

Amoeba on the Axiovert Standalone (with XYZ Control and Media)

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February 2003

THIS IS NOT A DEFINITIVE FINAL REPORT

FORMATIVE evaluation studies like this one often:

- **are conducted quickly**, which may mean
 - small sample sizes
 - expedited analyses
 - brief reports

- **look at an earlier version** of the exhibit/program, which may mean
 - a focus on problems and solutions, rather than successes
 - a change in form or title of the final exhibit/program

Microscope Imaging Station – Formative Evaluation **Amoeba on the Axiovert Standalone** **(with XYZ Control and Media)**

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PURPOSE

This study looks at visitors' experiences at the first prototype of a standalone Axiovert station with the specimen, amoeba. Specifically, it determines baseline information about:

What visitors do

- how long visitors stay (holding time)
- if visitors use the joystick and knob controls (to move and focus, respectively)
- if visitors can find a specimen to look at

What visitors look at

- on the main viewing monitor
- on the accompanying media piece
- if visitors notice the microscope behind the glass

What visitors thought

- how interesting visitors found the experience
- questions visitors have about their experience
- what connections visitors made between the microscope and the image they saw
- what visitors remembered seeing

SETUP

The equipment configuration is shown in Figure 1 and described in more detail in Appendix A.

Figure 1. Standalone exhibit setup



METHOD

- Observations:
 - An evaluator sat 15 feet away from the stand-alone station and observed visitors as they used the exhibit. If visitors came in a group, the first visitor to stop was observed. The evaluator noted when a visitor stopped at the exhibit, when s/he looked at the main monitor, the media monitor, and the microscope, and when that visitor left the exhibit. Demographic information was also noted.
 - A video camera was set up to record what visitors were looking at on the main monitor.
 - Adrian Van Allen created a tracking program to log what media screens visitors were looking at on the media piece.
 - The above three data types were then coordinated to determine what a visitor did and saw at the standalone based on a common clock. (The clocks used by the evaluator, the video camcorder, and the tracking software were synchronized to each other before each day's observation.)
- Uncued Interviews
 - When possible, a visitor whom we just watched was then approached and asked a series of questions about the experience and about what s/he saw. These questions are in Appendix B. We selected visitors to interview based on age (must be 8 or above) and holding time (must be longer than 15 seconds).

DATA COLLECTED

- Times. Data were collected during these days:

Day	Date
Thursday	2/13/03
Monday	2/17/03
Saturday	2/22/03

- Demographics

Gender	Count
Male	34
Female	25
Total	59

Age Group	Count
Under 8	13
Child	13
Teen	7
Adult	26
Total	59

FINDINGS

What did visitors do

How long did visitors stay at the exhibit?

- Figure 2 shows how long visitors stayed at the exhibit.

Figure 2. Histogram of the holding time for this exhibit. $N = 59$, Mean = 100 seconds, Median = 81 seconds, Maximum time = 363 seconds.

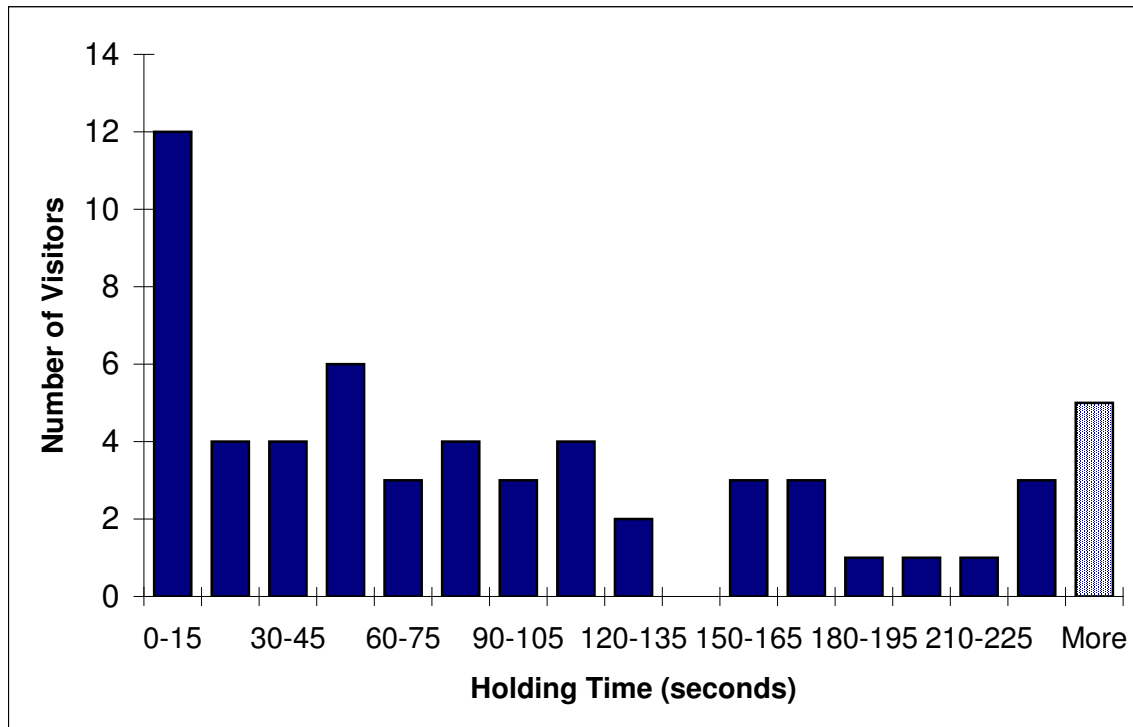


Table 1. Holding time according to age group

Age Group	Count	Mean Holding Time (seconds)	Median Holding Time (seconds)
Adult	26	131	109
Teen	7	80	37
Child (8-12)	13	75	58
Under 8	13	78	46

- Adults tend to stay longer than children and teens¹. That is, there is a significant difference between:
 - Adults and children; $t(37) = 2.507, p = .017 < .05$
 - Adults and children under 8; $t(37) = 2.083, p = .044 < .05$
 - Adults and teens; $t(31) = -1.943, p = .061 \sim .05$
- There is no detectable difference between the other age groups¹.
 - Teens and children; $t(18) = .152; p = .881 > .05$
 - Teens and children under 8; $t(18) = -.196, p = .847 > .05$
 - Children over and under 8-years; $t(24) = -.419; p = .679 > .05$
- There is no statistical difference between gender groups¹, $t(57) = .132, p = .896 > .05$

Microscope control

- 95% (56/59) visitors used the joystick to move the stage
- 85% (46/59) visitors used the focus knob to focus on a specimen

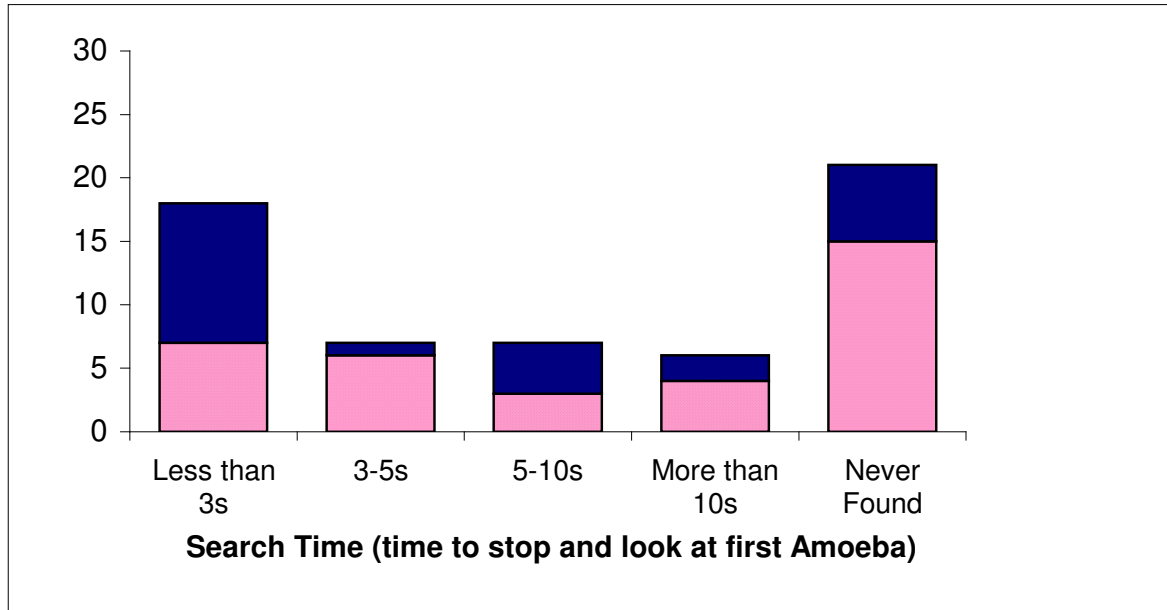
Finding a specimen

In this analysis, finding a specimen means that the visitor stopped and looked at an amoeba for 3 seconds or more. Scanning past an amoeba does NOT count as finding that amoeba.

- Figure 3 shows how long it took visitors to find their first amoeba.

¹ The statistical test was performed on ln-transformed data, which passed the one-sample Kolmogorov-Smirnov test for normal distribution.

Figure 3. Search Time



- 64% (38/59) visitors managed to find an amoeba to look at.
 - 31% (18/59) visitors found their first specimen within 3 seconds.
 - 43% (25/59) visitors found their first specimen within 5 seconds.
 - 54% (32/59) visitors found their first specimen within 10 seconds.
 - 10% (6/59) visitors took more than 10 seconds to find their first specimen.
- All the visitors who found an amoeba were able to focus on an amoeba.
- 36% (21/59) visitors never stopped and looked at an amoeba.
 - We were curious as to what, if anything, these visitors were looking at on the main viewing monitor. We found that
 - ♦ 7/21 got lost off the slide (The search area for the amoeba is circular whereas the xy limits are set for a rectangular search area. It is, therefore, possible to wander out of the search area.)
 - ♦ 4/21 passed over an amoeba without stopping
 - ♦ 4/21 had a chilomonas in view and may be looking at that and 2/21 chased a chilomonas around on the slide.
 - ♦ 3/21 spent 5 or less seconds at the exhibit
 - ♦ It is not clear from the data what four visitors who did not find an amoeba were looking at, if anything.
 - Table 2 shows, according to age group, the number of visitors who found an amoeba.

- ◆ There is a significant difference in the percentage of visitors who were able to find an amoeba between adults and children (between 8 – 12); Fisher's Exact Test, $p = .033 < .05$.
- ◆ There is no significant difference in the percentage of adults, teens, and children under 8 who were able to find an amoeba; Fisher's Exact Tests; $p > .05$

Table 2. Tally of the Number of Visitors who found an amoeba to look at

	Adult	Teen	Child	Child under 8	Total
Found	20	5	5	8	39
Not Found	6	2	8	5	20

- ◆ There is a significant difference in holding time between those visitors who found an amoeba (mean time = 120 seconds; median = 102 seconds) and those who did not (mean time = 66 seconds; median = 21 seconds)²; $t(57) = 4.068$, $p = .00 < .05$. Those who found an amoeba stayed longer at the exhibit.
- ◆ Visitors who found an amoeba were more likely to also have looked at the media piece compared to those visitors who did not find an amoeba. See Table 3. Fisher's Exact Test; $p = .000 < .05$. Furthermore, there is a significant positive correlation between looking at the media piece and finding an amoeba; Cramer's $V = .548$, $p = .00$.

Table 3. Tally of the Number of Visitors who found an amoeba to look at

	Looked at media	Did not look at media	Total
Found	33	5	39
Not Found	7	14	20
Total	40	19	59

- Of the visitors who did look at the media piece, there is no significant difference in the amount of time visitors spent looking at the media piece for visitors who found an amoeba (mean time = 37 seconds, median time = 23 seconds) and visitors who did not find an amoeba (mean time = 69 seconds, median time = 24 seconds); $t(38)^3 = -.132$, $p = .896 > .05$)

² The statistical test was performed on ln-transformed data, which passed the one-sample Kolmogorov-Smirnov test for normal distribution.

³ The statistical test was performed on ln-transformed data, which passed the one-sample Kolmogorov-Smirnov test for normal distribution.

- However, there is a marginally significant difference in the percentage of time visitors spent looking at the media piece between visitors who found an amoeba ($N = 38$, mean = 28%) and visitors who did not ($N = 21$, mean = 43%); $t(38) = -1.843$, $p = .073 > .05$. Visitors who did not find an amoeba tend to spend a higher percentage of their time looking at the media piece, provided that they looked at the media piece at all.
- 41% (24/59) visitors did NOT have to move the stage to find an amoeba to look at; a specimen was already in view. But, 25% (6/24) of these visitors never stopped and looked at an amoeba. Alternatively, 59% (35/59) visitors did have to move the stage to find an amoeba to look at. 15 out of these 35 visitors (43%) never stopped to look at an amoeba. There is NO significant difference between these two groups, those who had to move the stage and those who did not. Fisher's Exact Test, $p = .18 > .05$

What visitors look at

Viewing Monitor

- 98% (58/59) visitors looked at the main viewing monitor. The one visitor who did not look at the monitor spent about 3 seconds at the exhibit.
- Visitors ($N = 59$) spent an average of 45 seconds (median) or 66 seconds (mean) looking at the viewing monitor. The maximum length of time a visitor spent was 257 seconds.
- Visitors spent, on average (median), 71% of their total time at the exhibit looking at the main viewing screen.

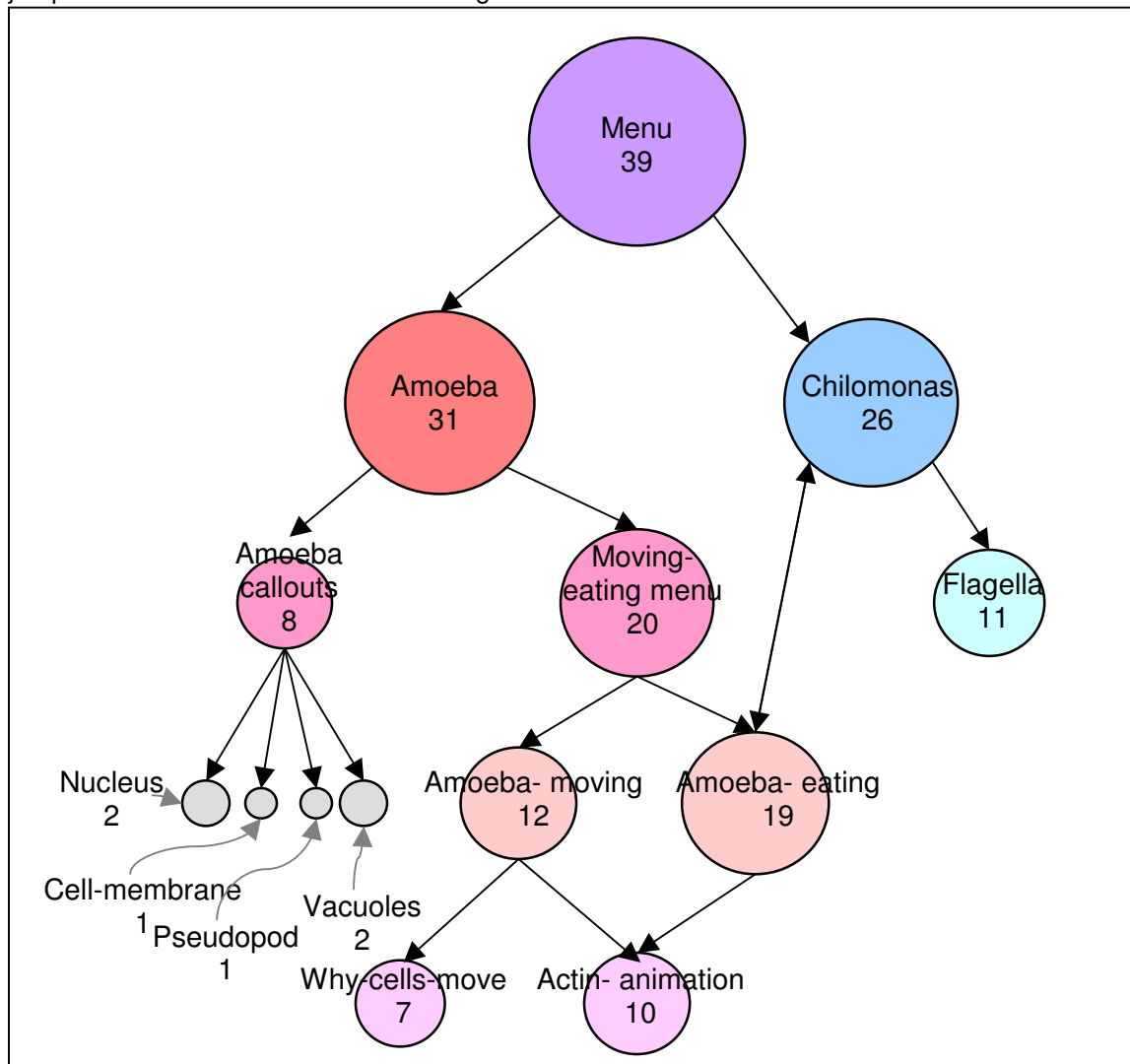
What Visitors Watched

- On average (median), visitors looked at 1 amoeba. The maximum number that a visitor looked at was 8 amoebae.
- 64% (38/59) visitors watched an amoeba
 - 71% (27/38) watched its cytoplasm move
 - 66% (25/38) of the visitors who found and looked at an amoeba watched it move with its pseudopod
 - 45% (17/38) stopped and watched a non-moving amoeba
 - No visitor found an amoeba eating its prey
- 42% (16/59) watched chilomonas move. 38% (6/16) of these visitors chased a chilomonas as it moved on the screen.

Media Piece

- 68% (40/59) visitors looked at the media piece. Figure 4 shows how many visitors looked at each media screen.
 - A majority of the visitors never looked beyond the basic description of the amoeba and the chilomonas.
 - Few visitors (less than 5%) looked at the callouts of the different parts of the amoeba

Figure 4. Visits to each screen on the accompanying media. Numbers indicate number of visitors who jumped to that screen. Arrows connecting bubbles show links between screens.



Microscope

- 22% (13/59) visitors looked at the microscope behind the glass.

What visitors thought (results of the uncued interviews)Visitors' Interest

- Most visitors found the exhibit *interesting* or *somewhat interesting*.

Interest Rating	Count (out of 18)
Interesting	8 (44%)
Somewhat Interesting	5 (28%)
Neutral	4 (22%)
Somewhat Not Interesting	1 (6%)
Not Interesting	0 (0%)

- Visitors found the exhibit interesting for the following reasons:
 - Using the Microscope (10/18). For example,

Visitor: I would never, if I don't come here, never get the opportunity to look through a microscope.

Of these 10 visitors, 4 mentioned that they particularly enjoyed searching for something to look at under the microscope
 - The microbes they saw (10/18). For example,

Visitor: [It's cool] looking at amoeba

Of these 10 visitors, 4 talked specifically about *moving* specimens:

Visitor: It was actually moving. You can see the moving color.
 - The image quality (2/18). For example,

Visitor: full color and vivid
 - The media piece (4/18)

Visitor: you can touch the computer screen and find out what's going on

- Visitors found the exhibit not interesting because
 - of difficulties⁴ using the exhibit (2/18):
 - Visitor: I'm unhappy about the limited range of focus, although I understand why you would have it.
 - Visitor: It's hard to find something to see, lots of empty space. And the small ones [chilomonas] move too fast
 - of the subject matter (2/18)
 - Visitor: I'm more a physics person
 - Visitor: It's basically cells, looking at cells

Visitors' Questions

As part of their interview, we asked visitors if they had any questions about what they saw.

- We grouped visitors' questions into 3 categories:
 - No questions. 12 /18 Visitors did not have any questions about the exhibit.
 - Questions that were answered in the media piece. There were no questions that fell under this category
 - Questions not answered in the media piece. In particular, visitors wanted to know:
 - ◆ About the microscope
 - Visitor: What type of microscope is it?
 - ◆ About the larger context
 - Visitor: [I] like to have another screen that explains what is amoeba with reference to the food chain, what they are naturally.
 - Visitor: What's the goal of the exhibit? Is it to look at amoeba?
 - ◆ About what's on the slide
 - Visitor: What exactly am I looking at, with reference to the real world? Is it in a drop of water or something?
 - Visitor: Most of the critters are on the edges, looks like they're trying to escape. Why do they do that?
 - ◆ More about the amoeba

⁴ Three additional visitors mentioned, during another part of their interview, having difficulties using the interface. These complaints include: problems focusing especially on the chilomonas, not knowing where the amoebae were, and the controls being too sensitive.

Visitor: Amoeba is a one-cell organism, right? It says how it moves with those things. I don't remember what they're called. [the actin, you mean?] But, I don't really get how that really works. How does the amoeba get that to work?

Connections visitors made between the microscope and the image

- 72% (13) of the (18) visitors interviewed thought the image was live, as opposed pre-recorded.
- When these 13 visitors were asked where they thought the live specimens were, they said
 - The microscope behind the glass (6/13)
 - Somewhere in the lab (2/13)
 - On some microscope somewhere (2/13)
 - The wooden box (the prototype desk) (2/13)
 - Did not know (1/13)

What visitors remember seeing on the viewing monitor

As part of their interview, visitors were asked to draw or describe whatever they remember seeing on the main viewing monitor. These descriptions were then coded for: 1) which parts they included and 2) what processes they noted.

- Parts visitors described
 - 15/ 18 visitors interviewed drew an amoeba
 - The following lists what visitors identified on their drawing. Note that very few visitors identified the parts (vacuoles, nucleus, psuedopod, and cell-membrane) that were called out in the media module.

Parts Identified⁵	Count (out of 15)
Psuedopods	0
Vacuoles	1
Cell-membrane	1
Nucleus	2
Cytoplasm	1
Circles or Dots	8

- Three visitors described the amoebas' shape

⁵ The bold font denotes those parts that were described in the media piece.

- 6/18 visitors drew a chilomonas but none of these visitors identified the microbe by name.
- Processes/ actions visitors described seeing the amoeba do the following

Amoeba Processes/ Actions Described⁶	Count (out of 15)
Moving	12
Flowing	5
Dead	1
Eating	1

- Of the 15 visitors who described an amoeba, 12/15 talked about how it moved either across the screen or internally. 5/15 made specific mention of how the inside of the amoeba seemed to move.
- 5/18 visitors described seeing a chilomonas move. Again, none of these visitors identified the chilomonas by name.
- Visitors seem to be more attuned to the actions and the movements they see for this specimen than its different parts.

SUMMARY WITH RECOMMENDATIONS

- The holding time for this exhibit prototype is about 1:40 (mean). There is no statistical difference in holding time compared to the standalone displaying the Zebrafish specimen, $t(111) = -.406, p = .686$. Also, this is roughly comparable to the exhibits with the highest holding power in the Traits of Life collection. (See Table 4.)

Table 4. Traits of Life exhibits with the highest holding times. Preliminary data from the Summative Evaluation for the Traits of Life Collection - G. Hein.

Traits Exhibit	Holding Time
Genetic Inheritance	01:49
Zoom in on Cells	01:45
Demo Station	01:34
Rotifer	01:30

⁶ The bold font denotes those processes that were described in the media piece.

- Visitors tend to focus on the actions, particularly, the movement of the amoeba and of the chilomonas. They described the amoeba moving but were less articulate about the different parts of the amoeba in their interviews.
- Most of the visitors interviewed rated the exhibit *interesting* or *somewhat interesting*. There is NO statistical difference in the interest ratings for this specimen and the Zebrafish specimen. Fisher's Exact Test⁷, $p = .17 > .05$.
- The visitors who found the exhibit less interesting complained about difficulties finding a specimen and focusing on fast moving specimens. A few visitors were simply not interested in the specimen.
- A majority of the visitors used the joystick to move the stage and the focus knob to focus.
- However, only 64% of the visitors were able to find an amoeba to watch. Not surprisingly, those people who did not find an amoeba stayed for a shorter period of time at the exhibit as compared to those visitors who were able to find an amoeba. Analysis suggests different reasons why some visitors failed to stop and look at an amoeba. These include: getting lost on the slide, passing over an amoeba without stopping, focusing instead on the chilomonas, simply giving up in the first 5 seconds of search. Furthermore, children, as opposed to adults, seem to have more trouble finding an amoeba to watch.

Recommendation: We may want to set tighter xy limits to prevent people from wandering out of the search area. For this study, we set the limits so that visitors can see the edge of the search space. Currently, the search area for the amoeba is circular whereas the xy limits are set for a rectangular search area. This means that there were certain areas that visitors could wander into in which they saw predominantly the Vaseline seal. Alternatively, we could revisit ways of indicating for the visitor where they are on the slide, or finding new ways of mounting the specimen.

Recommendation: We can also experiment with a denser concentration of amoeba in the search space. We averaged a density of 2.3×10^{-6} amoeba/square micron for this study.

- We could not detect a difference in the percentage of people who stopped and looked at an amoeba between those visitors who had an amoeba in view and those visitors who did NOT have an amoeba in view when they first approached the exhibit. Amoebas need to be in focus before the visitors can see interesting features/movement. That means, even if there is an amoeba in view at start, if it's not in focus, the visitor might not think to stop and look at it. Furthermore, this may also indicate some confusion as to what they should look for or even a lack of interest in what they see initially. The amoeba may be particularly challenging in this respect because there are no readily recognizable 'parts' to the amoeba and a visitors would need to look closely for longer than a second to see any movement.

⁷ The Fisher's Exact Test grouped *somewhat interesting* and *interesting* into one category and *neutral* and *somewhat not interesting* into another category.

- About 68% of the visitors looked at the media monitor. However, a majority of the visitors never looked beyond the basic description of the amoeba and the chilomonas. Furthermore, few visitors remembered the different parts of the amoeba when they were asked to describe what they saw on the main monitor.
- There is a significant correlation between those visitors who looked at the media monitor and those visitors who found an amoeba to look at under the microscope. We do not know if there is a causal connection.
- Some visitors had additional questions about the exhibit that were not addressed in the accompanying media module.
Recommendation: We may want to look at these questions, which are included in this report, to determine if we should somehow address them in future versions of the media piece.
- Less than 1/4 of the visitors looked behind the glass at the microscope. Of those visitors interviewed ($N = 18$), about 3/4 thought the image they saw was live, and less than 50% connected the microscope with what they saw. This may indicate that seeing the microscope is an important part of understanding and appreciating what they are seeing on the main viewing monitor. A future study can look at what effect seeing the microscope has on the overall experience at the exhibit.

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APPENDIX A***Equipment used for stand-alone***

- Axiovert200M
- MCU28
- Display
 - Optronics DEI750D
 - Sony Trinitron 19inch CRT monitor
- Metamorph version 5.0
- Game pad control: joystick2002_11_21_limits_scaled
- Interactive Media (on touch screen): amoeba-06- (rev.2) Projector

Setup

- Magnification 20x

Day	Number of Specimens	Search Area (micron)	Focus Range (micron)	Density (specimens/sq micron)
2/13/03	40	2000 r	210	3.2×10^{-6}
2/17/03	14	1500 r	90	2×10^{-6}
2/22/03	20	2000 r	100	1.6×10^{-6}

APPENDIX B***Interview Questions***

1. How interesting would you say that was? Would you say that exhibit was ...

Uninteresting	Somewhat Uninteresting	Neutral	Somewhat Interesting	Interesting
1	2	3	4	5

2. What made it _____ for you?

3. Did you have any trouble using the exhibit? What?

4. Do you have any questions about what you saw? What would you like to know about what you saw at that exhibit?

5. When you were playing with this exhibit, did you think that what you saw on the monitor was live or pre-recorded (for example, from a video tape)?

LIVE *PRE-RECORDED*

6. [Only if they said it's LIVE] Where do you think the living things that you saw are?

7. Did you see this [show photo of setup and gesture to area behind the glass]? *YES NO*

Do you believe there is any relationship between this [point to microscope on photo], this [point to main screen on photo] and this [point to media monitor on photo]? [For example, does this have anything to do with that in any way?] *YES NO*

How do you think they are related?

8. We're interested in how memorable this exhibit is. Could you draw for me a quick sketch of whatever you remember seeing on the main monitor [the big one right in front of the joystick]? (Probes: Just draw whatever you remember seeing, as if you were showing a little kid what you saw.)

Great, and can you tell me what your drawing shows? I just want to be sure I understand it. Like, what's this here? And this?

Can you tell me what the different parts are?

Is there anything else you remember seeing that you thought was too hard to draw or you decided not to draw?

Did you see anything happening?