

# Hall of Human Life *Catalyst Sort* Front-End Evaluation

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## EXECUTIVE SUMMARY

Between February and June 2008, the *Hall of Human Life* content development team set out to create goals, messages, and content ideas for a new exhibition on human life. During this time period, the team decided that the exhibition would focus on the main message that “Humans are changing” and provide the visitors with three lenses for viewing the exhibition: an ecological lens, an anatomical lens, and an evolutionary lens. As an entry point to these lenses for visitors, the exhibit team generated five catalysts that correspond to the ecological lens and highlight how environmental factors can change and alter both anatomy and human evolution. These catalysts include the following: physical, maturational, dietary, microbial, and experiential.

To help the team understand visitors’ perceptions and comprehension of the three lenses and the five catalysts, the Museum of Science Research and Evaluation Department conducted a front-end evaluation that focused on answering the following question: How do visitors react to the idea that there are environmental (or ecological) factors that affect both the human body (anatomy) and human evolution?

To answer this question, evaluators used interviews and on-line surveys that focused on specific factors within each of the catalyst categories and asked visitors to rate their level of awareness that these factors affect their body and human evolution. Audiences asked to participate in this study included visitors, who came to the Museum of Science during April 2008, and 3,000 members of the Museum’s E-news list. In total, input was received from 337 Museum of Science visitors.

Findings indicate that visitors had a variety of reactions to the factors that were the focus of this study. For a few of the factors (gravity, sunlight, temperature, canned/preserved foods, raw foods, viruses, vaccinations, and maturing & aging), participants were comfortable with the idea that these factors affect their bodies and human evolution. For other factors, participants were either surprised (text messaging technologies, language, and air travel) or unsure (artificial light, assistive technologies, and clothing) how the factor affects their bodies and/or human evolution.

There are a number of possible reasons for the differences in how visitors reacted to these factors. First, participants seemed to have a greater understanding of how the “natural” factors affect their bodies and human evolution than “man-made” technologies. Many visitors thought that “man-made” technologies were newer and therefore have not had a chance to act on the body or human evolution. Second, in general, visitors are able to understand and articulate the types of changes a factor can have on their bodies, but they appeared to have a more difficult time articulating the mechanisms behind evolution. Lastly, visitors seemed to have different conceptions of what would cause effects on the body versus human evolution. Participants focused on physical changes as evidence that a factor affects your body. For human evolution, visitors focused on time as the most important evidence that a factor could affect human evolution.

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# I. INTRODUCTION

## ABOUT THE EXHIBITION

Between February and June 2008, the *Hall of Human Life* (HHL) exhibition content development team at the Museum of Science, Boston, set out to create goals, messages, and content ideas for a new exhibition on human life. During this time period, the team decided that the exhibition would focus on the main message that “Humans are changing” and provide the visitors with three lenses for viewing the exhibition: an ecological lens, an anatomical lens, and an evolutionary lens. Each of these lenses corresponds to primary messages for the exhibition. As of June 2008, these messages included the following:

- Ecological Lens: I am an ecosystem constantly changing and being changed.
- Anatomical Lens: My DNA is active during my lifetime, causing changes in my anatomy and physiology.
- Evolutionary Lens: Humans evolved and will continue to evolve over generations.

As an entry point to these lenses for visitors, the exhibition team generated five catalysts that correspond to the ecological lens and highlight for visitors how environmental factors can change and alter both their anatomy and human evolution. These catalysts include the following: physical, maturational, dietary, microbial, and experiential.

A central goal of this initiative is to introduce Museum visitors to the complexity of their ecosystem, demonstrating that forces in that ecosystem – including man-made forces – affect changes in their biology and in the larger population of humans over generations. The content team for this initiative, therefore, wondered: Do people recognize that their bodies are changed by a variety of forces in the environment, including physical, maturational, food, microbial, and experiential forces? Will they find this surprising? Will they recognize or be surprised by learning about environmental impacts on the evolution of the human species? Will they understand that man-made technologies are an integral part of the environment that impacts them? Will they describe mechanisms of change and variability in human response to the environment, or assert changes unequivocally?

## ABOUT THE EVALUATION

To help the *Hall of Human Life* content development team understand visitors’ perceptions and comprehension of the three lenses and five catalysts, the Museum of Science Research and Evaluation Department conducted a front-end evaluation. The question guiding the evaluation was the following: How do visitors react to the idea that there are environmental (or ecological) factors that affect both the human body (anatomy) and human evolution?

To answer this question, evaluators used interviews and on-line surveys that focused on specific factors within each of the catalyst categories that provided visitors with tangible examples of the catalysts. A total of 14 different factors were included in this evaluation. Factors chosen to represent each of the five catalysts included the following:

- *Physical Catalysts*
  - Artificial Light
  - Gravity
  - Sunlight
  - Temperature
- *Experiential Catalysts*
  - Air Travel
  - Clothing
  - Language
  - Text Messaging Technology
- *Maturational Catalysts*
  - Assistive Technologies
  - Maturing and Aging
- *Dietary Catalysts*
  - Canned/Preserved Foods
  - Raw Foods
- *Microbial Catalysts*
  - Vaccinations
  - Viruses

These factors were chosen by content developers and evaluators because 1) they wanted at least two examples in order to explore visitors' reactions to the different catalyst categories; 2) they wanted factors that visitors would be able to easily understand and relate to and that could be explained with illustration; and 3) they wanted factors that represented both natural entities and man-made technologies.

Besides trying to understand visitors' perceptions of the catalysts, responses given by participants were analyzed to learn a bit about the kinds of topics, content, and experiences that would be of most interest to visitors. At the request of the content team, questions about visitor interest were not asked directly during the course of the evaluation; however, some visitors did freely offer this kind of information. As visitors were not asked directly about their interest in different topics, we cannot determine whether the interests participants expressed are representative of Museum of Science visitors in general. Nevertheless, the collected data do provide some hints as to what lenses and catalysts visitors are most interested in learning more about through the exhibition.

The planning for this evaluation began in April 2008. Evaluators collected data from April through May 2008. The final evaluation report was released in June 2008.

## II. METHODS

Data were collected at the Museum of Science, Boston and online from April through May 2008. Multiple data collection methods and audiences were used to develop a more complete picture of visitors' perceptions of the five catalysts (Table 1). Data collection methods employed included a card sort & interview and an online survey. Audiences asked to participate in this study included visitors at the Museum of Science and 3,000 members of the Museum's E-news list.

**TABLE 1. Number of Visitors Who Participated in the Different Data Collection Activities.**

Audience	Data Collection Methods	
	Card Sort & Interview	Online Survey
Visitors at the Museum of Science	42	68
E-news list members	0	227

### 1. CARD SORT & INTERVIEW PROTOCOL

Over April School Vacation Week, 32 individuals and 5 groups took part in a card sort and interview in the "Human Body Connection" at the Museum of Science. Evaluators sought to include males and females equally and a range of race/ethnicities. Age was limited to visitors 13 years of age and older as the content being tested was deemed too difficult for younger children. As a part of the protocol, visitors were asked to sort a series of factors. Two factors were chosen for each of the five catalysts. The ten factors chosen for the card sort were the following:

- *Physical Catalysts*
  - Artificial Light
  - Sunlight
- *Maturational Catalysts*
  - Assistive Technologies
  - Maturing and Aging
- *Dietary Catalysts*
  - Canned/Preserved Foods
  - Raw Foods
- *Microbial Catalysts*
  - Vaccinations
  - Viruses
- *Experiential Catalysts*
  - Language
  - Text Messaging Technologies

Visitors were handed the ten cards one at a time and told each card described a factor that affects their body. They were asked to sort the card as to whether they "knew," "suspected," or were "surprised" that each factor affects their body. After they had sorted all the cards, visitors were asked to pick one card they had placed in the "surprised" category and talk about why they were

surprised that factor affects their body. They were then asked to answer the same question for a card that they had placed in the “suspected” category and then one card from the “knew” category. After this sort was completed, the visitors were again handed the cards one at a time and told that these factors also affect human evolution. The visitors were then asked to sort the card as to whether they “knew,” “suspected,” or were “surprised” that each factor affects human evolution. After they had sorted the cards, visitors were asked to pick one card they had placed in the “surprised” category and talk about why they were surprised that factor affects human evolution. They were then asked to answer the same question for a card that they had placed in the “suspected” and “knew” categories. Because the card sort and interview took some time, visitors were offered a small token for their participation after they completed the interview. Copies of the factor cards and interview can be found in Appendices A & B.

## 2. ONLINE SURVEY PROTOCOL

The purpose of the online computer survey was to collect a large amount of data about visitors’ perceptions of the five catalysts. The survey was administered on-site at the Museum of Science as well as through email. The protocols for picking participants and filling out the survey are described below.

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### 2.1 *Recruitment of Visitors at the Museum of Science*

Over April School Vacation Week, 68 visitors completed the *Hall of Human Life* on-line survey at the Museum. Evaluators set up a computer containing the survey in the “Human Body Connection.” To randomize who answered the survey, evaluators asked every third visitor who crossed an invisible line near the computer to participate. Only visitors 13 years of age and older were invited to answer the survey as the evaluators deemed the content of the survey to be too difficult for younger visitors.

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### 2.2 *Recruitment of Visitors through the Museum’s E-news list*

On April 30, an email was sent to a random set of 3,000 people who are members of the Museum of Science E-news list. In the email, visitors were asked to participate in a survey about concepts that might be included in a new exhibition about human life. A reminder email was sent out May 9 in order to increase the return rate for the survey. Through this solicitation method, a total of 227 surveys were collected as of May 16, 2008 (return rate = 7.6%).

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### 2.3 *Online Survey Questions*

The format and content of the on-line survey answered by the Museum of Science on-site visitors and E-news list were exactly the same. First, these participants were asked to answer demographic questions related to their age, gender, race/ethnicity, and the context of their



Museum visits (whether anyone in their group or anyone they normally visit with is under the age of 18). Then, participants were asked to answer a series of questions similar to those asked in the card sort & interview. However, instead of being asked about only 10 factors, these visitors were presented with a list of 14 factors that fit into the five different catalyst categories. Those factors included the following:

- *Physical Catalysts*
  - Artificial Light
  - Gravity
  - Sunlight
  - Temperature
- *Maturational Catalysts*
  - Assistive Technologies
  - Maturing and Aging
- *Dietary Catalysts*
  - Canned/Preserved Foods
  - Raw Foods
- *Microbial Catalyst*
  - Vaccinations
  - Viruses
- *Experiential Catalyst*
  - Air Travel
  - Clothing
  - Language
  - Text Messaging Technology

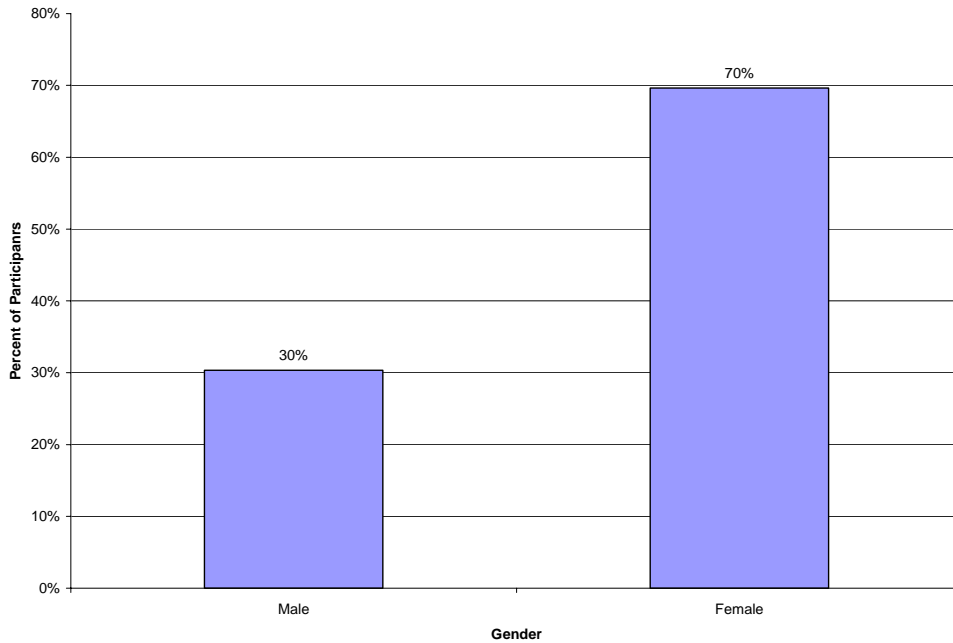
As with the card sort & interview, visitors were told that these factors affect their body and asked to choose whether they were “surprised,” “suspected,” or “knew” that each factor affects their body. They were then given an open-ended question that asked them to pick one of the factors they were surprised about and say why they were surprised this factor affects their body. On the next page of the survey, they were again presented with these 14 factors. This time they were told that the factors affect human evolution. They again were asked to choose whether they were “surprised,” “suspected,” or “knew” that each factor affects human evolution. Then, once again, they were asked to choose one of the factors they were surprised about and say why they were surprised this factor affects human evolution. Copies of the Museum and email online surveys can be found in Appendices D & E.

### 3. DEMOGRAPHICS OF STUDY PARTICIPANTS

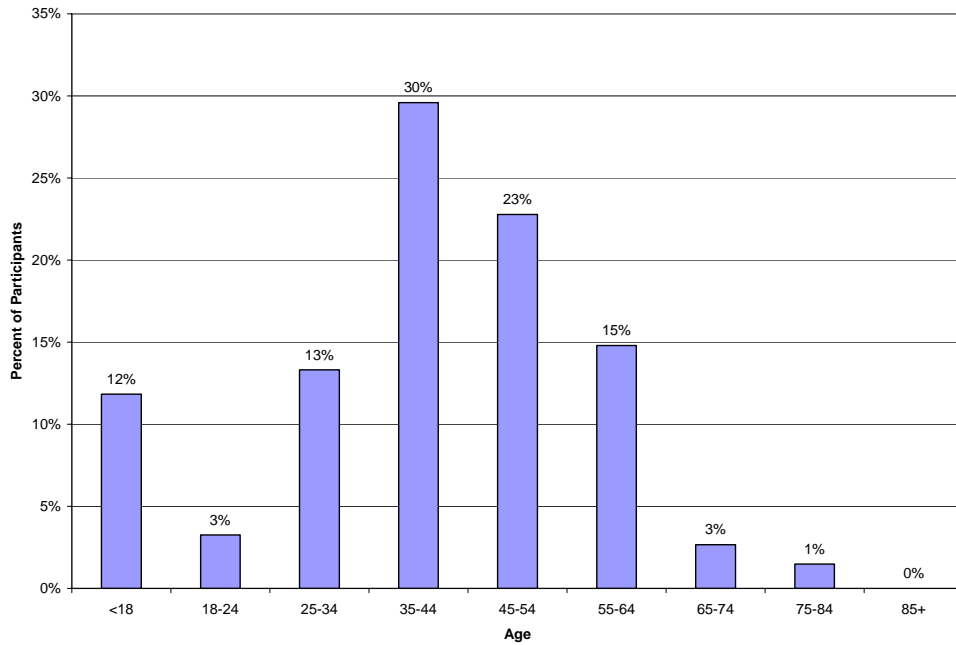
While evaluators did try to control the demographics of participants for the card sort, the 3,000 visitors who were asked to participate in the survey via email were selected at random from the existing E-news list (the demographics of which are currently unknown). When the demographics of all the study participants were combined, it was found that 70% of the participants were female and 30% were male (Graph 1). The reason for this gender bias may be that the E-news list includes more women than men as women are the primary decision makers who determine whether a family comes to the Museum. Analysis by gender, however,

demonstrates that there is not a statistically significant difference in the responses of male and female visitors to this particular survey making this gender imbalance unimportant to the study results. In addition to gender bias, adults are more heavily represented in the study than children (Graph 2). Unlike gender, however, there is a statistically significant difference in the responses of adults versus children. The HHL team should consider conducting another evaluation in the future that looks specifically at children’s reactions to this content by using a more child-friendly protocol. Another audience under-represented in these data are visitors of certain non-dominant cultural groups. Overall, over 90% of the study participants were white (Graph 3). This percentage is reflective of the Museum audience overall which according to the 2005/2006 Visitor Survey Report is 86% white (Opinion Dynamics Corporation, 2006). Nonetheless, if the Museum wishes to attract non-dominant cultural groups to the exhibition and create an exhibition that is reflective of these audiences’ backgrounds and experiences, the team should follow-up with additional studies that focus specifically on their views and perspectives. Additional information about the demographics of the participants can be found in Appendix F.

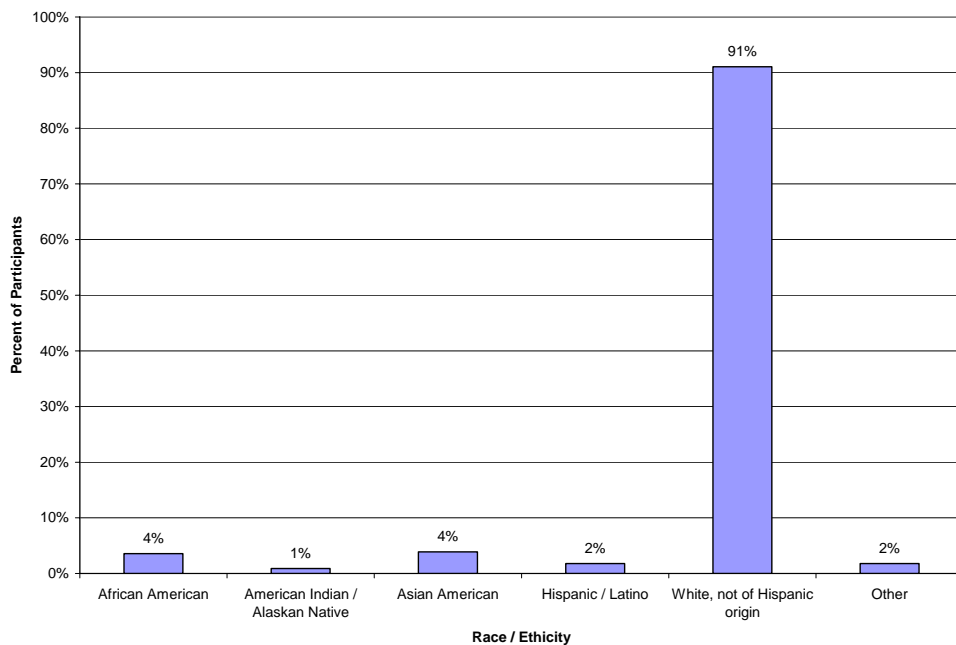
**GRAPH 1. Gender of Study Participants. (N=335)**



**GRAPH 2. Ages of Study Participants. (N=337)**



**GRAPH 3. Race / Ethnicities of Study Participants. (N=335)**



#### 4. DATA ANALYSIS

By collecting data in a variety of ways, the evaluator was able to triangulate the data. The logic behind triangulation is that “no single method ever adequately solves the problem of rival causal

factors” (Patton, 2002), p.247). Therefore, if data is collected through many sources, evaluators can avoid the problems of a one-method study, which is “vulnerable to errors linked to that particular method (e.g., loaded interview questions, biased or untrue responses)” (Patton, 2002, p.248). Studies that utilize multiple methods allow “cross-data validity tests” (Patton, 2002, p.248), and thus reduce the likelihood that the evaluator will draw a false conclusion based on the limits of any one instrument. In this case, data from the card sort & interview and online surveys were compared to allow for both in-depth insights into visitors’ thinking about the catalysts as well as large-scale quantitative data to which statistical analyses could be applied.

Data collected through the instruments were both qualitative and quantitative in nature. Quantitative data were analyzed through descriptive statistics such as percentages, counts, and means. In addition, comparative tests of significance were conducted when applicable. The level of significance was set at 0.05. Qualitative data were analyzed using inductive coding methods. Inductive coding analysis involves “immersion in the details and specifics of data to discover important patterns, themes, and interrelationships” (Patton, 2002, p.41). However, coding was started using preconceived coding lists based on concepts and themes that relate to the main messages of the exhibition.

### III. RESULTS AND DISCUSSION

The Results and Discussion section is split into four parts:

1. Visitors' reactions to and perceptions of the 14 factors;
2. Comparison of visitors' reactions to and perceptions of the effects of these factors (ecological lens) on the body (anatomy) and human evolution;
3. Visitors' reactions to and perceptions of the effects of the man-made versus the natural factors; and
4. Possible areas of visitor interest and engagement.

Analysis of the data indicates that there were no differences in how participants responded to the questions across instruments. Therefore, wherever possible, the data is combined in the sections below. However, differences between child and adult responses to the questions are noted in each section. Since it was found that there were no differences between the genders<sup>1</sup>, this data will not be called out separately.

#### 1. VISITORS' PERCEPTIONS OF THE CATALYST FACTORS

In both the interview and the online surveys, participants were asked to sort the given factors into categories of whether they “knew,” “suspected,” or were “surprised” the factor affects their bodies and human evolution. Analysis of the data (including the calculated mean understanding<sup>2</sup> of each of the factors and a chi-square test that looked for differences in visitor choices between the three categories) places visitors' perceptions and understandings into three categories: factors where more visitors “knew” that the factors affect their body and human evolution; factors where there was variation in visitor responses; and factors where more visitors were “surprised” that the factors affect their body and human evolution. The factors that fell into these categories and possible reasons why are described below.

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##### *1.1 Visitors knew that eight of the factors affect their bodies and human evolution.*

For eight of the factors, visitors said that they “knew” that the factor affects both their body and human evolution. These factors included the following:

- Gravity
- Sunlight
- Temperature

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<sup>1</sup> Differences between the responses of males and females were examined by comparing the following: categorical responses to each of the individual questions using a chi-square test; and comparison of the means between the total score for questions related to Body, Evolution, Technology, and Natural using an independent samples t-test. No differences were found between genders for any of these measures. The one exception was that females were more likely than males to know and less likely to be surprised about the relationship between evolution and vaccination.

<sup>2</sup> Mean understanding was calculated by giving a “surprised” response a value of one, a “suspected” response a value of two, and a “knew” response a value of three and then averaging the value for all respondents.

- Canned/preserved foods
- Raw foods
- Vaccinations
- Viruses
- Maturing & aging

For all of these factors, visitors were more likely than chance to say they “knew” the factors affected their bodies and human evolution than they were to say that they “suspected” or were “surprised” about their affects (Table 2). It is also worth noting that there were three factors (air travel, assistive technologies, and clothing) visitors were more likely than chance to say they “knew” affected their body, but when participants were asked about these factors in relation to human evolution, there were no statistical differences in the number of visitors that selected “knew” over the other two categories. Additionally, while visitors were more likely to say that they “knew” that air travel affected their bodies, visitors were also more likely to say that they were “surprised” that air travel affected human evolution. Conversely, although more visitors were also likely to say that that they “knew” that language affected human evolution, they were more likely to say that they were “surprised” that language affected their bodies. Possible reasons for the discrepancy between visitors’ choices for evolution and body for these two factors are discussed in the surprised section below.

**TABLE 2. Distribution of Responses and  $\chi^2$  Values for Participants Who “Knew” the Factors Affect Their Bodies and/or Human Evolution.**

Question	Factor	Number of Participants Choosing “Knew”	Number of Participants Choosing “Suspected”	Number of Participants Choosing “Surprised”	$\chi^2$	p Value
Body	Air travel	144	63	30	114.02	<.0005
	Artificial light	149	78	47	69.142	<.0005
	Assistive technologies	139	83	46	64.056	<.0005
	Canned/preserved food	191	65	18	224.211	<.0005
	Clothing	125	64	47	61.898	<.0005
	Gravity	217	12	8	444.495	<.0005
	Maturing and aging	264	6	4	593.97	<.0005
	Raw food	215	49	9	319.946	<.0005
	Sunlight	257	10	6	564.042	<.0005
	Temperature	222	13	2	487.939	<.0005
	Vaccinations	254	17	2	532.828	<.0005
Viruses	260	11	2	581.118	<.0005	
Evolution	Canned/preserved food	115	77	66	23.162	<.0005
	Gravity	145	51	35	124.938	<.0005
	Language	127	68	63	34.898	<.0005
	Maturing and aging	190	47	22	238.487	<.0005
	Raw food	146	70	43	80.057	<.0005
	Sunlight	185	56	21	220.558	<.0005
	Temperature	194	30	8	331.271	<.0005
	Vaccinations	171	60	29	161.003	<.0005
Viruses	217	37	7	358.094	<.0005	

The mean understanding score for the eight factors that visitors said they “knew” affect their bodies and human evolution provides further supporting evidence that these factors ranked highly with visitors in terms of their knowledge of their effects. Rank-order of the factors by mean show that these eight rank above the other factors for both the body and evolution questions, with a mean of greater than 2.20 for each of these eight factors (Table 3). The mean for each of these factors also falls above the median of the means for all of the factors combined with one exception: the mean score for canned/preserved food falls below the median of the means for both the Body and Evolution questions, with this factor ranking the lowest of all the factors in the “knew” category.

**TABLE 3. Mean Understanding Score of Participants For All the Factors Split By Body and Human Evolution Questions.**

<b>Factor</b>	<b>Mean Understanding for Body Question</b>	<b>Mean Understanding for Evolution Question</b>
Viruses	2.95	2.80
Maturing and aging	2.95	2.65
Temperature	2.93	2.80
Sunlight	2.92	2.63
Vaccinations	2.92	2.55
Gravity	2.88	2.48
Raw food	2.75	2.40
Canned/preserved food	2.63	2.19
Air travel	2.48	1.89
Artificial light	2.37	1.93
Assistive technologies	2.35	2.05
Clothing	2.33	2.07
Language	1.82	2.25
Text messaging	1.76	1.70

Additional evidence that many visitors “knew” these eight factors affect their bodies and human evolution is that they chose to discuss their surprise about these factors infrequently during the card sort & interview and online survey. None of the visitors, during either the card sort or online survey, discussed their surprise that viruses or temperature affect either their bodies or human evolution. In addition, very few people discussed their surprise at how vaccinations (4 of 334), raw foods (5 of 334), maturing and aging (7 of 334), sunlight (10 of 334), canned/preserved foods (14 of 334), or gravity (14 of 334) affect their bodies or human evolution during the card sort & interview and online survey (Tables 4 – 7).

**TABLE 4. Number of Participants Choosing the Factor to Answer the Card Sort Interview Questions: “Why are you surprised, did you suspect, or did you know that the factor affects YOUR BODY?” (N=37)**

	<b>Number of Visitors Talking about the Card</b>	<b>Number of Visitors Using Card for "Knew" Question</b>	<b>Number of Visitors Using Card for "Suspected" Question</b>	<b>Number of Visitors Using Card for "Surprised" Question</b>
Language	21	4	12	5
Text Messaging	20	2	9	9
Viruses	18	18	0	0
Sunlight	17	14	1	2
Canned/preserved Foods	16	5	10	1
Vaccinations	12	10	2	0
Raw Foods	12	6	6	0
Artificial Light	10	3	3	4
Assistive Technologies	10	2	6	2
Maturing and Aging	9	9	0	0



**TABLE 5. Number of Participants Choosing the Factor to Answer the Card Sort Interview Questions: “Why are you surprised, did you suspect, or did you know that the factor affects HUMAN EVOLUTION?” (N=37)**

	Number of Visitors Talking about the Card	Number of Visitors Using Card for "Knew" Question	Number of Visitors Using Card for "Suspected" Question	Number of Visitors Using Card for "Surprised" Question
Language	14	7	4	3
Sunlight	13	5	3	5
Vaccinations	11	10	1	0
Text Messaging	10	4	6	0
Artificial Light	10	2	2	6
Viruses	10	6	4	0
Assistive Technologies	10	5	3	2
Maturing and Aging	9	5	2	2
Canned/preserved Foods	9	4	3	2
Raw Foods	9	3	3	3

**TABLE 6. Number of Participants Choosing the Factor to Answer the Online Survey Question: “Pick one factor you were surprised about. Why were you surprised that this factor affects YOUR BODY?” (N=216)**

	Number of Survey Respondents	Percent of Survey Respondents
Language	81	38%
Text Messaging Technology	66	31%
None	19	9%
Clothing	16	7%
Assistive Technologies	16	7%
Artificial Light	15	7%
Air Travel	8	4%
Gravity	2	1%
Canned/preserved Foods	2	1%
Sunlight	1	0%
Raw Foods	1	0%
Temperature	0	0%
Maturing and Aging	0	0%
Viruses	0	0%
Vaccinations	0	0%

**TABLE 7. Number of Participants Choosing the Factor to Answer the Online Survey Question: “Pick one factor you were surprised about. Why were you surprised that this factor affects HUMAN EVOLUTION?” (N=197)**

	<b>Number of Survey Respondents</b>	<b>Percent of Survey Respondents</b>
Text Messaging Technology	56	28%
Air Travel	38	19%
Clothing	25	13%
None	25	13%
Language	16	8%
Artificial Light	12	6%
Gravity	12	6%
Canned/preserved Foods	9	5%
Assistive Technologies	7	4%
Maturing and Aging	5	3%
Vaccinations	4	2%
Sunlight	2	1%
Raw Foods	1	1%
Temperature	0	0%
Viruses	0	0%

Qualitative data collected through the interview as well as the online survey give some insights into why participants “knew” that these eight factors affect their bodies and human evolution. Visitors who took part in the card sort were asked to pick at least one card from their “knew” and “suspected” piles and describe why those factors affect the human body.<sup>3</sup> These participants seemed to have a clear and consistent idea for why each of the “knew” factors fit into this category. When participants discussed why they knew or suspected that viruses affect the body, the most common response was that viruses cause illness (11 of 18). One participant said, “[I know viruses affect your body] because you get sick when you get a virus” (Respondent #38). When participants decided to talk about the sunlight card, their most common response (8 of 15) was that they knew or suspected that this factor affects their body because it causes skin damage. One participant said, “[I know sunlight affects your body] because if you get too much, it can cause skin cancer” (Respondent #35). The most common response given by visitors who picked the canned/preserved food card to discuss was that they knew or suspected that this factor affects their body because of the preservatives found in the food (9 of 15). One of these participants said, “Preservatives [are used] to preserve food, but are not natural to [the] body” (Respondent #9). Similar to the previous factors, for the rest of the eight factors, when visitors were asked why they knew or suspected the factor affects the body, they were most likely to respond with one answer. For raw foods, many visitors talked about the affects of chemicals or pesticides that are on them (5 of 12). For maturing and aging, visitors talked about changes they notice in their body

<sup>3</sup> It is unknown why participants, who took part in the card sort, “knew” or “suspected” that gravity and temperature affects their body or human evolution because these factors were not a part of the card sort.

with age (6 of 9), including those that relate to general decline. Tables of the responses from these questions can be found in Appendix G.

While visitors did not vary very much in their responses about why they “knew” or “suspected” that the eight factors affect their bodies, they varied much more in why they thought these factors affect human evolution. Visitors, who chose to discuss why viruses affect human evolution, were split as to whether they “knew” it affects human evolution because viruses cause adaptations in humans (3 of 10), because we live longer now (2 of 10), or because viruses affect the process of survival of the fittest (2 of 10). One of these participants said, “[I know that viruses affect human evolution because] we have more knowledge about them to make us live longer” (Respondent #19). Another participant said, “[I know that viruses affect human evolution because] the body adapts to the adaptations of viruses” (Respondent #9). Similar variation can be found when participants discussed why they “knew” or “suspected” that vaccinations affect human evolution. The most common response that visitors gave was that they knew this factor affects human evolution because it causes adaptations and mutations in the human body (4 of 11). One of these participants said, “[I know that vaccinations affect human evolution] because the increase in vaccinations and prevention makes new diseases and the human body has to change” (Respondent #31). Other visitors (3 of 11) said they knew or suspected vaccinations affect human evolution because humans now live longer than they used to. One participant said, “[I know that vaccinations affect human evolution because humans have] longer life expectancy now” (Respondent #30). Participants also varied in their descriptions of why sunlight, maturing and aging, canned/preserved foods, and raw foods affect human evolution. Tables of the responses from these questions can be found in Appendix G.

***Differences between child and adult responses.*** There are some differences between the responses of children versus adults for some of the factors that fall into the “knew” category. Children were not more likely to say that they “knew” that air travel affected the body, or that gravity or canned foods affected human evolution. In fact, there was no statistically significant difference in whether children selected “knew,” “suspected,” or “surprised” for each of these factor/lens combinations.

***Summary:*** Analysis of the data suggest that many visitors know that gravity, sunlight, temperature, canned/preserved foods, raw foods, maturing and aging, viruses, and vaccinations affect their bodies and human evolution. Visitors, therefore, should have an easier time accepting these factors in the exhibition. Although visitors reported that they “knew” that these factors affected their body and evolution, this result should not be interpreted to mean that there is no opportunity for further learning by visitors about these factors. Participants were limited in how they felt the factors affect their bodies, and based on the varied responses given by the participants, visitors may have some confusion about why the factors affect human evolution. These factors, therefore, appear to both be accessible entry points for visitors and offer opportunities for further learning.

**1.2 There was variation in how visitors connected certain factors to human evolution.**

For three factors, visitors’ answers to the human evolution question were no different than if they had chosen their responses randomly. These factors included the following:

- Artificial light
- Assistive technologies
- Clothing

For these three factors, chi-square tests on the human evolution questions indicate that the distribution of the responses between the categories is not significantly different than chance, with visitors no more likely to select one of the three categories over another (Table 8). However, chi-square tests on the Body question indicate that visitors were more likely to say that they “knew” these factors had an effect on their bodies (Table 2). It is worth noting that the mean scores for each of these factors fell below the median of the mean scores for both the Body and Evolution categories (Table 3 & 4).

**TABLE 8. Distribution of Responses and  $\chi^2$  Values for Participants Who Were Unsure the Factors Affect Their Bodies and Human Evolution.**

Question	Catalyst	Number of Participants Choosing “Knew”	Number of Participants Choosing “Suspected”	Number of Participants Choosing “Surprised”	$\chi^2$	p-Value
Evolution	Artificial light	72	97	90	3.842	0.146
	Assistive technologies	88	92	75	1.75	0.417
	Clothing	85	74	70	5.832	0.054

The finding that there is not a statistically significant difference in visitors’ selection of whether they “knew,” “suspected,” or were “surprised” that the factor affected human evolution could be interpreted two different ways: 1) there is wide variation in visitors’ understanding of the effects of these three factors on human evolution, or 2) visitors were not certain of their responses and therefore the response they chose was more a reflection of chance than a purposeful response.

Results from the card sort & interview suggest that there is wide-variation in visitors’ knowledge of the effects of these factors on human evolution.<sup>4</sup> Some people felt that artificial light affects human evolution because it causes adaptations (2 of 4). Other participants suspected that artificial light affects human evolution but questioned how it could when little time has passed since it has been introduced (2 of 4). One of these participants said, “[Artificial lights are] fairly new things and [it] doesn't affect how our body

<sup>4</sup> It is unknown why participants, who took part in the card sort, “knew” or “suspected” that clothing affects their body or human evolution because this factor was not a part of the card sort.

develops” (Respondent #36). Similar results were seen when participants discussed why they “knew” or “suspected” that assistive technologies affect human evolution. A few people said that assistive technologies affect human evolution because they aid the body (3 of 8). One participant said, “A lot of elders will need it as we get older” (Respondent #14). Others “knew” or “suspected” assistive technologies affect human evolution because they cause adaptations (2 of 8) or are man-made (2 of 8). One of these participants said, “[Humans] will evolve to accommodate prosthetic joint replacements; the body will adapt more easily” (Respondent #10). Tables of the responses from these questions can be found in Appendix G.

Similar variation in responses was also seen when visitors chose to talk about why they “knew” or “suspected” that assistive technologies and artificial light affect their bodies. Participants’ responses to why artificial light affects their body were widely varied. Three of the responses (of 6) could not be coded. These participants said the following:

*[I knew that artificial light affects your body because] well, that does the opposite [of sunlight]. (Respondent #2)*

*[I knew that artificial light affects your body because] because 100 years ago it never had an effect. (Respondent #18)*

*[I suspected that artificial light affects your body because] because sometimes artificial lights are made with chemicals that can be harmful. (Respondent #39)*

Other participants said they “knew” or “suspected” that artificial light affects their body because it affects your eyesight (2 of 6) or because it affects mood (1 of 6). Participants also varied in why they thought assistive technologies affect their bodies. Some participants thought assistive technologies affect their bodies because it is an aid (4 of 8). One of these participants said, “I knew it helps you walk because it helps you stay active” (Respondent #6). Others thought they affect the body because assistive technologies can keep you alive (3 of 8) or because they are man-made parts (2 of 8). One of these participants said, “[I suspect that assistive technology affects your body because it] keeps you alive longer” (Respondent #36). This variation in responses may indicate that participants not only varied in their understanding of how these factors affect human evolution, but they also varied in terms of how they thought these factors affected the body.

***Differences between child and adult responses.*** Overall, children’s responses showed greater variation for more factors than the adults’ responses. There were three factors where there was not a statistical difference in the categories chosen by children for the Body questions (assistive technology, air travel and text messaging). There were an additional four factors where there was not a statistical difference in the categories chosen by children for the Evolution questions (air travel, text-messaging, canned food or gravity). It does not appear that the difference between the variation in children’s responses versus adults’ responses is due to low participation rates on the part of children (few of the choices had expected observations that were less than 5). Potential reasons why there was such variation in the responses of those under 18 should be investigated through further studies.

**Summary:** These findings suggest that there is a great deal of variation in how visitors think about the relationship between artificial light, assistive technologies, and clothing and human evolution, and maybe even between these factors and their bodies. These factors, therefore, offer areas for growth amongst certain visitor populations. In places where there are wide areas of variation, effective exhibit strategies might include designing components that allow for multiple entry points and outcomes. Additionally, it should be noted that concept categories with greater variation signal the need for more prototyping of these components earlier on in the project’s development.

***1.3 Visitors were surprised that three of the factors affect their bodies and human evolution.***

For three of the factors, participants were statistically more likely to say that they were “surprised” that the factor affects either their bodies or human evolution. These factors included the following:

- Text messaging technologies (Body and Evolution)
- Language (Body only)
- Air travel (Evolution only)

For all of these factors, chi-square tests indicate that the distribution of responses between the categories is significantly different than chance, with visitors more likely to say that they were “surprised” that the factor affected evolution than that they either “suspected” or “knew” about the relationship (Table 9). The mean score for the factor/lens combination also reflects the visitors’ surprise of the effects, with text messaging and air travel having the lowest means for the human evolution question, and text messaging technologies and language having the lowest scores for the Body question (Table 3).

**TABLE 9. Distribution of Responses and  $\chi^2$  Values for Participants who were “Surprised” the Factors Affect Their Bodies and/or Human Evolution.**

Question	Factor	Number of Participants Choosing “Knew”	Number of Participants Choosing “Suspected”	Number of Participants Choosing “Surprised”	$\chi^2$	p Value
Body	Language	81	61	130	37.873	<.0005
	Text messaging	60	88	125	25.529	<.0005
Evolution	Air travel	74	59	99	15.308	<.0005
	Text Messaging	52	76	130	57.657	<.0005

Qualitative data collected through the interview and the online survey provide some insights into why participants were “surprised” that language and text messaging affect human evolution and/or their bodies.<sup>5</sup> Visitors were “surprised” that language affects their body but

<sup>5</sup> It is unknown why participants, who took part in the card sort, “knew,” “suspected,” or were “surprised” that air travel affects their body or human evolution because this factor was not a part of the card sort.

“knew” that language affects human evolution. Nevertheless, qualitative data indicates that participants may have had some confusion about how they “knew” or “suspected” that language affects both of these lenses. Participants, who chose to talk about how language affects their bodies, often came up with the same effect. The most common response (4 of 16) given by participants was that language affects emotions and behaviors. One of these participants said, “[I knew that language affects your body because] from word of mouth, peer pressure: do different things with the body than would normally” (Participant #12). This response is much different than the physical changes that visitors often discussed when they “knew” that other factors affect their body indicating that participants may have been confused about how language affects their bodies.

Even though visitors “knew” that language affects human evolution, it is evident from looking at the data that participants had some difficulty articulating their reasons why. The most common response that participants gave when answering this question (4 of 11) was that language affects human evolution because it has an impact on socialization. One of these participants said, “[I knew that language affects human evolution because it is] how we communicate and coordinate - how we survive” (Participant #36). Other participants’ reasons had nothing to do with the impact of language on evolution at all. These participants said they knew language affects human evolution because language itself evolves and changes (3 of 11). One of these participants said, “[I knew that language affects human evolution because] ‘a hoe is a hoe’ [the word means something different now than it used to]. Language evolves and changes over time” (Participant #3). Because of the variation in these responses as well as how much the visitors seemed to have to reach to find an effect, it appears that visitors were confused about the idea that language affects human evolution. Tables of the responses from these questions can be found in Appendix G.

Similar to language, there was great variation and tangential elements in visitors’ responses about the effect of text messaging on their bodies and human evolution. The most common response given by the participants was that they suspected text messaging affects human evolution but felt that more time needs to pass before any changes can be discovered (3 of 10). A participant said, “[I suspected text messaging affects human evolution] because we didn’t have these types of technologies” (Participant #21). Other participants gave more tangential responses. A couple of people (2 of 10) felt that text messaging affects human evolution because it is becoming more important or because it creates physiological effects on the body. One of these participants said, “[I knew that text messaging affects human evolution] definitely because we use this to communicate -- as we grow it becomes part of our daily routine” (Participant #32). Participants seemed clearer in their understanding of how text messaging affects their body.

The most common response (6 of 11) given by participants about text messaging was that it affects your body physically. One of these participants said, “[I suspected that text messaging affects your body] ...because eyes get bloodshot if [it’s] on too long” (Participant #23). This clear, physiological response was also the kind of response most likely described for the “knew” factors described in Section 1.1. Therefore, it seems from this data that some participants had a better grip on how text messaging affects their bodies than how language

affects their bodies. Tables of the responses from these questions can be found in Appendix G.

***Differences between child and adult responses.*** Here again we see that there was greater variation in the children's responses than the adults' responses to these factors. There were no statistical differences in the number of children who chose each of the three categories when describing their knowledge of the effects of air travel on evolution, or the effects of text messaging on their body or evolution.

***Summary:*** These findings suggest that when visitors are surprised that a factor affects their bodies or human evolution, they may look to tangential effects to explain the relationship between the factor and human evolution. Therefore, these factors, just like the factors in the previous section, offer areas for growth and learning. In places where there are wide areas of variation, effective exhibit strategies might include designing components that allow for multiple entry points and outcomes. In addition, concept categories with greater variation signal the need for more prototyping of these components earlier in the exhibit development process.

## **2. VISITORS' PERCEPTIONS OF THE EFFECTS TO THE BODY AND HUMAN EVOLUTION**

The above-stated findings suggest that there may be differences in how visitors describe their awareness of the relationship between a factor and their bodies versus the relationship between a factor and human evolution. Further analysis confirms that there is a difference between visitors' self-reported knowledge related to these two lenses. The visitors' mean understanding of the effect of the factors on their bodies ( $M= 36.16$ ) was significantly higher than their mean understanding of the effect of the factors on human evolution ( $M= 32.17$ ) ( $n=289$ ,  $t=12.239$ ,  $p<.0005$ ). Qualitative data from the online survey and card sort & interview indicate some reasons for these differences as well as some reasons why visitors were surprised the factors affected their bodies or human evolution.

When looking at the "surprised" question from the online survey and card sort & interview, it becomes clear that visitors had widely differing interpretations of the questions about "your body" and "human evolution." When visitors were asked to describe why they were surprised a factor affects their body, an overwhelming number of the participants (35 of 242) seemed to discuss changes to the body in terms of visible, physical changes. One of these participants said, "[I] don't know how a text message can affect my (physical) body!" (Respondent #31925). Another participant said, "I would suspect that language affects the brain, but I assume that's not what you mean. I'm having trouble imagining what part of the body is affected. The mouth and teeth?" (Respondent #32572). Only a few participants described expecting an effect on their body to involve internal (6 of 242), harmful (6 of 242), or any other kind of change or effect. One of these participants said, "Just verbal language shouldn't cause a defect in the body" (Respondent #14). These data indicate that many visitors interpreted the question to be asking about physical changes due to the factors that were externally obvious.



For some of the responses where visitors talked about why they were surprised that a factor affected their body, you can see evidence that they are starting to formulate their own rationale for why the factor affects their body even though it was something they had never thought of before. Again, the most common response visitors gave was that they could imagine a physical effect from the factor on the body (28 of 242). One of these participants said, “Text messaging, surprises me, I think just because it had never occurred to me. It makes some sense, though, since I know typing affects my body and wrists, text messaging could have affects [sic] as well” (Respondent #32076). Another participant said, “[I] don't see the relationship between language and body unless it's related to how the mouth has to work to make certain sounds” (Respondent #32573). Another common response given by the respondents was that they were surprised but hypothesized that the factor could have an effect on the body internally (26 of 242). One of these participants said, “Language doesn't seem like something that could affect your body, except, I guess, through changing brain chemicals maybe” (Respondent #32184). Other visitors were surprised but saw that the factor could have psychological effects (15 of 242). A participant said, “I was surprised that language affects our bodies. ... Although, if I think about it, some people do not take verbal criticism. It makes them emotionally unstable which leads to insomnia. If you're not sleeping, the body cannot heal itself” (Respondent #32235). To see a more detailed breakdown of these responses look at the Table H2 in Appendix H.

People reacted to the human evolution question differently. Many visitors expressed their doubt that the factor could affect human evolution and explained their reasoning why the factor would not have an effect (70 of 219). One participant said, “Not sure why gravity would affect our evolution as it has been a constant (I think)” (Respondent #32546). Other participants wanted the Museum to give evidence as to how the factor could cause human evolution (31 of 219). One of these participants said, “I am also surprised that language also has a role and affects human evolution. I would be curious to know how?!” (Respondent #31699). Yet other visitors wanted to believe the Museum when we said the factor affects human evolution and provided their own hypotheses for how the factor could affect evolution (24 of 219). One of these participants said, “Sunlight - because it can affect your vision and hurt your eyes and go blind” (Respondent #25). A few participants provided responses that suggest that they believed the Museum without reservation (13 of 219), felt evolution is a thing of the past (3 of 219), or did not believe in evolution at all (2 of 219). These data indicate that the participants were sometimes skeptical that certain factors could affect human evolution. Table H3 in Appendix H provides a more detailed breakdown of the responses.

Interestingly, participants had very distinct ideas about why they were surprised that the factors affect human evolution. The most common response given by the participants was that human evolution cannot have occurred as a result of the factor because not enough time has passed since the introduction of the factor (32 of 219). One participant said, “I didn't think air travel and text messaging had been around long enough to affect human evolution” (Respondent #32569). Another participant said, “How can recent technologies affect evolution? Is there enough data yet?” (Respondent #32591). All other responses were only given by a few visitors. Some people thought that for a factor to affect human evolution it has to affect the physical body (13 of 219). One of these participants said, “I was surprised that air travel would affect evolution because I'm not sure it would have such a significant effect on the body” (Respondent #32216). Others thought it must cause change (8 of 219), affect the ability to reproduce (8 of 219), cause

mutations (7 of 219), or affect survival (7 of 219) to affect human evolution. To see a more detailed breakdown, look at Table H4 in Appendix H.

### 3. VISITORS' PERCEPTIONS OF THE EFFECTS OF MAN-MADE VERSUS NATURAL FACTORS

Analysis of the data by factor suggests that there may be a difference in visitors' perceptions of the effects of man-made versus natural factors on their body and human evolution. Of the six factors that visitors were not more likely than chance to "know" affect both their body and human evolution, five were man-made technologies and only one could be considered "natural" (language).

Deeper exploration of the data confirms that there appears to be a difference in visitors' perception of their knowledge related to the effects of man-made versus natural factors on the body and human evolution. The mean total score of the natural factors ( $M= 25.33$ ) is significantly higher than the mean total score for the man-made technologies factors ( $M= 21.72$ ) ( $t= 20.178$ ,  $DF= 333$ ,  $p<.0005$ ).<sup>6</sup> Comparison of the man-made technology factor scores to the natural factor scores within each catalyst category also reveals a difference between the two, with the natural factor repeatedly scoring higher than the technology factor (Table 10).<sup>7</sup> The higher score was present when comparing the total score for each factor (Body + Evolution), as well as the separate scores for the Body questions and Evolution questions. One exception was that there was no statistical difference between the Body scores for text-messaging and language.

It should be noted that it is not always true that visitors more readily acknowledge their understanding of the effects of natural factors than their understanding of technological factors. Looking across catalyst categories, we see that some technological factors have higher scores than some natural factors. For example, vaccinations have a mean total score of 5.32 while raw foods has a mean total score of 5.00 ( $t=5.337$ ,  $DF=333$ ,  $p<.0005$ ). This suggests that the catalyst category plays a substantial role in visitors' perceptions of the effects of a given factor. However, it is important to recognize that the natural factors consistently had higher mean scores than the technology factors when comparisons were made within catalyst categories.

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<sup>6</sup> The natural mean was calculated by first creating a natural score for each participant (by adding together their score for all the natural factors) and then averaging the score of all the participants. The man-made technology mean was calculated by first creating a man-made technology score for each participant (by adding together their score for all the man-made technology factors) and then averaging the score of all the participants.

<sup>7</sup> The natural factor mean was calculated by first creating a natural factor score for each participant (by adding together their score for the factor on both the Body and Evolution questions) and then averaging the score of all the participants. The man-made technology factor mean was calculated by first creating a man-made technology factor score for each participant (by adding together their score for the factor on both the Body and Evolution questions) and then averaging the score of all the participants.

**TABLE 10. Comparison of the Total Score (Body + Evolution) Between the Natural and Man-Made Technology Factor for the Five Catalyst Categories.**

	Mean	Independent Samples T-test Results
<b>Physical catalysts</b>		
Sunlight	5.43	t=18.089, df=333, p<.0005
Artificial light	4.16	
<b>Experiential catalysts</b>		
Language	3.88	t=5.603, df=333, p<.0005
Text-messaging	3.33	
<b>Maturational catalysts</b>		
Maturing and aging	5.44	t=6.564, df=333, p<.0005
Assistive technologies	4.21	
<b>Dietary catalysts</b>		
Raw foods	5.00	t=16.491, df=333, p<.0005
Canned/preserved foods	4.71	
<b>Microbial catalysts</b>		
Virus	5.59	t=6.534, df=333, p<.0005
Vaccination	5.32	

Qualitative data collected from the visitors during both the card sort & interview and the online survey suggest that one reason for the difference in visitors’ reactions to the natural versus man-made factors is the perception that factors need to be around for a long-period of time before they can affect human evolution (32 of 219 visitor responses). This perception could relate to either 1) a misinterpretation of the question, with visitors thinking that we were asking if the factor has *already* affected human evolution, or 2) a common misconception of evolution as something that happened in the past. Getting visitors to think, therefore, about how modern day inventions will affect human biology in the future will be both a challenge and an opportunity for this exhibition.

**4. POSSIBLE AREAS OF VISITOR INTEREST AND ENGAGEMENT**

Visitors were not asked directly about their interest in the three lenses and five catalysts through this study. However, sometimes visitors offered this information during their interview or survey, and this data provides some indications of possible areas of visitor interest. Since this was not the purpose of this interview, if the HHL team is interested in learning more about visitor interest, another study that focuses specifically on this topic should be pursued.

In the course of the cart sort & interview and online surveys, 28 participants talked about their interest in the exhibition in general or the three lenses of evolution, anatomy, and environment. Just about half the participants (13 of 28) said they were interested in the exhibition as a total concept. One of these participants said, “Sounds like an interesting potential exhibit” (Respondent #32246). Another respondent said, “When does it open? The idea sounds brilliant” (Respondent #32037). The same number of participants (13 of 28) said that they are interested in the content having to do with the evolution lens. One participant said:

*Anything affecting survival rates and/or reproductive rates will have an effect on human evolution. This, and other concepts relating to evolution need to be better understood by the general public, including children. (Respondent #32019)*

Fewer participants said that they were interested in the anatomy lens (7 of 28) or the environment lens (2 of 28) (Table 11). One participant said of his/her interest in the anatomy and environmental lenses, “This is a most important and fascinating blend of environmental factors on the wellbeing of the human body. I look forward to your survey results” (Respondent #32075). It should be kept in mind, however, that because we did not specifically ask visitors to compare their relative interest in the different lenses, we do not know if one lens is more interesting to visitors than another. To accurately gauge visitors’ interest in the three lenses it is important to ask specific questions about visitors’ interests in each of them.

**TABLE 11. Responses to Any of the Open-Ended Questions on the Card Sort & Interview or Online Survey That Indicate an Interest in the Exhibition or One of the Three Lenses. (N=28)**

	Number of Respondents
<i>Exhibition:</i> The participant mentions an interest in the exhibition/project in general.	13
<i>Evolution:</i> The participant mentions an interest in the idea of an exhibition about evolution or human evolution.	13
<i>Anatomy:</i> The participant mentions an interest in the idea of an exhibition about anatomy or physiology.	7
<i>Environment:</i> The participant mentions an interest in the idea of an exhibition about the environment, ecosystems, or ecology.	2

The data were also culled to see if visitors expressed interest in any of the five catalysts. Through all the card sort & interviews and online surveys, 27 participants expressed interest in at least one of the catalysts. The catalysts that were mentioned most often by the participants were experiential catalysts. Many visitors specifically mentioned that they wanted to learn more about the language factor (8 of 27), the text messaging factor (6 of 27), and air travel (4 of 27). One of these participants said, “It is very exciting that you are asking these questions in relation to the body. As I do early childhood programs that juxtaposes [sic] language development and body development I applaud you in your questions on language and text messaging. It would be great to have a more in depth conversation on this” (Participant #32075). Another participant said of air travel, “Air travel. Apart from things like altitude and having your ears pop, how else does it affect you?” (Participant #32115). Many participants also discussed their interest in the physical catalysts. In particular, participants discussed their interest in learning more about the artificial light factor (4 of 27). One participant said of the artificial light factor, “I would love more detail on how artificial light affects the body” (Respondent #31923). Other participants named other physical factors (3 of 27) which they thought should be added to the catalyst list. Those factors included radon (Participant #32109), electro-magnetic fields (Participant #32173), and water (Participant #32588). A few participants (3 of 27) were interested in the Museum adding more dietary factors including breastfeeding (Participant #32184), agricultural developments (Participant #31929), and diet (Participant #31922). A final factor also stood out in these data

was “modern” technologies (3 of 27) (Table 12). One of these participants said, “I have not spent a lot of time thinking about how newer products affect me and my children. I would also be interested in microwaves, computers, etc...” (Participant #31963). As stated before, these data are likely not indicative of the interests of Museum visitors at large. Nevertheless, they do seem to indicate that visitors may be most interested in learning more about the catalysts that they had the most confusion or surprise about during the card sort and on the survey.

**TABLE 12. Responses to Any Open-Ended Questions on the Card Sort & Interview or Online Survey Which Indicate an Interest in Learning More about the Factors. (N=27)**

	<b>Number of Participants</b>
<i>Experiential Catalysts</i>	
Language	8
Text Messaging Technology	6
Air Travel	4
Experiential Catalysts-Other	1
Clothing	1
<i>Physical Catalysts</i>	
Artificial Light	4
Physical Catalysts-Other	3
Gravity	1
Sunlight	0
Temperature	0
<i>Dietary Catalysts</i>	
Dietary Catalysts-Other	3
Canned/preserved Foods	0
Raw Foods	0
<i>Other</i>	
"Modern" Technologies	3
<i>Maturational Catalysts</i>	
Assistive Technologies	1
Maturing and Aging	1
<i>Microbial Catalysts</i>	
Viruses	0
Vaccinations	0

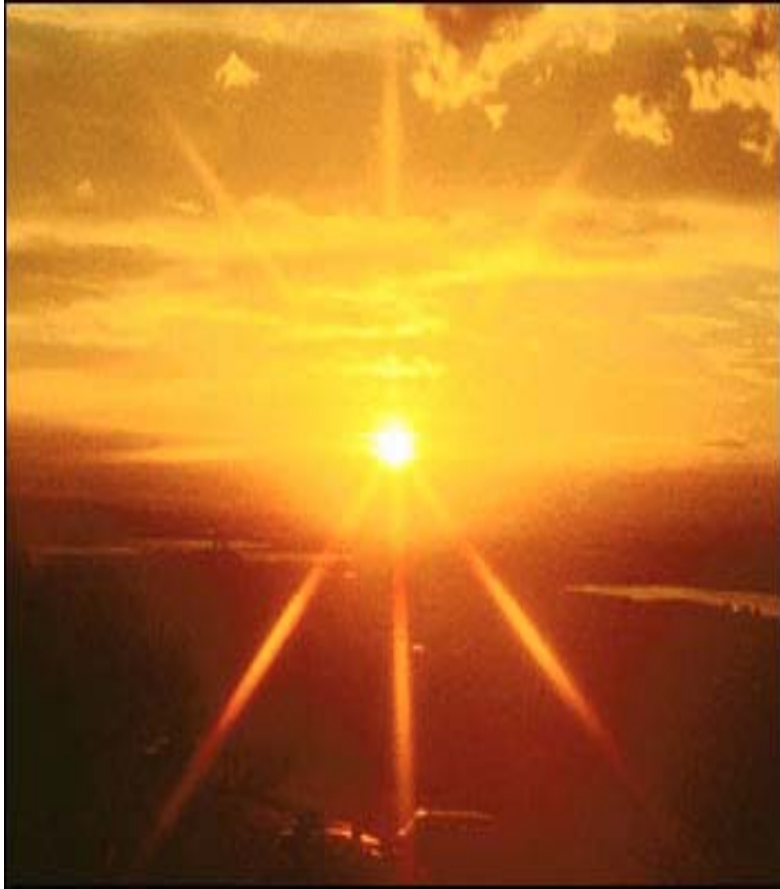
## IV. CONCLUSION

The data indicate that visitors had a variety of reactions to the factors that were the focus of this study. For a few of the factors, participants were comfortable with the idea that they affect their bodies and human evolution. For other factors, participants were either surprised or unsure how the factor affects their bodies and/or human evolution. There are a number of possible reasons for the differences in how visitors reacted to these different factors. First, participants seemed to have a greater understanding of how the “natural” factors affect their body and human evolution than “man-made” technologies. This seemed to have to do with the idea that the “man-made” technologies are newer and therefore have not had a chance to act on the body or human evolution. Second, visitors seemed to have a better understanding of how factors affect their bodies than human evolution. Much of this difference seems to be because visitors are able to understand and articulate the types of changes the factor can have on their body, while they appeared to have a more difficult time articulating the mechanisms behind evolution. These explanations of how the body or human evolution could be affected by the factors differed a great deal. Participants seemed to focus on physical changes as evidence that a factor affects your body. For human evolution, visitors seemed to focus on time as the most important evidence that a factor could affect human evolution. If a factor was not around long enough in the eyes of the visitor, then it was likely that they would think that it could not cause evolution.

Just because some factors were better understood than others does not mean that any of these factors should be excluded from the *Hall of Human Life* exhibition. Visitors actually showed a great deal of interest in learning about and better understanding the mechanisms that they did not understand very well. In addition, these little understood factors are areas where visitors could increase their understanding. There is also benefit to be found in the factors that visitors understood well. Including these factors in the exhibition may provide visitors with easier and more familiar entry points into the exhibition and its content. Therefore, the range of visitors’ understandings of the different factors that were included in this study is actually a great strength in terms of the exhibition.

Nevertheless, it is important to note a few things about the lesser understood factors. Exhibit developers should be careful when presenting to visitors these factors for a couple of reasons. First, visitors seem to come with more misconceptions about these factors. Second, visitors may come to the exhibit with more skepticism about these factors. Therefore, it is important to thoroughly test any exhibit ideas and concepts that concern these factors in order to make sure that visitors understand the goals and messages they are trying to achieve.

**APPENDIX A: CARD SORT FACTOR CARDS**



**Sunlight**



**Artificial Light**

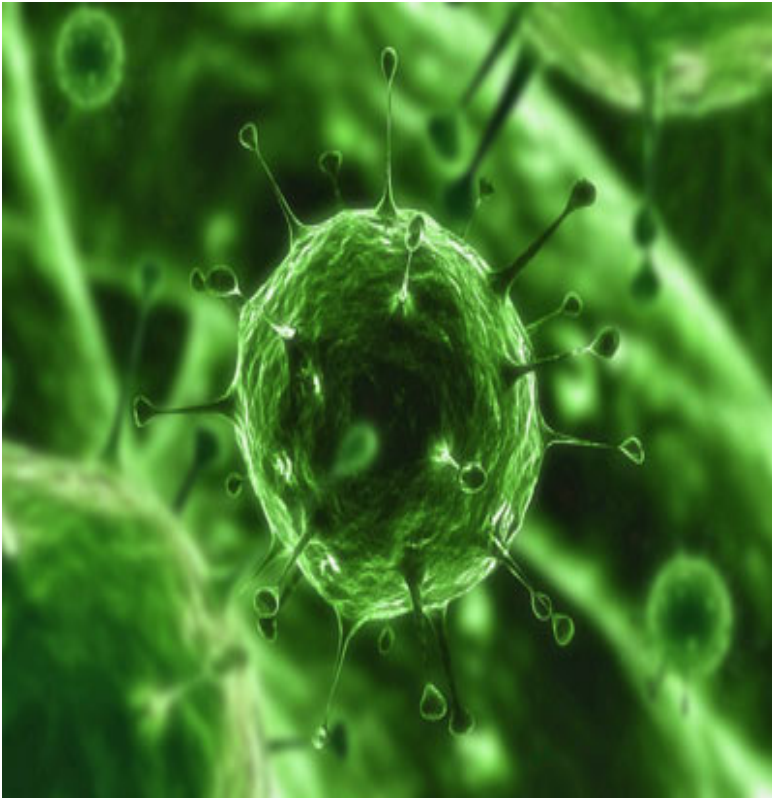


Raw Foods



Canned / Preserved Foods

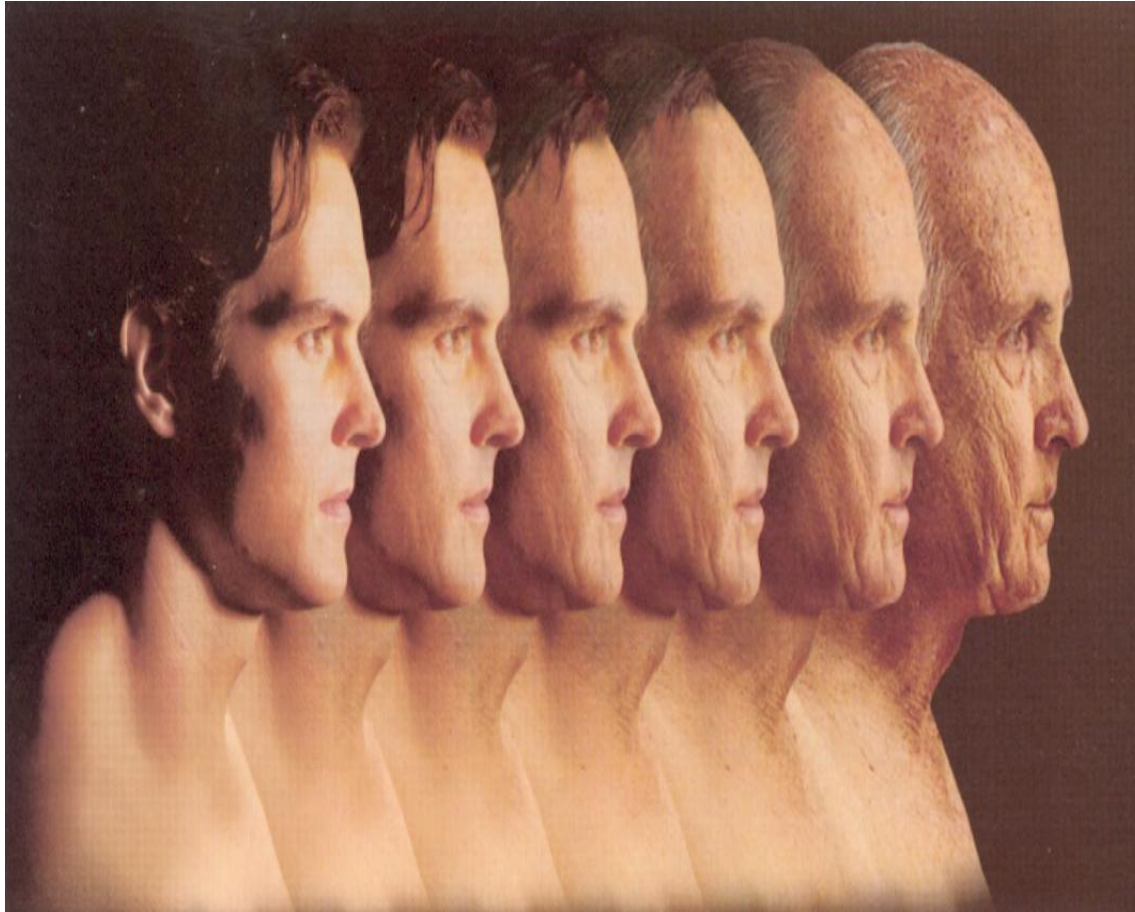




Viruses



Vaccinations

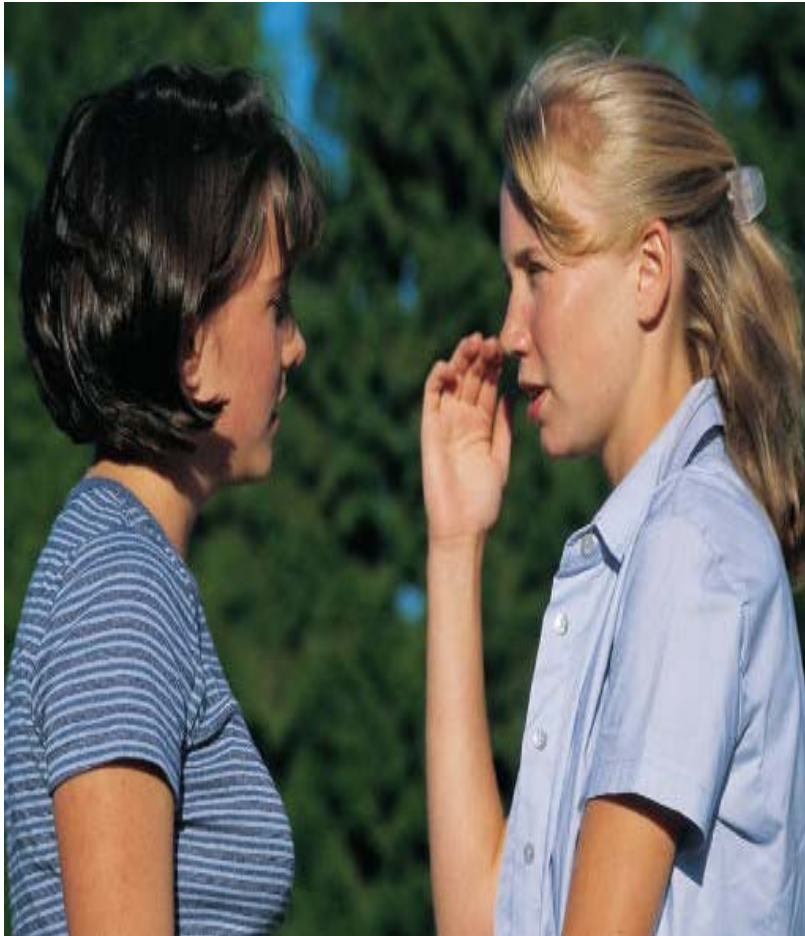


Maturing and Aging



Assistive  
Technologies





Language



Text messaging technologies

## APPENDIX B: CARD SORT INTERVIEW

Protocol: Place a cart in the “Human Body Connection.” The cart will be covered with ten pictures and three labels taped to the cart that say “surprised,” “suspected,” and “knew.” Approach visitors over the age of 13 that are a mixture of genders, ages, and races/ethnicities. Say to the visitors: “We are in the process of creating a new human biology exhibition, and we are asking for help from our visitors. Would you like to help?”

### **Your body section**

1. What we are going to do is a card sort activity. All of these cards depict parts of our environment that affect your body. What we would like you to do is look at each of these pictures, and then sort them into three different categories. Place here [point to surprised label] any cards where you are surprised the factor affects your body. Place here [point to suspected label] any cards where you suspected that the factor affects your body, but weren't quite sure before. Then, place here any factors that you feel you knew affects your body. When you are done, we'll talk about your choices.

<b>Catalyst</b>	<b>Surprised</b>	<b>Suspected</b>	<b>Knew</b>
<i>Physical</i>			
Sunlight			
Artificial Light			
<i>Dietary</i>			
Canned/preserved foods			
Raw foods			
<i>Microbial</i>			
Viruses			
Vaccinations			
<i>Maturation</i>			
Maturing and aging			
Assistive technologies			
<i>Experiential</i>			
Language			
Text Messaging			

2. OK, now let's talk about the ones that surprised you. [Point to cards in the “Surprised” category] Pick one of the cards that you placed in this category, and let's talk about why you are surprised that this factor affects your body.
3. OK, now let's talk about the ones in this category. [Point to the cards in the “Suspected” category] Pick one of the cards that you placed in the “suspected” category, and tell me why you suspect that this factor affects your body.
4. OK, now let's talk about this category. [Point to the cards in the “Knew” category] Pick one of the cards that you placed in the “knew” category, and tell me a bit more about why you know that this factor affects your body.

**Human evolution section**

1. For our next activity, we are going to do the same thing, except this time the focus is on human evolution, and not your body. So again, all of these cards represent parts of our environment that affect the evolution of humans. What we would like you to do is look at each of these pictures, and then sort them into three different categories. As you look at these pictures, please place here [point to surprised label] any cards where you are surprised that the factor affects human evolution. Place here [point to suspected label] any cards where you suspected that the factor affects human evolution, but weren't quite sure before. Then, place here any factors that you feel you knew affects human evolution. When you are done, we'll talk about your choices.

<b>Catalyst</b>	<b>Surprised</b>	<b>Suspected</b>	<b>Knew</b>
<i>Physical</i>			
Sunlight			
Artificial Light			
<i>Dietary</i>			
Canned/preserved foods			
Raw foods			
<i>Microbial</i>			
Viruses			
Vaccinations			
<i>Maturation</i>			
Maturing and aging			
Assistive technologies			
<i>Experiential</i>			
Language			
Text Messaging			

5. OK, now let's talk about the ones that surprised you. [Point to cards in the "Surprised" category] Pick one of the cards that you placed in this category, and let's talk about why you are surprised that this factor affects human evolution.
6. OK, now let's talk about the ones in this category. [Point to the cards in the "Suspected" category] Pick one of the cards that you placed in the "suspected" category, and tell me why you suspected that this factor affects human evolution.
7. OK, now let's talk about this category. [Point to the cards in the "Knew" category] Pick one of the cards that you placed in the "knew" category, and tell me why you know that this factor affects human evolution.
8. OK. That is it! Before we end, is there anything else you would like to tell us about what we talked about here today?

**Demographics (Evaluator should guess these based on observation)**

9. Gender:

10. Age:

11. Race/ethnicity:

12. With children under 18?

Great! Thanks again for your help. We really appreciate your efforts. [Give them a take away gift]

## APPENDIX C: EMAIL ONLINE SURVEY SOLICITATION

**From:** "Museum of Science" <reply@email.mos.org>  
**To:** <ahampe@mos.org>  
**Date:** 04/28/2008 03:44 PM  
**Subject:** Help Us Plan Our New Exhibit

 Museum of Science April 30, 2008

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**Take Our Survey** 

Greetings,

The Museum of Science wants to hear from you! We are looking for help from our visitors in planning for a new exhibition about human life. Please take 5 - 10 minutes to take a [survey](#) about concepts and ideas which might be included in the new exhibition.

[Take the survey!](#)

Thank you for your help,

Science Sandy  
Editor, *Museum Update*

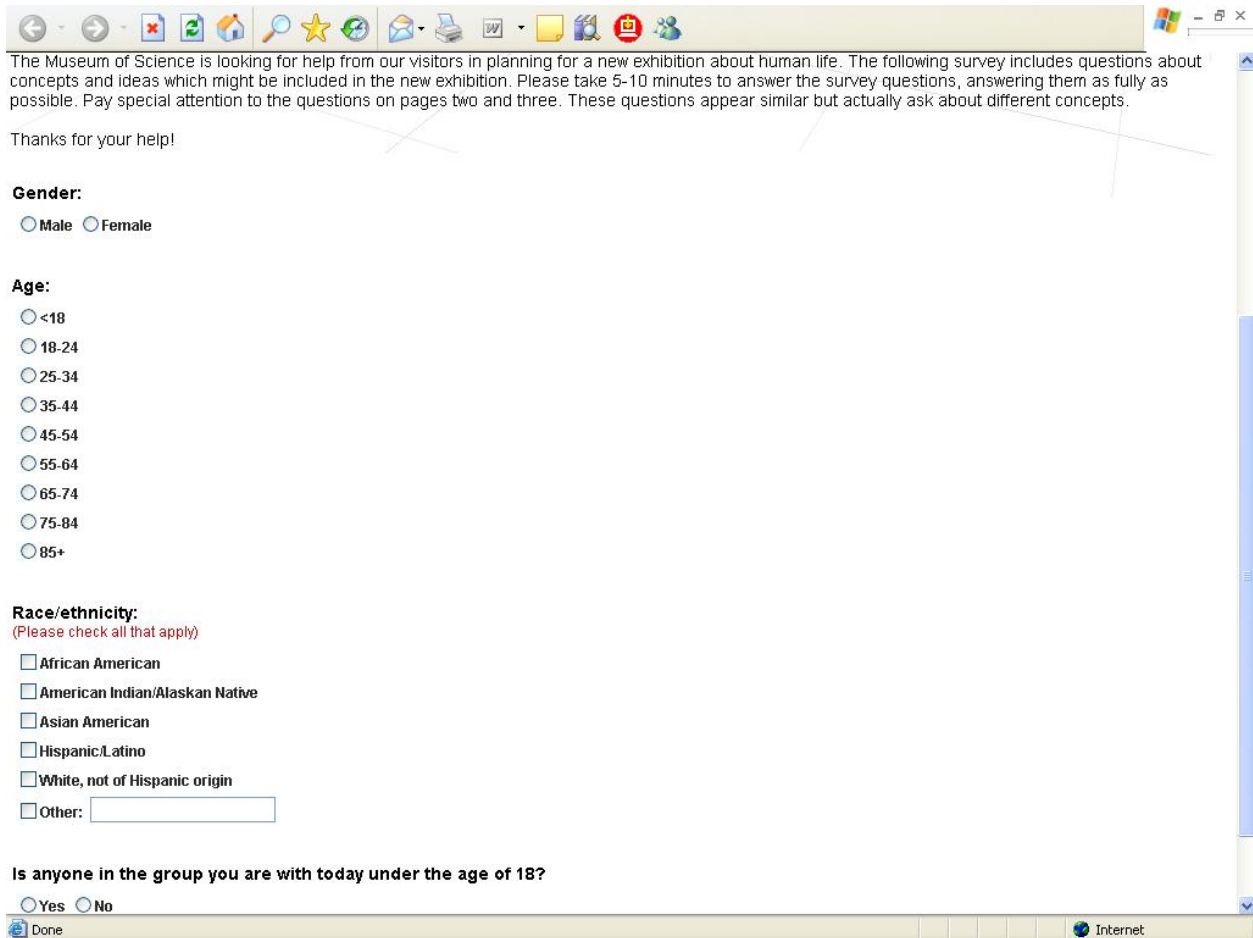


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**Museum of Science**

## APPENDIX D: MUSEUM ONLINE SURVEY



The Museum of Science is looking for help from our visitors in planning for a new exhibition about human life. The following survey includes questions about concepts and ideas which might be included in the new exhibition. Please take 5-10 minutes to answer the survey questions, answering them as fully as possible. Pay special attention to the questions on pages two and three. These questions appear similar but actually ask about different concepts.

Thanks for your help!

**Gender:**

Male  Female

**Age:**

<18  
 18-24  
 25-34  
 35-44  
 45-54  
 55-64  
 65-74  
 75-84  
 85+

**Race/ethnicity:**  
(Please check all that apply)

African American  
 American Indian/Alaskan Native  
 Asian American  
 Hispanic/Latino  
 White, not of Hispanic origin  
 Other:

**Is anyone in the group you are with today under the age of 18?**

Yes  No

Done Internet



**YOUR BODY**

Please look over the factors below. All of these factors affect YOUR BODY. For each factor, please tell us if you are surprised, if you suspected, or if you knew that the factor affects YOUR BODY.

	Surprised	Suspected	Knew
Sunlight	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Artificial light (from light bulbs, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gravity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Temperature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Raw foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Canned and preserved foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Viruses	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vaccinations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maturing and aging	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Assistive technologies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Air travel	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Language	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Text messaging technology	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Clothing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Pick one factor you were surprised about. Why were you surprised that this factor affects YOUR BODY?

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Done Local intranet

**HUMAN EVOLUTION**

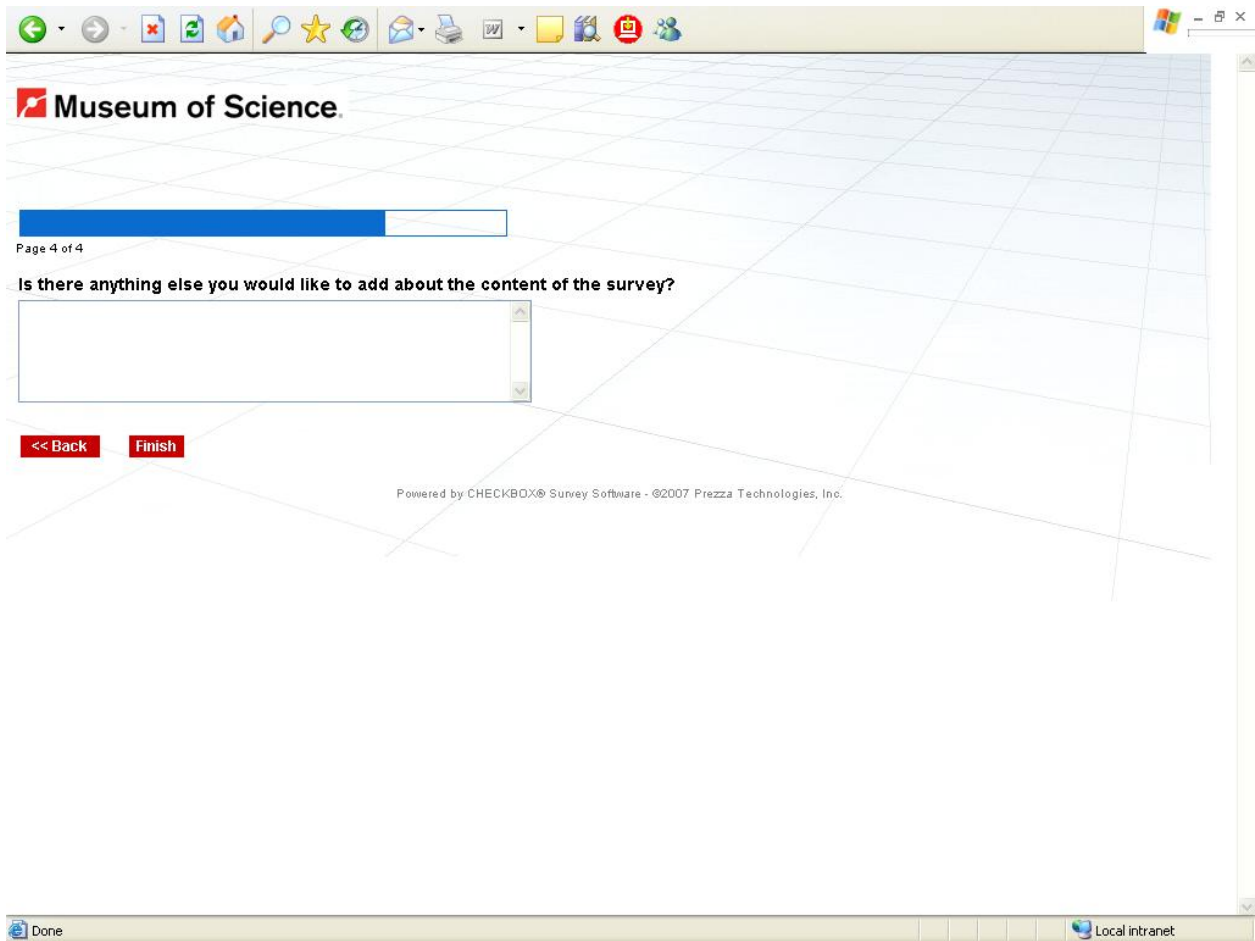
Please look at these factors again. These factors also affect HUMAN EVOLUTION. For each factor, please tell us if you are surprised, if you suspected, or if you knew that the factor affects HUMAN EVOLUTION.

	Surprised	Suspected	Knew
Sunlight	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Artificial light (from light bulbs, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gravity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Temperature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Raw foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Canned and preserved foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Viruses	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vaccinations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maturing and aging	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Assistive technologies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Air travel	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Language	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Text messaging technologies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Clothing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

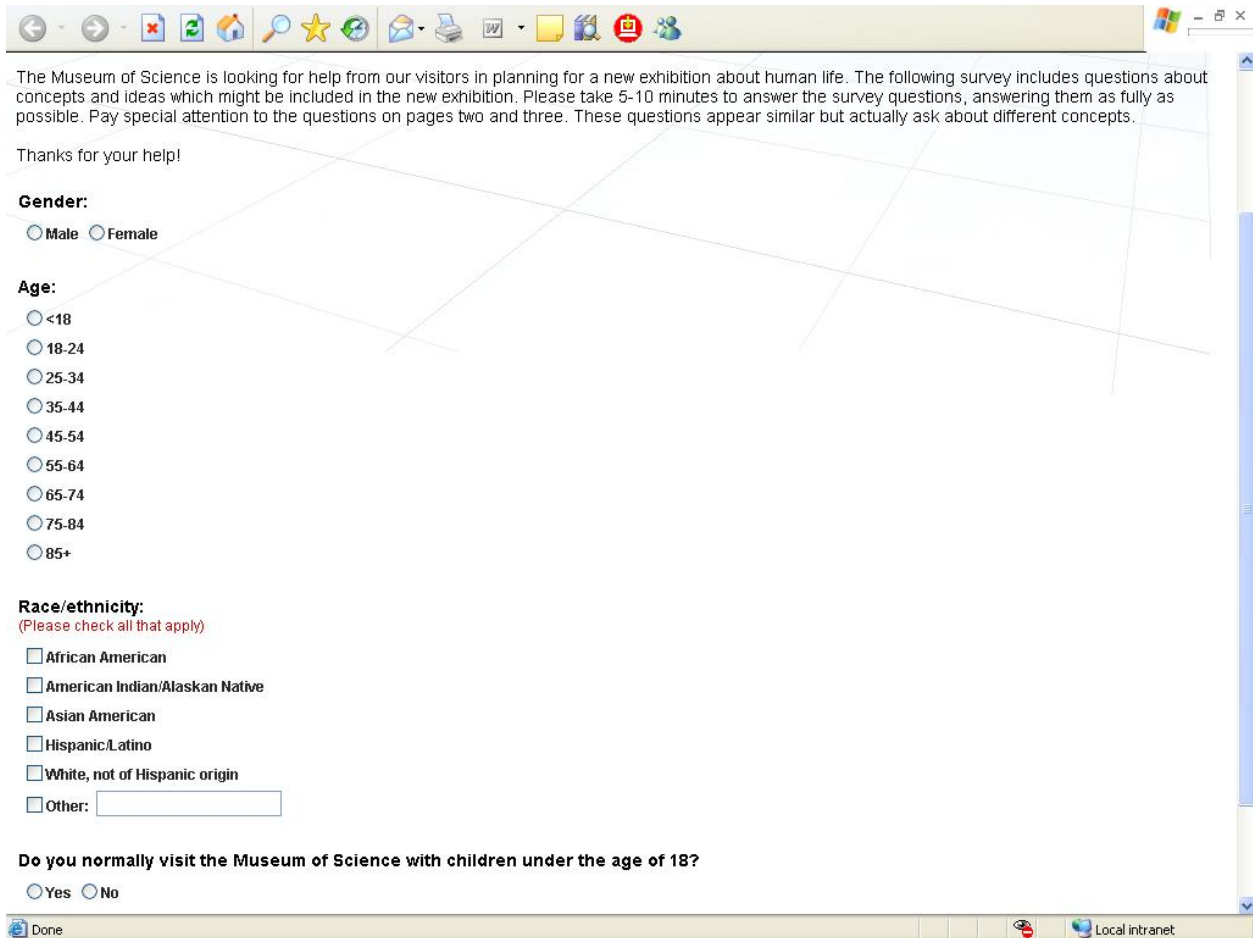
**Pick one factor you were surprised about. Why were you surprised that this factor affects HUMAN EVOLUTION?**

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## APPENDIX E: EMAIL ONLINE SURVEY



The Museum of Science is looking for help from our visitors in planning for a new exhibition about human life. The following survey includes questions about concepts and ideas which might be included in the new exhibition. Please take 5-10 minutes to answer the survey questions, answering them as fully as possible. Pay special attention to the questions on pages two and three. These questions appear similar but actually ask about different concepts.

Thanks for your help!

**Gender:**

Male  Female

**Age:**

<18  
 18-24  
 25-34  
 35-44  
 45-54  
 55-64  
 65-74  
 75-84  
 85+

**Race/ethnicity:**  
(Please check all that apply)

African American  
 American Indian/Alaskan Native  
 Asian American  
 Hispanic/Latino  
 White, not of Hispanic origin  
 Other:

**Do you normally visit the Museum of Science with children under the age of 18?**

Yes  No

Done Local intranet

**YOUR BODY**

Please look over the factors below. All of these factors affect YOUR BODY. For each factor, please tell us if you are surprised, if you suspected, or if you knew that the factor affects YOUR BODY.

	Surprised	Suspected	Knew
Sunlight	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Artificial light (from light bulbs, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gravity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Temperature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Raw foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Canned and preserved foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Viruses	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vaccinations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maturing and aging	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Assistive technologies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Air travel	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Language	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Text messaging technology	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Clothing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Pick one factor you were surprised about. Why were you surprised that this factor affects YOUR BODY?

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**HUMAN EVOLUTION**

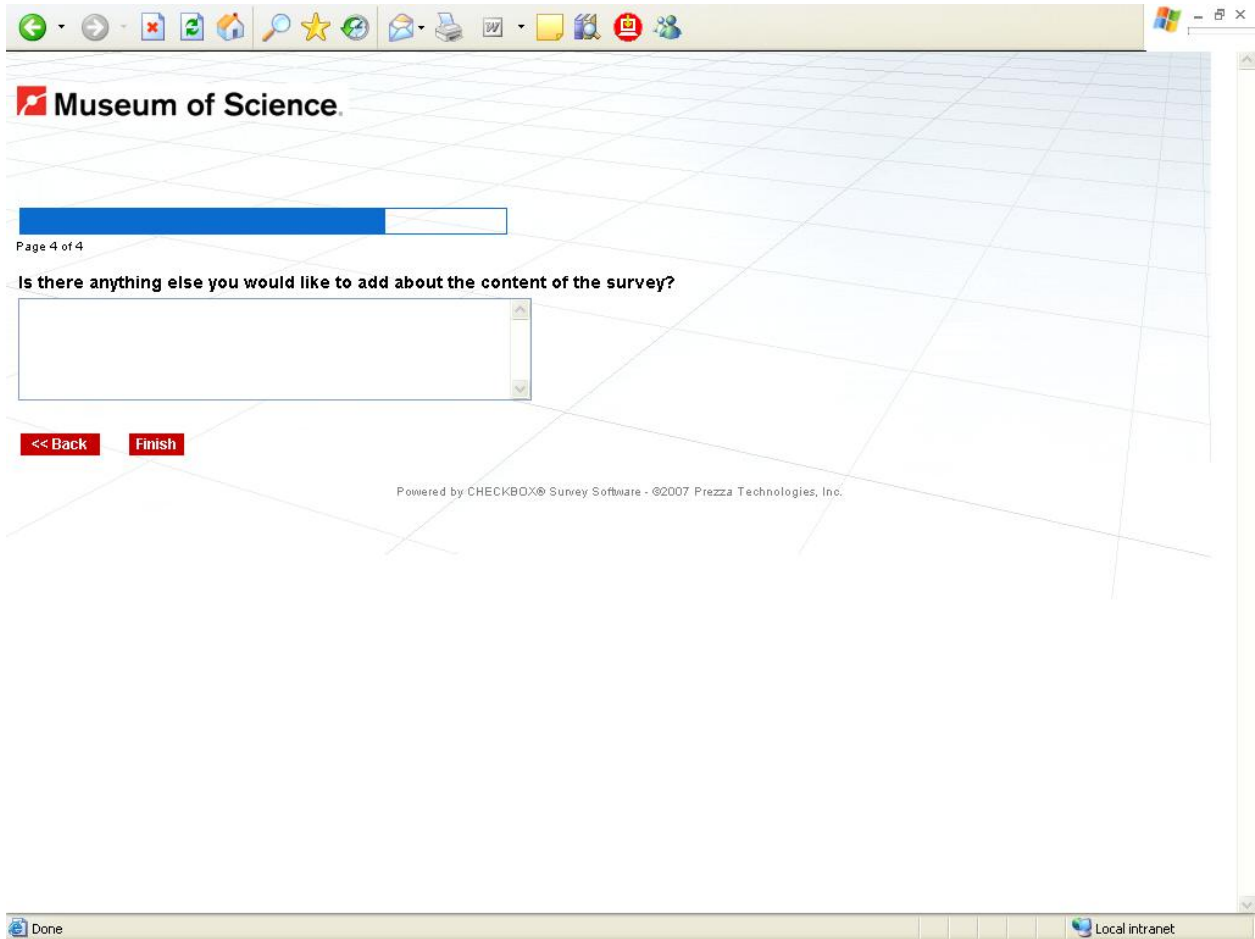
Please look at these factors again. These factors also affect HUMAN EVOLUTION. For each factor, please tell us if you are surprised, if you suspected, or if you knew that the factor affects HUMAN EVOLUTION.

	Surprised	Suspected	Knew
Sunlight	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Artificial light (from light bulbs, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gravity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Temperature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Raw foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Canned and preserved foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Viruses	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vaccinations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maturing and aging	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Assistive technologies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Air travel	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Language	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Text messaging technologies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Clothing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Pick one factor you were surprised about. Why were you surprised that this factor affects HUMAN EVOLUTION?**

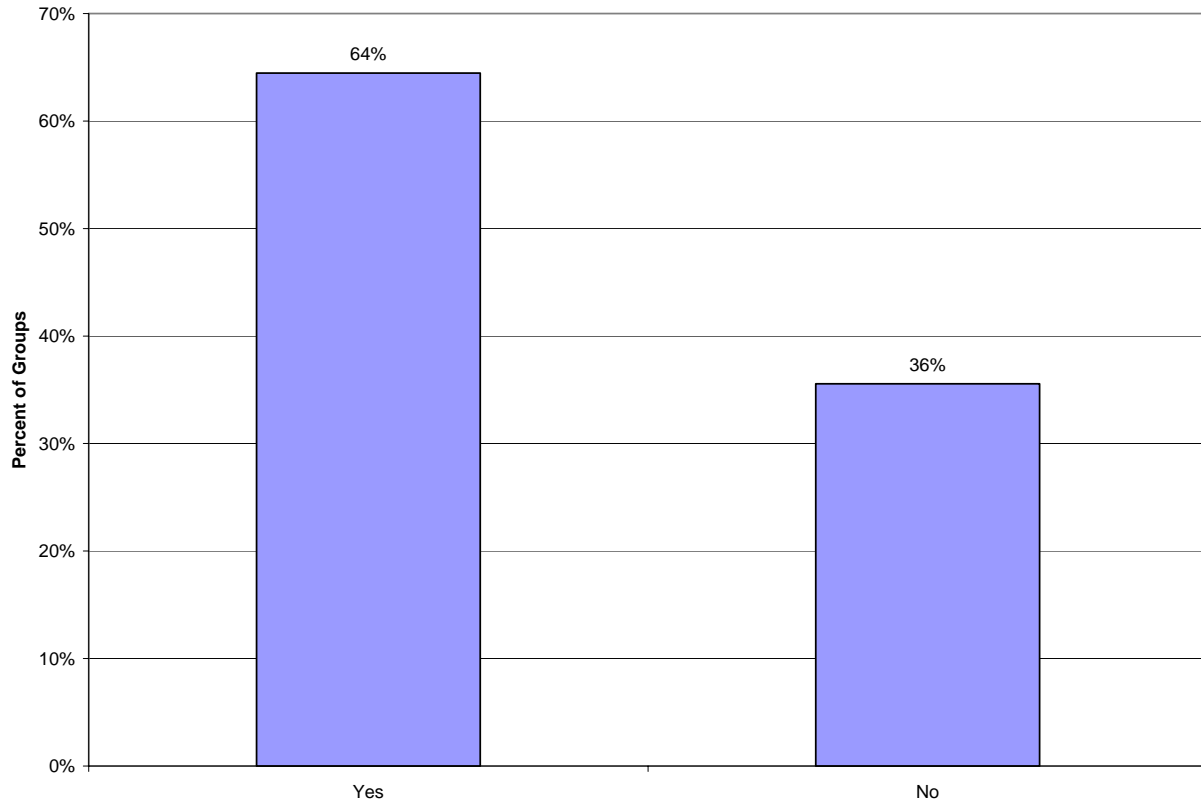
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## APPENDIX F: OTHER DEMOGRAPHIC DATA

**TABLE F1. Visitor Responses to the Card Sort & Interview Question: “Is anyone in the group you are with today under the age of 18, or do you normally visit the Museum of Science with children under the age of 18?” (N=332)**





**APPENDIX G: CARD SORT & INTERVIEW “KNEW” AND  
“SUSPECTED” QUESTION DATA**

**TABLE G1. Visitor Responses to the Card Sort & Interview Question: “Why did you suspect or know that artificial light affects your body?” (N=6)**

	<b>Number of Respondents</b>	<b>Example quote</b>
I knew/suspected for another reason.	3	"Because sometimes artificial lights are made with chemicals that can be harmful." (Interview #39)
I knew/suspected because artificial light affects eyesight.	2	"Because natural and artificial light -- artificial light affects sight." (Interview #1)
I suspected/surprised because artificial light affects mood.	1	"I think it goes with sunlight. If you turned on all the lights, could help mood." (Interview #30)

**TABLE G2. Visitor Responses to the Card Sort & Interview Question: “Why did you suspect or know that artificial light affects human evolution?” (N=4)**

	<b>Number of Respondents</b>	<b>Example quote</b>
I suspected but the technology is still new.	2	"Fairly new things and doesn't affect how our body develops." (Interview #36)
I knew because artificial light causes adaptations.	2	...mutations to protect but make long range sight hard. (Interview #10)
I knew because artificial light affects the brain.	1	"Affects the brain..." (Interview #10)

**TABLE G3. Visitor Responses to the Card Sort & Interview Question: “Why did you suspect or know that assistive technologies affect your body?” (N=8)**

	<b>Number of Respondents</b>	<b>Example quote</b>
I knew/suspected because assistive technologies aid the body.	4	"I knew it helps you walk because it helps you stay active." (Interview #6)
I suspected because assistive technologies keep you alive.	3	"...helps people live longer." (Interview #18)
I knew/suspected because assistive technologies are man-made parts.	2	"Integrating outside elements leads the body to adapt." (Interview #10)
I suspected for another reason.	2	"Because it helps the body develop." (Interview #7)

**TABLE G4. Visitor Responses to the Card Sort & Interview Question: “Why did you suspect or know that assistive technologies affect human evolution?” (N=8)**

	<b>Number of Respondents</b>	<b>Example quote</b>
I knew/suspected because assistive technologies aid the body.	3	"A lot of elders will need it as we get older." (Interview #14)
I knew/suspected because assistive technologies are man-made parts.	2	"Makes up for defects but we developed it." (Interview #36)
I knew/suspected because assistive technologies cause adaptations.	2	"If we keep living longer, it might change how bones form." (Interview #5)
I knew because now we live longer.	1	"Will make us live longer." (Interview #11)
I suspected for another reason.	1	"Because as people evolve they need assistive technologies to evolve." (Interview #15)

**TABLE G5. Visitor Responses to the Card Sort & Interview Question: “Why did you suspect or know that canned/preserved foods affect your body?” (N=15)**

	<b>Number of Respondents</b>	<b>Example quote</b>
I knew/suspected because canned/ preserved foods contain preservatives.	9	"Because of the content of preservatives may affect, depending on what preservatives are used." (Interview #35)
I knew because canned/preserved foods can spoil.	3	"Botulism: most lethal poison per gram." (Interview #10)
I knew/suspected for another reason.	2	"A lot of time we're told that it has some effect." (Interview #29)
I knew/suspected because canned/preserved foods cause cancer.	2	"Chemicals can get in the body--have something to do with cancer." (Interview #19)

**TABLE G6. Visitor Responses to the Card Sort & Interview Question: “Why did you suspect or know that canned/preserved foods affect human evolution?” (N=7)**

	<b>Number of Respondents</b>	<b>Example quote</b>
I knew/suspected because canned/preserved foods last longer than other foods.	3	"Because we're able to keep food longer; make people healthier and live longer." (Interview #38)
I suspected for another reason.	2	"...doesn't affect how our body develops." (Interview #36)
I knew because canned/preserved foods cause cancer.	1	"Increase chance of cancer." (Interview #19)
I suspected but the technology is still new.	1	"Fairly new things..." (Interview #36)
I knew because canned/preserved foods cause adaptations.	1	"Constant exposure will maybe lower botulism; minor food poisoning will decrease." (Interview #10)

**TABLE G7. Visitor Responses to the Card Sort & Interview Question: “Why did you suspect or know that language affects your body?” (N=16)**

	<b>Number of Respondents</b>	<b>Example quote</b>
I knew/suspected because words affect emotion and action.	4	"From word of mouth, peer pressure: do different things with the body than would normally." (Interview #12)
I knew/suspected for another reason.	2	"Such a very important part of life has to in some form of impact on humans." (Interview #8)
I knew/suspected because language causes physiological changes.	2	"Any form of communication causes physiological adaptations." (Interview #10)
I suspected because language affects learning.	1	"I didn't know it affects--just affects being able to know." (Interview #16)

**TABLE G8. Visitor Responses to the Card Sort & Interview Question: “Why did you suspect or know that language affects human evolution?” (N=11)**

	<b>Number of Respondents</b>	<b>Example quote</b>
I knew/suspected because language is a part of socialization.	4	"Without it you can't talk to people; no socialization without that." (Interview #17)
I knew/suspected because the ways humans communicate evolve.	3	"Different ways to communicate with language: sign language, computer, Braille--will change drastically as we go forward in the future. Now we communicate through email, webcams." (Interview #35)
I knew because language evolves.	2	"A hoe is a hoe' [the word means something different now than it used to]. Language evolves and changes over time." (Interview #3)
I suspected because words affect emotion and action.	1	"Could interpret many ways; big problems through people talking, like gossip." (Interview #28)
I suspected for another reason.	1	"One way we are different and can separate ourselves." (Interview #9)

**TABLE G9. Visitor Responses to the Card Sort & Interview Question: “Why did you suspect or know that maturing and aging affect your body?” (N=9)**

	<b>Number of Respondents</b>	<b>Example quote</b>
I knew because with maturing and aging your body changes.	4	"Makes sense eyesight declines, organs decline." (Interview #2)
I knew because you can see the changes that occur with maturing and aging.	2	"We can see it." (Interview #29)
I knew because maturing and aging happens to everyone.	2	"The way of the world--everyone ages." (Interview #22)
I knew for another reason.	1	"Maturing and aging is the basis of evolution." (Interview #18)

**TABLE G10. Visitor Responses to the Card Sort & Interview Question: “Why did you suspect or know that maturing and aging affects human evolution?” (N=7)**

	<b>Number of Respondents</b>	<b>Example quote</b>
I knew/suspected for another reason.	2	"Species has gotten older." (Interview #24)
I knew/suspected because with maturing and aging your body changes.	2	"People will live differently as they mature and get older." (Interview #25)
I knew because maturing and aging is the basis of evolution.	2	"Maturing and aging is basis of evolution." (Interview #18)
I knew because now we live longer.	1	"People are living longer--another sign of evolution: more to contribute." (Interview #10)

**TABLE G11. Visitor Responses to the Card Sort & Interview Question: “Why did you suspect or know that raw foods affect your body?” (N=12)**

	<b>Number of Respondents</b>	<b>Example quote</b>
I knew/suspected because raw foods contain chemicals.	3	"Because sometimes they have chemicals that you don't know about." (Interview #25)
I knew/suspected for another reason.	2	"Because it's bad for you." (Interview #22)
I knew/suspected because of the nutrients in raw foods.	2	"...more processed and refined over time. Change in nutrients." (Interview #31)
I knew because raw foods are sprayed with pesticides.	2	"Depends on if it has been sprayed by pesticides." (Interview #19)
I suspected because raw foods are better than canned foods.	2	"Should be healthier than canned food." (Interview #16)
I suspected because raw foods can contain microbes.	2	"Because there could be bacteria." (Interview #27)

**TABLE G12. Visitor Responses to the Card Sort & Interview Question: “Why did you suspect or know that raw foods affect human evolution?” (N=6)**

	<b>Number of Respondents</b>	<b>Example quote</b>
I knew because raw foods can contain microbes.	2	"Used to have microbes to process raw meat during caveman times... we wouldn't be able to process what they ate a few hundred years ago." (Interview #10)
I suspected because raw foods affect people differently.	2	"Would affect negatively or positively. Some swear by raw." (Interview #30)
I suspected because of the way raw foods are now processed.	1	"...now spray pesticides." (Interview #37)
I knew because raw foods have always been around.	1	"Well, they ate raw foods back then." (Interview #35)

**TABLE G13. Visitor Responses to the Card Sort & Interview Question: “Why did you suspect or know that sunlight affects your body?” (N=15)**

	<b>Number of Respondents</b>	<b>Example quote</b>
I knew/suspected because sunlight causes skin damage.	8	"See the changes: tan, burn, skin cancer" (Interview #26)
I knew because sunlight affects uptake of vitamin D.	3	"[Sunlight] help [you] absorb vitamin D." (Interview #19)
I knew because sunlight affects mood.	2	"[Sunlight is] good for depression." (Interview #5)
I knew because sunlight affects sleep cycles.	2	"You have internal systems that tells you when to wake and sleep." (Interview #31)
I knew because sunlight affects eyesight.	2	"...can affect eyesight." (Interview #35)
I knew because sunlight makes you healthy.	2	"...[Sunlight] makes you healthy. [You] need an even balance" (Interview #16)
I knew/suspected because sunlight affects plant life.	2	"[Sunlight] affects the creation of all [plants, animals]." (Interview #11)

**TABLE G14. Visitor Responses to the Card Sort & Interview Question: “Why did you suspect or know that sunlight affects human evolution?” (N=8)**

	<b>Number of Respondents</b>	<b>Example quote</b>
I knew/suspected because of the effect of the ozone layer.	3	"Because of rays from ozone layers." (Interview #14)
I knew/suspected for another reason.	2	"Because of the way the earth evolves around the sun, we're getting closer to the sun." (Interview #15)
I knew/suspected because sunlight is necessary to life.	2	"Supports life everywhere." (Interview #38)
I knew because sunlight causes adaptations.	2	"The dermis will evolve to protect against skin cancer." (Interview #14)
I knew because sunlight affects mood.	1	"Because it does a lot for you; it makes you feel good and is relaxing." (Interview #14)

**TABLE G15. Visitor Responses to the Card Sort & Interview Question: “Why did you suspect or know that text messaging affects your body?” (N=11)**

	<b>Number of Respondents</b>	<b>Example quote</b>
I suspected because text messaging has a physiological affect.	6	"Bad because eyes get bloodshot if on too long." (Interview #23)
I knew for another reason.	2	"Eventually will give emotion problems." (Interview #5)
I suspected because text messaging could create radiation.	1	"It's just a machine, hand held, unless there is radiation it's not going inside you." (Interview #19)
I suspected because text messaging causes poor language skills.	1	"People don't talk a lot." (Interview #16)

**TABLE G16. Visitor Responses to the Card Sort & Interview Question: “Why did you suspect or know that text messaging affects human evolution?” (N=10)**

	<b>Number of Respondents</b>	<b>Example quote</b>
I suspected but text messaging is a new technology.	3	"Like light bulbs, new technology will affect people." (Interview #18)
I knew because text messaging is becoming more important.	2	"Definitely because we use this to communicate. As we grow it becomes part of our daily routine." (Interview #32)
I suspected because text messaging has a physiological affect.	2	"You might think so because we are not as active when using it." (Interview #31)
I knew/suspected for another reason.	2	"Different way to communicate. It will not affect as directly as [illegible]." (Interview #24)
I knew because text messaging causes adaptations.	1	"Electromagnetic radiation will cause evolutionary adaptations to protect against tumors." (Interview #10)

**TABLE G17. Visitor Responses to the Card Sort & Interview Question: “Why did you suspect or know that vaccinations affect your body?” (N=12)**

	<b>Number of Respondents</b>	<b>Example quote</b>
I knew because vaccinations cure disease.	5	"Because it makes you healthier when you have a virus." (Interview #6)
I knew/suspected because vaccinations have a negative effect.	4	"Because some vaccinations can have different issues that can affect the body." (Interview #21)
I knew for another reason.	3	"[Vaccinations are] good for you. My kids probably have better vaccinations than I did and their kids will have better vaccinations than them." (Interview #1)

**TABLE G18. Visitor Responses to the Card Sort & Interview Question: “Why did you suspect or know that vaccinations affect human evolution?” (N=11)**

	<b>Number of Respondents</b>	<b>Example quote</b>
I knew because vaccinations cause adaptations/mutations in viruses and humans.	4	"Because the increase in vaccinations and prevention make new diseases and the human body has to change." (Interview #31)
I knew because now we live longer.	3	"Longer life expectancy now." (Interview #30)
I knew because new medicines are always being produced.	2	"Find new meds to help us." (Interview #27)
I knew because people can pass along resistance.	2	"Body grows immune--produce offspring immune." (Interview #34)
I suspected for another reason.	1	"Because of viruses." (Interview #14)

**TABLE G19. Visitor Responses to the Card Sort & Interview Question: “Why did you suspect or know that viruses affect your body?” (N=18)**

	<b>Number of Respondents</b>	<b>Example quote</b>
I knew because viruses cause illness.	11	"Because you get sick when you get a virus." (Interview #38)
I knew because viruses are bad.	3	"Because they're really bad." (Interview #22)
I knew for another reason.	3	"Knew it would hurt because they are bacteria." (Interview #27)
I knew because viruses affect the body.	2	"Different viruses affect the body in different ways." (Interview #15)

**TABLE G20. Visitor Responses to the Card Sort & Interview Question: “Why did you suspect or know that viruses affect human evolution?” (N=10)**

	<b>Number of Respondents</b>	<b>Example quote</b>
I knew/suspected because viruses cause adaptations.	3	"Body adapts to adaptations of viruses." (Interview #9)
I knew because now we live longer.	2	"Longer life expectancy now." (Interview #30)
I knew because viruses affect the body.	2	"It affects how you grow: could help you grow if good virus, could damage cells, could make you disfigured, mental problems from plagues." (Interview #28)
I knew/suspected because viruses cause survival of the fittest.	2	"G-d's practical joke about population control." (Interview #10)
I suspected for another reason.	1	"So many things coming out every time there is something new." (Interview #4)



## APPENDIX H: CARD SORT & INTERVIEW AND ONLINE SURVEY “SURPRISED” QUESTION DATA

**TABLE H1. Visitor Responses to the Card Sort & Interview and Online Survey Question: “Pick one factor you were surprised about. Why were you surprised that this factor affects YOUR BODY?” Coded by Whether The Participant Was Surprised Any of the Factors Affect Their Body. (N=253)**

	Number of Respondents	Percent of Respondents
<i>Surprised:</i> The participant describes why they were surprised by one or a few of the catalysts affecting their body.	210	83%
<i>Unsure:</i> Based on the response, it is unclear whether the participant was surprised any of the catalysts affect their body.	27	11%
<i>Not surprised:</i> The participant says they were not surprised that any of the catalysts affecting their body.	16	6%

**TABLE H2. Visitor Responses to the Card Sort & Interview and Online Survey Question: “Pick one factor you were surprised about. Why were you surprised that this factor affects YOUR BODY?” Coded by Why the Participant Was Surprised the Factor Affects Their Body. (N=242)**

	Number of Respondents	Percent of Respondents
<i>General:</i> The respondent only gives a general response with no explanation.	107	44%
<i>Physical:</i> The participant is surprised and says that for the catalyst to affect the body there should be an external physical reaction such as sunburn, growth, etc.	35	14%
<i>See physical:</i> The participant is surprised but does see that the catalyst could have a physical affect on the body.	28	12%
<i>Internal:</i> The participant is surprised and says that for the catalyst to affect the body there should be an internal physical change or chemical reaction such as through nutrients differences, internal reaction to chemicals, etc.	6	2%
<i>See internal:</i> The participant is surprised but does see that there could be an internal physical change or chemical reaction.	26	11%
<i>External:</i> The participant is surprised and says that for the catalyst to affect the body there should be an external force or change.	3	1%
<i>See external:</i> The participant is surprised but does see that there could be an external affect or change.	19	8%
<i>None:</i> The respondent only gives the catalyst they are surprised about without any further explanation.	22	9%

<i>Psychological</i> : The participant is surprised and says that for the catalyst to affect the body there should be a psychological or mental reaction such as change in emotion, action, behavior, etc.	0	0%
<i>See psych</i> : The participant is surprised but does see that there could be a psychological / mental affect on the body.	15	6%
<i>Not surprised</i> : The respondent did not mention the change/effect on the body and they were not surprised about the catalysts.	15	6%
<i>Term</i> : The respondent does not understand what the catalyst is referring to.	14	6%
<i>Everyone</i> : The participant is surprised and says that for the catalyst to affect the body it has to affect everyone.	4	2%
<i>See everyone</i> : The participant is surprised but does see that the factor impacts everyone.	2	1%
<i>Harm</i> : The participant is surprised and says that for the catalyst to affect the body it should cause harm.	6	2%
<i>See harm</i> : The participant is surprised but does see that there could be a harmful affect or change.	0	0%
<i>Not relevant</i> : The participant is surprised and says that they felt the catalyst is not relevant to body changes/affects.	5	2%
<i>Other</i> : The participant is surprised and says that they expect a change to the body that does not fit into any of the above mentioned codes.	4	2%
<i>Natural</i> : The participant is surprised because they felt for the catalyst to affect the body it should be a natural force or change.	1	0%
<i>See natural</i> : The participant is surprised but does see that there could be a natural force or change.	2	1%
<i>Change</i> : The participant is surprised and says that for the catalyst to affect the body it needs to change.	2	1%
<i>See change</i> : The participant is surprised but does see that the catalyst changes.	0	0%
<i>Genome</i> : The participant is surprised and says that for the catalyst to affect the body there should be a genetic reaction such as through DNA, genes, etc	0	0%
<i>See genome</i> : The participant is surprised but does see that there could be a genetic reaction such as through DNA, genes, etc.	0	0%

**TABLE H3. Visitor Responses to the Card Sort & Interview and Online Survey Question: “Pick one factor you were surprised about. Why were you surprised that this factor affects HUMAN EVOLUTION?” Coded by the Participants’ Reactions to the Links Between the Catalyst and Human Evolution. (N=219)**

	Number of Respondents	Percent of Respondents
<i>Doubter:</i> The participant doesn’t see the catalyst as having an effect on evolution and gives an explanation of why it cannot affect evolution.	70	32%
<i>General:</i> The participant doesn’t mention only gives a general response.	53	24%
<i>Evidence seeker:</i> The participant wants evidence that the catalyst is causing evolution. They say things such as “There is no evidence that modern things have affected evolution YET” and ask how or why the factor affects evolution.	31	14%
<i>Museum believer:</i> The participant is not quite sure of the effect on evolution from the catalyst but is inclined to believe there is an affect because the Museum of Science has told them so. They give an explanation for how the catalyst could cause evolution.	24	11%
<i>None:</i> The respondent only gives the catalyst they are surprised about without any further explanation.	19	9%
<i>Believer:</i> The participant feels without reservation that the catalyst affects evolution.	13	6%
<i>Other:</i> The participant does not fit into any of the above codes.	4	2%
<i>Evolution is over:</i> People who feel that evolution has happened in the past but is no longer occurring.	3	1%
<i>Non-believer:</i> The participant says that evolution did not occur or does not occur on humans.	2	1%

**TABLE H4. Visitor Responses to the Card Sort & Interview and Online Survey Question: “Pick one factor you were surprised about. Why were you surprised that this factor affects HUMAN EVOLUTION?” Coded by Why the Participant Was Surprised the Factor Affects Their Body. (N=219)**

	Number of Respondents	Percent of Respondents
<i>General:</i> The respondent only gives a general response.	79	36%
<i>Time:</i> The catalyst needs more time to affect evolution.	32	15%
<i>None:</i> The respondent does not give a mechanism but only gives the catalyst they are surprised about.	23	11%

<i>Physical body:</i> The catalyst needs to affect the physical body to affect evolution.	13	6%
<i>Change:</i> The catalyst needs to cause change to affect evolution.	8	4%
<i>Reproduction:</i> The catalyst needs to affect the ability of people to reproduce to affect evolution.	8	4%
<i>Mutation:</i> The catalyst needs to cause mutation in human genomes to affect evolution.	7	3%
<i>Survival:</i> The catalyst needs to affect survival to affect evolution.	7	3%
<i>Culture:</i> The catalyst affects cultural evolution but not human evolution.	6	3%
<i>Always around:</i> The factor needs to have not always been around to affect evolution.	4	2%
<i>Behavior:</i> The catalyst needs to affect behavior to affect evolution.	4	2%
<i>Internal:</i> The catalyst needs to cause an internal affect to the body to affect evolution.	4	2%
<i>Not surprised:</i> The participant was not surprised that the factor affects evolution.	4	2%
<i>Widespread:</i> The catalyst needs to be widespread enough to affect evolution.	4	2%
<i>Other:</i> The respondent mentions a mechanism that does not fit into any of the above mentioned codes.	4	2%
<i>Opposite:</i> The catalyst does not affect evolution but evolution does affect it.	3	1%
<i>Past:</i> The catalyst needs to have affected things in the past to affect evolution.	3	1%
<i>Artificial:</i> The catalyst needs to be artificial to affect evolution.	2	1%
<i>Environment:</i> The catalyst needs to act on the environment to affect evolution.	2	1%
<i>Long term:</i> The catalyst needs to cause a long-term affect to affect evolution.	2	1%
<i>Non-believer:</i> The participant does not believe in evolution.	2	1%
<i>Term:</i> The respondent does not understand what the catalyst is referring to.	2	1%
<i>Uncommon:</i> The catalyst needs to be uncommon or rare to affect evolution.	2	1%
<i>Variation:</i> The catalyst needs to affect variation in the population to affect evolution.	2	1%

## REFERENCES

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