People have lived here for 10,000 years
20,000ya	20,000 years ago it was wetter and cooler here
200,000ya	Eruptions and earthquakes could happen here again
0 TODAY	The entire MYT is squeezed into the first meter of the DTT
6Ma	The Grand Canyon is 6 million years old
70Ma	Without uplift there would be no Grand Canyon
270Ma	The top layer is 270 million years old
590Ma	Animal life appeared 600-500 million years ago
1,010Ma	1.2 billion years is missing from the rock record
1,160Ma	The tilted layers are the Grand Canyon Supergroup
1,720Ma	Vishnu basement rocks are near the canyon's bottom
1,840Ma	Elves Chasm Gneiss is the canyon's oldest known rock

Two methods were used to test each of the 13 wayside panels above; (a) critical review; and (b) observation/interview with respondents. The results/recommendations below are a compilation based on all data gathered.

In the interest of time and efficiency, the following brief focuses on making recommendations rather than individual findings from the off-site testing. When possible, we have included direct quotes from respondents as examples of the type of things that were problematic.

Overall the responses to the waysides were positive. The purpose of the recommendations is to suggest things that need to be taken care of before we get on-site in May. These are not necessarily recommendations for final product, but rather what will make for a good mock up on which to conduct rapid prototyping. We tried to limit our recommendations to only those things that we were confident will be problems for visitors, not all the things we thought would make for a better wayside.

Because of the size of the photographs for each wayside, I am not including them in this document. They are in a number of files, which I will send under separate cover.

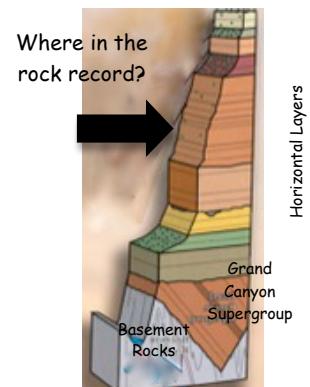
General issues to be considered for all signs

1. **You Are Here:** There was no clear consensus on the *You Are Here* locators. We recommend that this be tested in situ. For on-site testing we recommend having each prototype wayside's WIS include the single large medallion marking the location of the wayside, and nothing else. In addition however, print and bring plenty of cutouts of people, arrows, and the words "You are here" that we can paste and test in various locations.
2. **WIS Rock Column:** Some good news is that there are (finally) indications that a rock column as part of the WIS will help visitors. Respondents really liked seeing the colored rock-column graphic images on 270Ma (layers), 590Ma (Cambrian), and 1,720 (basement). They especially appreciated seeing how—as you progressed from wayside to wayside—you went further into the canyon. "It's also very fun to visually see on the graphic, the age of the rock getting older as it goes down." Interestingly, they did not get this message from the "Where in the rock record?" icon and they continued to be confused by the image.

Our recommendation for on-site testing is to replace the current icon graphic with a shrunk version of the colored graphic, flipped, and with the three groupings labeled. The Colorado River does not need to be labeled in the WIS. See example below.

In addition, bring multiple different to-scale versions of (a) a photograph of the portal icon; (b) an abstract drawing of the portal icon (similar to what we have on the current prototypes); (c) the 270 rock column; and (d) any other versions we want to test.

Keep the question: Where in the rock record? There was some indication that repeated use of the phrase "rock record" on the waysides will help to drive home the idea that rocks encode geologic time and stories.



3. **Waysides that have the WIS rock column:** We recommend that the WIS rock column be included in the WIS for the following signs: 270Ma, 590Ma, 1,010Ma, 1,160Ma, 1,720Ma, and 1,840Ma. We also recommend that it be omitted from the 0Today, 6Ma, and 70Ma waysides (as it already is on the 0Today) as it proved confusing to respondents.

4. **WIS distances:** Make sure both WIS's have the distances between markers "to scale." Add the trail to Headquarters on both.
5. **Date ranges:** "Backwards" dates, for example 600-500 years ago, were counter-intuitive, tended to confuse most respondents, and took up mental energy, distracting them from the main message.

In addition, respondents were confused by what was meant by the date ranges. Were they referencing a point in time or a range? In some cases it's one, and in others it's the other. This needs to be clarified in each instance. In the recommendations below we tried to suggest ways around this.

6. **The use of the:** Sometimes "the" is used in front of Grand Canyon and sometimes it's not. "Most people are used to speaking about The Grand Canyon. It feels like there's a typo when 'the' is missing." And another respondent: "I think people are used to reading 'the' Grand Canyon. It makes me feel like there's a typo when 'the' is omitted." Most important is to always be consistent. Decide which it will be. Our recommendation is to always include "the" as this will be less jarring to visitors.
7. **Photographs:** Because this is our final opportunity to test the waysides, we need to have all of the actual photographs that will be used, especially the views from the waysides, and close ups of fossils visitors will search for.
8. **Size of text:** All text needs to be large enough to be seen by all visitors and to comply with ADA requirements. Some of the text is pretty tiny. We recommend defining standards for this project and making sure all text adheres.
9. **Periods in headings:** Because each heading is a main message, include a period at the end of each heading.
10. **Proof reading:** Have an editor proof-read all signs before final printing for on-site testing. We don't want to waste limited time by having visitors stumble over typos and inconsistencies.
11. **Big vs. Long:** Use one BIG step rather than one LONG step on all signs and portals.
12. **Pronunciation guides:** Many respondents continued to stumble over the pronunciation of many words. For example, they often read KIE-bab as KEE-bab. We are inventorying all difficult-to-pronounce words and recommend doing a brief focused off-site test of all the pronunciation guides during the month of April.

20ya – It's about time.

Recommendations:

1. Heading:
 - a. We recommend changing the heading to “Walk a million years!” Respondents didn’t find the current heading compelling or informative. “Walk a million years” makes the paragraph directly under the heading more meaningful. In addition, there is currently no place on the sign that says the visitor will be walking a million years so the paragraph about “stretching out time at the beginning” was confusing.
 - b. Change “geologic time *scales*” to “geologic time *frames*.” Respondents stumbled over the word *scales* and indicated *frames* was more familiar and easily understood.
2. Talk about time...:
 - a. “Ancient peoples farmed the *river* bottom...” s/b “Ancient peoples farmed the *canyon* bottom...” ?
 - b. There was concern that this section was too wordy. We recommend leaving it basically as it is except moving the paragraph “We stretch out time at the beginning...” to below the text “Million Year Trail” in the MYT WIS. This (a) makes the middle section less wordy; (b) incorporates the explanatory text on all MYT waysides so visitors will see it closer to where the scale changes actually occur; and (d) reinforces the idea that the MYT is different than the DTT.
3. Imagine the number one million:
 - a. Change the drawing of the quarters to look more like a stack of quarters. “The funneling shape going down to just a line makes it difficult to imagine a stack of quarters.” Also, the top of stack of quarters looks like it’s floating way up in the air in relation to the south rim (bottom left hand corner of picture), although it lines up with the north rim in the top right corner of the picture.

10,000ya – People have lived here for 10,000 years.

Recommendations:

1. Heading:
 - a. Change the heading to “People arrived here 10,000 years ago...” and begin the next paragraph with “...and still live here today. At least 12 different....”
 - b. One respondent pointed out that “the word ‘tribe’ needs some human modifier as tribe can also refer to groups of plants and animals.” They suggested inserting “Native American” before the word “tribes”. Another suggestion was that “nation” might be a more appropriate word than “tribe.” We recommend discussing this as a team and with the National Park Service to come to consensus on the best treatment.
2. All four photos with text:
 - a. Add an action verb above (and at an angle to?) each medallion that says “Find.”
 - b. Label each photo with a brief sentence (main message) as the middle two are.
3. John Wesley Powell
 - a. Suggested heading: John Wesley Powell conducted important early scientific research in the Grand Canyon.
 - b. The paragraph of text makes his explorations sound rather ethereal. Suggest the following rewording: “...first *boated* through the Grand Canyon in 1869.”
4. WIS:
 - a. Correct the “You are here” medallion. It should be 10,000 not 1,000.
5. Granaries:
 - a. This photograph and text elicited a lot of interest, and just about everyone thought this was pretty cool. But when they read “These granaries” they invariably asked, “What granaries?” Additionally, one respondent pointed out that identifying Ancestral Puebloans as “early Americans” is probably inappropriate. Our recommendation is to leave off the reference to “early Americans”. One possible rewrite to address both issues: “They stored their corn in granaries like these in the walls of the canyon.” There were however additional concerns with reference
6. Hunters:
 - a. “10,000 year old hunters” was confusing for respondents. We recommend revising slightly, for example: “Nomadic peoples hunted large mammals ” followed by “These large mammals, like the ancient sloth, are now extinct.” This of course assumes the drawing is of a sloth. Or maybe the message here is that both people and large mammals used to live here. Suggested heading and text: “Nomadic peoples arrived in Grand Canyon.” “They hunted many large mammals such as the ancient sloth that used to live in the Canyon.”

20,000ya – 20,000 years ago it was wetter and cooler here.

Recommendations:

1. Heading:
 - a. Title was okay.
 - b. The current sub-heading was confusing to respondents. Replace the sub-heading with something like: “Planet Earth goes through cyclic climate changes. They are still taking place today, around the globe and also here at the Grand Canyon.”
2. Left hand diagram and text:
 - a. Revise the heading slightly: “Imagine how *past* global climate cycles affected the Grand Canyon.”
 - b. Remove the paragraph of text under the heading.
 - c. Replace the TODAY medallion with just the word TODAY.
 - d. Remove the paragraphs: “Today’s interglacial time...” and “The last glacial time...” These were not necessary for respondents to understand the graph.
 - e. Add a simple label “20,000 years ago” onto the graph.
3. Right hand diagram and text:
 - a. In the text under the heading: The word “banding” created confusion. Replace “banding records” with “bands record.”
 - b. “...at seasonal to 10,000 year time scales” was confusing. Suggest removing it, ending the sentence with “biological activity.” Alternatively, add a separate sentence that says something like: “A single band can record an event that was as short as a single season, or as long as 10,000 years.”
 - c. Respondents were repeatedly frustrated because they wanted to know how to “read” the bands. “The text doesn’t tell me what the light vs. dark bands mean.” If this is not something that can easily be explained, e.g. “the dark bands indicate decades of drought” then some other explanation needs to be given. For example: “Different colored bands can mean different things depending on which climate cycle the planet was in” or “Dark bands can indicate particularly dry times or times when lots of animals died.”

200,000ya – Eruptions and earthquakes could happen here again.

Recommendations:

1. Heading:

- a. While the heading for this sign was compelling and interesting to respondents, it tended to focus people on the present rather than thinking about 200,000 years ago. In fact, this sign overall seems to be confused about what/when it's talking about. If it is to be located at 200,000ya (or 100,000ya?) it should at least be starting with information about that time. What was happening at the Grand Canyon 100,000ya? That's where this sign should start. We recommend replacing the sub-heading with something like: 100,000 years ago volcanoes became active in this region again. Even today volcanoes, earthquakes, and erosion work together to shape this spectacular landscape.
- b. During a recent conversation it appeared that one of the intents of this sign was to set the stage for the 70My uplift & erosion panel. Should on this sign refer to the pushing and pulling of the Earth's crust?
- c. See also comments on "0 Today" wayside.

2. Lava dams:

- a. This section raised more questions than it answered:
 - i. When did the volcanoes erupt in the Grand Canyon?
 - ii. Why was the dam only temporary?
 - iii. How long did the dam last?
 - iv. Is there a volcanic dam in the picture and if so where is it? "I just can't tell what the picture is showing me."

Our recommendation is to remove this section from the sign, unless visitors can see a lava dam from where they are standing.

3. Timeline of volcanism:

- a. Make correction: "1-100 *million*" s/b "1-100 *thousand*."
- b. Clarify whether this is a timeline of volcanism *at the Grand Canyon*?
- c. The "1-100 thousand years ago" is confusing. Does this mean 1,000 through 100,000 years ago? Or is it really today through 100,000 years ago, in which case the "1" should be replaced by "Today."

4. Find the location of recent GC earthquakes:

- a. Respondents found the information in this graphic/text interesting but found the diagram difficult to read and understand. The location of the Grand Canyon itself was confusing. This was partly because of the relatively complex and busy diagram, but also because of the text explaining that "Lava poured into the Canyon here". This text is pointing to a spot far away from You Are Here and the canyon. The Bright Angel Fault is labeled but most visitors won't know what or where that is so it won't serve as an orienting device. We recommend simplifying the graphic to show just the outline of the Grand Canyon as visitors are familiar with it and with the canyon labeled. Keep the "You Are Here." This was an important orienting device.
- b. The key in the bottom left hand corner of the graphic is important, but wasn't noticed by most respondents. For example, after studying this graphic/text for a

long time, one respondent asked “How ‘recent’ are the earthquakes depicted by the red marks?” We recommend removing the text immediately below the heading for this section (it is basically redundant) and replacing it with the key i.e. red dot and text.

0 TODAY – The entire Million Year Trail
is squeezed into the first meter of the Deep Time Trail.

Recommendations:

1. Overall:
 - a. Respondents did not understand this panel very well, and only noticed the bracket to Today after studying it for quite a while. It was unclear however whether the problems will be alleviated in situ. Our recommendation is to leave the sign basically as is and test it on-site, with some few minor modifications as outlined below.
2. Heading:
 - a. Consider an alternate heading that has Deep Time Trail on the left and Million Year Trail on the right. For example: This first meter of the Deep Time Trail has **all** the events of the Million Year Trail squeezed into it.
3. WIS:
 - a. Consider fading out the WIS (on this panel only), making it more transparent. This will make the sign less busy, and help guide people's attention to the top half of the sign.
 - b. Do a clearer representation of the orange bracket pointing to Today.
4. Sub-text under heading:
 - a. Define 2 billion years as 2,000 million so visitors make the connection between the text under the heading and the 2,000 million years at GC Village.
 - b. Clarify volcanic eruptions and earthquakes. At different places along the Trail of Time the message is that (a) they are happening today; (b) they have been happening for the past million years; and (c) they happened 100,000 years ago. If 100,000 is an important number (i.e. a wayside will be there), perhaps the message is that 100,000 years ago volcanic activity started up again? See "100,000ya" wayside comments.

6Ma – The Grand Canyon is 6 million years old.

Recommendations:

1. Heading & Walk six big steps text:

- a. This title seemed to work well. It was interesting to note however that most respondents continue to have a problem visualizing the idea that this was a (relatively) flat plain that the river carved into, and yet when it's pointed out to them, they are fascinated by this information.

Our recommendation is to test and compare two versions of this sign on-site. This can be done by printing test an alternative version of the sub-heading, something like: The Grand Canyon is 6 million years old. Followed by: "6 million years ago there was no Grand Canyon and you could walk straight across." Then replace the text under "Walk six big steps" with something like: "These represent [omit 'steps'] the 6 million years it has taken the Colorado River to carve the Grand Canyon. This incredibly long time is a short time [omit 'period of'] compared to the age of the rocks in the canyon walls."

To test the original sub-heading and text, I will bring the full-size print out I have and we can cut-and-paste it on-site.

2. WIS

- a. Respondents had a difficult time with "Where in the rock record?" on this sign in particular because the age of the rock at the bottom (where the arrow is pointing) is billions of years old, and yet we're talking only 6 million years ago. Our recommendation is to omit it on this sign.

70ya – Without uplift there would be no Grand Canyon.

Recommendations:

1. Overall:
 - a. There was still confusion about the two different topics on the sign: “It’s confusing, there are two different subjects, erosion and uplift. The heading says uplift, and sign body tends to talk about erosion.” And there’s still a lot of information on this sign. One respondent expressed her feelings of being overwhelmed rather bluntly: “I hate signs like this. I feel like I read them and walk away and that I don’t remember anything.” We recommend dealing with the complexity by slight rewording the various texts as outlined below.
2. Heading & sub-heading:
 - a. See note under General Issues about “70-50 million years ago”. Respondents were confused about what was meant by this time range. “When I first read it, ‘from 70-50’ seemed like you were really trying to say ‘at some point in time 50-70 million years ago’”. We recommend rewording the sub-heading slightly, something like: The Colorado Plateau used to be at sea level, but beginning about 70 million years ago, was squeezed and uplifted many meters high. This set the stage for the carving of the Grand Canyon. (Note: This re-write focuses on the concept of uplift.)
3. Uplift diagram:
 - a. The diagram seems to be working well for most respondents. Based on areas of confusion, we recommend slightly revising the text as follows:
 - i. Flat sedimentary rock layers formed, one on top of the other.
 - ii. Starting about 70 million years ago, tectonic forces (?) pushed in and the Colorado Plateau and Rocky Mountains were lifted high above sea level.
 - iii. This high elevation allowed the Grand Canyon to form. For the last 50 million years, erosion has worn away the layers leaving the Kaibab Limestone, which is what you are standing on. (Note: This recommended switching of text in iii—i.e. uplift first, erosion next—provides a segue into the concept of erosion.
4. Hand diagram:
 - a. Okay, no one said the hand was creepy :-) Our recommendation is to test the creepiness-factor one final time on-site and then be done with it.
 - b. Respondents seemed to be able to figure out what the diagram/activity was about even without being on site. This is good.
 - c. This photograph is much better than past ones, but is a bit small. For on-site testing it is imperative that we have a really high quality final photograph so we can accurately assess the effectiveness of this activity. The photograph should be larger than the one on the current prototype so the canyon is clearly recognizable.
 - d. We recommend shortening the text under the diagram: “Measure the thickness of the canyon.”
 - e. To sharpen the text, we recommend eliminating the beginning of the text on the far right hand side of the diagram: “2km (1.2 miles) of rock was once on top of

the rock you see in the canyon. Erosion has stripped away all the rock layers younger than 270 million years old, including those with dinosaur fossils (65 million years old).

5. WIS

- a. Respondents were confused by the rock column. "The arrow on top of the Rock Record graphic looks like a mistake...like it's pointing in the wrong direction. I don't now what it is." We recommend eliminating it from this sign.

270Ma – The top layer is 270 million years old.

Recommendations:

1. Heading & sub-heading:
 - a. The text “Between 280 and 270 million years ago...” made some respondents stop and do the math. Others just skimmed over it, not understanding the magnitude of time this represents. We recommend revising this text: “The top four layers were deposited as sediments over a 10 million year period. Each layer...etc.”
2. Left rock column and text:
 - a. The photograph and rock column continue to be a very popular feature. “I love the graphic exploding out the layers and telling what they are and relating them to the photo of what I’m actually seeing. This is very cool!!”
 - b. In the far left text include a pronunciation guide for KI-bab.
 - c. One respondent asked if the top four layers were the only sedimentary rocks. We recommend labeling with a vertical bracket “Sedimentary rocks.” This will also reinforce the “three rock groupings” in the portal icon. Also, the labeling for the Supergroup and the Basement Rocks need to be more noticeable.
3. Right fossil section:
 - a. This section also continues to be popular. “It’s so amazing to think about the concept of the area once being a tropical sea and it’s a desert today.”
 - b. We recommend reminding folks that back then it was at sea level, for example: “270 million years ago this region was at sea level and was a tropical sea.” This sets the stage for and/or reminds visitors of the information on 70Ma.
 - c. No one stumbled over the word “entombed” but this needs to continue to be tested on-site. It will be interesting to see how adults explain this concept to their children.
 - d. Make sure the photograph is of the actual rock/fossil that visitors will touch.

590Ma – Animal life appeared 600-500 million years ago.

Recommendations:

1. Heading & sub-heading:
 - a. The range of ages in the title was again confusing for respondents. We recommend rewording to something like: “There was an explosion of life around 590 million years ago.” Then the sub-heading: Sedimentary rock layers at the Grand Canyon record an explosion of life over a 100 million year period starting about 600 million years ago.” (Note: The fact that this took place all over the Earth is covered in the text under Evolution of Animals.)
2. Evolution of Animals
 - a. This heading is a “book chapter” heading type. Replace with an action verb, e.g. “Imagine the evolution of animals.”
 - b. Make sure all of the “2,500” label at the bottom right on the diagram is visible.
 - c. “Proterozoic” s/b “Proterozoic”
3. Touch Grand Canyon Fossils:
 - a. Make the word “fossils” in the heading all lower-case.
 - b. Replace the pronunciation of Trilobites with: TRY-lo-bites.
 - c. Make sure the photograph that is included is of the actual rock/fossil that visitors will touch.
 - d. “...deposited as an sea...” s/b “...deposited as a sea...”
4. Find Grand Canyon rocks
 - a. Last sentence should read: “They are from 525 to 505 million years old.”

1,010Ma – 1.2 billion years is missing from the rock record.

We didn't have a completed version of this wayside to test off-site. Based on numerous discussions with the project team, and a careful review of existing graphics that represented the Great Unconformity, we came up with a new/hybrid graphic that we then tested with respondents.

Recommendations:

1. Heading:

- a. Test and compare two versions of the heading for this sign on-site. For the first version, replace the existing title with "1.2 billion years of rock is missing." Then compare visitor responses to this original heading. This will require printing out a to-scale version of this original heading that can be cut-and-pasted on-site.
- b. Suggested sub-heading text: Gaps in the rock record, like chapters torn from a book, are called unconformities. They represent times when rocks were eroded from the region.

2. Find the Great Unconformity:

- a. Because this should (and will) be the first activity most people do, it should be moved to the left-hand side of the sign.
- b. Suggested text: "Find the Great Unconformity... ..using the viewing tube. The Great Unconformity is where 1.2 billion years of rock record is missing. 525 million year old rocks lay directly on top of 1,700 million (almost 2 billion) year old rocks. [new paragraph] What happened here during all that time? Since the rock record is missing, it is difficult to say."
- c. Suggested graphic: We recommend a very high quality photograph directly under the text, a photograph that is a very clear example of the Great Unconformity and with arrows pointing to the "ancient basement rocks" and "younger sedimentary rocks." See example #A below.
- d. Under the graphic/photograph include text such as: "There are many unconformities in the Grand Canyon, but the Great Unconformity is the biggest."
- e. Note: If this won't fit on the sign with the suggested graphic sequence below, it could be on the tube instead.

3. Visualize how unconformities form:

- a. We suggest replacing this heading with something like: "More than a billion years is gone. The Grand Canyon has one of the world's best rock records, yet it's still incomplete."
- b. Then include a seven-step graphic such as #B below. (Note: Make sure the original granite is not part of the basement rocks, or is at least colored in.) The first six steps of this graphic & text sequence was rapid-prototyped off-site with respondents, with positive results.

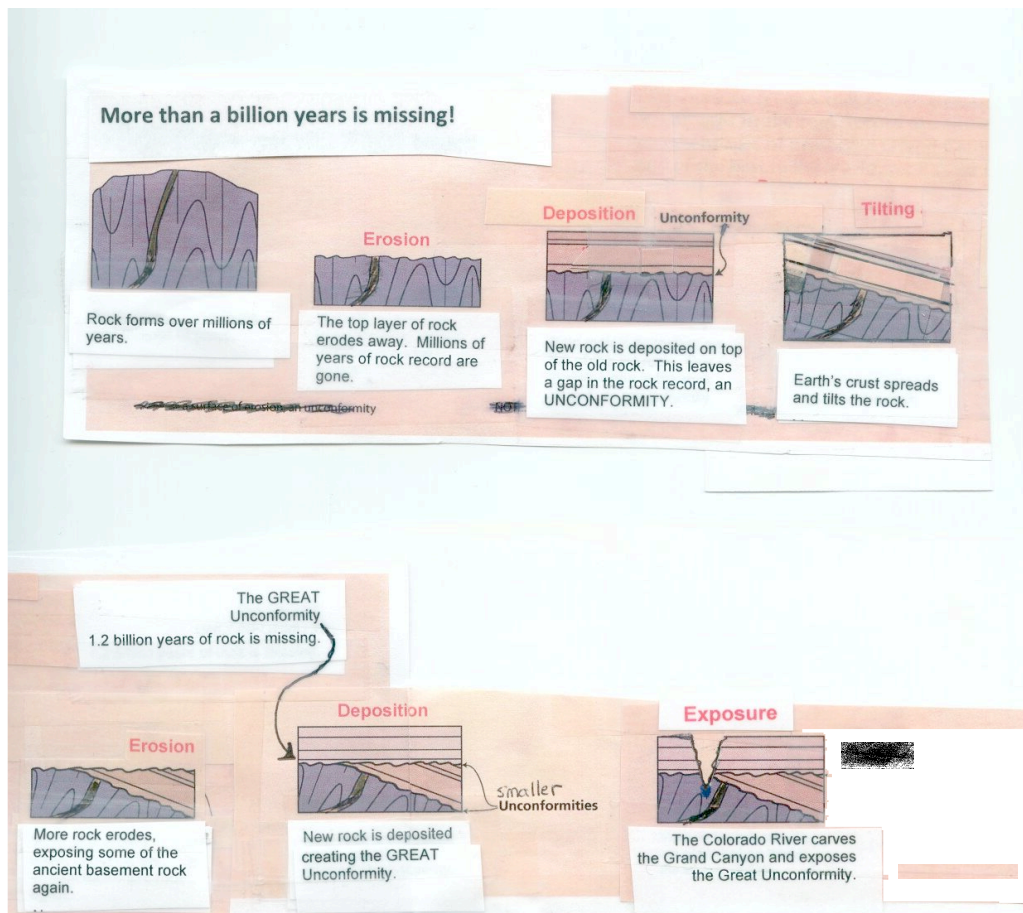
#A



craggy ancient basement rocks

much younger sedimentary rocks laying flat on top

#B



1,160Ma – The tilted layers are the Grand Canyon Supergroup.

Recommendations:

1. Heading:
 - a. This title will confuse visitors because much of the Grand Canyon looks “tilted” to naïve visitors. We recommend changing the title to read something like: “Single-celled fossils are in the Grand Canyon Supergroup” or “The Grand Canyon Supergroup is rare” or “Early Earth fossils are found only in the Grand Canyon Supergroup” etc. In other words, what’s really cool (to the visitors) about the Grand Canyon Supergroup?
 - b. We recommend revising the sub-heading text, for example: “The Grand Canyon Supergroup offers a rare glimpse into a time when only single-celled life lived on Earth.”
2. Find the Supergroup rocks:
 - a. We recommend changing the title to something a bit more catchy, for example “**Catch a glimpse** of the rare Grand Canyon Supergroup. These rocks can be seen in only a few places in the Grand Canyon. [Note: This actually could be the heading for the whole sign. Pretty compelling!]
3. Tilting due to faulting:
 - a. We did not have a diagram to test here. We recommend coming up with a simple three- or four-step diagram, perhaps some variation of the last four graphics on the Unconformity panel.
4. Touch an early Earth fossil:
 - a. Make sure the photograph is of the actual rock/fossil that visitors will touch.
 - b. Revise text slightly: “The Supergroup sediments were deposited beginning about 1,250 million years ago until about 740 million years ago. During this time only single-celled life existed on Earth. Fossils found in the Grand Canyon Supergroup tell us what some of these organisms looked like.”
 - c. Respondents thought that each of the “circles” in the photograph represented a single-celled organism and were confused about whether or not a single cell could be that big. We recommend revising the text to clarify.
 - d. It was unclear what “single-celled Chuaria” are.
 - e. Stomatolites and Chuaria both need pronunciation guides.

1,720Ma – Vishnu basement rocks are near the canyon's bottom.

Recommendations:

1. Heading & sub-heading:
 - a. The dates confused respondents. We recommend slightly rewording the sub-heading to place these dates at the end of the text, for example: "The ancient Vishnu basement rocks record the formation of the continental crust of the Southwest. They are from 1,750 million to 1,660 million years old."
 - b. Test
 - c. Test
2. Use the viewing tube:
 - a. The text "...the core of the now-eroded mountain range" confused respondents. We recommend revising the heading and text to be simply: "Find the basement rocks by looking through the viewing tube" followed by a photograph.
 - b. Make sure the photograph is of the actual rock that visitors will touch.
 - c. Respondents were confused about the text: "Look for evidence that they flowed." "Does that mean as in a lava flow, that this rock I'm touching is volcanic rock? But it doesn't look like volcanic rock I've seen before in Hawaii. It actually looks more like river-tumbled rock. Did it flow in a river?" We recommend clarifying the text.
3. Imagine how continents formed:
 - a. Respondents were not sure what the connection was for this section. "[It] seems like it just fell into these signs out of nowhere." "We jumped from the micro-view of the Grand Canyon's 'layers of history' to the macro-view of how continents are made with no mention of how the two are related."
 - b. Terms that were confusing: microplates colliding; welding to the continent; plate tectonic forces. We recommend removing this entire middle section.
 - c. "Vishnu" is used in the heading and sub-heading but not elsewhere on the rest of the sign. Is this accurate?
4. Right hand rock column:
 - a. Make sure all the text and labels are large enough and clear enough to be read.
 - b. We recommend revising the text slightly as follows:
 - i. Sedimentary Rocks – form in layers from sediments that get buried and then harden.
 - ii. Igneous Rocks – form when magma crystallizes. The light layers are granites that froze [as in ice freezes? or should it be "became solid"?]
 - iii. Metamorphic Rocks – form when heat and pressure changes them from flowing like taffy into hard rock.

1,840Ma – Elves Chasm Gneiss is the canyon's oldest known rock.

Recommendations:

1. Heading & sub-heading:
 - a. Starting the heading off with a complex and unfamiliar phrase was difficult for respondents. We recommend rewording it slightly, for example: "The canyon's oldest known rock is Elves Chasm Gneiss (NICE). Many people pronounced chasm starting with a "ch" sound rather than a "k" sound but that may be accurate.
 - b. Revise the sub-heading slightly, for example: "It is 1,840 million (1.84 billion) years old and is the oldest known rock in the entire Southwest. [Note: Respondents noted that Elves Chasm Gneiss was mentioned repeatedly (and redundantly) on this sign.]
2. Touch a piece of Elves Chasm Gneiss
 - a. This was a compelling heading. "An 1840 million year old rock!! And I get to touch it??!!"
 - b. We recommend shortening the text slightly, for example: This is a type of rock called gneiss (NICE). It came from the Elves Chasm area, 32km (20 miles) west of here.
 - c. The next sentence was confusing for respondents. Consider replacing with something like: "This rock was first formed as granite when magma cooled 1,840 million years ago. Pressure and heat then changed it into gneiss (NICE) about 1,700 million years ago." [Note: Gneiss is spelled incorrectly in the original text.]
3. How old?:
 - a. Include "(NICE)" after Gneiss.
 - b. Make sure the photograph is exactly what visitors will see.
 - c. Replace the heading with an action verb, for example: **Imagine** how old.
4. How rocks are dated:
 - a. The first sentence was confusing to respondents. Consider revising this first sentence, for example: "Geologists can tell how old a rock is by analyzing radioactive atoms that are naturally in them."
 - b. Consider replacing the graphic of an atom with a photograph of something like a (female person-of-color) geologist in a lab coat next to a machine.