Cells: The Universe Inside Us
Summative Evaluation
October 2009

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Introduction

In order to assess the impact of the exhibition *Cells: The Universe Inside Us* at the Maryland Science Center an exit questionnaire was administered to museum visitors who had not seen the exhibition as well as those who had seen it. One hundred forty-nine visitors were interviewed between August 7, 2009 and August 19, 2009. Fifty-one visitors were interviewed before they had seen the *Cells* exhibit (pre-test); ninety-eight people were interviewed after viewing the exhibit (post-test). The following analysis compares what people know about cells before and after seeing the *Cells* exhibit.

The study involved people ages 14 and older. Both pre-test and post-test requested information on participant demographics. (see Appendix for questionnaires).

RESULTS

Pre- and Post test Responses to Cell Content Questions

The purpose of the pre-test was to determine how much visitors know about cells before seeing the *Cells* exhibit. Visitors in the pre-test group were asked eight questions. Visitors in the post-test group were asked the same eight questions after seeing the exhibit. Comparisons between the pre- and post-test groups reveal how much the respondents learned by seeing the exhibit. The following tables compare the two groups for each of the eight questions.

Table 1: What are some of the different types of cells in your body?

Number of correct responses	Pre-test		Post-test	
	Number of Participants	Percent	Number of Participants	Percent
0	7	14%	9	9%
1	6	12%	14	14%
2	12	24%	22	22%
3	**18**	**35%**	**35**	**36%**
4	3	5%	13	14%
5 or more	5	10%	5	5%
Total	51	100%	98	100%

Table 1 shows a comparison of the number of correct responses that visitors were able to give when asked to name different types of cells in the body. The percentages of correct responses are very similar for the pre-test and post-test groups. About one-third of respondents in both the pre-test and post-test groups were able to name 3 different types of cells. (X^2 p = .6038)

Table 2: What sorts of things do our cells help us do?

Number of correct responses	Pre-test		Post-test	
	Number of Participants	Percent	Number of Participants	Percent
0	3	6%	2	2%
1	18	**35%**	30	31%
2	6	12%	36	**37%**
3	15	29%	15	15%
4	5	10%	11	11%
5 or more	4	8%	4	4%
Total	51	100%	98	100%

Table 2 shows a comparison of the number of correct responses that visitors gave when asked to name different functions of cells in the body. *Thirty-five percent of the pre-test group was able to correctly name 1 function, while 37% of the post-test group was able to name 2 functions. (X^2 p = .0200).* .

Table 3: How does a single cell grow into a person?

	Pre-test		Post-test	
	Number of Participants	Percent	Number of Participants	Percent
Correct	34	**67%**	68	**69%**
Incorrect	17	33%	30	31%
Total	51	100%	98	100%

Table 3 shows a comparison of the number of correct and incorrect responses given by visitors when asked how a single cell grows into a person. The results are similar for the two groups, with 67% of the pre-test group and 69% of the post evaluation group answering correctly. (X^2 p = .7345)

Table 4: What are some of the different parts of the cell?

Number of correct responses	Pre-test		Post-test	
	Number of Participants	Percent	Number of Participants	Percent
0	8	16%	16	16%
1	13	**24%**	18	18%
2	8	16%	21	22%
3	10	20%	28	**29%**
4	10	20%	10	10%
5 or more	2	4%	5	5%
Total	51	100%	98	100%

Table 6 shows a comparison of the number of correct responses that visitors gave when asked to name different parts of the cell. *In the pre-test group, the highest percentage of respondents (24%) was able to correctly name 1 part of a cell. In the post-test group, the highest percentage (29%) was able to correctly name 3 parts of a cell. (X^2 p = .4457). On this question, there is improvement from pre-test to post-test group.*

Table 5: What kinds of things are scientists studying about cells?

Number of correct responses	Pre-test		Post-test	
	Number of Participants	Percent	Number of Participants	Percent
0	12	24%	11	11%
1	25	**49%**	47	**48%**
2	8	16%	27	28%
3	6	11%	5	5%
4	0	0%	8	**8%**
5 or more	0	0%	0	0%
Total	51	100%	98	100%

Table 5 shows a comparison of the number of correct responses that visitors gave when asked to name things that scientists are studying about cells. The majority of visitors in both the pre-test group (49%) and the post-test group (48%) were able to name one thing. *However, eight percent of the post-test group was able to name 4 things versus 0% of the pre-test group and the percent giving two correct answers also increased. This is a significant improvement (X^2 p = .0216).*

Table 6: How are cancer cells different from normal cells?

	Pre-test		Post-test	
	Number of Participants	Percent	Number of Participants	Percent
Correct	33	**65%**	67	**68%**
Incorrect	18	35%	31	32%
Total	51	100%	98	100%

Table 6 shows a comparison of the number of correct and incorrect responses given by visitors when asked to describe how cancer cells differ from normal cells. The results are similar, with 65% of the pre-test group and 68% of the post-test group answering correctly. (X^2 p = .6517)

Table 7: What are stem cells?

	Pre-test		Post-test	
	Number of Participants	Percent	Number of Participants	Percent
Correct	22	**43%**	51	**52%**
Incorrect	29	57%	47	48%
Total	51	100%	98	100%

Table 7 shows a comparison of the number of correct and incorrect responses given by visitors when asked to define a stem cell. *The results show improvement, with 43% of the pre-test group and 52% of the post-test group answering correctly. (X^2 p = .3023)*

Table 8: Why are stem cells important?

	Pre-test		Post-test	
	Number of Participants	Percent (%)	Number of Participants	Percent (%)
Correct	31	**61%**	62	**63%**
Incorrect	20	39%	36	37%
Total	51	100%	98	100%

Table 8 shows a comparison of the number of correct and incorrect responses given by visitors when asked why stem cells are important. The results are similar, with 61% of the pre-test group and 63% of the post-test group answering correctly. (X^2 p = .7667)

Post-test Questions Regarding the Cell Exhibit
The questions in this section focus specifically on visitors' reactions to *Cells: The Universe Inside Us*.

Table 9: What would you say this exhibition is about?
(multiple answers accepted; 85 participants responding)

Response	Number of Participants	Percent
Cells	**30**	**35%**
The body	16	19%
Cell structure	13	15%
Cell functions	13	15%
How cells work	9	11%
Health	5	6%
Biology	4	5%
Research	4	5%
Other	13	15%

- Most visitors correctly identified the subject of the exhibition.

Other includes:
  Importance of cells (3)
  Science (2)
  Education (2)
  Cell health (2)
  Reproduction
  The world inside us
  Life
  Growth

Table 10: Which exhibit station in this area did you like best?

Response	Number of Participants	Percent
Dance Dance Revolution	**13**	**15%**
Shadow Game	**12**	**14 %**
Heart	8	9%
UV Skin Test	7	8%
DNA puzzle	6	7%
All of it	6	7%
Human Development	5	6%
Interactives	4	5%
Other	25	29%
Total	86	100%

- Dance, Dance Revolution and the Shadow Game were the favorite exhibits.

Other responses include the following:
Big cells
Tumor
Muscles
Movement
Parts of cell
Cell game
Nanotechnology
Age progression
Nanomedicine
Body zoom

Visitors were asked to explain their responses. Their reasons include the following:
Dance, Dance Revolution
Interactive (2)
Active
It was harder than it looks
Connects to everyday life
I like to do it
It was fun
I play it at home
My kids loved it and it got their hearts going

Shadow Game
Really interactive (3)
Interactive and you could see things close-up
Kept kids involved
I already studied cells, so I enjoyed it

UV Skin Test
Learning about yourself
Interactive and interesting
Can see the damage
Interesting
It was cool

DNA Puzzle
Informative
Interactive
Simple and interactive
Complex and fun
Taking it apart

Human Development
New information (2)
See what we looked like a long time ago
Interesting to see the fetal pigs
Comparing humans and pigs
Similarities of different fetuses

Stem Cell Station
Shows you how they grow

Tumor
You *can dissect the tumor and see it's origin*

Age Progression
You can see the progression

Nanomedicine
New information
Interactive
Personally interesting

All Of the Exhibit
I liked the interactive parts   (2)
Taught new facts in a fun new way
I'm studying this stuff
I liked all the interactive stuff because my eight-year-old daughter liked it

Table 11: Were there any stations that were too hard, or that you couldn't get to work properly?

Response	Number of Participants	Percent
Yes	25	27%
No	**67**	**73%**
Total	92	100%

- Nearly three quarters of the respondents did not report difficulties with any of the exhibit stations.

If the participants said that there *were* stations that were either too hard or did not work properly, they were asked to explain which station and why it was too hard. Their replies include the following:

Shadow game (5)
It was confusing
It didn't make sense
Didn't work, weak interaction

Promise of stem cells video (2)
Putting the body together (2)
Heart Video
It didn't work

Mice/trackballs could be easier

Blood
Hard to understand and it didn't capture my attention

Kiosk with phone
It was too loud

UV light
I didn't see anything

- Note that the interactive with the greatest number of complaints (Dance, Dance, Revolution) was also the visitor's favorite.

Table 12: What do you think about the amount of written information in this area?

Response	Number of Participants	Percent
Too Much	5	5%
Too Little	7	7%
About Right	**84**	**88%**
Total	96	100%

- Most people thought the amount of printed information was about right.

Table 13: What do you think about the appearance of the area?

Response	Number of Participants	Percent
Too Cluttered	6	6%
Too Empty	4	4%
About Right	**86**	**90%**
Total	96	100%

- Visitors liked the appearance of the exhibit.

Table 14: What do you think about the science information in the exhibit?

Response	Number of Participants	Percent
Too Hard	3	3%
Too Easy	8	8%
About Right	**85**	**89%**
Total	96	100%

- *People thought the science information was on the right level.*

Table 15: In This Exhibition, dancers help explain how cells work. Did you notice the dancers?

Response	Number of Participants	Percent
Yes	54	56%
No	42	44%
Total	96	100%

- *About half of the visitors noticed the dancers used in exhibit explanations.*

Table 16: If "yes", can you tell me one thing about the cell that was explained using dancers?

Response	Number of Participants	Percent
Mitosis	**9**	**21%**
Exercise	**8**	**19%**
Nerves	5	12%
Heart	4	10%
Other	16	38%
Total	42	100%

- *Forty percent of the visitors correctly observed that the dancers were used to explain mitosis and the way the muscles move in exercise.*

Other responses include the following:
> *Movement (2)*
> *ATP*
> *How awesome they are*
> *Shape of protein*
> *Fighting cold*
> *Disease*
> *How oxygen is carried*
> *How they work together*
> *Jumping Jacks*
> *Didn't notice anything but their presence*

Table 17: What did you think about the dancers?

Response	Number of Participants	Percent
I dislike them	2	4%
I think they didn't make a difference	20	38%
I like them	**30**	**58%**
Total	52	100%

- *The majority of people who noticed the dancers liked them.*

Additional comments:

Positive:
 "Thought it was different"
"Liked how they explained the questions"
"Enjoyed the art aspect"
"Not necessary but visually good"
"Good for little kids"
"Helped explain the material better"

Negative:
"They didn't really explain anything"
*"Exciting to look at, but girl in wheelchair representing low-impact exercise was a poor
      choice"*
 "Nice addition, but not essential"

Table 18: How would you rate the *Cells* exhibit overall?

Response	Number of Participants	Percent
Excellent	**34**	**35%**
Good	**47**	**49%**
OK	9	9%
Fair	6	6%
Poor	1	1%
Total	97	100%

- To calculate an average numerical rating, each rating category was assigned a value as
  follows: Excellent (5), Good (4), OK (3), Fair (2), and Poor (1). *The average rating for
  the exhibit was **4.1** out of a possible 5*. In general, a 4 or above is a good overall rating.

At the end of the survey, visitors were asked to elaborate on what they liked and what they
disliked.

What did you like? (with examples)

 Good for kids (7)
     "Good learning tool for kids"
     "Interactive aspect great for kids & adults"
     "Good for all ages, kept kids involved"

Information (12)
> *"Very Informative"*
> *"Easy to understand, interesting"*
> *"Learned new things"*
> *"Lots of information; good amount, not overwhelming"*
> *"Cool to learn about your body. Can spend hours inside."*
> *"Clear, easy to understand"*

Activities/hands-on in general (10)
> *"Hands-on, visual, and varied"*
> *"Watching people explain as opposed to just pictures"*
> *"Very interactive, easy to relate to, not frightening or overwhelming"*

Specific activities (9)
> *"Neat to walk through the cell" (4)*
> *"Video of white blood cells and other videos"(2)*
> *"DNA"*
> *"Shadow game"*
> *"The human bra was funny"*

Design (10)
> *"Easy to navigate"*
> *"Liked the overall appearance"*
> *"Liked the colors and topics; overall feel"*
> *"Liked the atmospheres and questions"*
> *"Size: everything was big, colorful, attractive. Everything caught your eye."*
> *"The set up. [You] can see what parts look like"*
> *"Liked how doctors and scientists have personality."*

General (7)
> *"Liked all of it" (3)*
> *"I am a doctor and found the exhibit to be a great idea! I actually saw a few friends around in the quotes."*
> *"Fun"*
> *"Most impressive. Good to visualize and touch what's in the books."*
> *"Good presentation, best one seen yet with relevant info"*

What did you dislike?

> *"Needs more hands-on items"(3)*
> *"More hands-on. Maybe a table with parts of a cell"*
> *[Needs] "more interactivity" (2)*
> *"More games"*
> *"Needs microscopes"*
> *"I wanted more things to see"*
> *"Needs more animation and visual draw"*
> *"No clear path or direction. Live dancers would be better"*
> *"Boring and not child-friendly"*
> *"Incoherent and incohesive [sic]"*
> *"Too dark"*
> *"More personal touches like doctors talking"*
> *"More pictures to differentiate from turquoise color"*
> *"Could be more immersive"*

Conclusions

Visitors responded very positively to *Cells: The Universe Inside Us* and gave it an overall rating of 4.1 out of 5. They gave favorable ratings to the amount of printed information, the level of the science information and the appearance of the exhibit.

In terms of learning science content, the comparison of pre-test and post-test showed limited change. This is not unusual for an exhibition experience since people spend a relatively short time in an exhibit hall, visit only selected stations, and focus on different parts of the whole not necessarily the parts in the test questions. Nevertheless, four of the eight questions showed improvement from pre-test to post-test scores.

The results of the comparison between the pre and post-test groups indicate that the majority of visitors already know the basics about cells: different types of cells, how they grow into a person and the difference between cancer and normal cells. For example, the question "How does a single cell grow into a person?" was answered correctly by 67% of the pre-test group and 69% of the post-test group (Table 3). In retrospect, some of our questions were probably too elementary and general to tease out the increment between pre-and post-test.

Though the number of correct answers was often comparable in the pre and post-test groups, the results do show that the post-test group had a more nuanced and sophisticated understanding of the information presented in the exhibit. For example, 35% of the pre-test group was able to correctly name one function of cells in the body, while 37% of the post-test group was able to name 2 functions (Table 2). Similarly, in the pre-test group, the highest percentage (24%) was able to name 1 part of a cell, while 29% of the post-test group was able to name 3 parts of the cell (Table 4). Eight percent of the post-test group was able to correctly name 4 things that scientists are studying about cells, versus 0% of the pre-test group (Table 5). With respect to the question, "What are stem cells?" the results show improvement, with 43% of the pre-test group and 52% of the post-test group answering correctly.

The most popular parts of the exhibit were the Dance, Dance Revolution-style game and Explore-a-Cell (shadow interactive). These whole-body interactives are very appealing to visitors. About a quarter (27%) of the respondents encountered a station that they felt was either too difficult or did not work for them. The most common area of difficulty was the shadow game, though it was still voted as one of the favorites.

A little more than half (56%) of the visitors noticed the dancers in the exhibit. Of those who noticed them, 44% could correctly name something explained by the dancers, most commonly mitosis. Fifty-eight percent of visitors who noticed the dancers said that they liked them.

The majority of visitors rated the amount of written information, the appearance of the exhibit, and the science information as "about right". Overall, 84% of the visitors rated the exhibit as "Very Good" or "Good".

The rating scales and comments show that visitors appreciated the exhibition and felt that they had learned from it. It is difficult to show leaning through pre-/post test comparison since visitors tend to cruise through an exhibition and attend to only selected aspects. Nevertheless, it is apparent that visitors to *Cells: The Universe Inside Us* came away with a clearer understanding of the parts of the cell, the nature of stem cells and the kinds of things that scientists are studying about cells, which are all important points of emphasis in the exhibition.

Table A: Age

	Pre-test		Post-test	
	Number of Participants	Percent	Number of Participants	Percent
14 - 19	10	20%	15	15%
20 - 29	**10**	**20%**	**29**	**30%**
30 - 39	8	15%	20	20%
40 - 49	12	23%	23	23%
50 - 59	7	14%	7	7%
60+	4	8%	4	4%
Total	51	100%	98	100%

Table B: Gender

	Pre-test		Post-test	
	Number of Participants	Percent	Number of Participants	Percent
Male	26	51%	43	44%
Female	**25**	**49%**	**55**	**56%**
Total	51	100%	98	100%

Table C: Number of People in the Visitor's Group

	Pre-test		Post-test	
	Number of Participants	Percent	Number of Participants	Percent
1	2	4%	8	8%
2	**19**	**37%**	**28**	**29%**
3	11	21%	20	21%
4	9	18%	21	22%
5	3	6%	9	9%
6 or more	7	14%	11	11%
Total	51	100%	97	100%

Table D: Type of Group

	Pre-test		Post-test	
	Number of Participants	Percent	Number of Participants	Percent
Alone	2	4%	6	6%
Friends	13	25%	21	22%
Family	**31**	**61%**	**65**	**68%**
Family and Friends	4	8%	1	1%
Organized Group	1	2%	2	2%
Other			1	1%
Total	51	100%	96	100%

Table E: From Which State Do You Come?

	Pre-test		Post-test	
	Number of Participants	Percent	Number of Participants	Percent
Maryland	**18**	**35%**	**41**	**42%**
Pennsylvania	11	22%	21	21%
New York	5	10%	4	4%
Virginia	3	6%	2	2%
New Jersey	3	6%	10	10%
Connecticut	1	2%	4	4%
Other	10*	20%	16**	16%
Total	51	100%	98	100%

* Other pre-test locations include the following: *DE, IN, OH, MA, KS, TX, FL, Spain, Canada*

** Other post-test locations include the following: NC, WI, KY, MI, MA, OH, Washington DC, NV, *Spain, Canada, United Kingdom*