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57

Evaluation of the "What is Life?" Exhibit at the Worcester Ecotarium

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By

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Approved:

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Acknowledgements

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Abstract

This project is designed to perform an evaluation of a science center exhibit, and will be used to provide recommendations for improving the exhibit. Through a collaborative effort with the Worcester Ecotarium, this project team performed an evaluation of an exhibit entitled "What is Life?" designed to help visitors visualize and learn about the world of microbes. This report outlines an evaluation that this team believes will result in an effective and beneficial guide for the Ecotarium to use in further developing this exhibit.

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Introduction

The Worcester Ecotarium is a science center primarily dedicated to teaching patrons about ecological science. To this end, the majority of the exhibits at the Ecotarium deal with different organisms and the ways in which these organisms interact with each other and with their environment. One important facet of ecology is the study of microorganisms. In order to teach its visitors about this topic, the Ecotarium has designed two exhibits, "Microdiner" and "What is Life?" exhibit. The former exhibit is a model diner where patrons can sit and listen to a member of the museum staff in the role of a cook, put on a play and in the process learn about microbes. The "What is Life?" exhibit is similar to a classic museum exhibit. It contains written materials and pictures on the walls, and a small number of stations where patrons can look at examples of life in a wetland community. This second exhibit will be the focus of the proposed IQP.

The staff at the Ecotarium believes that this exhibit is not getting enough attention, and that it should be evaluated to see whether "What is Life?" interests visitors and what if anything needs to be changed. This proposed IQP would seek to determine these things by means of a questionnaire and a study of patron behavior. If time allows, these observations will be used to suggest and implement changes in the exhibit.

Literature Review

Exhibit Design

The idea of developing museum exhibits that are interesting and that draw the attention of museum patrons is a very old one. Museum staff have long understood that although their exhibits must be informative, it is perhaps equally important that they be interesting enough to catch an individual's attention and hold it (Damer).

This process of making exhibits more interesting and fun has in part led to the development of the science center. Science centers differ from science museums in that they are informal and based on an interactive experience where patrons learn by touching and manipulating objects associated with an exhibit. In addition, science centers (and recently museums) commonly employ various types of visual imagery designed to draw attention (Damer). We believed that a good exhibit should provide a type of interactive experience to the patron, facilitate understanding by relating the topic to something the patron already knows about, and in so doing, teach the patron something previously unknown while clearing up any previous misconceptions.

Examples of museums where these techniques are performed include the National Holocaust Museum, the Smithsonian Air and Space Museum, and the Creative Discovery Museum in Chattanooga, Tennessee. The Holocaust Museum in Washington, D.C. uses a number of visual effects to draw the attention of patrons. In this museum, patrons walk along a timeline from the beginning to the end of the holocaust. Although major events are displayed along the main pathway, visitors can stop at various points to obtain more

detailed information as well. This museum makes good use of contrast. Several areas are designed to contain items that point out the scale and magnitude of brutality suffered by large populations as well as areas that emphasize the suffering of individuals (Pearson).

The Air and Space museum makes use of many visual techniques. In several places, items are placed in order to draw immediate attention and invoke curiosity among patrons. Other areas involve interaction by allowing visitors to light up panels displaying different kinds of data and fly airplanes using a simulator.

The main purpose of the Creative Discovery Museum is to reinforce the relationship between science and art. In order to accomplish this goal, the museum makes use of grandiose architecture and intense visual designs in order to attract the attention of its target audience of grade school-age children. Before making any final decisions on exhibit design, the museum's designer did what many such individuals are learning to do and first performed field tests with his 9-year-old daughter (Lee).

Only since the late 70's and early 80's, have exhibit designers utilized analysis of museum exhibits via patron observation and interactive analysis in order to test their ability to attract and educate. One of the major reasons for this kind of evaluation is the recent development of exhibits involving complex, and at times rather expensive equipment. Designers and funding agencies are naturally rather reluctant to include or allot grants for such equipment if they don't feel it will interest museum patrons. These types of analysis can take many forms. Often time's designers will first survey individuals to see what is generally known about a topic to see what the future exhibit can add. At other times, when designers are more certain about the information that will be

presented, a prototype exhibit is assembled and visitors are monitored to see if and how they will interact with it and whether they understand the material presented.

Psychological Flow

One important goal of the "What is Life?" exhibit at the Ecotarium is to provide a sense of immersion in the exhibit. Another is to provide an experience where a visitor's skills are fully involved in overcoming a challenge that is just about manageable, and so acts as a magnet for learning new skills and increasing challenges. These goals are designed to encourage "flow activities" to provide a better learning experience for the visitor.

Flow measures the subject's ability to concentrate, level of intellectual challenge, ability to understand the information available in the exhibit, and sense of being allowed to use the exhibit space to suit individual preferences. If the subject is engaged in a "flow activity" then he or she is experiencing immersion in the subject, which provides flashes of intense living against the dull background of everyday life (Csikszentmihalyi, 1997). These flashes of intense living are what provide the greatest learning experiences if well directed.

The psychological flow experiences that are the result of these "flow activities" can be determined by measuring visitor attention. Visual observation is a useful survey technique for the purpose of determining the attention of a visitor on a particular focus. Attention can be measured by determining its duration, scope, and intensity. Experimentally, it is possible to make observations of allocation of attention or gaze direction in a museum exhibit. These observations include determining the percentage of

the exhibit explored, the number of stops made, and the total time spent in an area. The attention a visitor gives to any points of interest has strong face validity for identifying psychological flow (Harvey et al).

A visual observation method that has been used to determine flow in a visitor entering an exhibit is survival analysis (Harvey et al.). Survival analysis is conducted by comparing the proportion of visitors remaining in the area of interest in ascending one-minute intervals, minus the time spent for resting or spent on activities not specifically related to the exhibit.

Another method that has been used to determine psychological flow in a visitor is the analysis of his or her perception through the use of the "Experience Sampling Form" developed to measure flow in everyday life. (Harvey et al.). This method allows visitors to rate the presence and strength of design features, can measure the visitor's sense of immersion, and can assess visitor challenge and adequacy of skills. Harvey accomplishes this task in an experiment at the Denver Museum of Natural History through the use of a well designed questionnaire that measures the presence and strength of the design features, assesses the visitor's skills and challenge, and measures the visitor's sense of immersion.

It is the determination of the flow experiences that enable an evaluation to successfully assess the sense of immersion and mental challenge the exhibit provides for the visitor. It is the goal of science museums in general to encourage "flow activities" to provide the best possible learning experience for the visitor.

Front-end Evaluation

A formative evaluation consists primarily of interviews and focus groups. It is a means of obtaining and analyzing data for decision-making purposes. It is an informal evaluation that can tell us about visitors' interests and what they want to know about a topic and is usually carried out with a minimal amount of time and resources. Formative evaluation is, however, a useful technique for examining the teaching efficiency as well as the behavioral and motivational impact of an exhibit on a museum patron.

The first step to formative analysis is an interview designed to determine what visitors already know about the topic to be presented. Once an understanding of patron knowledge has been developed, the evaluator can then develop a questionnaire designed to determine what the patron is able to learn or grasp from the exhibit.

Another important part of a formative evaluation is the observation of patron activity. By paying attention to what visitors are interacting with and for how long as well as their emotions and comments, the evaluator can determine whether parts of the exhibit are interesting and understandable or whether they need development.

Evaluation Design

The challenge of an evaluation is to make the curator and staff more aware of the impact of museum exhibits on the people that use them, and to incorporate visitors into the exhibit development process (McLean). A good evaluation helps communication, not only by more effectively disseminating the information contained in exhibitions, but also by exchanging information with the people who attend them. To achieve these ends, there

are a number of different evaluation methods that may be implemented. Two methods that we are concerned with are the front-end evaluation and the summative evaluation.

Questionnaire Design

The function of a questionnaire is measurement, and the specification should state the main variables to be measured. There are a number of decisions that need to be made before any of these variables can be measured (Oppenhiem). These decisions include the following:

1. The main and auxiliary methods of data collection should be determined. Such methods may include, but are not limited to interviews, mail questionnaires, observational techniques, and study of documents.
2. The method of approach to the respondents (after selection through sampling procedures), which includes sponsorship, a stated purpose of the research, confidentiality, and anonymity.
3. The build-up and logical order of question sequences and other techniques within the framework of the questionnaire including "funneling" of responses as well as factual vs. opinion or attitude-based questions.
4. The use of pre-coded vs. free-response questions. In order to make these decisions work it is necessary to become familiar with what is known by conducting pilot work. The primary purpose of pilot work is to enable the use of multiple choice questions in place of free response questions without significant error due to misinterpretation or confusion of the answers. Pilot work can also be used to determine a popular control exhibit by asking visitors which exhibit they like best.

The methods of data collection with a questionnaire can be as different or creative as the evaluator wishes. For the purpose of a museum exhibit evaluation, the methods should be limited to self-administered questionnaires or group-administered questionnaires.

Self-administered questionnaires are presented by an interviewer, its purpose is explained, and the respondent is left alone to complete the questionnaire. This ensures a high response rate, accurate sampling, and a minimum of interviewer bias, while permitting interviewer assessments, providing necessary explanations (but not the interpretation of questions), and gives the benefit of a degree of personal contact (Oppenheim).

Group-administered questionnaires are given to groups of respondents assembled together. Two or more persons should oversee the administration of the questionnaires, give help where needed in a non-directive way, check questionnaires for completeness, etc. Variations in procedure may also be introduced such as reading the questions aloud and having the respondents answer them in blank booklets to ensure the respondents answer all the questions in the same order and have enough time to complete each question. There is the problem of contamination through copying, talking or asking questions, but generally, groups of forty or less can be easily controlled (Oppenheim).

Question ordering and wording is also a big concern for questionnaire design. Double-barreled or double negative questions should be avoided to eliminate confusion. Factual questions are more difficult to design and may deal with knowledge, motives or attitude. If we offer the respondent a list or set of multiple choice answers to these types of questions, we run the risk that these answers may become subject to ordinal biases.

The "split ballot technique" can be done during the pilot work and divides the sample into two or more equivalent parts. Each part is presented with a different answer sequence, which makes it possible to measure the ordinal bias and make allowances for it. Classification questions are a special type of factual questions that ask about age, sex, marital status, income, education, etc. These questions tend to be predominantly sociological, but for some inquiries they are psychological. They are subject to the same biases as the factual questions and special care should be taken to avoid misinterpretation by the respondent.

The "What is Life?" Exhibit

The "What is Life?" Exhibit is composed of several smaller sub-sections, each of which seeks to convey specific information about microorganisms.

Size Relationship

One of the essential concepts that the "What is Life?" exhibit wants to convey is that of the size relationship between man and microbe. Upon entering the exhibit, the patron is immediately drawn to the large eight-foot-tall microscope standing in the middle of the exhibit hall's entrance. Walking underneath the lens of the microscope gives the patron can see cells on a similar scale. This lends the impression that the visitor is dealing with small things that cannot be seen by the naked eye, and is given some idea of the working scale. The patron now has the general idea that microbes are very small compared to things in the everyday world, and can feel a little more at ease about immersing themselves into a world that may seem completely foreign.

Communities within Communities

Another underlying theme dealt with in the exhibit is that of the community within a community. Simple examples are given of symbiotic relationships between the elements that make up a community that reinforce the scale concept. Patrons are shown that termites live together in a type of community and that within each termite, there exist communities of microbes that break up food. The intent of these exhibits is to encourage the patron to delve further into the mysteries of the community and learn that life is full

of complex communities that exist on all levels. It is then possible for the patron to conclude that even multi-cellular organisms, including humans, are made of these communities, and further, that these communities are one of the key ingredients to the amazing complexity of life.

Microbial Communities and the Environment

Even if the patron has not grasped the concept of communities within communities it is easy to see that they have some sort of effect on the environment. Some examples of how these microbial communities affect the environment on a scale that is familiar to us are given. For instance, the exhibit includes a display on a lake that turns red during certain times of the year because of the activity of sulfur bacteria. In fact, if the patron is able to draw this conclusion, the next step is to introduce the Gaia Hypothesis.

The Gaia Hypothesis and the Role of Microbes

The Gaia Hypothesis states that the environment, the atmosphere, plants and animals, and the oceans are all regulated by a complex feedback system. This portion of the exhibit allows the visitor to discern the influential role that microbes and higher life forms have on the environment as a result of oxygen production, gas exchange, photosynthesis, and conjugation. This amazing cycle of regulation is further contrasted by the absence of life on neighboring planets and even our own moon. The patron will possibly wonder why our life on Earth is ubiquitous whereas other planets with similar

geological composition are devoid of life. This may cause the visitor to become curious about the origin of life on Earth and of man's role in the evolution of life on our planet.

A Time Line of Life on our Planet

It is one of the main goals of the exhibit to teach the patron the significance of microbial life on the evolution of our environment. To emphasize this, a time line is mounted on a wall where the patron can unravel a rope wound around a wheel. This rope is a timeline 45 feet long where man is represented by a mere one-foot piece at the end. This is intended to make a strong suggestion that something was at work changing our environment long before man walked the Earth. If the patron delves further into this mystery, it becomes clear that a long chain of events beginning with the actions of primitive organisms, and resulting in radical changes to our atmosphere, geology, and oceans that are unlike those of any other known planet. The story unfolds with the beginning of simple individual microbial organisms that somehow adapted to form productive communities. Through symbiotic relationships these microbes formed increasingly complex communities and organisms, all the while changing the environment so that it would become more habitable for higher forms of life.

Formative Evaluation

Problem Description

The decision to work with the "What is Life?" exhibit was a result of a meeting with Ecotarium staff member Dr. Root. Dr. Root feels that this exhibit may not be visually appealing to museum patrons. She also feels that the museum could benefit from an in-depth evaluation of the exhibit's ability to attract patrons and to successfully convey information to those who observe it. In order to aid the Ecotarium in meeting its goals as a science center, we would like to determine whether the exhibit is successfully conveying information on the topic area to patrons. We therefore propose to study the exhibit for its ability to do the following:

1. Provide a multi-sensory interactive experience for the patron.
2. Touch on something in the patron's own life, something the patron knows about.
3. Educate the patron about the subject matter and provide an experience that may remove some of the misconceptions the patron has.

Based on the above research, we will then analyze these results and make suggestions we feel that the museum can implement to increase the effectiveness of the exhibit. Then, if possible, we would like to implement these suggestions and determine the effectiveness of these changes.

In order to accomplish the former goal, we have decided to study people of different age and education levels in order to determine what parts of the exhibit are most interesting and effective and which parts could be changed. This will likely involve

survey methods involving both visual observation and a questionnaire that will be given to patrons both as they exit the exhibit. The information we gain from our front end analysis of what works and what doesn't work in an exhibit will then be used to form a hypothesis of what specific changes need to be made in the exhibit we have chosen to analyze.

Questionnaire

Based on the methods of questionnaire design that were studied, we have constructed the following questionnaire that we feel will most accurately measure patron perception of the exhibit. Simultaneously, we will conduct visual observations to measure patron flow to determine where patrons are spending the most time, and how well the exhibit secures and maintains attention.

Rating the presence and strength of the design features:

1. How much more exciting was it to learn about microbes at this exhibit then by learning another way, such as reading a textbook?
2. At what location within the exhibit did you spend the most time? Why?
3. What, if anything, did you learn by observing this exhibit?
4. What is your favorite exhibit? Why? What was better about this exhibit than "What is Life?"
5. Why did you decide to visit the "What is Life" exhibit?

Assessing the visitor's skills and challenge:

1. Have you ever studied microbes before? When and in what capacity?

2. What is your age?

3. Where do you live?

4. Does this exhibit clear any misconceptions you may have had?

Measuring the visitor's sense of immersion:

1. Did you have a sense of being in the place this exhibit describes?

2. Do you desire to return to the exhibit at some later time?

3. What was your level of comfort in this exhibit?

4. Did the exhibit make microbes come to life for you?

5. How memorable will this exhibit be for you? (Ask one or two questions about material presented in the Microbes exhibit)

6. How exciting do you find microbes?

Did this exhibit make you want to learn more about microbes?

It is our intention to see how much the patron grasps about the abundance of information presented by this exhibit. We have devised a plan to gauge this. First, a survey will be administered that attempts to measure what each patron understands about each of the underlying concepts before they enter the exhibit hall. This will give us a basis for determining what misconceptions the patron may have and what material will be easy to grasp. We will then watch the patron as they move through the exhibit and make visual observations of what they interact with, including notes on how long they spend in target areas and what comments they make. Once we have determined what is known by the average visitor, we will develop a questionnaire which will be designed to gauge how effectively they exhibit was able to educate the patron and interest them in further exploration of each of the topics presented. We will then use the data gathered to evaluate the effectiveness of the exhibit at achieving the museums primary goals.

Results

Preliminary Evaluation

As stated, the first part of our evaluation seeks to determine what visitors knew prior to visiting the exhibit through the use of a questionnaire (appendix 1). The set of questions was small enough to ensure adequate visitor participation, and at the same time broad enough to gain an adequate cross-section of visitor knowledge concerning microbes. This questionnaire was administered to 77 people with age ranges between 7 and 64. (All responses representing at least 10% of the total will be discussed here.)

In response to the first question "What does the word bacteria bring to mind?" 33 (43%) associated bacteria with germs. Another 20 (26%) thought of disease, infection, and sickness.

In response to the second question "Can you think of an example of a good or beneficial bacteria?" 35 (45%) could not. Those that could responded with a wide range of answers. The most common response for those that knew was either penicillin or medicine, and represented 11 (14%) of the responses.

The majority of the patrons asked "How big are bacteria?" (50 or 65%) knew that they were microscopic. Another group of 15 (19%) knew only that they were very small. For the most part, visitors were unable to determine precisely what size the organisms were when asked to compare size with a human cell or virus.

The question "What was early life on Earth like?" produced a wide range of responses. There were however many common answers. 21 (27%) patrons questioned

believed that vegetation was among the earliest life on Earth. Another 21 (27%) believed that bacteria, microbes, or single-celled organisms were present. 14 (18%) felt dinosaurs were among the earliest life on earth and 10 (13%) believed that early life consisted of water dwelling organisms.

The responses to the final question "What do you think people would like to learn or experience about microbial life?" were equally varied. The most common response by 9 (12%) people evaluated was that people should understand how microbes affect us. Although less than 10%, there were two other groups of popular responses. 7 (9%) thought people should get a general overview or knowledge of the subject, and another 7 (9%) felt people should understand the microbial role in evolution.

In summation, this preliminary evaluation taught us that although some visitors realize that microbes can serve various useful purposes, most visitors to the exhibit see microbes primarily as harmful, disease-causing organisms. Furthermore, the fact that most examples given by patrons of useful microbes concerned mainly medicine and human health indicates a possible lack of knowledge concerning their role in our environment.

The number of respondents that pointed to microbes as being among the earliest life on Earth was fairly high. However, the possibility of bias in this response should be considered due to the fact that this question followed three questions that dealt directly with microbes. In retrospect, we realized that this setup of the evaluation may have led respondents to choose microbes as a response.

Finally, the information that patrons felt that they would like to learn indicated to us that, while a good number were interested in the evolution and environmental roles,

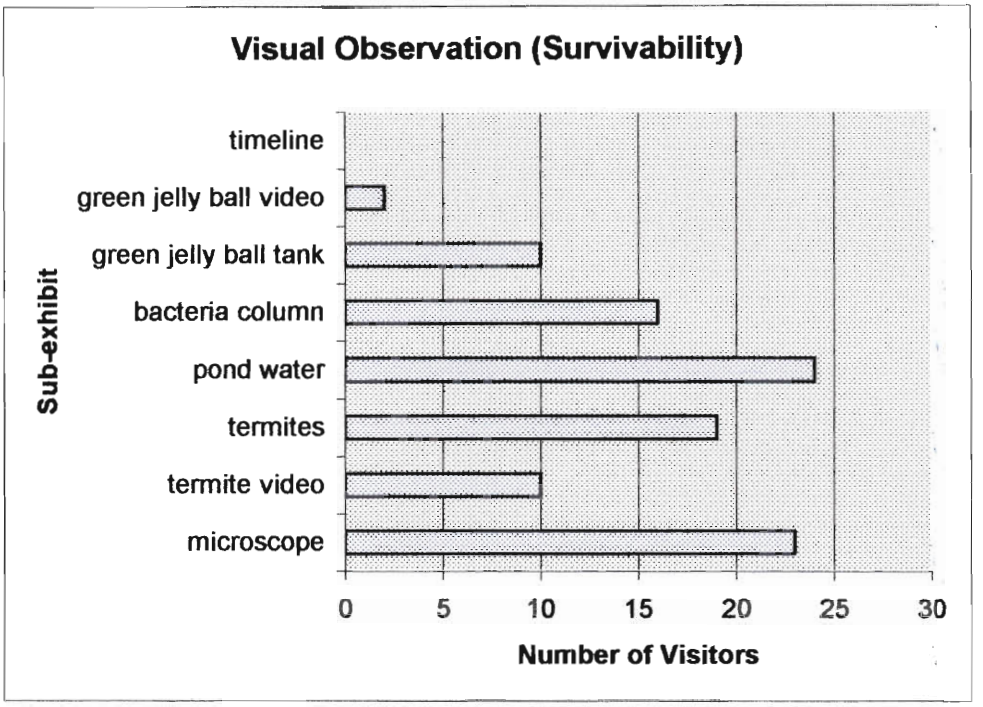

Figure 1

The exhibit is designed to allow the visitor to follow any path he or she may choose. The hall consists of a left side and a right side separated by a wall. The survivability of the left side (52) is 51% less than the right side (107) (figure 2). This is due in large part to the contributions of the microscope and pond water survivability to the right side.

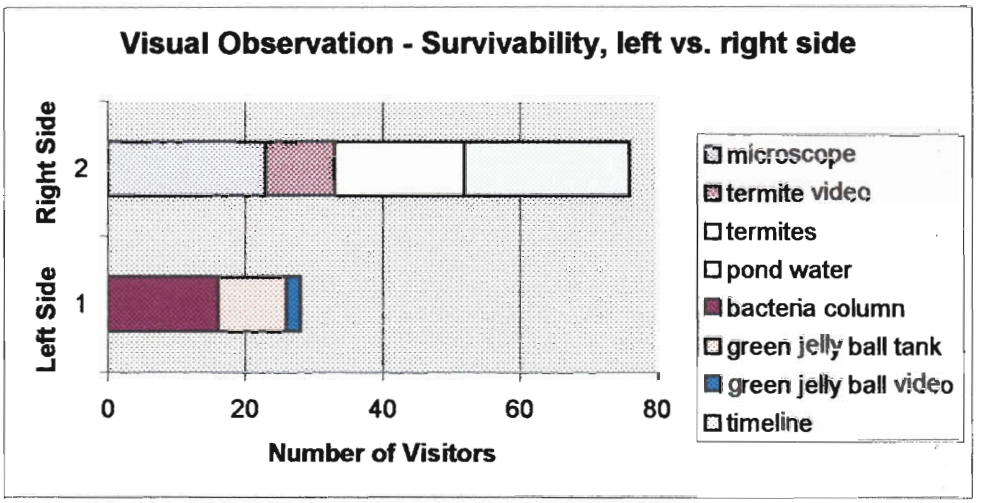

Figure 2

The visual observation was also intended to record the relevant comments and actions of visitors as they interacted with the sub-exhibits (appendix 3). The visitors generally felt that the exhibit hall was too hot, and that the poor maintenance of the sub-exhibits was dissatisfying. It should be noted that the majority (59.1%) of the visitors did not venture past the secondary skin to interact with the rest of the exhibit, and those that did, generally did not raise any significant questions about these sub-exhibits.

The general implication of this data is that the flow experience required for peak learning was not present in all but a few items in the exhibit. The interaction of the visitor with the secondary skin appeared to be the only source of immersion experience. However, the lack of maintenance and unavailability of specimens in these devices did not result in the learning experience intended by the creators of the secondary skin and did less to draw patrons deeper into the exhibit.

Secondary Evaluation

The final section of the evaluation consists of a questionnaire that tries to determine what the visitor has learned from the exhibit (appendix 4). The questionnaire was administered to people exiting the exhibit and the questions asked depended on which parts of the exhibit they had observed. For instance, people that observed the bacteria column were asked questions about the Gaia Hypothesis and those that observed the termite exhibit were asked about communities. In addition, visitors were asked a universal set of questions.

This questionnaire was administered to 47 people with age ranges between 7 and 67. (All responses representing at least 10% of the total will be discussed here, for a more complete explanation refer to appendix 6.)

In response to the first question "Do you think that people will understand that things in this exhibit are microscopic?" 33 (70%) felt that people would understand. 8 (17%) felt that people would not understand.

When asked whether they had learned a useful function performed by microbes in the course of the exhibit, an overwhelming 41 (87%) reported that they had not learned anything new.

Those patrons visiting the timeline area of the exhibit were asked whether they had learned how long microbes had been on Earth and how this compared to man's time on Earth. Out of the 12 visitors questioned, 10 (83%) did not learn this information.

The 15 patrons surveyed that had visited the parts of the exhibit pertaining to the role of organisms in regulating the environment were asked whether the environment had an affect on life. All 15 (100%) agreed. When asked whether life had an affect on the

environment, 6 (40%) said no. The remaining individuals surveyed came up with a number of examples. However, only 2 (13%) mentioned examples related to microbial life. Lastly, when asked if they had learned how O_2 had come to make up the major component of the Earth's atmosphere, 14 (93%) stated that they had not.

When asked whether they could discern the difference between an individual and a community, 8 (62%) did so correctly. 5 (38%) were unable to do so. When asked if they could produce examples from the exhibit of organisms acting together as a part of a community, 5 (38%) said no, 2 (15%) mentioned green jelly balls, 2 (15%) mentioned bacteria, and 4 (31%) mentioned termites or the termite gut. The eight patrons that were able to demonstrate an understanding of a difference between an individual and a community were asked if they felt other visitors could do so as well. 5 (63%) felt that they would. 3 (38%) believed that people wouldn't.

38 visitors were asked if they found anything in the exhibit surprising. 28 (74%) were not surprised. The remainder of the patrons surveyed mentioned a variety of other parts of the exhibit as surprising.

28 patrons were asked to rank the exhibit on a scale of 1-10. The average score was 6.

Finally, visitors were asked what they thought could be done to improve the exhibit. Because those surveyed generally gave multiple responses, there were a total of 57 responses. 27 (47%) of these responses dealt with a need for more interactive material. 7 (12%) felt that the labels needed to be clearer and more easily understood.

In conclusion, it seems clear from this final evaluation that the "What is Life?" exhibit is not properly conveying information to museum patrons. This statement is

based on the fact that the vast majority of visitors were unable to answer specific questions about exhibit content. For instance, 93% of the visitors that examined the bacteria column and surrounding information were unable to explain the key concept, and 87% of the visitors surveyed were not able to tell how long microbial life has existed on Earth. In addition, 83% of the visitors surveyed stated that they had learned nothing new about microbes as a result of walking through the exhibit.

During evaluation process, the visitors made a number of suggestions and observations that suggest improvements to the exhibit. The most popular visitor concerns were confusion over the large microscope at the entrance, a need for more interactive exhibits, a need for the exhibit to be less complicated, and repair/maintenance of exhibit stations. The large microscope was by far the most confusing aspect of the exhibit for the visitors. Several patrons were observed spending a great deal of time on and around the microscope trying to determine its significance, eventually becoming frustrated and moving on. Many other patrons felt that the exhibit was far too complicated for younger children. This was echoed by their performance on the evaluation. Lastly, many patrons were frustrated or confused by the lack of material or working equipment at the "Life Here!" stations.

We believe that the Ecotarium can make significant changes in the visitor experience in the "What is Life?" exhibit by implementing some simple changes to the appearance of the material rather than the underlying themes. These changes should include a better system of labeling which generalizes the material for the visitor and better management and maintenance of the resources available . Perhaps adding some sort of new interactive device that shows the relationship of microbes to our everyday

world would spark new curiosities and contribute to the overall ability of the exhibit to convey its messages.

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Appendix 1

Evan Ferrell
Tony Matos
IQP Evaluation Form Date:

1. Age/Sex:

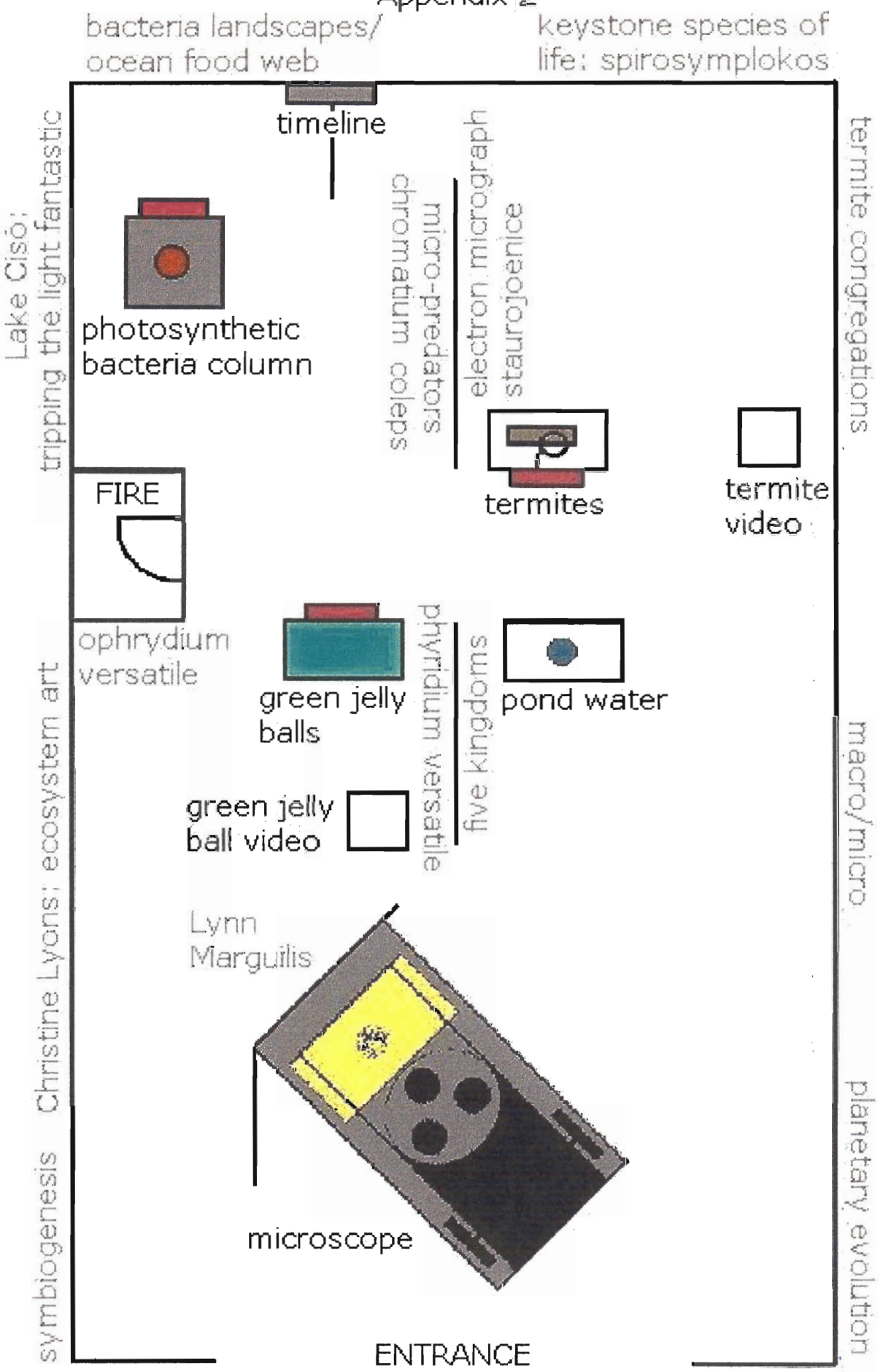
2. What does the word bacteria bring to mind?

3. How big are bacteria?

4. What was early life on earth like?

5. What do you think people would like to learn or experience about microbial life?

Appendix 2


bacteria landscapes/
ocean food web
keystone species of
life: spirosymplokos
timeline
Lake Cisó;
tripping the light fantastic
termite congregations
photosynthetic
bacteria column
micro-predators
chromatium coleps
electron micrograph
staurojoenice
termites
termite
video
FIRE
ophrydium
versatile
green jelly
balls
phyridium versatile
five kingdoms
pond water
green jelly
ball video
Lynn
Margulis
microscope
symbiogenesis Christine Lyons; ecosystem art
macro/micro
planetary evolution
ENTRANCE

Appendix 3

Visual Observations

Age/Sex	Remarks
44/F	This <bacteria column> has lots of microbes.
37/F	What's the point of the microscope?
37/F	It's really, really hot in here.
26/F	This is the germ section.
63/F	It's hot!!
11/M	It's hot in here!
24/M	Bring swim trunks or a sauna towel!
60/F	Sue did a wonderful job…
21/F	I remember we used to draw this <spirosymplykos> in biology.
30/F	Want to go on to something else?
12/M	Yeah, it's pretty boring in here…

Teacher	What's the point of the microscope?

Other Interactions

-Numerous kids jump on the scope and spin the knobs.
-Numerous kids tap dancing on the microscope slide.
-Kids cannot see into the pond water microscope.
-Visitors disappointed over evaporated pond water, lack of termites and lack of green jelly balls.

Appendix 4

Evan Ferrell
Antonio Matos
IQP Questionnaire Form Date:

Universal

1. Age/Sex:

2. Do you think that people will understand that things in this exhibit are microscopic?

3. Having gone through this exhibit, can you think of any useful function of microbes that you didn't know before? Do you think other people will understand the importance of this function?

Earth History

4. Were you able to learn how long microbes have been on the Earth and how this compares to the existence of man on the Earth? Do you think that other visitors will understand this?

Gaia Hypothesis

5. Does the environment have an effect on life?

6. Besides humans can you think of any examples of living things affect the environment?

7. Were you able to learn why the Earth's atmosphere contains so much oxygen?

Communities

8. What is the difference between an individual and a community? Can you think of examples in the exhibit where individual organisms actt together in a community? Do you think visitors will understand this concept?

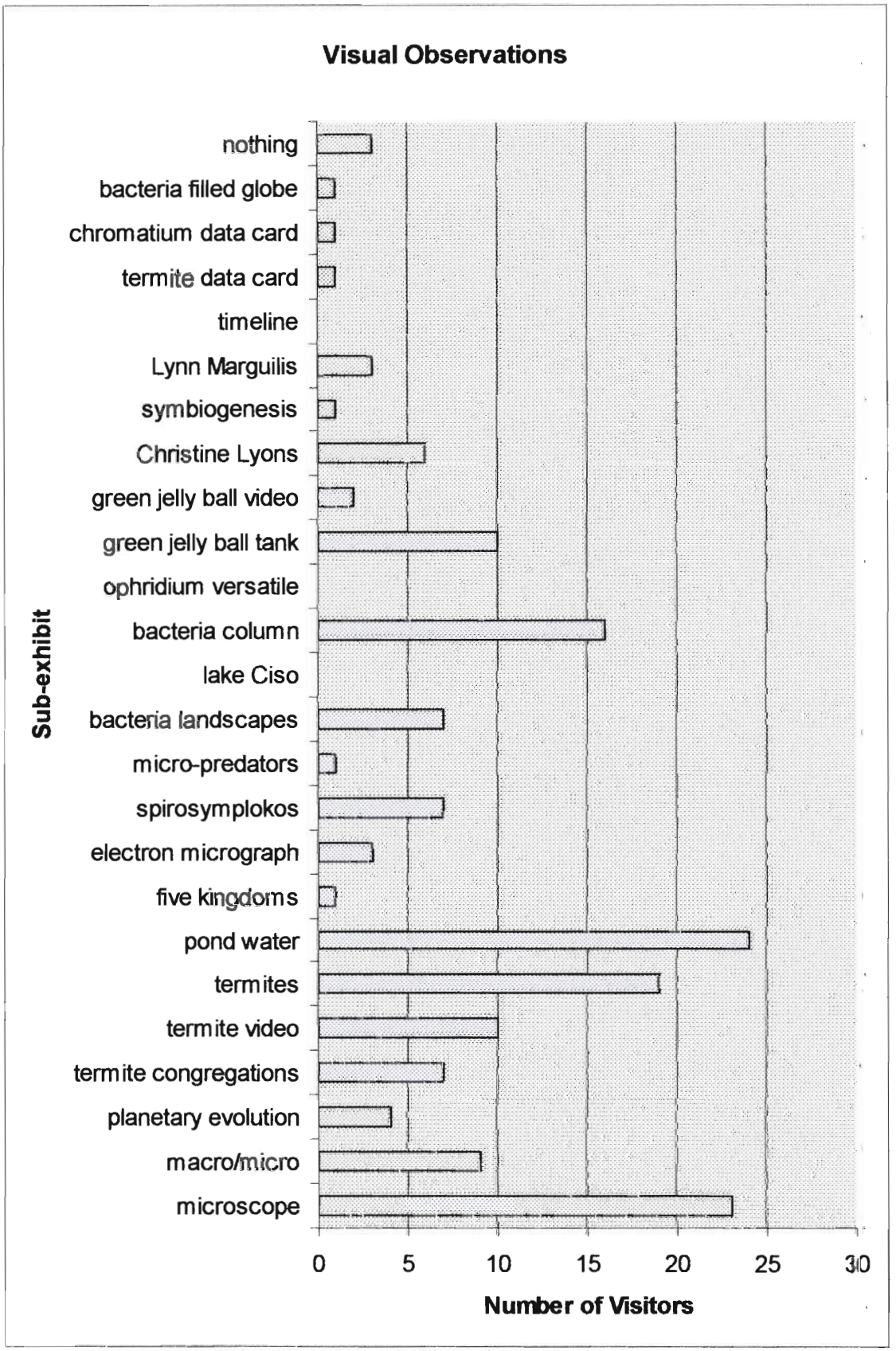
Universal

9. Did anything in the exhibit surprise you?

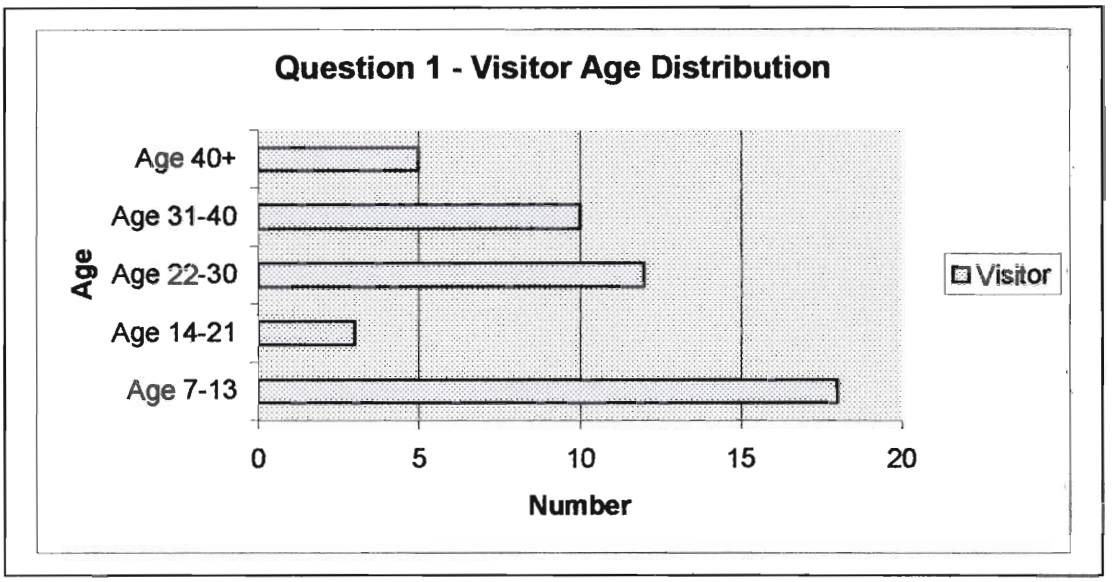
10. How interesting was this exhibit on a scale of 1-10? 1 2 3 4 5 6 7 8 9 10

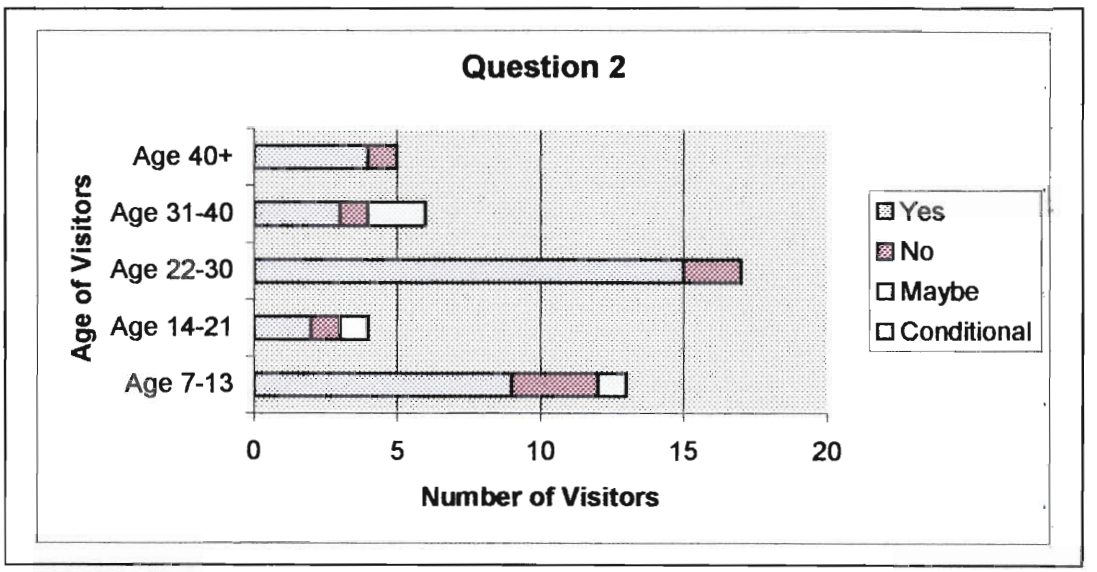
11. How could this exhibit be improved so that people will get more out of it?

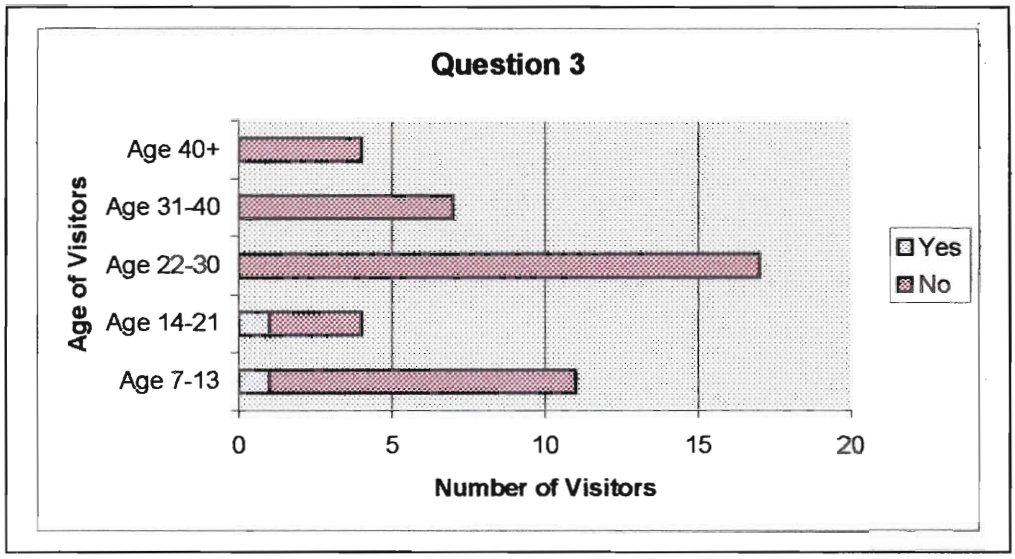
Appendix 5 – Visual Observations

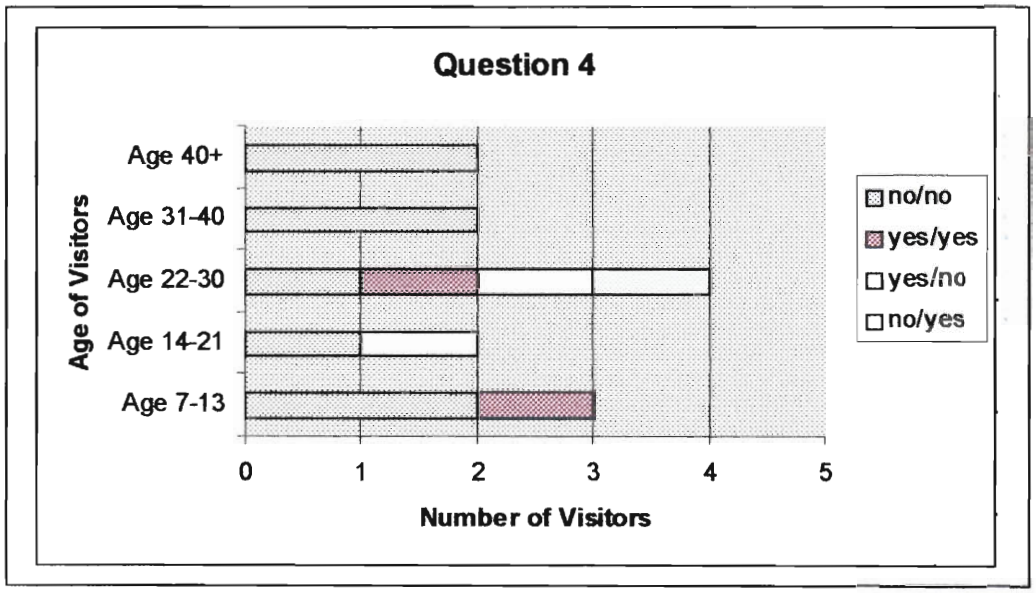


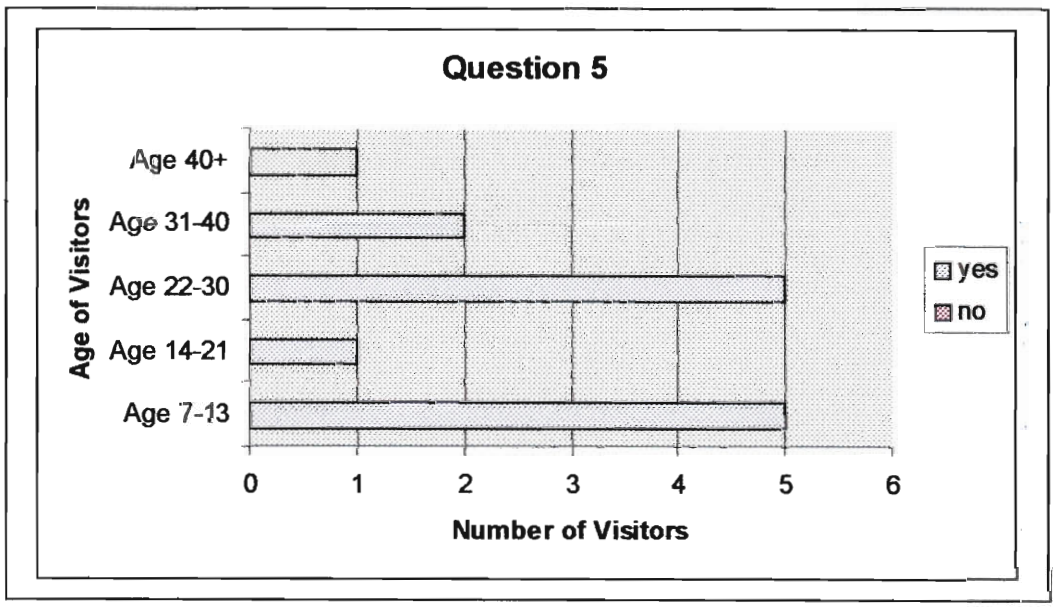
Appendix 6

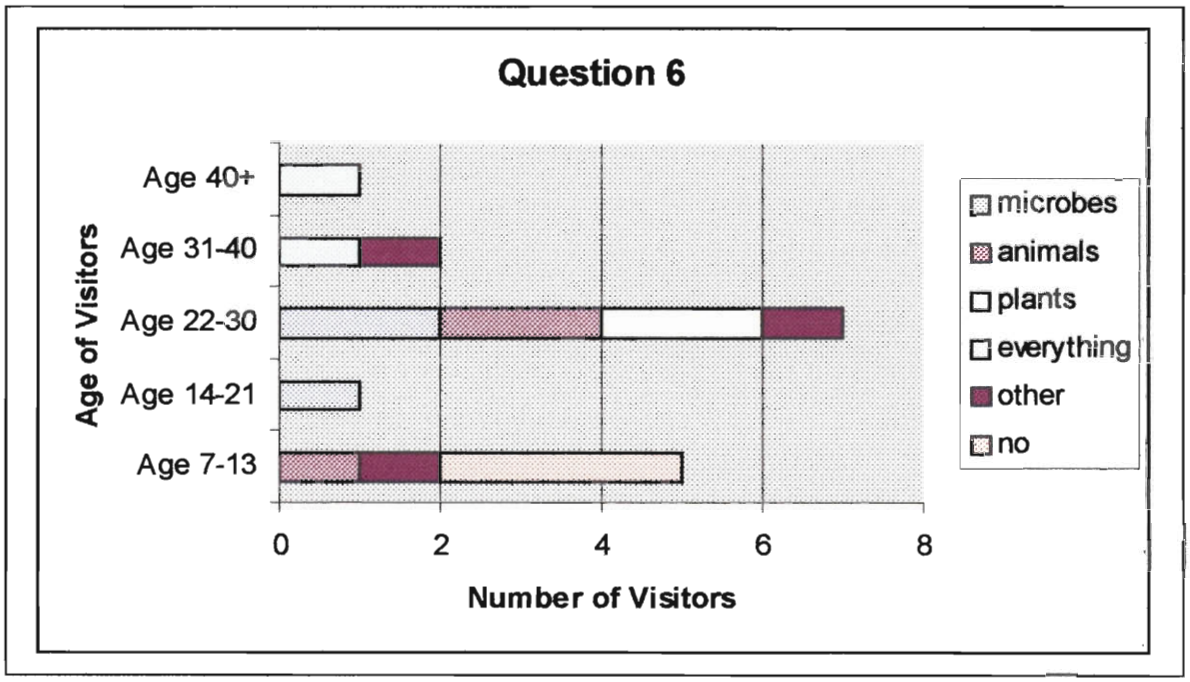

Question 1 - Visitor Age Distribution
Age 40+
Age 31-40
Age 22-30
Age 14-21
Age 7-13
Age
0
5
10
15
20
Number
Visitor

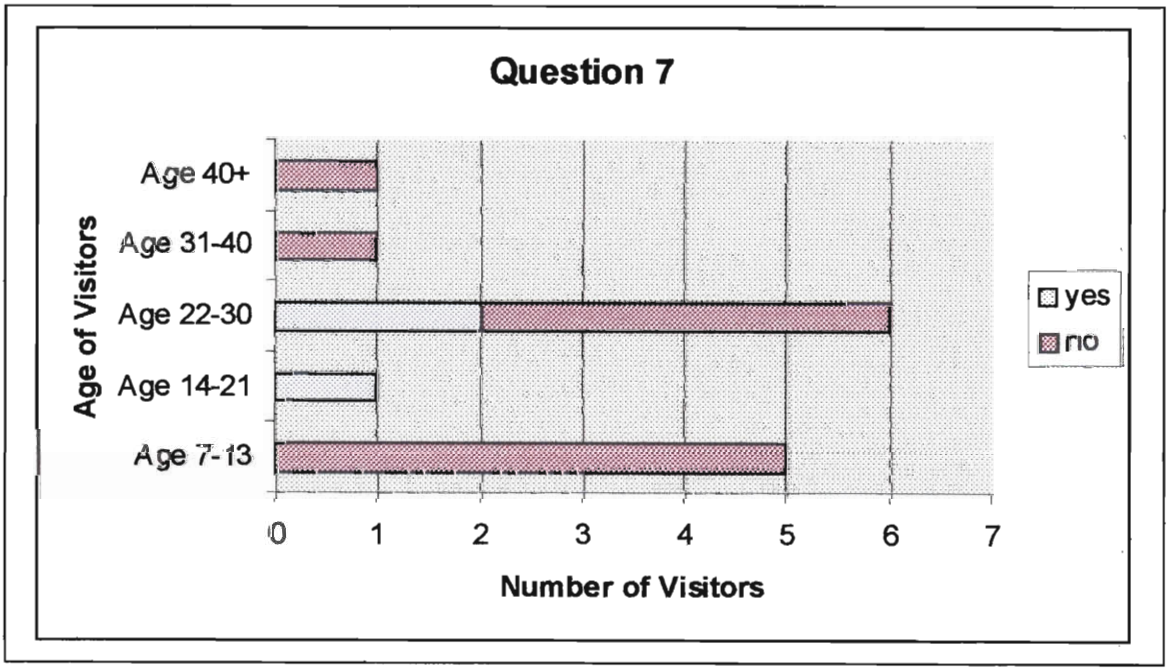

Question 2
Age 40+
Age 31-40
Age 22-30
Age 14-21
Age 7-13
Age of Visitors
0
5
10
15
20
Number of Visitors
Yes
No
Maybe
Conditional


Question 3
Age of Visitors
Age 40+
Age 31-40
Age 22-30
Age 14-21
Age 7-13
0
5
10
15
20
Number of Visitors
Yes
No

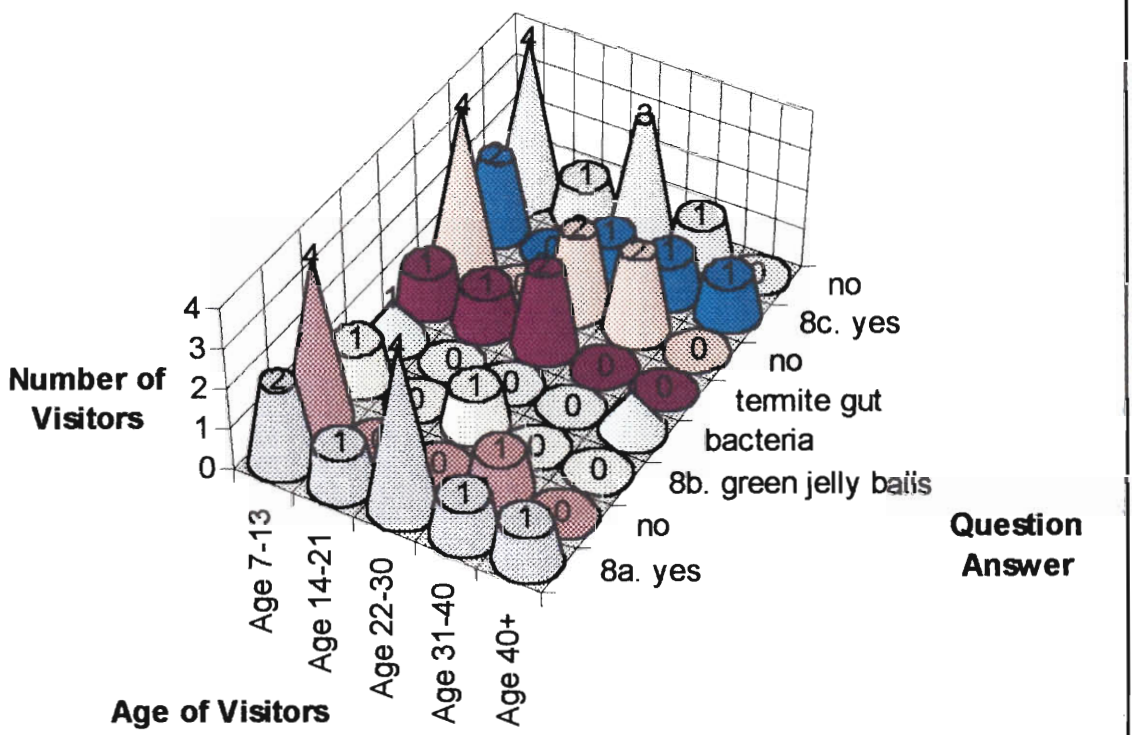

Question 4
Age of Visitors
Age 40+
Age 31-40
Age 22-30
Age 14-21
Age 7-13
0
1
2
3
4
5
Number of Visitors
no/no
yes/yes
yes/no
no/yes


Question 5
Age of Visitors
Age 40+
Age 31-40
Age 22-30
Age 14-21
Age 7-13
0
1
2
3
4
5
6
Number of Visitors
yes
no

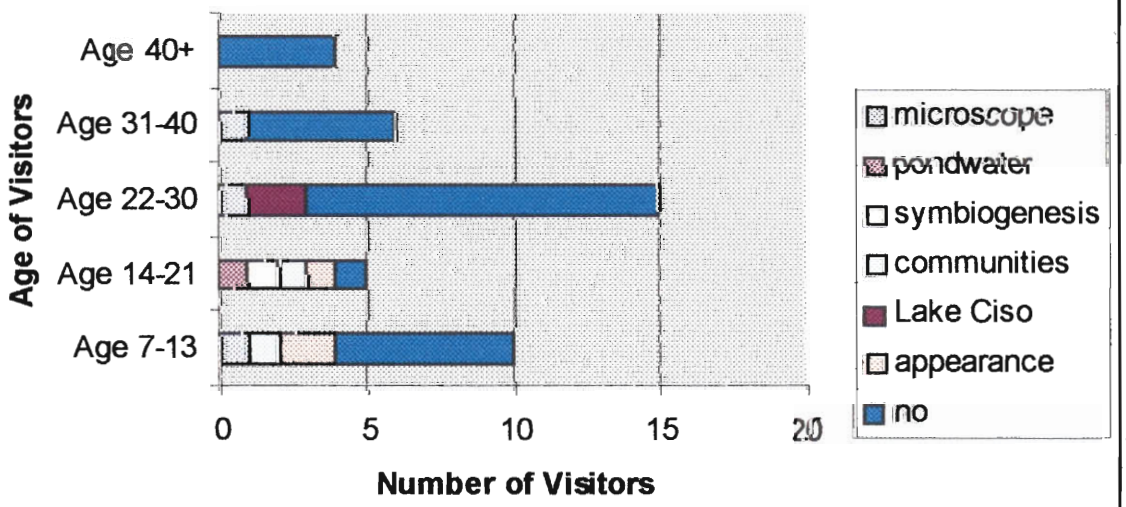

Question 6
Age of Visitors
Age 40+
Age 31-40
Age 22-30
Age 14-21
Age 7-13
0
2
4
6
8
Number of Visitors
microbes
animals
plants
everything
other
no


Question 7
Age of Visitors
Age 40+
Age 31-40
Age 22-30
Age 14-21
Age 7-13
0
1
2
3
4
5
6
7
Number of Visitors
yes
no

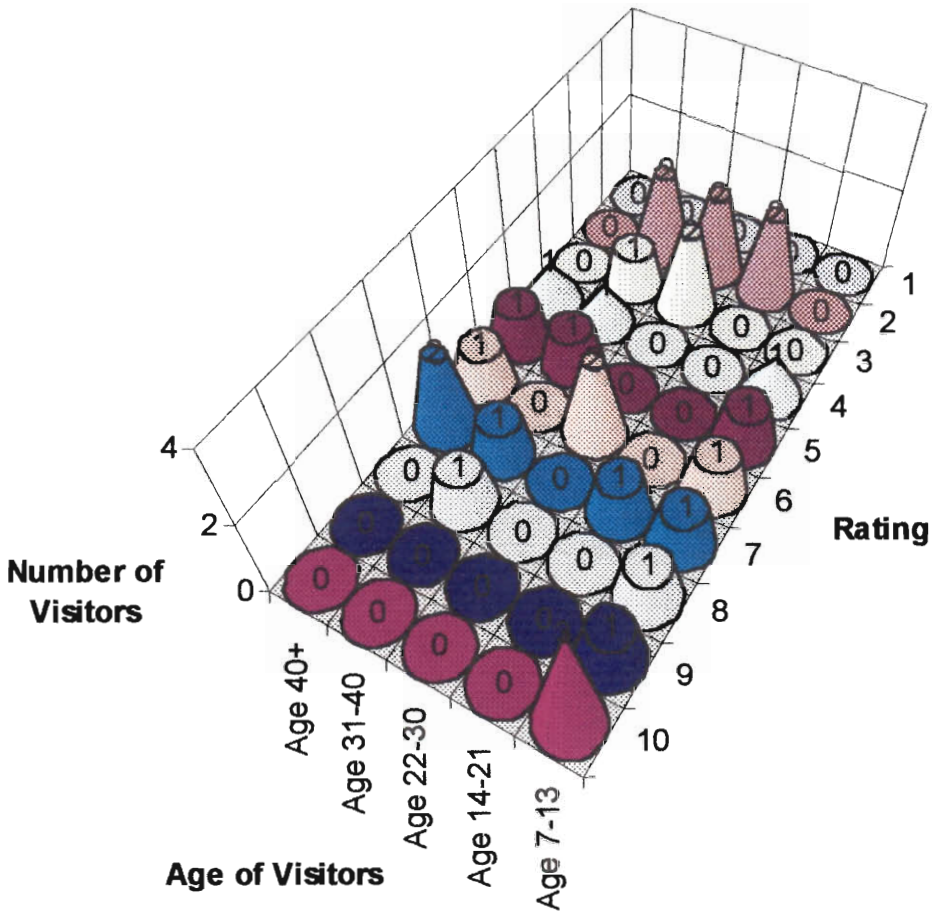
Question 8 (a,b,c)



Question 9



Question 10



Question 11