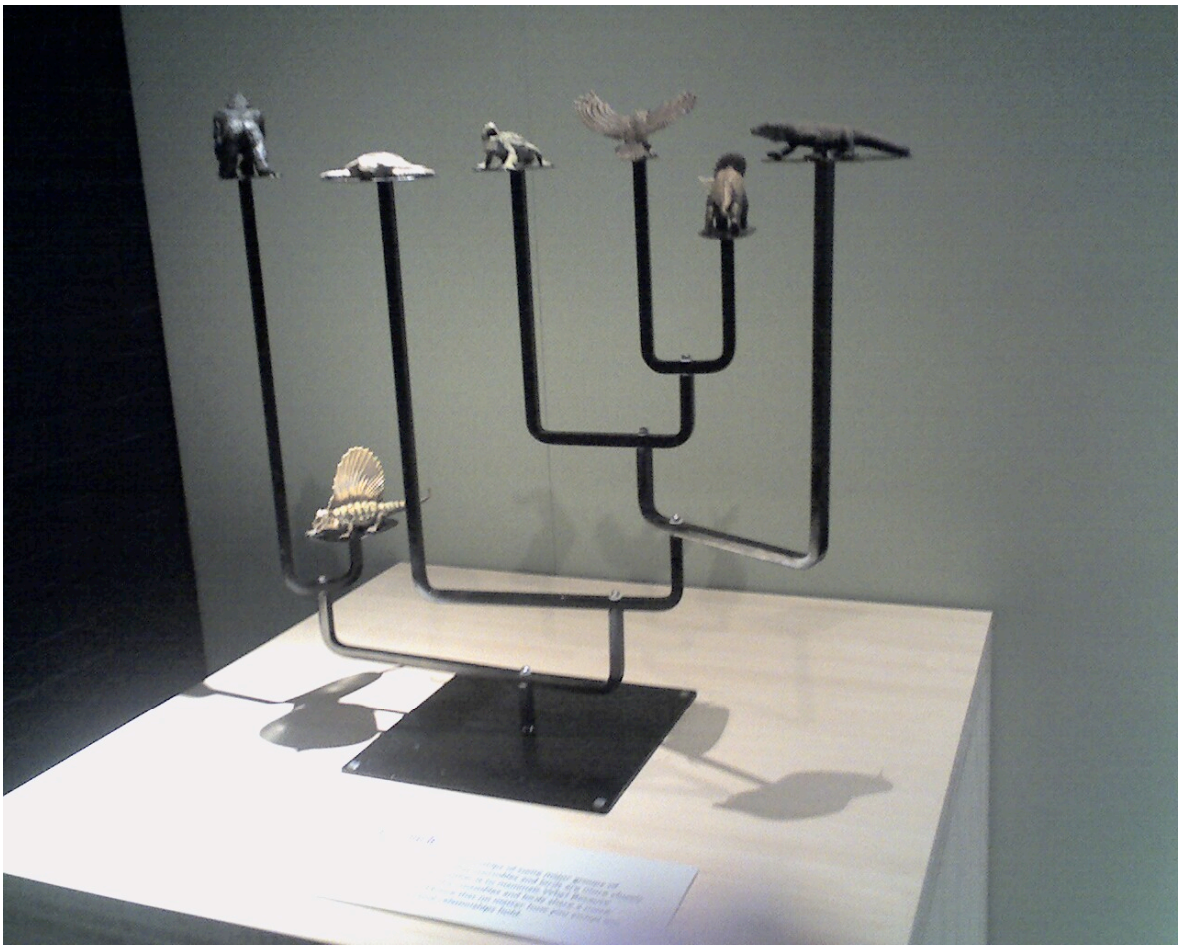
Yale Peabody Museum of Natural History

"Travels in the Great Tree of Life"

A Summative Evaluation



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I learned so much. I knew nothing about it [before]. Female 14-18

Summary

This summative evaluation report aims to examine the impact of "Travels in the Great Tree of Life," a temporary exhibition at the Yale Peabody Museum of Natural History. The 1000-square-foot exhibition seeks to convey concepts of phylogenetic relationships based on recency of common ancestry. In addition, its goal is for visitors to come away with an understanding of the vast scope and complexity of the Tree of Life (herein referred to as ToL) and some practical applications of ToL research.

Data collection employed a mixed methods approach. Structured exit interviews were conducted with 102 randomly selected museum visitors throughout June 2008. An additional 74 visitors were observed unobtrusively as they toured the exhibition during the same time period.

This summary touches on the main findings. Readers are encouraged to continue on for more in-depth analyses.

Most visitors came from nearby—New Haven or other locations in Connecticut. Interview and tracked samples included youngsters and adults, the majority adults between 19 and 59 years. Most visitors were in groups of family or friends, and half the adults were accompanied by children younger than 18 years. The vast majority of adults had attained high levels of formal education; 35% said they had special training in science. Very few visitors had heard about the exhibition before they came; those who had cited "personal communication."

Tracked visitors stopped at an average of 33% of the 18 exhibit elements. By far the most popular exhibit, the elephant shrews, attracted 82% of visitors. Carnivorous plants, *Rafflesia* and aardvark all attracted 50% or more visitors. Among media elements, the introductory film drew 32% of the audience and the computer game 46% (visitors who played and/or watched others play). The film that focused on practical uses drew a smaller audience—just 1 in 5 visitors. It was somewhat hidden in an alcove which had no provision for sitting down while watching.

Visitors' time in the exhibition ranged from more than 50 minutes to less than 2 minutes, averaging 10 minutes. Half the visitors stayed for less than 10 minutes, but half stayed longer and some considerably longer. When compared to other exhibitions of similar size and content, 10 minutes average time is quite respectable.

The majority of interview respondents (57%) defined the ToL as showing "relationships between organisms" or "evolution." This is a tremendous increase from front-end findings where only 29% of the potential exhibition audience demonstrated understanding of scientific Trees. When describing something new they learned in the exhibition, 41% of visitors cited the interrelationships of organisms. Many visitors noted surprising relationships—cat and mushroom (in the computer game) and poison ivy and mango were particularly noteworthy.

Visitors who had seen the exhibition demonstrated ability to read Trees: when asked if the mushroom or the flower pictured on a cladogram was closer to the human, 78% chose the mushroom and 56% could explain why correctly. Visitors learned this in a variety of exhibit elements. The sculptural Tree outside the exhibit, along with its label, could have provided an important addition to visitor learning, however very few visitors stopped to examine or manipulate it, preferring to enter the exhibit rather than linger outside.

Visitors came away from the exhibition recognizing the ToL as current, ongoing research. The majority of interviewees agreed, "The exhibition made me realize that it takes a very powerful computer to work on the ToL," however this information appeared to have less overall impact than did the unexpected interrelationships visitors observed among and between species.

The practical applications of the ToL were not communicated to visitors as effectively as they might have been. When asked about uses cited in the exhibition, only 29% of interviewees mentioned health and medicine, 15% environmental uses and 5% food and agriculture. Most visitors seemed to believe that the primary value of the ToL is basic scientific knowledge and education. Tracking indicated that the film and graphic panel that convey this information did not attract many visitors. This was a missed opportunity to let the public know that ToL research has importance to science and society beyond advancing basic knowledge.

The two other media pieces—the introductory film and the computer game—effectively conveyed content about phylogenetic relationships, attracting and holding visitors' attention. One in three tracked visitors watched the introductory film for an average of 5.5 of a possible 10 minutes. The computer game attracted about half the visitors (both children and adults) and players spent more than 5 minutes on average—long enough to complete the entire game without sidebars. Interviews confirmed the film and game's effectiveness in conveying the phylogenetic story.

Introduction

A summative evaluation of the Yale Peabody Museum's exhibition on phylogeny, "Travels in the Great Tree of Life" (herein referred to as the exhibition) was conducted to examine its impact on its visitors. The exhibition is installed in a 1000-square-foot gallery close to the museum's main entrance.

The exhibition aims to convey one principal concept and two subsidiary ideas:

- Visitors should come away understanding the concept of phylogenetic relationships. Relationships among species are based on recency of common ancestry, not on observable similarity of physical characteristics.
- Visitors should understand that the Tree of Life (ToL) is huge. Resolving the relationships within it is a complex undertaking, with current research producing some surprising findings.
- Understanding relationships in the ToL has a number of practical applications.

The purpose of this study is to find out to what extent the exhibition's visitors grasp these ideas. In addition, the study examines how visitors use the exhibition. Of particular interest is visitors' use of media, principally the interactive computer game designed to engage and instruct visitors—particularly children—about the exhibition's primary cognitive goal.

The Discussion and Implications section of this report compares summative evaluation findings with findings from front-end audience research conducted during exhibition planning. This retrospective pre- and post-visit framework highlights the change in the public's perception of the main ideas and showcases the exhibition's cognitive impact on its visitors.

Methodology

A mixed methods approach was used to gather data for this study. Structured exit interviews provide visitors' subjective response—what stood out immediately following the exhibition experience and how engaged visitors were by the topic and its interpretation. Structured observation of visitor behavior in an exhibition (timing and tracking) supply objective data about what a random sample of the visitor population actually does in an exhibition and for how long—the exhibit components they attended to, the labels they read and the interactive and media components they used. These findings together with exit interviews result in a more complete picture of the exhibition's impact on its audience.

Exit interviews

Peabody staff trained by the evaluator interviewed more than 100 museum visitors on Thursdays (free admission), Saturdays and Sundays from May 31 through June 29, 2008.

Visitors 10 years and older were approached as they exited the exhibition and asked for their opinions about it: "Hello. We are asking people today about what they thought of Travels in the Great Tree of Life, the exhibition you just left. There are no right or wrong answers, just your opinions. Your answers will be completely anonymous. It will only take about 5 minutes and you will really be helping the museum." Interviewers were instructed not to select a subject with any criteria other than that he or she was the next person to exit. They were asked to encourage reluctant participants saying, "We understand that visitors don't have much time and don't always read about exhibits, but their opinions are just as important to us." If a visitor definitely did not want to participate, they were to note the reason on a refusal log. The refusal rate was quite high, 40%. Visitors with young children said they had to keep moving. Other reasons centered on lack of time or something like, "We just came to see the elephant shrews."

Statistical analysis was performed to investigate differences based on age, education and scientific background. Findings are reported where significance was found.

Quotes from the interviews are included throughout the report to add richness to the data. Complete transcripts of open-ended questions can be found in Appendix 3.

Structured observation

Peabody staff and interns tracked and timed 74 visitors unobtrusively as they viewed the exhibition. Data were collected throughout June 2008, on Thursdays, Saturdays and Sundays.

Data collectors were instructed to select their subjects at random, using no criteria other than observing the next visitor to cross an imaginary line. When the line was crossed, data collectors started a timer and traced the subject's path through the exhibition on a floorplan, noted the exhibit components where she or he stopped for at least 2 seconds, read a label, watched a video or used an interactive. The amount of time the visitor watched or used media was noted as well as the visit's total time.

Complete demographic data (tracked sample demographics consist of only what was observable) can be found in Appendix 1. The data collecting instruments are included in Appendix 2. Examples of completed tracking forms showing different types of pathways can be found in Appendix 4.

Findings

Visitor Characteristics

The evaluator did not have access to the Peabody Museum's audience data, thus these characteristics may or may not be representative of its entire audience.

- Male and female visitors were equally likely to visit the exhibition (interview sample: 48% male and 52% female; tracked sample: 54% male and 46% female).
- The vast majority of interviewed visitors came from nearby (41% from the New Haven area, 39% from elsewhere in Connecticut). Tracked sample unknown.
- Young people were represented in both samples (23% of interview respondents and 15% of tracked visitors). The majority of both samples consisted of adults from 19 to 59 years old (half the tracked visitors were estimated to be between 40 and 59 years of age[1], while 30% of interviewed visitors self-identified as 19-39 years). Some 10% of both samples were aged 60 years and older.
- The vast majority of visitors came with family or friends (1 in 10 were alone) and 50% were with children younger than 18 years of age.
- The vast majority of adult interview respondents had attained high levels of formal education—a Bachelor, Master's or professional degree.
- 35% of interview respondents of all ages and educational levels said they had special training in science and 90% felt "moderately well informed" to "very well informed about scientific discoveries and technology" (30% and 60% respectively).

Most visitors found out about the exhibition after they arrived at the museum. Only 13% of interview subjects said they came to the museum particularly to see the exhibition. Most of the respondents who had heard about it before their visit cited "personal communication."

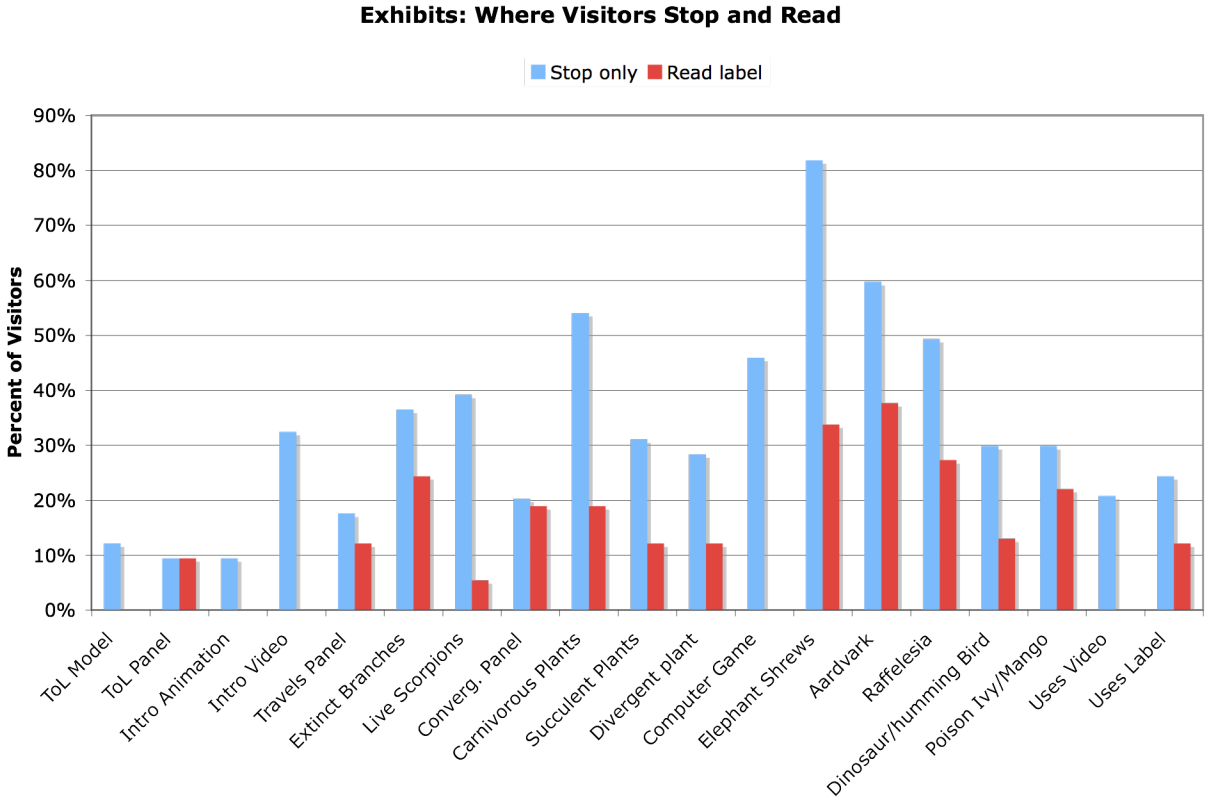
The next section discusses tracking and timing results because they will be referenced in subsequent findings to illuminate exit interview results. The relationship between observations of visitor behavior in exhibitions (timing and tracking) and responses to exit interviews can indicate which exhibit components convey content messages most effectively.

[1] Tracked visitors' ages were estimated, largely by teenagers, who may have misjudged.

Visitor Behavior in the Exhibition

The exhibition, covering just 1000 square feet, is quite densely packed with information, media and specimens. For purposes of observing visitor behavior, 19 exhibit elements were identified (figure 1). "Travels in the Great Tree of Life" is not a balanced exhibition: one of the displays, live elephant shrews, far outperforms the others in terms of attracting visitors. However, visitors stopped at 33% of the exhibition on average. Exit interview findings suggest that, rather than distract or detract from the takeaway message—a basic understanding of phylogenetic relationships—the elephant shrews and the neighboring display of a mounted aardvark (a relative), enhance it. As figure 1 indicates, a fair number of visitors who stop at exhibit components also read about them, and the message is well served by redundancy throughout.

Figure 1



The elephant shrews attract more than 8 in 10 visitors. Among other top performers, the aardvark (with other examples of the Afrotheria) attracts the next highest percentage of visitors (60%). The carnivorous plants display draws more than half (54%) the visitors. The computer game attracts 46%, however, only 31% were players and the remainder watched others play.

Table 1 ranks the exhibits that attract the highest percentage of visitors (at least 30%), from highest to lowest. Ten exhibit elements of 19, more than half (55%) attracted more than 30% of the audience.

Table 1. Exhibit elements that attract 30% or more of audience

Exhibits	**Percent of visitors**
Elephant shrews	82%
Aardvark	60%
Carnivorous plants	54%
Rafflesia	49%
Computer game	46%
Live scorpions	39%
Extinct branches	36%
Introductory film	32%
Succulent plants	31%
Poison ivy and Mango	30%

Beverly Serrell has conducted research comparing many exhibitions across museum type and size of exhibition.[2] She defines what she has called the diligent visitor as one who attends to 50% or more of an exhibition and well-used exhibitions as those whose visitors attended to at least 50% of the exhibit elements. Nonetheless, she found very few exhibitions achieved that high standard. "Travels in the Great Tree of Life" falls within the norm of the many exhibitions Serrell studied and compared.

Figure 2. Black and rufous elephant shrews.
Photo by Heidi Hellmuth, Philadelphia Zoo.

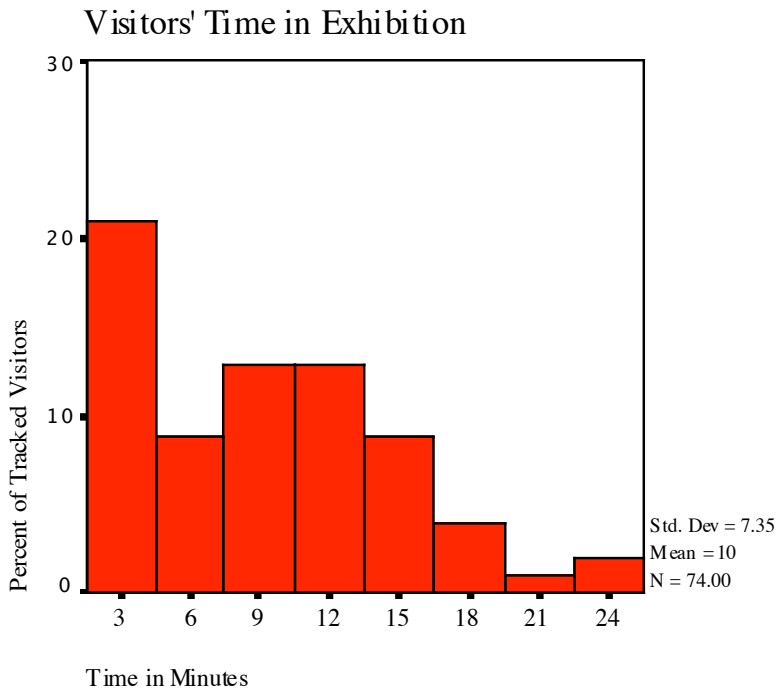
[2] Serrell, Beverly. (1998) "Paying Attention: Visitors and Museum Exhibitions." American Association of Museums, Washington, DC.

Time in Exhibition

In educational and cognitive psychology, it is generally accepted that there is a positive correlation between time and learning. That is, the more time a person spends ("time on task"), the more likely s/he is to learn something. The 74 visitors who were tracked spent from 1.5 minutes (1 person) to almost an hour (1 person spent 51 minutes) in the exhibition. The average was 10 minutes. Figure 3 illustrates the distribution of time spent in the exhibition.

In Serrell's study of timing and tracking data collected from many exhibitions, she defined what she calls "thoroughness of use." She concluded that a measure she calls "sweep rate" (square feet divided by average time spent in the exhibition) suggests how thoroughly visitors use an exhibition. Serrell found that on average, acceptable sweep rates for exhibitions ranged from 200 to 400 square feet per minute, with larger exhibitions showing faster passage through. The sweep rate for "Travels in the Great Tree of Life" is 100, quite satisfying when viewed through Serrell's framework.

Figure 3



The Main Idea: Phylogenetic Relationships

Visitors participate in informal science educational opportunities for a variety of reasons, one of which is interest in learning. But they don't come with the idea of being tested on what they learned, as they do when studying science in a formal educational setting. They are not cued to study for a test and do not expect one. Our emphasis in exit interviews was to avoid making visitors feel that they "failed": if they didn't understand, it is the museum which failed to make concepts appealing and understandable.

We asked visitors how they would explain the ToL to a friend or family member, phrasing the question thus to avoid the appearance of a test.

Table 2

ToL represents…	**Frequency**	**Percent**
Relationships between/among organisms, connections	38	38
Evolution	19	19
Diversity	7	7
Other	14	14
Don't know, not sure	21	21
Wrong answer (conservation, preserve ecosystem, nature)	3	3
Total	102	102*

* Percents add up to >100% due to rounding

"Relationships between organisms" is perhaps a more precise definition of the ToL than "evolution"; however, showing how organisms are phylogenetically related demonstrates evolution. Taken together, these two categories indicate that more than half (57%) of exhibition visitors came away understanding what the ToL signifies—a major accomplishment for "Travels in the Great Tree of Life." In addition, most of the responses categorized as "other" implied an understanding of phylogeny but were vague in articulating the concept. For example as these visitors said: the ToL represents "the basics of all life, all being" (Female 14-18), "the development of animals" (Male 19-39) and "how things are made, genetics are formed" (Male 10-13). Those responses suggest an understanding of phylogenetic relationships but were not expressed clearly.

The following quotes from the interviews illustrate visitors' views expressed in their own words. (See Appendix 3 for complete transcripts).

Relationships

How branches of life all the way from DNA to mammals and plants are connected. Male 40-59

How things are related to each other. I never would have suspected some of the relationships. Female 19-39

Building stones of life and evolution and relationship between species. Male 60 and over

Nature and how things have unexpected relatives. Female 10-13

Evolution

A graphic representation of evolution. 40-59

The evolution of all things from a common ancestor. Female 19-39

The ToL is a system to record the ancestry of all types of life on the planet. Female 14-18

A way of organizing living things and how they evolved. Female 60 and over

Diversity

Something that people should be aware of: the biodiversity of our planet. Male 19-39

A lot of variety, so much still to learn. Female 40-59

Other

How the branches are closer to each other, and how you follow them all the way down. 10-13

The ToL is impressive, it's a picture [of life]; it includes elephant shrews. Male 14-18

Most of the arachnids started from the same life form and then became so different. Male 40-59

Cognitive Impact: New learning

When asked to tell the interviewer one thing the visitor had learned in the exhibition that he or she hadn't known before, 9 in 10 (88%) were able to articulate something specific. The most frequent response category was "About organisms' relationships (you wouldn't expect) and evolution" (41% of responses). The second most frequent response had to do with interesting facts about particular species (30%). Somewhat fewer respondents said they had learned about current research in the ToL (18%) and just a few noted learning about practical uses of ToL research (6%). Their open-ended comments were categorized as table 3 illustrates.

Table 3. Visitors learned things that they didn't know before

Learned	**Frequency**	**Percent***
About organisms' relationships (you wouldn't expect) & evolution	37	41
Facts about animals and plants	27	30
About current research and the ToL	16	18
Practical uses of the ToL	5	6
Other	5	6
Total	90	100

*Percents add up to >100 due to rounding.

The redundancy of the phylogenetic message, the exhibition's number 1 learning goal, helped ensure that visitors "got it." Aspects of the message were repeated in all the exhibit elements, but especially in the Tree model and text panel at the exhibition entrance, the introductory film, the Travels text panel, Extinct Branches, information about carnivorous and succulent plants, the computer game, the elephant shrews, the aardvark mounted specimen, the *Rafflesia* and *Albertosaurus*/hummingbird displays, the poison ivy and mango exhibit element and information about practical uses.

Significant differences were found between responses based on age [$x^2(20, N=89) = 44.24$, $p < .01$] and self-reported understanding of science and technology [$x^2(10, N=88) = 18.84$, $p < .05$]. Respondents aged 10-13, 40-59 and 60 plus were more likely to learn about organisms' relationships and evolution, while respondents aged 14-18 and 19-39 were more likely to learn facts about animals and plants. A third of respondents who were "very well informed" learned about current research and the ToL, a third learned facts about animals and plants. Half the respondents who were "moderately well informed" learned about organisms' relationships and evolution. Two-thirds of "poorly informed" respondents learned facts about animals and plants.

It is unfortunate that so few visitors stopped or manipulated the sculptural phylogenetic model outside the exhibition entrance. An interview subject noted this in his final comments:

The "phylogenic relationship" exhibit is generally skipped. Perhaps it could be worked into the exhibit instead of being walked past on an outside wall. Male 40-59

Visitors' own words best express what they learned.

Learning about phylogenetic relationships: I learned that…

… the cat is closer to a mushroom than flower. Male 10-13
… dinosaurs are related to so many things like birds. Female 40-59
… all things are connected in some way even though they are so different. Male 10-13
… the aardvark is related to the elephant. Male 19-39
… lots of those relationships that were bizarre. I suppose the huge distance of time has let a lot of weird things happen. Female 40-59

About current research and the ToL

[I learned that] ToL existed. Male 10-13
HIV, fungus—I didn't know they could trace their evolution. Female 19-39
Research: I didn't know so many people were doing research. Male 19-39
I didn't know how much there was still to categorize (regarding life on our planet). Female 60 +

Facts about animals and plants

About spiders. I really liked the way it was presented. It was illuminating. Male 40-59
Insectivorous plants, had never seen them before. Female 19-39
Pitcher plants evolved separately on different continents. Female 19-39
That elephant shrews were neither elephant nor shrew. Female 19-39

"Other" learning

I was not aware of Darwin's statement about [the ToL]. Male 60 and over
I'm a scientist, but I didn't know all the applications of biodiversity. I didn't know how it was being used. Male 19-39
Snake. Look into its genes to find a bite antivenin from a snake that is related. Female 19-39

How to Read the ToL

Did the exhibition succeed in conveying to visitors how to read a ToL? Visitors were shown a small bit of the ToL and asked which species was more closely related to the human—the mushroom or the flower (see figure 4).

Figure 4

A large majority of respondents answered correctly (78%), the mushroom. How could they tell? Of those who responded correctly, more than half (56%) could explain why—the mushroom is closer or on the same branch. Just 14% said they had guessed and another 14% thought the flower was closer. This cladogram and its interpretation are displayed on a panel outside the exhibition where visitors could see it as they enter. But as tracking reveals, few visitors (9%) stopped to read it. Several respondents (10%) cited the interactive game as their source for knowing that the mushroom is phylogenetically closer than the flower to the human. Five people said they "just knew it," providing no further explanation. Visitors' own words:

<u>Mushroom is closer to human, on the same branch</u>

The branch is closer. If you follow the branches down, the flower is further away. 10-13

The mushroom branches later than the flower branches. Male 19-39

Fungus is related to cat. Cat is related to us. Male 10-13

The mushroom is on a higher level in Tree of Life. Male 14-18

Surprising Relationships

The exhibition makes its point about phylogenetic relationships by highlighting some surprising relationships and visitors take note. When asked if they saw anything in the exhibition that surprised them, 15% of the respondents pointed to some of the unexpected relationships between organisms. A number of visitors of all ages cited the "cat game" as their source for learning about surprising relationships. In addition to new knowledge, exhibit information sometimes provided practical insight, as the second comment below indicates.

[I was surprised by] how many things are inter-related to each other; a cat is related to a mushroom. I never knew that. Male 60 and over

The mangoes and the poison ivy relationship: when I eat more than two mangoes my tongue swells a little and now I know why. Female 10-13

More Surprises

Among the interviewees, 73% reported seeing something in the exhibition that surprised them (8 people cited two surprises). The biggest surprise for visitors was seeing live animals in a museum exhibition (38% of visitors' surprises)—"live animals" in general (14%) and "the elephant shrews" specifically (24%). The second most frequently mentioned surprise was learning about organisms' surprising relationships (15%). If we add to that the percent of responses that referred to the ToL in general, we find that 20% of what visitors found surprising in the exhibition were relatively abstract scientific concepts.

Table 4. Did anything in the exhibition surprise you? What was it?

Surprises	**Frequency N=74**	**Percent**
Elephant shrews	18	24
Organism relationships	11	15
Live animals (in general)	10	14
Giant flower, *Rafflesia*	10	14
T. rex (*Albertosaurus* display)	6	8
Plants, carnivorous plants	6	8
ToL (in general)	4	5
Scorpions	3	4
Computer game	2	3
Arachnid animation	2	3
Films (in general)	1	1
Other	9	12

Some examples from the interviews:

Live animals

Live scorpions and hanging pitcher plants. I didn't expect living things, and I didn't know plants that ate insects got so big. Male 19-39

Elephant shrew: It has a long nose. It looks like a mouse, but it isn't. It looks like an elephant, but it isn't. Male 14-18

ToL and research

T. rex. *I thought dinos were more lizards then birds. Female 19-39*

How complicated ToL is. I didn't know how immense it is. Male 60 and over

Practical Applications of the ToL

Visitors come away from "Travels in the Great Tree of Life" with limited awareness of the variety of practical applications stemming from ToL research. Just 6% cited practical applications as something new they learned in the exhibition. When asked specifically if they could think of any practical uses for the ToL, 3 in 4 respondents said they could (6 people named two uses). However, when asked to name one, the top of mind response for almost half the respondents (47%) was "basic knowledge" or "education." Almost 1 in 3 interviewees (29%) recognized the ToL's practical uses in "health and medicine"—a few visitors mentioned seeing information about the ToL's use in research on the HIV virus. Just 5% mentioned the ToL's value to food and agriculture.

Table 5

Practical Uses of the ToL	**Frequency N=76**	**Percent**
Basic knowledge, education	36	47
Health, medicine, antivenin	22	29
Save the environment, endangered species	12	15
Food, agriculture	4	5
Cultural considerations (e.g., we're all the same so let's get along)	3	4
Other	4	5

Tracking results correlate and shed light on the findings. Almost a quarter of tracked visitors (24%) stopped at the text panel that discusses practical uses but only half of them appeared to be reading it. All of the visitors who stopped were adults. About 1 in 5 (21%) of tracked visitors stopped to watch the video about practical applications (all adults), but the average time was only 1.5 minutes out of the film's 4 minutes. Three people watched for 3.5 to 5.5 minutes. Selected visitor responses:

<u>Basic Knowledge and Education</u>

Exploration of more animals and flowers around the world, which will get more knowledge for scientists. Male 10-13

For people to understand the interrelatedness of species. Male 40-59

Something worth having in a school curriculum. Kids would really take to it. Male 40-59

Food and Agriculture

Develop more food and fuels. Female 60 and over

Genetically modified crops. 40-59

Use plants that eat insects in heavy insect areas. Male 19-39

Health and Medicine

Disease: tracking them and possibly curing people. Female 19-39

Medicine and other things related to biogenetic projects. Antivenin can be developed from related organisms. Male 19-39

The Environment

Preserve what's here on earth now. Female 40-59

Work on saving endangered species and bring them back. Male 40-59

As a way to be more connected to our world. Female 19-39

A few people noted a practical benefit that is closer to anthropology than biology: understanding that we are all related should make us more tolerant of each other as human beings.

Cultural Associations

Every student in the U.S. should come here. Maybe they wouldn't judge each other because they would know we're all related. Female 10-13

To demonstrate to people that we have a common ancestor; if we educate people more, that means less violence and wars. Male 40-59

Great for racial relations and cultures; as world gets smaller we find more alikeness. Female 40-59

ToL Complexity and Current Research

One of the cognitive goals for the exhibition was for visitors to understand that the ToL is almost unimaginably extensive; resolving the relationships within it is a complex undertaking, with research taking place currently. Multiple-choice questions in the interview delved into these issues.

Table 6. The ToL is…

The Tree of Life is…	Frequency	Percent
old technology	26	26
cutting edge	64	63
Not sure	12	12
Total	102	101*

*Percents add up to >100 due to rounding

Table 7. The ToL is…

The Tree of Life is…	Frequency	Percent
still growing	99	97
basically complete	1	1
Not sure	2	2
Total	102	100

Clearly, visitors understand that the ToL is ongoing and a subject of current research (table 7). Although a majority of interviewees agreed that the ToL is "cutting edge," table 6 suggests that visitors are less sure about the hi-tech nature of ToL research than they are that ToL is "still growing" (63% and 97% respectively). The purpose was to find out if the exhibition conveys to visitors that today's research involves massive amounts of data and requires the use of extremely powerful digital technology. In retrospect, asking if the ToL is "old technology" or "cutting edge" may have been misleading. Does it mean that thinking about evolutionary relationships is brand new? In that case, one should disagree. Does it mean that expressing relationships as a cladogram is brand new? That too would be incorrect.

Visitors were asked if they agreed or disagreed with three statements:

1. The exhibition showed me that new scientific discoveries are being made that change the ToL.
2. The exhibition made me realize that it takes a very powerful computer to work on the ToL.
3. The exhibition illustrates that a dinosaur is more closely related to a hummingbird than to a crocodile.

All the statements are true ("agree" is the correct response) to avoid lending credence to incorrect information. (People who see false information in a trusted institution may believe it is true simply because they see it in print.) Statement 2 in table 8 confirms, as table 6 suggests, that the exhibition could have made a stronger point about the hi-tech nature of ToL computing. The majority, 6 in 10 respondents, agreed that it takes a very powerful computer to work on the ToL; however, 4 in 10 disagreed or were not sure.

Table 8. Agree or Disagree

	Agree		Disagree		Not sure	
Statements	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**
1. The exhibition showed me that new scientific discoveries are being made that change the ToL.	94	92	2	2	6	6
2. The exhibition made me realize that it takes a very powerful computer to work on the ToL.	61	60	25	25	16	16
3. The exhibition illustrates that a dinosaur is more closely related to a hummingbird than to a crocodile.	56	55	18	18	28	28

The information was displayed in a text and graphics panel, "Tree of Life: A Monumental Scientific Challenge," located close to the *Rafflesia* display. Tracking indicates that only 9% of the audience stopped to look at the panel and only 3% read some or all of it. One visitor commented that she was surprised by "the amount of research going on" and that "no computer is big enough to organize it all" (Female 60 and over).

Overall, more than half the respondents agreed with statement 3, "The exhibition illustrates that a dinosaur is more closely related to a hummingbird than to a crocodile." However, there is a significant difference [$x2(8, N=101) = 22.34$, $p < .01$] among respondents, based on age. The majority of interviewees in the three older groups agreed with the statement, while younger visitors, ages 10-13 and 14-18, were more likely to disagree or say they were not sure.

An interviewer commented: "Subject (Male 19-39) wasn't sure about the dinosaur/hummingbird relationship. He thought "no" (disagree) at first, but kept glancing at the phylogenetic Tree model. I told him he could go look at it if he wanted. He did, and when he came back he agreed that dinosaurs and hummingbirds are related."

Affective Impact: Exhibit Highlights

Virtually all visitors were able to cite an aspect of the exhibition that was a particular highlight for them (2 visitors said they were "not sure" and 2 said "all of it"); 13 people mentioned two highlights. Some of these favorite exhibits were grouped in categories as illustrated in table 9, or more visually, in figure 5 on the following page.

Table 9. Visitors' Personal Highlights of the Exhibition

Highlights	Frequency	Percent N=102
Elephant shrews	**43**	**42**
Giant flower, *Rafflesia*	12	12
Computer game	10	10
Films	9	9
Live animals (general)	**8**	**8**
Information about the ToL	7	7
Plants, carnivorous plants	**6**	**6**
Scorpions	**4**	**4**
Uses of the ToL	4	4
Models, displays	4	4
Arachnid animation	3	3

When all live specimens are looked at as an aggregate, (**bold** in table 9) they constitute 60% of what visitors identified as their personal choice of the exhibition's highlight.

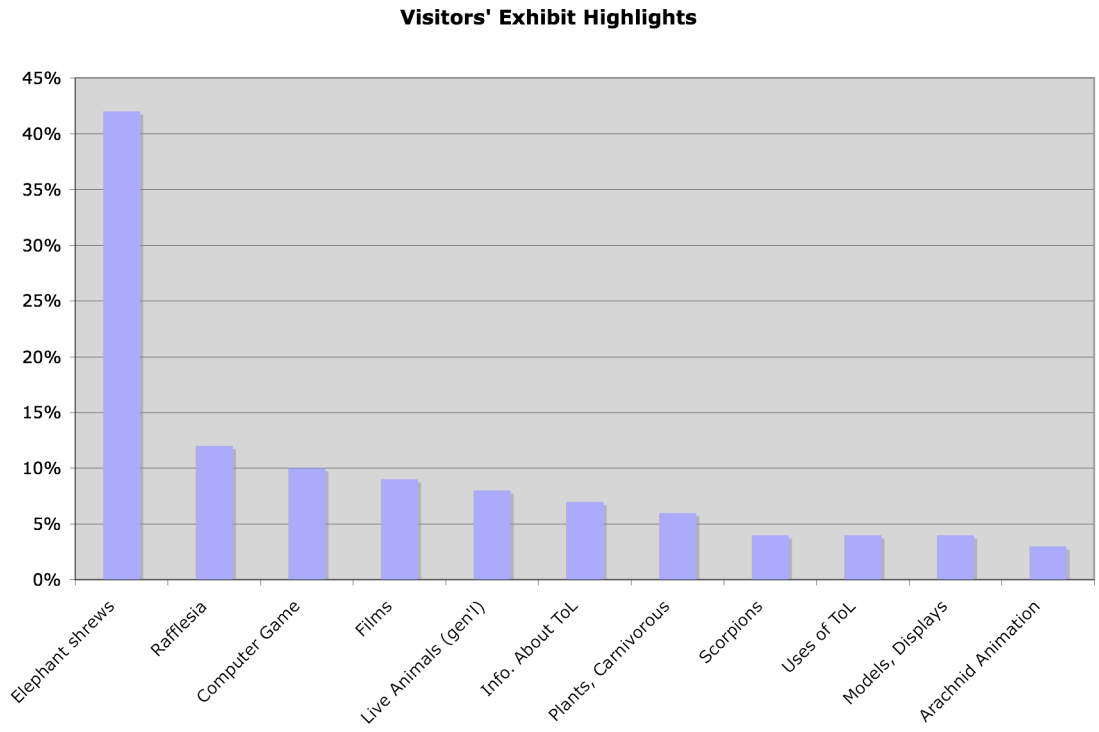
As one might expect from the tracking results, the most frequently mentioned exhibition highlight was the elephant shrews—more than 4 in 10 visitors cited them as their favorite. Perhaps more surprisingly, the *Rafflesia* was cited by a relatively high percentage of visitors. Apparently this stunning model attracted visitors' curiosity and drew them to find out about what they were seeing.

Table 10. Visitors' Reasons for their Choices

Reasons	Frequency	Percent N=98
Did not expect to see live animals in the museum; engaging; cute	28	28
Informative, interesting	22	22
Unique, never saw anything like it	19	19
Fun, good for kids, cool	10	10
Interested in the topic	9	9
Other	11	11

As table 10 indicates, visitors did not expect to see live animals in the museum—and many of them found the elephant shrews irresistibly cute. Visitors cited highlights because they found them informative or unique—"I never saw anything like…."—and because their children were engaged and presumably learning.

Figure 5



Selected comments from the interviews about visitors' favorites follow.

<u>Elephant Shrews</u>

They're the first live animal I've seen [in the museum]. They remind me of extinct animals. Male 10-13

[The highlight was] watching the crickets being fed to the elephant shrews. It's so cool! Female 40-59

It's astounding to think they're related to certain animals. Male 60 and over

Their noses were like fingers—cute. They are different from a lot of animals. Female 40-59

<u>Information about the ToL</u>

[I liked] learning about the concept. Male 60 and over

[The highlight was seeing] the connection of species; it never occurred to me how many things are related somewhere in their evolution. Male 10-13

… the stuff about the poison ivy and the mangoes; I didn't know that poison ivy and fruits could be related. Male 10-13

Rafflesia

[I was interested] because of my trade: I'm a chemist working on perfumes.

It was horrible. Smelly and not very pretty, but so interesting. Female 40-59

I've never seen a flower that big. Female 10-13

Carnivorous Plants

I am curious about how the Venus fly trap traps and eats insects, I have one at home. Male 19-39

They eat insects and things. Female 10-13

Introductory Film

[It achieved its] goal of explanation of subject, it was well produced and pleasing to look at. Male 40-59

It did really well at explaining the basic concepts of the ToL to what's going on now with research. Male 40-59

Uses Film

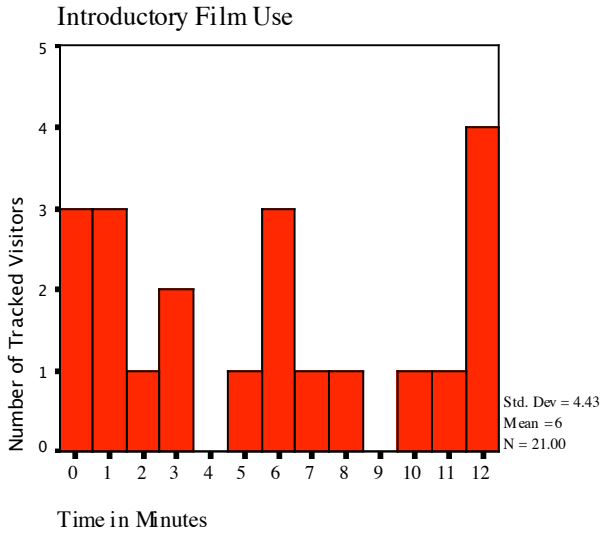
It showed the effects of deforestation. Female 40-59

Media: Tracking and Timing Findings

Media elements were one of the ways the exhibition conveyed its main themes. Immediately outside the entrance, an animated film designed to attract visitors and set the mood looped through images of branching Trees of Life inhabited by attractive organisms. It had no plot and visitors were not expected to watch a full sequence.

Inside the gallery, a 10-minute introductory film presents an overview of the topic.

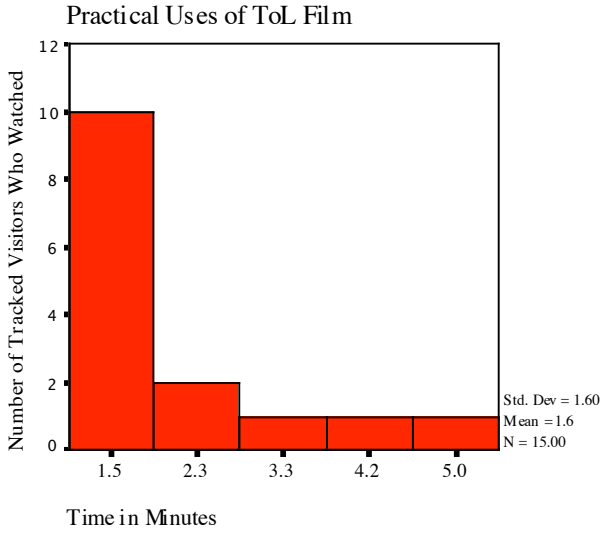
Figure 6



One in 3 tracked visitors (32%) watched the film for an average of 5.5 minutes out of a possible 10 minutes. Visitors' time distribution spent watching the introductory film is illustrated in figure 6.

A 4-minute film showed some of the practical uses for ToL research.

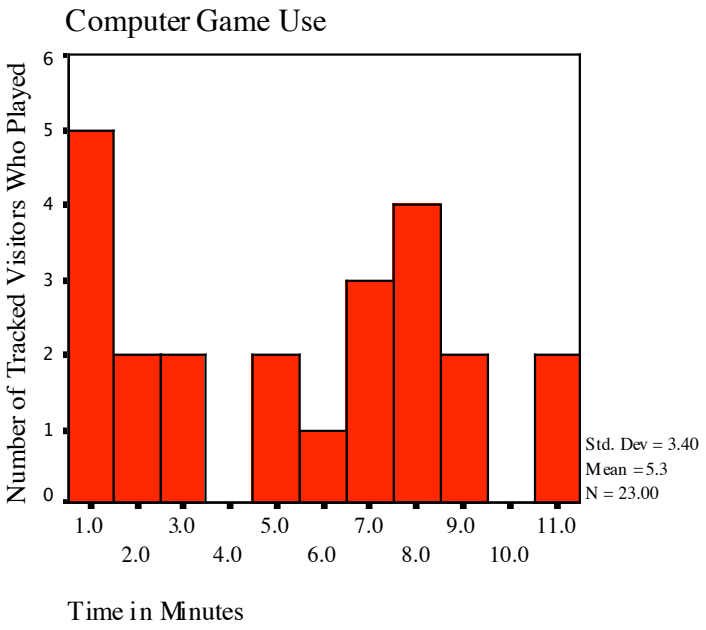
Figure 7



A film outlining practical uses of ToL was shown in an alcove but without a place for visitors to sit. One in 5 tracked visitors (21%) watched the film for an average of 1.6 minutes out of a possible 4 minutes. Visitors' time distribution watching the Uses film is illustrated in figure 7.

A computer game designed for interactive fun, presents the phylogenetic relationships story.

Figure 8



If played straight through, the game requires 5 minutes, but can take up to 10 minutes if the player pursues all the "learn more about" segments. As figure 8 shows, the average time of play was just over 5 minutes and a few people played for as long as 11 minutes.

The data in figure 8 reflect only the 23 visitors who actually played the game (31% of tracked visitors); an additional 11 people watched others play, some for a long enough time to glean the content messages. Children enjoyed playing the game; however, they were by no means the only users. Children 18 years and younger made up 35% of the players, adults 19-39 made up 39% and adults 40-59 constituted 26% of the players.

Responses to the exit interview reflect visitors' level of engagement with the game: many responses that revealed understanding of the exhibition's phylogenetic message included references to the cat, the principle actor in the game, such as "I never knew that cats were related to fungus," or "…that cats are related to so many different species."

Exit interviews reflect a slightly more inflated picture of media use. Respondents were asked to self-report their use of each of the media elements.

Media: Exit Interview Findings

Introductory film

Nearly a quarter (22%) of exit interview respondents said they watched all of the introductory film and another 22% said they watched some of it, for a total of 44%. Just 32% of tracked visitors were observed to watch all or part of the film. Possible explanations for thee discrepancy: 1) visitors saw the film playing as they passed by but were not counted because they did not stop for 2 seconds or longer (the time data collectors were instructed to count "stops"); 2) visitors saw the film playing as they were being interviewed; 3) interviewees wanted to be polite and please the interviewer.

Practical Uses film

Among interview respondents, 18% said they watched all of the Uses film and 34% said they watched some of it, for a total of 52%. Just 21% of tracked visitors were observed watching the film. Again the same reasons could explain the discrepancy, but in this instance watching while moving along would have been even more likely due to the film's location and lack of seating. It would also have been difficult for data collectors to see clearly whether a visitor was looking at the film and not something else, as the film was in an alcove along with several other displays, among them the popular poison ivy/mango exhibit.

Figure 9. Playing the Computer Game

Computer game

Observed behavior and self-report were closer for this component: 34% of interviewees said they played all of it and 16% said they played some of it, totaling 50%. A total of 46% of tracked visitors stopped at the game and 31% played. Some of the interviewees may have been kibitzing while watching others play without actually touching the screen but considered that they were playing as well.

Label Text

Figure 1 on page 5 compares the percentage of visitors who stopped at each exhibit element with the percentage who were observed reading the label. Exit interviews asked respondents to estimate how much they read in the exhibition *overall*— "almost everything," "about half" the available text, "just a little" or "nothing at all."

Table 11. Label Text Read

Amount Read	Frequency	Percent
Almost everything	13	13
About half	39	38
Just a little	42	41
Nothing at all	8	8
Total	102	100

As table 11 illustrates, half the visitors said they read "almost everything" or "about half" the text (13% and 38% respectively, equaling 51%) and half said the read "just a little" or "nothing" (42% and 8% respectively, totaling 49%). Tracking cannot confirm these results because they show only where visitors read at individual exhibit elements. However, anecdotal observation suggests that visitors were quite honest about how much label text they read.

Interviewees were asked if the text was easy or difficult to understand. The vast majority (86%) said it was easy to understand; 4% said it was difficult and 10% said "some of each." Was there too much, too little or about the right amount of text? Just 19% said there was "too much to read" and 4% said "too little." Following the Goldilocks strategy, 77% of the interviewees deemed there to be "about the right amount" of text in the exhibition. Most people seem to believe correctly that in an exhibition they are free to read as much or as little as they like. It is incumbent upon the exhibition developers to create label text panels that visitors want to read. One interviewee commented:

The diagrams were very helpful. I like having more to read. It's nice to have little things like these quotes [on banners at the beginning of exhibit]. Male 19-39

Visitors' Final Thoughts

Exit interview respondents were asked if there was anything they would like us to know about the media exhibit components. The question was misunderstood and respondents commented on the entire exhibition and its components. Among visitors' comments, 72 of them (47%) were a version of "it was all good." Another 8% thought the exhibition was too brief and wanted more, while 17% offered some sort of critique or suggestion. A selection of the suggestions follows; the full text can be read in appendix 3.

All Good

It was a really worthwhile exhibit. Male 40-59

I didn't dislike anything. "Travels in the Great ToL" is amazing as was the one about how bugs change; you can pick and choose, different levels for different ages. Female 40-59

I think it was great. You should keep it. It was really interesting and held our attention. Female 40-59

Other Positive Comments

Computer game is really great. Male 10-13

Good, great way to illustrate science. 40-59

I looked at the computer and it seems really educational. 19-39

Critique or Suggestion

Needs more interaction. Should [have a] walk through evolutionary [time]; [you need] more DNA in the exhibits. Female 19-39

[It would be] nice to have a handout—too much information at once. Male 19-39

The idea of convergence wasn't explained well enough, i.e., looks vs. environmental pressures. 40-59

[There should be a] seat for the [Uses] video near the end. Male 60 and over

The sign on the elephant shrews says what the elephant shrews are not, but not what they actually are. What would have been good is something to say that the museum knows one of the elephant shrews is limping and he's being looked after. Female 60 and over

Should put bilingual signs even if just a summary. 40-59

Discussion and Implications

Primary Learning Goal: Phylogenetic Relationships

In preparation for this exhibition, front-end analysis of visitors' preconceptions[3] revealed that many people interpret the expression, "Tree of Life," as a vague ethical or environmental concept relating to the Bible, biodiversity, the ecosystem, conservation or to the Tree of Life in Disney World. Findings showed that very few people thought of the Tree of Life as a cladogram, a scientific construct. The exhibition has succeeded admirably in redressing these misconceptions. When asked how they would explain what the Tree of Life represents, almost 6 in 10 visitors were able to articulate a reasonably accurate explanation: 39% said the Tree represents relationships between or among organisms, 19% said it represents the evolution of species and others mentioned indistinct connections to "all life" and "where animals come from." This represents a huge advance over front-end findings: more than double the 29% of front-end interview respondents' top of mind association with the ToL as having to do with evolution or the interrelationships of species.

Visitors exiting "Travels in the Great Tree of Life" did not seem to confuse cladograms with timelines nor did they seem to think of them as showing evolutionary "progress" from simple to complex life forms, two other misconceptions found in the front-end study. At no time during the exit interviews did any visitor mention Disney World!

Front-end findings also indicated that most people did not understand how to read conventional scientific Trees. During the exit interview, when visitors were shown a cladogram with three organisms on it and asked, "Does it show that a mushroom or a flower is more closely related to a human?" 78% correctly selected the mushroom and most of them could explain why. For example:

The branch is closer. If you follow the branches down, the flower is further away. 10-13

Front-end audience research revealed that the nodes, or branching points of the cladogram, were not well understood. This topic was not a focus of the exhibition and was not addressed in the exit interviews; findings cannot verify that visitors understood that nodes signify the point of divergence where speciation took place.

[3] Giusti, E. and Scott, M. (2006) "Yale Peabody Museum of Natural History: Tree of Life Visitor Study." Unpublished report.

Participants in the front-end study expressed confusion about the placement of humans on the Tree—several tried to understand how the Tree could be interpreted to illustrate human superiority, or why humans were placed on the same level as a "lower species." The exhibition appears to render moot the notion of human superiority: none of the interview respondents alluded to this when asked which organism on the Tree was closer to the human.

The evolutionary time span was confusing for front-end research participants: those who tried to interpret a cladogram as a timeline could not grasp that both a dinosaur and a human could be at the top of a branch, seeming to exist contemporaneously. Time was not an issue for summative exit interview respondents. To explain why the mushroom was more closely related to the human than the flower, they typically said "It's closer on the branch," or "Its branch is closer." Even though they did not articulate the preferred nomenclature, "recency of common ancestry," their reading of the Tree could be deemed to imply this concept.

Located immediately outside the exhibition entrance, a tactile 3-dimensional model with interpretive graphics and text could have gone far to explain how to read and interpret a scientific Tree. Unfortunately, its placement seemed to inhibit all but 12% of visitors from stopping there. Typically, visitors do not want to linger outside an exhibition—they are eager to see what's inside and tend not to pause at displays outside. One of the main goals of the sculptural Tree was to show people that a cladogram or Tree is actually a 3-dimensional construct. The relationships remain the same no matter how the branches are manipulated in space. The sculpture also addresses visitors' misinterpretation of the 2-dimesional cladogram as a timeline. Displaying the branches in 3 dimensions with species at their tips focuses on the diverging paths of speciation, providing visitors a concrete example of a somewhat abstract construct—recency of common ancestry.

Secondary Learning Goal: ToL Research is Complex and Ongoing

The vast majority of exit interview respondents knew that the ToL is current research: 99% said the ToL is "still growing" as opposed to "basically complete." And 94% of respondents agreed, "The exhibition showed me that new scientific discoveries are being made that change the ToL." Visitors took away ideas about surprising results in the research findings: many of them remarked that they were surprised to learn of the close relationships between cat and fungus or poison ivy and mangoes.

Somewhat fewer visitors expressed understanding of the huge size of the Tree of Life and its complexity that requires a very powerful computer to work on it. Six in 10 interviewees agreed, "The exhibition made me realize that it takes a very powerful computer to work on the ToL," but very few respondents expressed interest in this topic in their open-ended remarks. Information about the complexity of ToL research was displayed in text and graphics on a panel, "Tree of Life: A Monumental Scientific Challenge." Tracking indicates that only 9% of the audience stopped to look at the panel and only 3% read some or all of its text. The panel may be overly text heavy or appear dauntingly technical to visitors. Typically, text panels do not attract visitors unless the visitor is highly motivated and interested in the topic, or the panel contains compelling graphics or embedded objects.

The ToL is itself an abstract idea and abstract ideas typically are difficult to turn into museum exhibitions. The museum has succeeded on the whole in rendering this abstract concept concrete through its use of objects, principally live and mounted specimens. However, conveying the enormity of the ToL and the notion that it is incredibly complex may be beyond the scope of a museum exhibition. Overall, the ToL's revelations about surprising relationships came across to visitors, as did the idea of research in progress. Visitors appear to find both the Great Tree of Life and Travels in it "cutting edge."

Tertiary Learning Goal: Practical Applications

Visitors do not come away with a strong sense of how the ToL can be used by science and society. When asked to name something new they learned in the exhibition, just 6% of respondents cited some of the ToL's practical applications. When asked if they could name any practical uses for the ToL, 75% of the respondents said they could. The most frequently cited benefit (29%), advances in health and medicine, was followed by the helping the environment and conservation (15%) and food and agriculture (5%). A few people mentioned an interesting social application for phylogenetic research: the ToL could help with race relations because it shows that we are all related.

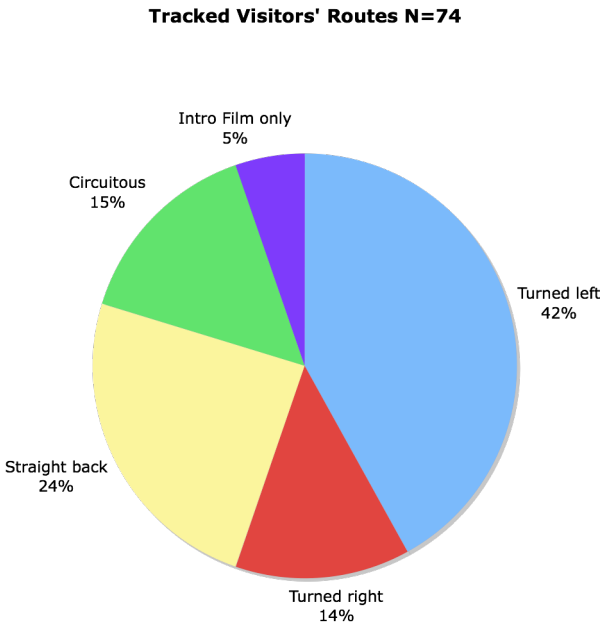
Somewhat disappointingly, almost half (47%) respondents' top of mind ideas were similar to front-end findings: people still seem to believe that the primary purpose of Trees is to advance scientific knowledge and education. The "Uses" film offered a number of interesting practical applications, but only 21% of tracked visitors stopped to watch it and only briefly. A place to sit might encourage more viewers, but the alcove where it was shown is a bit cramped for a bench. The wall panel that gave further details about practical applications attracted 1 in 4 tracked visitors and half that number appeared to read any of it.

Compared to the other two, this learning goal was less effectively conveyed by the exhibition. There were many complex scientific ideas to cover in very few square feet. The film on its own may convey the point about practical applications. If media elements are to be distributed after the exhibition closes, evaluating the Uses film's impact on audiences apart from the exhibition might be worthwhile.

Additional Considerations

"Travels in the Great Tree of Life" was not designed to be experienced sequentially. Visitors can move through the 1000-square-foot exhibition space, stopping where they see an exhibit element that attracts their attention in no particular order and nonetheless come away learning about phylogenetic relationships. The conventional wisdom says that visitors typically turn right upon entering a gallery and continue along the walls until they come to the exit. In "Travels in the Great Tree of Life" more visitors turned left (42% of tracked visitors) than right (14%). A number of them (24%) marched straight back to the elephant shrews or computer game (they may have been returning or knew where they were going), 15% moved back and forth and in circles and 5% departed after watching only the introductory film. Figure 10 illustrates the distribution of pathways; Appendix 4 contains examples of each type. Turning left is not surprising in this exhibition because that is where the sight lines leada. To the right, one cannot see past the wall where the ToL animated film sequence is shown, not a circumstance that would draw visitors in that direction.

Figure 10



The *Albertosaurus* skull with a hummingbird suspended between its jaws had surprisingly little impact on visitors. Although it occupied a case in the very center of the exhibition, just 1 in 4 tracked visitors stopped at it, and half that number read about it. Interviewees were more surprised by the less prominently placed poison ivy/mango relationship and the cat/mushroom relationship in the computer game than about the dinosaur/hummingbird tie. When asked if they agreed or disagreed that "The exhibition illustrates that a dinosaur is more closely related to a hummingbird than to a crocodile," only 55% of interviewees agreed and the rest either disagreed or were not sure. The label placement made for difficult reading, but one cannot ensure that relocating it at a more accessible height would have made a difference.

Displays placed in the center of a gallery are often overlooked as visitors skirt the walls, and this seems to have occurred with the *Albertosaurus* and hummingbird. The pitcher plants, seemingly much less compelling than the giant dinosaur skull and tiny hummingbird within it, were mentioned frequently in interviews, while the dinosaur display was virtually ignored.

The interactive computer game was highly effective in engaging visitors (1 in 3 used it and the average use time was more than 5 minutes, sufficient to complete basic play). Exit interview responses indicated that people who played or even watched others play took away the exhibition's main idea about phylogenetic relationships: they are not always as they appear. Visitors had fun and learned, a good combination of affective and cognitive impact.

Live animals were a huge success, particularly the elephant shrews, with tremendous affective impact. Did they advance the exhibition's main message about phylogenetic relationships? To a degree, and one can infer from the number of visitors who stopped at the adjacent aardvark display that the phylogenetic connection was noted. For example, "It's astounding to think [the elephant shrews] are related to certain animals" (Male 60+). The elephant shrews undoubtedly lengthened the dwell time for many visitors, providing greater opportunity to encounter and grasp the main idea.

The exhibition employed a variety of cladogram formats, from the free-flowing, organic trees in the animation and graphics to the angular V-shaped branching in the label (figure 3), the right-angled model in the 3-dimesional sculpture (on the cover) and even the mammoth round version in the "Challenge" panel. Visitors were able to learn that Trees are simply a way to visualize relationships and not an end in themselves.

Appendix 1. Demographic Data

Interview Respondents

Table 12

Gender	Frequency	Percent
Female	49	48
Male	45	44
Missing data	8	8
Total	102	100

Table 13

Age	Frequency	Percent
10-13 years	18	18
14-18 years	5	5
19-39 years	40	39
40-59 years	28	29
60 plus years	9	9
Missing data	1	1
Total	102	101*

*Percents add up to >100 due to rounding.

Table 14

Residence	Frequency	Percent
New Haven area	41	40
Other Connecticut	39	38
Other USA	18	18
International	3	3
Missing data	1	1
Total	102	100

Table 15

Visiting…	Frequency	Percent
Alone	10	10
With family	79	78
With friends	13	13
Total	102	101*

*Percents add up to >100 due to rounding.

Table 16. How well informed are you about scientific discoveries and technology?

How informed	Frequency	Percent
Very well informed	30	29
Moderately well informed	59	58
Poorly informed	10	10
Missing data	3	3
Total	102	100

Table 17

Special Training in Science	Frequency	Percent
No	66	65
Yes	35	34
Missing data	1	1
Total	102	100

Table 18

Highest level of education completed	Frequency	Percent
Middle school	9	9
High school	6	6
Some college	13	13
Bachelor degree	27	27
MA/PhD/Professional degree	34	33
Missing data	13	13
Total	102	101

*Percents add up to >100 due to rounding.

Table 19

Grade just completed	Frequency	Percent
3rd – 6th grade	14	74
7th – 11th grade	5	26
Total	19	100

Tracked Sample

Table 20

Gender	Frequency	Percent
Female	33	45
Male	39	53
Missing data	2	3
Total	74	101*

*Percents add up to >100 due to rounding.

Table 21

Age	Frequency	Percent
10-13 years	6	8
14-18 years	3	4
19-39 years	19	26
40-59 years	37	50
60 plus years	8	11
Missing data	1	1
Total	74	100

Appendix 2. Data Collection Instruments

Exit Interview

Hello. We are asking people today about what they thought of Travels in the Great Tree of Life, *the exhibition you just left. There are no right or wrong answers, just your opinions. Your answers will be completely anonymous. It will only take about 5 minutes and you will really be helping the museum.*

1 Did you come to the museum today particularly to see *Travels in the Great Tree of Life*? __No __Yes
If yes: Do you remember where you heard about it? __No __Yes: Can you tell me where:

__Personal recommendation __In the Museum __Internet __Other:_____

2 When you tell a friend or family member about this exhibition, how would you explain what the ToL represents?

3 (*Show cladogram)* Here is a diagram showing a small part of the scientific Tree of Life. Does it show that a mushroom or a flower is more closely related to a human? __mushroom __flower; How can you tell?

4 I am going to read you pairs of words; please tell me which of them you think applies to the ToL. If you are not sure, just let me know.

__Old technology or __Cutting edge __Not sure
__Still growing or __Basically complete __Not sure

5 What was the highlight of the exhibition for you? (What part did you like best?)

5a Why did you like that?

6 Did you see anything in the exhibition that surprised you? __No __Yes:
6a What was it?

6b Why did it surprise you?

7 Please tell me if you agree or disagree with the following statements. If you are not sure, let me know.

	Agree	**Disagree**	**Not sure**
The exhibition showed me that new scientific discoveries are being made that change the ToL.			
The exhibition made me realize that it takes a very powerful computer to work on the ToL.			
The exhibition illustrates that a dinosaur is more closely related to a hummingbird than to a crocodile.			

8 Can you think of any practical uses for the ToL? __No__Yes:
8a What are they?

9a Some people like to read about the exhibits, some don't. About how much did you read in this exhibition? (*Interviewers read choices)*:

__Almost everything __About half __Just a little __Nothing at all

9b *If visitor read anything:* Was the writing easy or difficult to understand? *(Interviewers do <u>not</u> read choices)*

__Easy __Difficult __Some of each

9c Do you think there was too much to read, too little or about the right amount?

__Too much __Too little __About right

10 We would like to know if visitors watch the videos or use interactive computers in the exhibition:

10a Did you watch the film at the <u>beginning</u> of the exhibition? __Yes, all of it __Yes, some of it __No

10b Did you watch the video about <u>uses of the ToL</u>? __Yes, all of it __Yes, some of it __No

10c Did you use the interactive computer <u>game about the cat</u>? __Yes, all of it __Yes, some of it __No

10d Is there anything you would like us to know about any of those exhibit elements, either good or bad?

11 Could you tell me one thing you learned in this exhibition that you didn't know before?

Now something about you so we can know our visitors better:

Respondent is __Male __Female

<u>Your age</u>	<u>Your Residence</u>	<u>Are you visiting…</u>
__10-13 __ 14-18	__ New Haven area __Other Connecticut	__ Alone
__ 19-39 __40-59	__ Other USA:	__With family
__ 60 and over	__ International:	__With friends
How many children under age 18 are with you today? Ages:		
Do you feel very well informed, moderately well informed or poorly informed about scientific discoveries and technology? __Very well informed __Moderately well informed __Poorly informed		
Do you have special training in science? __No __Yes Please specify:		

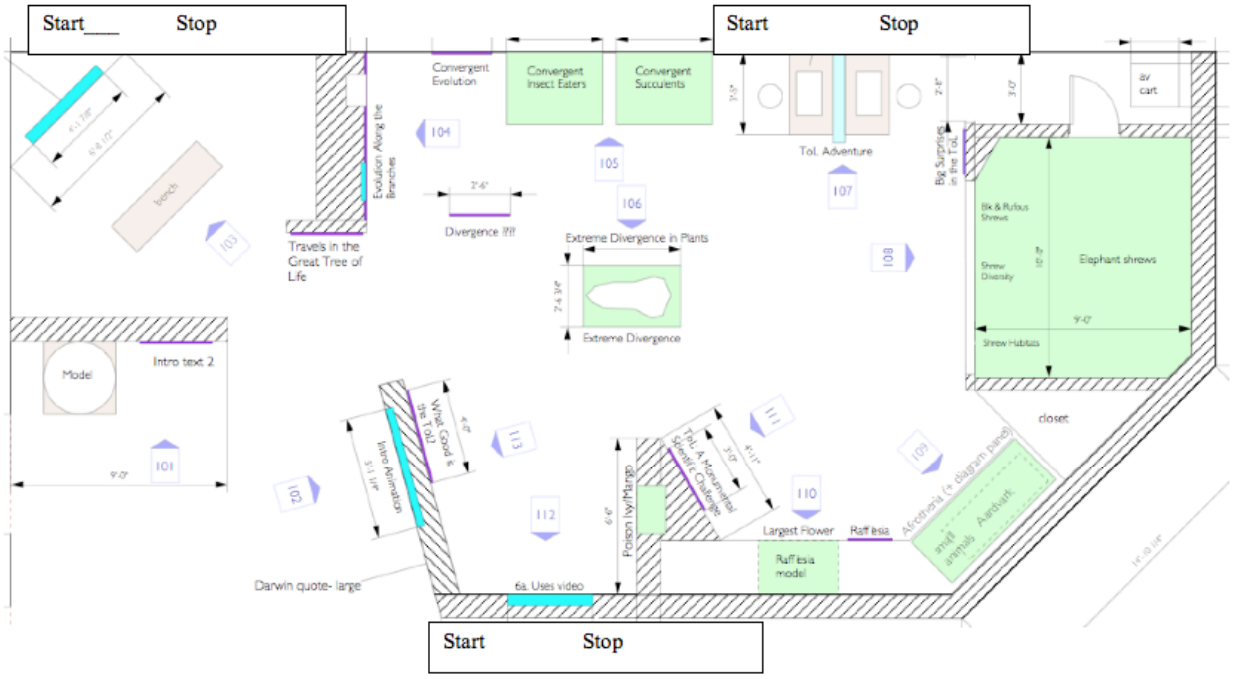
What is the highest level of formal education you completed or the grade you just completed"

❑ Middle school ❑ High school ❑ Some college ❑ Bachelor's degree ❑ MA/PhD/Professional

❑ Grade just completed: _____

Thank you very much for your time and your ideas

Travels in the Great Tree of Life Tracking Form



X=stop R= read W=watch U=use

__Male __Female

Age

__10-13 __14-18
__19-39 __40-59
__60 and over

Total Time:

Tracker name:

Date:

Appendix 3. Interview Transcripts

Question 2. How would you explain [to a friend or family member] what ToL represents?

Relationships between/among species

Animals related to other animas, dinosaurs. Male 19-39
Like a Buddhist concept where everything is related and connected. Male 40-59
How branches of life all the way from DNA to mammals and plants are connected. Male 40-59
All of life from plants to animals. Female 40-59
The arrangement of all life. Male 19-39
How everything is related. Female 19-39
How things are related to each other. I never would have suspected some of the relationships. Female 19-39
Different living things depending on each other to make up the world. Male 10-13
How different things are related. Male 10-13
Structural explanation where everything goes and how it's all related. Male 19-39
All species by some point are related but not those you might expect to be. Male 10-13
Demonstration of life on Earth interrelated. 14-18
Interconnections with all living plants & animas on Earth. Female 19-39
It gives greater understanding of connectiveness with all life on earth. Female 40-59
It represents the whole world, different species and how they connect. Female 40-59
Interconnectedness of all life forms and how they're descended and related. Male 40-59
Illustrates at some point in past all things came from common ancestor. Male 40-59
Building stones of life and evolution and relationship between species. Male 60 and over
The cat. How everything is related, the basis of all life. Male 60 and over
The relationship between the origin of all species. 10-13
How animals are related. Male 10-13
Nature and how things have unexpected relatives. Female 10-13
The most fascinating thing (about the ToL) is that cashews and poison ivy are related. Female 19-39
How things are related from old to now. Female 19-39
Our history of plants, animals, and how they're related. Male 40-59
The ToL represents cycles of how things are related. Male 10-13
It explain different forms of life, different ways of evolution, everything is how connected to each other. Female 19-39

Evolution

Shows where animas came from. Male 10-13
Graphic representation of evolution. 40-59
Biodiversity, evolution of a species. Male 19-39
It explains the descendants of species. 19-39
From the beginning of time, how things have evolved, new discoveries are being made. Female 40-59
The evolution of all things from a common ancestor. Female 19-39
How you can trace back all the species. Female 40-59
The ToL is a system to record the ancestry of all types of life on the planet. Female 14-18
A way of organizing living things and how they evolved. Female 60 and over
Shows evolution origin / shows genetic similarities with us & other animals. Female 19-39
Show evolution of species & hierarchy of creatures. Male 19-39

Diversity
Botanical - varieties of plants. Female 40-59
Something that people should be award of—the biodiversity of our planet. Male 19-39
A lot of variety, so much still to learn. Female 40-59
Shows good diversity of species in clear way. Female 19-39

Other
How the branches are closer to each other, and how you follow them all the way down. That it is good and they should come see it. Female 14-18
How things are made, genetics are formed. Male 10-13
Have to see shrews, they are worth the whole visit. Female 40-59
Interesting - something you don't think about. Female 40-59
Life. Female10-13
The basics of all life, all being. Female 14-18
Development of animals. Male 19-39
Mostly history. Female 40-59
The ToL is impressive, it is a picture (of life) it includes elephant shrews. Male 14-18
Most of the arachnids (spiders & scorpions) started from the same life form and then became so different. Male 40-59
Great discoveries about life. Female 19-39

Question 3. Does the ToL show that the mushroom or flower is more closely related to human? Why?

Mushroom is closer, on same branch
Line is closer to baby. Male 10-13
Branch is closer Male 40-59
Branch is closer. If you follow the branches down the flower is further away. 10-13
Mushroom closer to us - closer to baby. Female 19-39
Branches later than the flower branches. Male 19-39
Fungus is related to cat. Cat is related to us. Male 10-13
Fungus is more closely related to a human - common ancestors along the ToL. Female 19-39
Nothing connecting between the mushroom and the human, but the mushroom is between the flower and the human. Female 10-13
The split between mushrooms and humans occurs later than the spilt between flowers and humans. 10-13
I looked at the thing with the cat and it (the cat) was related (to the mushroom). Male 19-39
Higher level in Tree of Life. Male 14-18

Flower is more closely related to human than mushroom
She likes flowers and would prefer to think they are more closely related. Female 60 and over
Because it is smooth. Female 19-39
They have some cells in common. Male 40-59
The mushroom more organic and the lily has no roots and it is water and land based. Male 40-59

Right answer, wrong reason
Mushroom is more simple, not as complex as the flower. Female 40-59
It's alive and it's a fungus. We have fungus in us. Male 10-13
More complex being. Male 60 and over
The molecules are shaped like ours Female40-59
People eat mushrooms. Male 19-39
Genetically we're from the same amoeba. Male 10-13
The baby's head is a circle and the mushroom is a circle. Female 10-13

Question 5a. Why did you choose that [highlight]?

Elephant Shrews
They are the first live animal seen/reminds him of extinct animals. Male 10-13
Got grandson excited. Male 40-59
I like animals and I had a scorpion. Male 10-13
Watching the crickets being fed to the elephant shrews, it's so cool. Female 40-59
Look like half rat, half possum, half deer, half mammal. Male 10-13
Shrews - thought they were pictures or skeletons, watching their behavior. Female 40-59
Dino & bird - very dramatic getting its point across. 14-18
Live animals great for kids - intro video very informative. Male 19-39
Astounding to think they're related to certain animals. Male 60 and over
Adorable, don't look real. Female 19-39
Noses were like fingers - cute - (different from a lot of animas). Female 40-59
Thought they were dead (extinct). Male 10-13
They are interesting and live in such a small space. Female 40-59
I had never seen them before. They seem like an interesting species. Male 19-39
They're adorable. Female 19-39
They're fascinating. Female 60 and over
Their interaction with each other as brothers. Male 19-39

Rafflesia
Because of my trade, chemist working on perfumes.
Never saw anything like it. The size and how they must smell. Female 40-59
It was horrible. Smelly and not very pretty, but so interesting. Female 40-59
I've never seen a flower that big. Female 10-13

Information about the ToL
[I liked] learning about the concept. Male 60 and over
[The highlight was seeing] the connection of species; it never occurred to me how many things are related somewhere in their evolution. Male 10-13
[The highlight was] the Tree itself: understand relationships of living creatures today that you would never consider alike. Female 40-59
…finding out how many species there are (in the ToL). Male 60 and over
…the stuff about the poison ivy and the mangoes; I didn't know that poison ivy and fruits could be related. Male 10-13
…how the animals that we see everyday are related; their evolution is very interesting. Male 19-39

Question 8a. Practical applications of the ToL

Education
Gene mapping Male 40-59
The foundation of all life. Male 19-39
Relationships and evolution of plants and animals. 19-39
Classroom applications. Female 40-59
Exploration of more animals and flowers around the world - which will get more knowledge for scientists. Male 10-13
How things are related to each other. Male 10-13
Curiosity about animals Male 19-39
Learn evolution of various plant & animal life. Male 10-13
Micro biology used everyday in science. 14-18
Research on a comparable relatives if needs to be done with similar results. female 19-39
Makes species more real. Identify w/changes in world - global warming great to teach evolution. Why earth in condition. Female 19-39
School systems, good for education. Male 19-39
People to understand inter relatedness of species. Male 40-59

Health and medicine
Disease - tracking them and possibly curing people. Female 19-39
Medicine & other things related to biogenetic project. Antivenin can be developed from related organisms. Male 19-39
Genetics, disease cures for the future . Female40-59
Antivenin discoveries and virus cures. Male 19-39
Help fight disease & extinction (might be able to solve this problem). Female 40-59
Use for cures of diseases. Relationships with animals. 60 and over
How to cure diseases. Female 40-59
Tracking growth of disease. Female 19-39
Improved quality of life for human etc. Female 40-59
Cure for cancer. Male 40-59

The environment
Future of environment. Male 19-39
Save environment. Female 19-39
Preserve what's here on earth now. Female 40-59
Save environment. Female 19-39
Work on saving endangered species and bring them back. Medical research. Male 40-59
As a way to be more connected to our world. Female 19-39

Food and Agriculture
Develop more food & fuels. Female 60 and over
Food use throughout the world. Female 40-59
Genetically modified crops. 40-59
Use plants that eat insects in heavy insect areas. Male 19-39

Question 10d. Is there anything you would like us to know about any of the exhibit elements, good or bad?

All good

No, nice setup, nice display. Male 19-39
Everything was excellent. There's always room for learning. Female 40-59
Good mix of all elements - great for children. 19-39
Great, lighting and everything Male 19-39
Impressive Female 19-39
Good exhibit all in all Female 19-39
Visually striking. 60 and over
Good - very well done, compact Female40-59
Good - learned more Female 40-59
Good overall Male 19-39
Diversified, superb job. Female 40-59
It was a really worth while exhibit. Male 40-59
Really cool - organization of Tree itself (its shape). Male 40-59
Really like layout, not overwhelming. Female 40-59
I didn't dislike anything. Travels in the Great ToL amazing as was the one about how bugs change you can pick and choose - different levels for different ages. Female 40-59
I think it was great. You should keep it. It was really interesting and held our attention. Female 40-59
It was interesting Female 19-39
All very impressive Male 19-39
Well presented Female 40-59
It was good. I liked it all. Female 19-39

Critique or suggestion

Need more interaction. Should walk through evolutionary more DNA in exhibit. Female 19-39
Game - too much noise. Male 40-59
Nice to have handout - too much info at once. Male 19-39
The idea of convergence wasn't explained were enough. Convergence wasn't explained well enough i.e. Looks vs. Environmental pressures. 40-59
Seat for the video near the end. Male 60 and over
It'd be better if you could play the video games yourself. Female 14-18
I wish the videos could stop and start on our own. I wish after a few seconds the cat game would go back to the title screen. Female 14-18
Sign on the elephant shrews says what the elephant shrews are not, but not what they actually are. What would have been good is something to say that the museum now one of the elephant shrews is limping and he's being looked after. Female 60 and over
That cats and mushrooms are related. That house cats are closer to cheetahs than mountain lions. Female 40-59
Too slow interactive computer game - her 12 year old was bored with it. Female 19-39
The "phylogenic relationship" exhibit is generally skipped. Perhaps it could be worked into the exhibit instead of being walked past on an outside wall. 40-59
Should put bilingual signs even if just a summary. 40-59

Other positive comments

I like the Venus fly traps and stuff. You have to follow the branch all the way down. 10-13
Very cool having all the live things - animals and plants. Male 40-59
Like pitcher plants. Female 19-39
Layout good, scorpions alive and so close = good. Male 19-39
Computer game is really great. 4 stars out of 5 for displays. Male 10-13
Shrews are awesome. If movies are long or games are slow people feel rushed and leave before they're done. 10-13
Pretty cool esp. Live animals. Female 40-59
Good, great way to illustrate science. 40-59
I looked at the computer and it seems really educational. 19-39
Daughter liked shrews.
I feel bad for the cricket that the scorpion will eat. 19-39
Shrews. Female 40-59
Best elements: shrews, scorpion, plants. Nice to have live exhibits. Female 19-39

Exhibition smaller than expected

It was smaller than expected. Female 40-59
Too small, not enough, more fossil use. Female 40-59

Question 11. One thing learned in the exhibition you didn't know before

I learned so much. I knew nothing about it [before]. Female 14-18

<u>About current research and the ToL</u>
[I learned that] ToL existed. Male 10-13
HIV, fungus – I didn't know they could trace their evolution. Female 19-39
Its existence. I didn't realize ToL was an ongoing study. 19-39
Explore new species is an ongoing study. Female 40-59
Can find anything as long as someone is willing to study it Female. 60 and over
Pretty much study this all the time like we are spreading the info. 14-18
Tree of Life (didn't know anything about it). Female 19-39
Research didn't know so many people were doing research. Male19-39
That we only think we know ~20% of all life on earth. Male 40-59
I didn't know how much there was still to categorize (regarding life on our planet) . Female 60 and over
Whole concept was new to her. Female 19-39

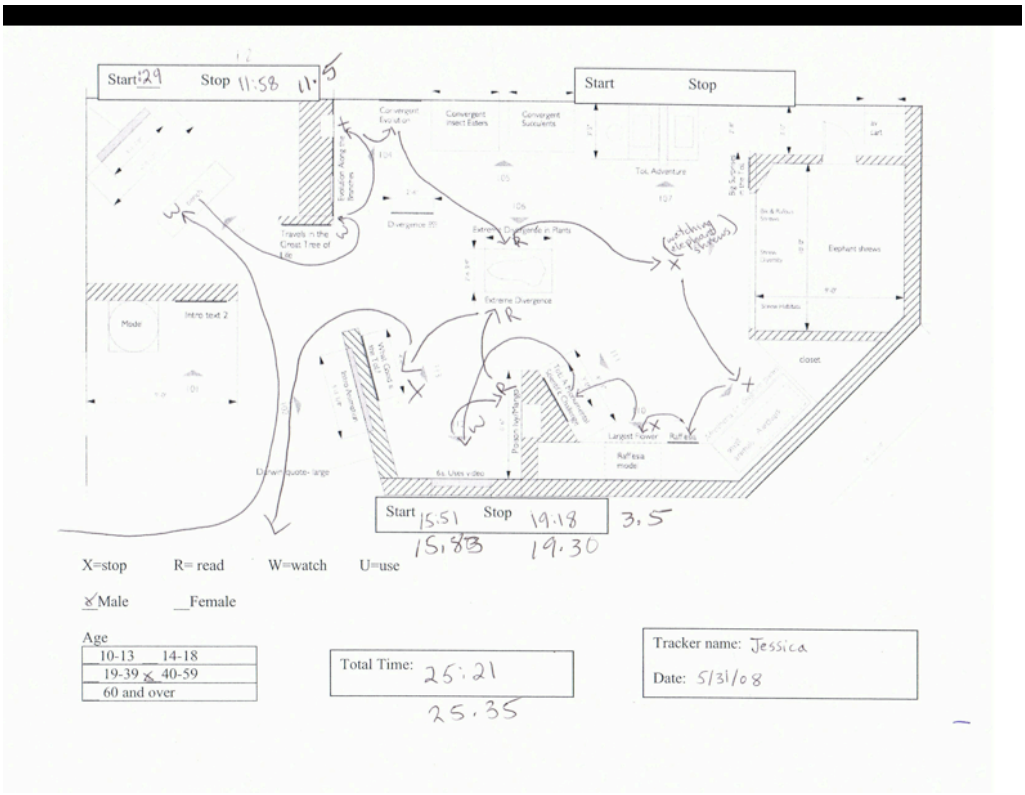
<u>About organisms' relationships you wouldn't expect, evolution</u>
Cat is closer to mushroom than flower. Male 10-13
Did that the cat is related to mushroom. Male 10-13
Dino & bird related & domestic cat related to many other animals, more than he thought. Male 19-39
That cheetahs are more related to babies and stuff. 10-13
Cat related to mushroom. That's just wild. Male 19-39
Cat is more closely related to a fungus than a plant. Male 40-59
That dinosaurs are related to so many things like birds. Female 40-59
Cats are more related to starfish than octopus. Male 10-13
More animals are related to the cats than he thought . Male 10-13
Lineages of certain animals. Female 40-59
All things connected in some way even though they are so different. Male 10-13
How some animals are connected. Female 19-39
Close relations between many living creatures. Female 40-59
All the unusual relationships with life. 60 and over
How things unalike are related to each other. Female 40-59
How people are connected to species you wouldn't think were connected. Female 40-59
Bird/human arm. Male 40-59
Shrew - didn't know who they were related to. Male 60 and over
Aardvark is related to elephant. Male 19-39
Cat & mushroom. Female 40-59
Lots of those relationships that were bizarre. I suppose the huge distance of time has let a lot of weird things happen. Female40-59

Facts about animals and plants
Shrew (that it existed) Female 40-59
About spiders. I really liked the way it was presented. It was illuminating. Male 40-59
That the cat was more closely related to a mushroom. Female 40-59
How big the flower was. Female 60 and over
That elephant shrews existed. Male 40-59
Insectivorous plants, had never seen before. Female 19-39
Pitcher plants evolved separately on different continents. Female 19-39
Whip scorpion is not venomous. Male 19-39
That shrews exist. Male 10-13
That there are such things as elephant shrews. Female 40-59
Relationships plants have to each other. The *Rafflesia* especially was very unique. Female 19-39
Mangos & poison ivy Female 40-59
Pincher (*sic*) plants, never heard of them. Female19-39
Different plants. Female 19-39
Shrews exhibit and man-eating plant. Male 40-59
The flower was new to me. It was interesting that it's a parasite. Male 19-39
Shrews going extinct (she heard of shrews before). Female 19-39
Never seen shrews or known about their existence. Female 40-59
That plants eat insects. Male 19-39
That elephant shrews were neither elephant nor shrew. Female 19-39
Existence of shrews. Male 19-39

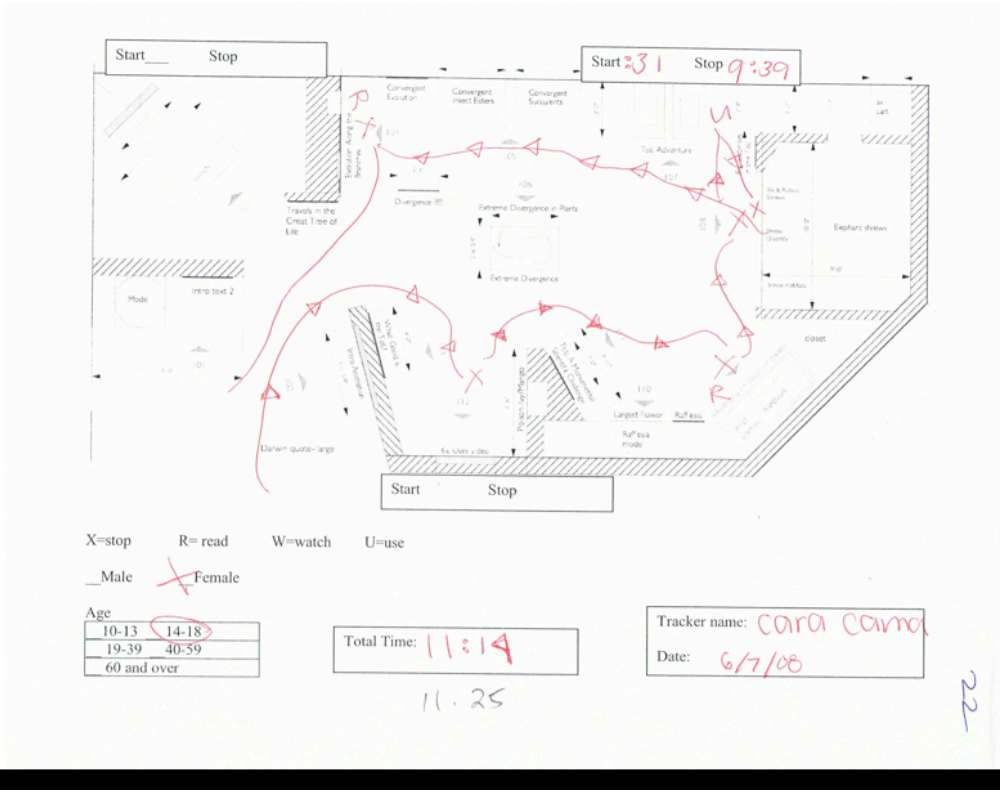
"Other" learning
Did not know # of species in world. Male 40-59
I was not aware of Darwin's statement about it. Male 60 and over
We've been here lots and we've learned lots. Female 19-39
Learned about different antivenin. Male 19-39
Uses of Tree of Life for viruses and anti venoms. Male 19-39
I'm a scientist, but I didn't know all the applications of biodiversity. I didn't know how it was being used. Male 19-39
Snake. Look into genes to find bite antivenin which snake is related. Female 19-39

Appendix 4. Examples of Tracked Visitors' Pathways

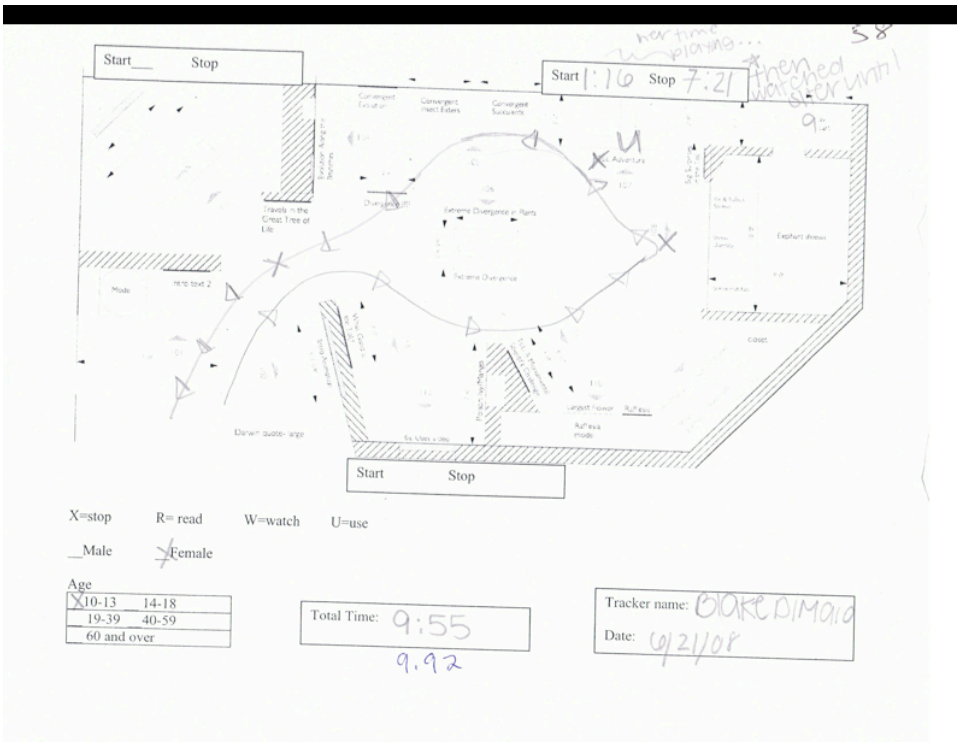
Left Turn



Right Turn



Straight Back



Back and Forth