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**Acceptance of evolution and knowledge of related scientific tenets:  
A survey of science center visitors**

A Thesis Presented

by

**Dustin Growick**

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Abstract of the Thesis

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In the United States, routine public polling of American adults has shown that there is a general lack of acceptance of evolutionary theory and related scientific constructs. This problem effects educational policy and implementation in the arenas of both formal and informal education. Only very recently have surveys and studies begun to be enacted specifically at centers of informal education (science & technology centers and museums of natural history). Exclusively conducted at COSI Columbus (Ohio), over 600 museum guests independently completed a questionnaire that was designed to gauge visitors' understanding and acceptance of evolution, as well as their readiness to approach related topics. On the whole, COSI visitors were both more accepting of evolution and more knowledgeable of associated scientific themes. Additionally, even those visitors who subscribed to a creationist doctrine were not ignorant of the principals of natural selection. The areas displaying the highest levels of misinformation—both for creationists and those who accept evolution—were that of the timescale of biological change and the age of the earth. The findings of this study suggest that demographically similar sites of informal education should not shy away from presenting or exhibiting evolutionarily related content, as their visitors are more knowledgeable and more accepting of the theory than the general American public.

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## INTRODUCTION

In 1925, high school biology teacher John Scopes challenged the Butler Act, a Tennessee state law that effectively forbade the teaching of evolution (see the 1925 trial *The State of Tennessee vs. John Thomas Scopes*). The famous and controversial proceedings that followed have engendered a near century of public debate over evolutionary theory. Routine polling of the prevailing American attitudes and beliefs with respect to this issue have exhibited a stark bifurcation between those accepting the validity of the evolutionary theory and those who subscribe to a creationist doctrine. But unlike one's vote for a candidate running for political office, the legitimacy of evolution is not simply a matter of public opinion.

Outside of the formal education arena, evolutionary theory has been recognized and reinforced by exhibits and programming at natural history museums across the country. Among the paramount goals of these museums—which are, by definition, evolution museums—is to increase the public understanding and acceptance of the natural principles and processes that gave rise to the abundant biodiversity we see today. Science centers—the close cousin of the natural history museum—have been more reticent to incorporate related topics as their focus is not explicitly evolutionary. The particulars of this situation beg some important questions: should these centers of informal education have evolutionary programming? Are science centers doing the public a disservice by avoiding the topic for fear of controversy? If evolutionary topics are to be approached, how should the material be best presented?

As with any subject matter, front-end research is necessary before a science center can tackle the evolution issue. In order to design effective exhibits and educational programs, it is absolutely essential that administrators and educators first gauge the level of scientific understanding and acceptance of their target audience. But only very recently have studies and surveys related to evolutionary topics been executed exclusively at STCs (science and technology centers). These studies involve important and necessary research, as the opinions of the general public are not likely the same as that of people who visit science centers—it is reasonable to assume that the STC visitor is both more scientifically literate and more accepting of evolution, as their voluntary attendance speaks to their general interest in science.

More specific research is needed on both the proportion of STC visitors that accept evolutionary theory as well as on their level of knowledge with respect to related scientific constructs. Only when these underpinnings are fully investigated can STCs begin to design appropriate and approachable programming and exhibits dealing with evolutionary topics. This study aims to provide science centers with the information necessary to do just that.



## Statement of the Problem

Simply put, the public is considerably unaccepting of evolution. Recent polls indicate that the American populace is split into two diametrically opposed worldviews – those who accept that all life on our planet is the result of lengthy, natural processes, and those who believe that all of nature’s splendor, including mankind, was created in its present form.

In the last decade, in school districts around the country, science classrooms have become the central battleground for these polarized factions. Guided by beliefs based in large part on inaccurate evidence-based reasoning, proponents of creationism and intelligent design have attempted to add “creation science” to the curriculum of our nation’s schools. Prime examples of this include the Discovery Institute’s *Critical Analysis of Evolution* (a guide to high school science curriculum designed to strengthen their “wedge strategy” to “reverse the stifling dominance of the materialist worldview, and to replace it with a science consonant with Christian and theistic convictions”), recent court battles in Georgia, Kansas and Ohio over science class curriculum, and most notably the newly opened \$25 million Creation Museum in northern Kentucky. In addition, lawmakers in numerous states are actively considering legislation and proposals that question the scientific validity of evolution (Hoffstadt, 23).

Those who support including “creation science” in the public school curriculum continue to proclaim “...evolution is a theory, not a fact, regarding the origin of living things. This material should be approached with an open mind, studied carefully, and critically considered”. These are the exact words stickered to the inside of every biology textbook in Cobb County, Georgia from 2002-2005. More recently, local rulings in favor

of the inclusion of intelligent design and/or disclaimers citing that evolution as “simply a theory” have been overturned in Georgia, Kansas and Ohio, due at least in part to the outspoken efforts of scientific professionals:

Logically derived from confirmable evidence, evolution is understood to be the result of an unguided, unplanned process of random variation and natural selection. As the foundation of modern biology, its indispensable role has been further strengthened by the capacity to study DNA. In contrast, intelligent design is fundamentally unscientific; it cannot be tested as scientific theory... (The Elie Wiesel Foundation for Humanity, Nobel Laureates Initiative, September 2005)

Contrary to what proponents of intelligent design claim, evolution is not “simply a theory” (i.e. something that undergoes testing but can never be proven) in the way that many religious fundamentalists claim (Eskow 2005, 1). Widely accepted scientific theories are developed through a method of continual and repeated hypothesis, observation, testing, and confirmation. As such, evolutionary theory is as much a verified scientific fact as the “theories” of relativity or plate tectonics. While these two “theories” may not be widely understood by the public, their respective levels of acceptance are certainly higher than that of evolution. Additionally, the scientific method—where testable hypotheses are rigorously examined—is something of which about half of Americans are ignorant (see section entitled *Knowledge and Acceptance of Evolution in the General Public*). Much public polling has been conducted on the evolution/creationism debate, and only marginal increases have been seen with respect to the public’s view of evolutionary theory.

Public opinion surveys have not, however, been widely implemented at either natural history museums or science and technology centers. For a review of studies done

at such institutions, see latter section *STC Visitor's Knowledge and Acceptance of Evolution*. These free-choice learning institutions represent underutilized educational opportunities to help publicly confront both the campaign of misinformation as well as the public's general uncertainty about evolution. Sitting outside of local school systems, both natural history museums and science centers are public resources integral to the dissemination of proper information on the topic. Due in large part to their drawing power, STCs have the unique "potential to help the public understand and appreciate evolution" (Diamond & Scotchmoor 2006, 21).

Martin Weiss, vice president for science at the New York Hall of Science, comments "in science centers, where evolution is viewed as the province of natural history museums, it is unusual to find an exhibit or a program on the topic" (2006, 3). When Weiss and his colleagues surveyed staff members of the Association of Science and Technology Centers, they found that "the barrier to presenting evolution cited most often was concerns about negative reaction by the community..." While this is, of course, a valid concern, it is absolutely necessary for STCs to not avoid the subject, lest the public remain confused about and/or unaccepting of evolutionary theory. It is not unlikely that many in the public view the science center's "abdication of responsibility" (Weiss 2006, 5) as an indication of less than complete support for evolutionary theory. As non-scientific centers such as the Creation Museum begin to open, it is critical that the STC community unapologetically voice its support for evolutionary theory. Unlike local school boards, the administrators and curriculum planners of science centers have been much less sympathetic to the demands of proponents of "creation science". Their position is scientifically important—as far as the general public is concerned, one of the

major independent representations of basic scientific discourse is that exhibited by the STC. But the position of the science center is also legally important—in a secular society that constitutionally guarantees the separation of church and state, religion should not determine what we believe about the scientific world. Nonetheless, the current debate over evolution and creationism illustrates that religion continues to have significant influence over what the public believes about science.

### **Significance of the Problem**

Over the past decade, a widespread lack of evolutionary literacy has remained prevalent. Perhaps not coincidentally, the high proportion of the American public who do not accept evolution as fact has also remained considerable. Recent studies, however, suggest that this lack of confidence in evolution is *not a widespread phenomenon outside of the U.S.* (Miller, Scott & Okamoto 2006). When comparing thirty-four different countries (thirty-two European, plus Japan), the United States ranked second to last in public acceptance of evolution. Recent data from Kisiel, Silver, et al. (2006) corroborate this rejection of evolutionary theory by most Americans.

The problem of evolutionary literacy and acceptance may be much worse among American adults than minors. Each of the public polls discussed below represent responses exclusively from people over the age of eighteen. However, when compared to the attitudes and knowledge of minors still participating in secondary education, the results differ greatly. For example, according to the Trends in International Mathematics and Science Study (National Center for Education Statistics), American eighth grade

science students ranked eighth internationally, with average scores increasing fifteen points from 1995 to 2003.

While the future looks bright, it is the adults of today that guide educational policy and curriculum. The effect of this leadership has been seen in local school boards across the nation (see above). It has become apparent that many who sit on these school boards are subscribers to either “creation science” or intelligent design, or are simply unacquainted with evolutionary theory and scientific concepts. This problem has grown such that U.S. Rep. Doris Matsui (D-CA) recently introduced H.R. 1453, the Scientific Communications Act of 2007. If passed, the bill would fund National Science Foundation (NSF) programs that include instruction on how to communicate scientific principles to the nonscientist. The goal of the bill is to better arm scientists with the tools necessary to communicate complicated constructs to educational policymakers and business leaders. The ramifications of these science outreach programs would surely go a long way to help reduce Darwinian illiteracy.

Because parents are not actually present in their children’s classrooms, the reach of informal education for adults is easily much greater at science centers and natural history museums. As such, the widespread unfamiliarity of American adults with respect to evolution is a problem that informal education facilities are in a unique position to combat. STCs have the opportunity to raise the consciousness and understanding of the entire community in an intellectual and interactive setting. An immediate benefit of this may be better evolutionary awareness and comprehension in those that make policy decisions within the K-12 system – the people that most immediately affect the classroom education of our young citizens.

For years, natural history museums have led the charge with content that is overtly evolutionary. Countless other types of STCs have incorporated related programming as well, with the quality and breadth of these evolutionary exhibits varying dramatically. A good example of an unremarkable showcase of Darwinism is found in the Life Exhibition Area at COSI Columbus, where a short laser light show entitled *Origins* hurriedly examines the progression of life on earth and the beginnings of the universe itself. Unfortunately, this exhibit is relegated to a concealed corner with no supplemental material or related programming to encourage and aid inquiring minds. Many other STCs either have no exhibits or programming dealing with evolution or have areas where evolutionary concepts would be appropriate, yet fail to incorporate them. Still other sites are reticent to approach curriculum that explicitly discusses human origins.

In no way should this absence of programming be interpreted as a lack of support for evolution. The Association of Science-Technology Centers has a detailed, wholehearted endorsement of evolutionary education. Countless other individual centers have similar positions (see that of COSI Columbus in appendix). However, written support or endorsement of a field does not necessarily equate to encouraging or implementing informal education on the topic. The purposes of this study, detailed in the following section, strive to arm STCs with the information necessary to bridge that gap.

## **Purposes of the Study**

The purpose of this study is to examine museum visitor's knowledge, attitudes and beliefs with respect to evolutionary theory. Ultimately, this information can be used help guide future STC programming and approaches to informal evolutionary education. STCs are unique venues responsible for public scholarship outside of the classroom, and as such, it is imperative, from a programming standpoint, to know the level of understanding with which their visitor's approach evolution and related concepts. This information will prove indispensable in contributing to a more scientifically informed public. It is the ultimate hope of studies like this "that by better understanding visitors' interests and attitudes about and understanding of evolution, museums would be better positioned to develop exhibits and education programs that would be more effective for teaching the theory of evolution" (Kisiel, et al. 2006, 2).

Over the past decade, numerous polls on the theory of evolution and the doctrine of creationism have helped us better understand the general public's attitudes and level of acceptance of the contradictory worldviews. However, only very recently have studies begun to examine the inclinations of visitors to centers of informal education (an overview of these can be found in the latter section *STC Visitor's Knowledge and Acceptance of Evolution*). Some of these studies ask important questions about visitor's viewpoints (see Stein & Storksdieck 2005), while others go as far as to determine the differing patterns of naturalistic reasoning employed when trying to explain evolutionary change (Evans et al., 2006). Fewer still investigate the demographic background of survey participants. Some of these studies include data collected at multiple STCs, while

others are site-specific, but there are two common threads to all these studies. The first is an attempt to show that museum guests are willing and able to discuss evolution. The second is a contribution of information invaluable to guiding future evolutionary programming.

The objectives of this study are numerous. Perhaps the most simple is an attempt to determine if STC guests (specifically COSI visitors) are more accepting of evolution than the general public. This can easily be determined by means of your basic evolution or creation question. As far as standard questioning is concerned, few studies carried out at STCs determine a visitor's specific level of knowledge when it comes to scientific constructs associated with evolutionary theory. By avoiding queries that could elicit answers that are opinion-based and instead asking technical questions with cut-and-dry right or wrong answers, this study aims to determine the following:

- 1) What percentage of COSI visitors accept the validity of evolution?
- 2) How comfortable/familiar are COSI visitors with the multiple components of evolution (survival of the fittest, genetic variation, mutation, inheritance)?
- 3) With which areas/concepts are COSI visitors least knowledgeable?
- 4) Is there a general underestimation of the amount of professional support and scientific evidence for the theory?
- 5) Which demographic variables most affect respondent's viewpoints and overall knowledge of the subject?



Essentially, the ultimate purpose of this survey is to encourage STCs to address evolutionarily related issues, and to provide COSI and other demographically similar centers of informal education with a supplemental guide to aid in the inclusion of explicitly evolutionary curriculum.

### **Definition of Terms**

*Evolution:* the process of change through time, whereby different kinds of living organisms develop, diversify, and increase in complexity from earlier forms.

*Natural Selection:* the principal vehicle of evolution—a process of interaction between an individual and the environment through which some individuals are more successful at surviving and reproducing. Natural selection rests on three principles: variation among individuals, inheritance of variation, and the struggle for existence.

*Darwinism:* the theory of evolution of species by natural selection first advanced by Charles Darwin.

*Creationism:* the belief that the universe and living organisms originate from specific acts of divine creation, as in the biblical account, rather than by natural processes such as evolution.

*Intelligent Design:* the theory that life cannot have arisen by chance and was designed and created by some intelligent deity.

*Informal Education:* public education that takes place outside of the classroom or academic institution. Natural history museums serve as a prime example.

*STC*: Science and Technology Centers. Science centers and natural history museums dedicated to furthering the public understanding of science.

*COSI*: Center of Science and Industry (Columbus, Ohio)—an example of a *STC*.

## **REVIEW OF THE LITERATURE**

### **Knowledge and Acceptance of Evolution in the General Public**

As with many other polarizing issues, general public polling (not specific to *STC* sites) on the topic of mankind's origins has not been scarce. Relatively routine public surveying has been additionally supplemented during recent Presidential election years by political polls that included questions on evolution and creationism. Depending upon the general length and authors of the poll, specific questionnaire wording has varied both in form and function. Consequently, it should be no surprise that different polls have produced different results. Additionally, given the breadth of polls on the topic, the dissimilarities of certain surveys render them nearly incomparable.

For example, there are glaring incongruities between the Opinion Dynamics (OD) poll (reported by Fox News, August 27, 1999) and the Mason-Dixon (MD) Polling & Research survey (commissioned by the Cleveland Plain Dealer, June 2002). In the OD poll, respondents had three options to the question “which do you think is more likely to actually be the explanation for the origin of human life on earth?” – “Biblical account of creation”, “theory of evolution”, or “both”? Fifty percent answered “the Biblical account

of creation”, while 26% percent choose the rarely offered “both are true” option. The MD poll, however, gave respondents five distinct and very detailed choices answer the question “which of the following statements comes closest to your view about the development of life on earth?” No option garnered more than 29% of the vote. Which poll should be deemed more reliable and functional, the curt survey or the detail-oriented questionnaire? Further examination of both polling data and methodology on the topic of evolution and creationism will begin to highlight the different ways in which brevity and detail necessarily effect statistical outcomes.

Perhaps the best example illustrating how questionnaire wording can affect results lies in the significant differences between the Pew Research Center poll (July 2005) and the Gallup poll (May 2006). While only 13% of Gallup’s respondents believe in human evolution strictly by natural selection, that percentage is doubled in the Pew poll. Closely related then, is that Gallup found that 36% of people believe that the evolutionary process was guided by God or a supreme being, versus only 18% of people in the Pew poll. These two polls serve as prime examples of how both question wording and ordering can markedly affect results. It is interesting to note that differences in results are often borne from the way answer options are worded. When questions make no mention of God, people are more likely to select a natural process for the development of all species on earth, because it affords respondents the belief that God set the evolutionary process in motion. When God is explicitly mentioned, survey participants are more likely to choose His option rather than a strictly evolutionary answer that could imply disbelief (Pew Research Center Pollwatch 2005).

It should be noted, however, that when you coalesce the numbers to simply compare those who believe that God created life in its present form and those who subscribe to an evolutionary process (God guided or not), these polls display similar results; the Pew poll shows 48% accepting evolution by natural processes vs. 42% believing life has existed in present form only, while the Gallup poll reveals 49% accepting an evolutionary process vs. 46% believing God created human beings in their present form. The similarities between the results of these two polls are not surprising – the general public is evenly divided on this issue, with surveys consistently yielding somewhere between 40% and 50% subscribing to the idea that human beings are the result of an evolutionary process, and roughly the same percentage believing that human beings were created in their present form.

The July 2006 Pew Research Center poll may be the most important. This relatively recent poll is unique in the fact that it is the only survey in which 50% (or higher) of respondents choose the evolutionary option as the explanation for the origin and development of life on earth. Just over half of poll respondents chose the option “humans and other living things have evolved over time”, while only 42% chose “humans and other living things have existed in their present form since the beginning of time”. Numerous previous polls showed figures at or above 50%, but the percentages were always in favor of the creationist position. Contradicting these findings are those of an even more recent poll, conducted by Newsweek in March of 2007, which shows 43% of the population subscribing to a lengthy, natural process of development, while 48% citing the belief that humans were created by God sometime in the last 10,000 years.

The Pew Research Center poll (July 2006) showed an additional sign of an increase in the general public's acceptance of evolution. In 2005, when asked "from what you've heard or read, is there general agreement among scientists that humans evolved over time, or not?", only 54% of poll respondents said "yes". Only one year later, that number was up to 62%. This eight-point difference far outweighs the poll's three-point margin of error.

While the potential drawbacks of Gallup's poll were demonstrated above, Gallup should be commended for maintaining one of the most interesting and statistically useful polls on this topic. Over the past fourteen years, Gallup has consistently asked the same question of the general American public: "Which one of the following statements comes closest to your views on the origin and development of human beings? 1) Human beings have developed over millions of years from less advanced forms of life, but God had no part in this process, 2) Human beings have developed over millions of years from less advanced forms of life, but God guided this process, or 3) God created human beings pretty much in their present form at one time within the last 10,000 years or so." (Options rotated 1-3, 3-1). Table 1 (below) shows the results of the poll over the last fifteen years.

**Table 1:** Gallup poll on human origins (1982-2006)

|         | Guided by God | God Had No Part | God Created in Present Form | Other/ No Opinion | Total |
|---------|---------------|-----------------|-----------------------------|-------------------|-------|
| 5/2006  | 36%           | 13%             | 46%                         | 5%                | 100%  |
| 11/2004 | 38%           | 13%             | 45%                         | 4%                | 100%  |
| 2/2001  | 37%           | 12%             | 45%                         | 5%                | 100%  |
| 8/1999  | 40%           | 9%              | 47%                         | 4%                | 100%  |
| 11/1997 | 39%           | 10%             | 44%                         | 7%                | 100%  |
| 6/1993  | 35%           | 11%             | 47%                         | 7%                | 100%  |
| 1982    | 38%           | 9%              | 44%                         | 9%                | 100%  |

Since 1982, Gallup’s poll has consistently demonstrated little to no change in the general public’s views on the topic of evolution and creation. When comparing data from 1982 with the most recent poll (5/2006), the only changes that are outside of the poll’s three point margin of error (albeit very slightly) are the 4% increase in people believing God had no part in the evolutionary process and the same percentage point decrease in people responding ‘other/no opinion’. A potential explanation for this change may be found in the shifting demographics of religiosity in the United States.

According to the American Religious Identification Survey (ARIS), the number of people identifying themselves as having no religion (atheist, agnostic, humanist or secular) more than doubled between 1990 and 2001 (from 14,331,000 to 29,481,000). Whether the 4% increase in people claiming ‘God had no part in the evolutionary process’ can be specifically attributed to this growing and increasingly vocal minority is uncertain.

The 2004 Gallup poll also hints at the level to which people underestimate the validity of Darwin’s theory of evolution. A full 64% of respondents said evolution was

either “just one of the many theories and one that has not been well supported by evidence” or that they “don’t know enough about it to say”. Other types of survey question responses exhibit the public’s lack of appreciation for the dearth of evidence supporting Darwinism (Nisbet 2005, 3). For example, when the recent Newsweek poll (March 2007) asked the question “Do you think the scientific theory of evolution is well-supported by evidence and widely accepted within the scientific community?” Fifty-two percent said they believed that the theory was “not well-supported” by evidence or that they didn’t know. Another great example of the public’s underestimation of support and evidence for the theory is the later discussed 2005 Harris poll, where poll respondents were asked “do you agree that Darwin’s theory of evolution is proven by fossil discoveries?”

While most polls ask some form of the question “have human beings evolved over time or were they created in their present form?”, only recently have more thorough polls inquired about the public’s opinions *and general knowledge* of the topic. In addition to asking about how valid one views evolutionary theory, these multifaceted polls include questions about the scientific constructs and principles that comprise modern biological and evolutionary thought. The data gathered from these polls are, arguably, even more useful than simply asking the habitual ‘evolution or creation’ questions. When faced with the standard query, many view the response as more opinion-based rather than as a factual question with a cut-and-dry answer. In an attempt to nullify this incorrect preconception, the most valuable polls delve deeper into the public’s scientific background by asking questions that leave little to no room for opinion-based interpretation. By doing this, the survey results demonstrate a better

understand of the scientific competency the layperson uses to form their opinion on the validity of evolutionary theory. Additionally, by gathering detailed demographic information, the survey can better pinpoint the variables (e.g. religiosity, income, level of education, etc.) that have the greatest influence on particular segments of the population.

One of the most recent and best examples of these ideas in action is the far-reaching *Public Acceptance of Evolution* (Miller, Scott & Okamoto 2006), from which a number of valuable insights can be taken. First, the authors commented on dichotomous polling of U.S. adults over a twenty-year period (1985 to 2005). When asked, ‘true’, ‘false’, or ‘not sure/don’t know’ to the question “human beings, as we know them, developed from an earlier species of animals”, results show that acceptance of evolution has dropped from 45% to 40%, while rejection of evolution has *also dropped*, from 48% to 39%. As a corollary, the percentage of American adults who were unsure about evolution *tripled*, from 7% to 21%. Though this issue has been hotly contested in the public arena for more than twenty years, people are still approximately evenly divided between those accepting or rejecting evolution (Miller, Scott & Okamoto 2006, 765). *Public Acceptance of Evolution* also compared data from 1993 and 2003, successfully showing that “a dichotomous true-false question format tends to exaggerate the strength of both positions”. When asked the same question, but given the possibility of answering “definitely true, probably true, probably false, definitely false or unsure”, only 14% of U.S. adults choose “definitely true” to describe evolution. Approximately one-third of respondents resolutely rejected the theory. Lastly, when the authors grouped the “probably” and “not sure” categories together, about 55% fell under the umbrella of “varying degrees of uncertainty” for their “tentative view about evolution”. This



recognition of the general unease that evolutionary theory elicits in most Americans is in direct disagreement with the fourteen-year trend to the contrary exhibited by the Gallup poll.

The main objective of Miller, Scott & Okamoto's study is to exhibit a cross-national comparison of public acceptance of evolution in thirty-four different countries (thirty-two European, plus Japan). According to the authors, "regardless of the form of the question, one in three Americans firmly rejects the concept of evolution, a significantly higher proportion than found in any western European country". In fact, only the Turkish have fewer citizens accepting the validity of evolutionary theory.

One of the strengths of *Public Acceptance of Evolution* is the detailed demographic information gathered alongside participant responses. By analyzing the backgrounds of survey respondents, the authors were able to show the strong correlation between fundamentalist religious beliefs and the rejection of evolution. In fact, the influence of religiosity was nearly twice as much in the United States than in any other country. The authors argue that the effect of widespread biblical literalism (viewing the the creation account of Genesis as an exactly literal) in the United States trumps the findings of the scientific process. Those of Protestant faiths in Europe (and in the U.S.) more often view the creation story of Genesis as metaphorical and therefore not in direct conflict with modern scientific principles founded in Darwinian thought (Miller, Scott & Okamoto 2006, 765).

The final and most illuminating part of Miller, Scott & Okamoto's 2006 study examines the American's responses to a "genetic literacy" test. By asking specific true or false questions, the authors investigate the level of educational background that poll

respondents bring to the table, specifically by determining respondents “acceptance of selected scientific constructs”.

The statement that elicited the most standard distribution of answers (true - 40%, false - 39%, not sure - 21%), and the query used in European comparisons, was the aforementioned “human beings, as we know them today, developed from an earlier species of animal”. This statement seems to be the most reliable at gauging the layperson’s acceptance of evolution, as the question makes no mention of God, nor does it necessitate any level of specialized scientific knowledge in the respondent.

Additional true or false statements elicited interesting results. When faced with the statement “human beings have somewhat less than half of the DNA in common with chimpanzees”, 38% incorrectly answered “false”, while 48% were “not sure”. When asked if “more than half of human genes are identical to those of mice”, only 32% replied “true”, with 47% in the unsure camp. And finally, when asked if “the earliest humans lived at the same time as the dinosaurs”, a full 50% of people answered either “true” or “not sure”.

Questions specific to evolution and natural selection were also asked. When faced with the true or false question “over periods of millions of years, some species of plants and animals adjust adapt and survive while other species die and become extinct”, a hearty 78% replied “true”, while only 16% said they believed the statement to be false. However, when asked if “human beings were created by God as whole persons and did not evolve from earlier forms of life”, 62% of the same population replied “no”.

These data suggest that many people subscribe to a “human exceptionalism perspective” (Miller, Scott & Okamoto 2006, 766), in that Americans are wary of extending

evolutionary principles to themselves and to our species as a whole. This perspective is possibly born out of respect for fundamentalist religious views that purport man's position as distinct from the rest of the animal kingdom, and consequently exempt from many of its natural processes.

A Harris Interactive poll taken in both 1994 and 2005 sheds greater light on the human exceptionalism standpoint. In 2005, while only 38% of people believed that "humans evolve[d] from earlier species", 49% believed that "*all* plants and animals have evolved from other species" (my italics). The two most plausible explanations for this rather substantial discrepancy are the human exceptionalism perspective taken by many Americans, or that 11% of people simply do not consider human beings to be animals.

Another interesting detail that is drawn out of the 2005 Harris poll has to do with the extent to which public misinformation shapes viewpoints on human evolution. When the pollsters asked "do you agree that Darwin's theory of evolution is proven by fossil discoveries?", 54 % of the population responded either "strongly disagree", "somewhat disagree", or "unsure". This is the exact same percentage that replied "no" to the question "did humans evolve from earlier species". It would be interesting to test if personal views on evolution affected whether or not one believes fossil discoveries support the theory, or vice versa. Either way, a strong correlation between the two is very plausible.

## Summary of Public Opinion Polling

Public polling on the acceptance of evolution has been vast. In *Polling Opinion about Evolution: Low Information Public Underscores Importance of Communication Strategy*, Matthew Nisbet notes that “polls are one way for decision-makers to consult the public about policy, reassuring the public that at some level their opinion counts, and that science-related decision making is not simply dominated by technocrats and scientists” (2005,1).

There is a two-fold problem with this view, the first having to do with survey form. It has been demonstrated by multiple surveys (see above) that specific question wording necessarily affects results. When given a multitude of answer options, we see public views varying widely (see Mason-Dixon Poll, 2002). When asked for a dichotomous answer to questions such as “did humans evolve from earlier species?” (see Harris Interactive Poll, 2005), nearly all surveys show the public leaning slightly towards a creationist theory to describe human origins. With such a wide array of statistical results, it would be erroneous to merely select one as representing the prevailing public opinion. This factor is compounded even more when you consider that most of these public opinion polls do not ask *any* demographic information. Much greater detail is needed from these surveys if one wishes to pinpoint a target population, be it for the purposes of elementary education, governmental policies, or programming at STCs.

As Nisbet himself points out, the second major problem with using public opinion polling to guide scientific education and/or programming is that the majority of Americans may simply be too ignorant when it comes to the topic of evolutionary theory.

While most multi-year polls show little to no change in the proportion of people subscribing to evolution or creationism, nearly all show an increase in the percentage of people choosing the ‘not sure’ or ‘don’t know’ options. As a corollary to this uncertainty, substantial doubts still abound with concern to the evidence for evolution, as well as with the theory’s acceptance within the scientific community (see Gallup 2001, Gallup 2004, Newsweek 2004, Newsweek 2007).

### **Knowledge and Acceptance of Evolution in STC Visitors**

Over the past decade, polling on the public’s views and literacy of evolutionary theory have been ubiquitous. The need for this research is great, as it is important to understand the prevailing public opinions on a topic that penetrates so many spheres of discourse and remains a substantial influence with respect to the design and implementation of public science center curriculum.

The STCs of America have remained steadfast in their support of evolutionary concepts, but public opinion polls have not gone unnoticed. Though studies performed at STCs and natural history museums have not been as numerous as public opinion polls, their breadth and quality has been far superior. Recognizing that perhaps their chief goal is to encourage visitation, professionals within the STC community have begun to formulate their own studies in order to gauge the similarities and differences between museum visitors and the general population. In doing so, they can obtain the information necessary to best structure scientific programming for their unique target population.

Perhaps the most widely known STC study is Stein and Storksdieck's *Life Changes Museum Visitor Survey* (2005). The main goal of this study was to better understand the level of evolutionary literacy of the science museum visitor versus that of the greater U.S. population. In order to do so, researchers administered 387 one-page questionnaires to museum visitors at different sites across the country. Seven science museums were selected in an attempt include a variety of STCs that differed not only in size, but in location, scope of focus, and demographic variability. Sample size varied substantially per location— the St. Louis Science Museum obtained 27% of the total responses while the Science Museum of Minnesota contributed only 5%. *Life Changes Museum Visitor Survey* focused on capturing the museum visitor's acceptance of evolution, as well as investigating related attitudes, understanding and beliefs (Stein & Storksdieck 2005, 8-9). The authors compared their results with those obtained by a People for the American Way Foundation telephone survey conducted in 1999.

While there were only minor differences between museum and general public populations when it came to recognizing and defining evolution, there was great variability between populations when it came to personal views of the theory (it is important to note that the discrepancies here could be due in part to the effects of self-selection). About half (49%) of STC visitors described evolution as either “a completely accurate account of how humans were created and developed” or an account that was “mostly accurate”. Only 27% of respondents in the national poll shared those views. Furthermore, only 12% of museum visitors believed evolution to be an account that was “completely not accurate”. This view was held by 21% of respondents in the national sample.

When asked what principles should be instructed in schools, more museum visitors (18% vs. 13% for the general public) thought that evolution and creationism should *both* be taught. However, only 1% of museum visitors thought that only creationism be taught, while 16% of respondents in the national sample favored a school curriculum that featured creationism exclusively. Multiple options were available for those that favored evolutionary curriculum. These included “schools should teach only evolution”, “schools should only teach about evolution in science classes”, and “schools should teach evolution as scientific theory”. There is obvious potential for considerable overlap within these answer options. Still, 54% of the museum sample selected one of the “only” options, asserting that only evolution should be instructed either in science class or in general. In the public poll, only 37% of respondents held those views.

When museum visitors were asked if they felt that STCs should have exhibitions featuring evolution, the response was generally favorable. Nearly two-thirds (59%) of survey participants believed that STCs should “definitely” do so, while 27% said “perhaps”, possibly meaning that their decision depended upon how the topic was presented (Stein & Storksdieck 2005, 9). The survey also asked how interested museum visitors would be in bringing children to exhibits that focused on evolutionary topics. The data indicated that a full 84% were either “very” or “somewhat” interested in visiting a Darwinian exhibition with their children. Those replying “somewhat” could again be a segment waiting to gauge their answer upon the way in which the topic was approached. Only 16% were not at all interested in taking kids to an evolution exhibit.

Valuable insight is to be gained from Stein and Storksdieck’s *Life Changes Museum Visitor Survey*. The authors obtained substantial data indicating that museum

visitors are more accepting of evolution than the average American. Furthermore, regardless of prevailing public opinions, the authors note that STC guests "...tend to expect science in a science museum, and the fact that they choose to visit such a museum likely makes them tolerant toward the presentation of this [evolutionary] topic"(2006, 9).

Because data were collected at many locations, *Life Changes Museum Visitor Survey* is very useful for broad generalizations about the American science museum visitor. A moderate drawback is the relatively small sample size specific to each institution involved. Surveying only twenty to thirty respondents (for the museums with the smallest representation in the study) is nowhere near a large enough sample to accurately portray your population on the whole.

*Life Changes Museum Visitor Survey* is not the only multifarious study that has been conducted across multiple STCs. Presented at the National Association of Research in Science Teaching (NARST) annual meeting in April of 2006, *Investigating the Public Understanding of Evolution by Natural Selection* (Kisiel, et al. 2006) examined museum visitor's level of acceptance of evolutionary theory, as well as their understanding of concepts related to evolution. This study is unique in that it included responses from six American natural history museums, as well a one location in each Australia, Canada, and Great Britain, respectively. Also unique to the project is that children as young as seven were included among the 750 respondents.

One impetus for the study was that misconceptions about the mechanisms of the theory—even by those who accept its validity—prevent many Americans from truly understanding evolution (Smith 1994, Sundberg 2003). Interviews of guests at natural history museums were aimed at eliciting explanations about the concept of biological



change over time, the fossil record, and the order in which evolutionary events take/took place (Kisiel et al. 2006, 2).

According to *Investigating the Public Understanding of Evolution by Natural Selection*, only 13% of those interviewed at American natural history museums rejected evolution or were uncertain about their level of acceptance. However, respondents at all three museums outside of the U.S. were still less likely to reject evolutionary theory than American study participants. As far as a specific scientific construct is concerned, when participants were asked to explain the process by which evolution happens, only 19% of natural history museum visitors provided an explanation congruous with natural selection (Kisiel et al. 2006, 3). Furthermore, only 45% of the Americans interviewed possessing either a master's or doctorate degree correctly employed natural selection when attempting to explain the process of evolution (Kisiel et al. 2006, 4).

As far as the American participants were concerned, an individual's level of education was not found to be related to their tendency to accept evolution. This was not the case, however, for the demographic variable of age, with the data showing a "significant relationship between age and the rejection of evolutionary theory"—the older an individual was, the more likely they were to reject evolutionary theory (Kisiel et al. 2006, 3). This was not the case outside of the U.S., where not one of the three sites showed evidence of a relationship between age and acceptance of evolution.

When it comes to evolutionary theory, it is important to know the attitudes, opinions, and level of knowledge of the museum visitor population. Of even greater significance is understanding exactly how STC visitors approach evolution; more specifically, with what reasoning patterns and intellectual frameworks do individuals

conceptualize the topic? In *A Conceptual Guide to Museum Visitors' Understanding of Evolution*, Evans et al. (2006) set out to do just that. The research for the study was centered around the NSF funded exhibition *Explore Evolution* and was conducted at three separate Midwestern natural history museums. Thirty-two museum visitors participated in an interview in which they were asked to explain evolutionary change in seven different organisms—fly, finch, HIV, diatom, ant, whale, and human. The researchers did not mention the term evolution during the interviews.

Evans et al. set out to investigate the thought processes employed when an individual attempts to explain biological change in an organism. Participant responses were grouped into one of the three following distinct reasoning patterns:

*Informed Naturalistic Reasoning*: Use of an evolutionary term or concept (e.g. variation, inheritance, selection).

*Novice Naturalistic Reasoning*: Proposes a natural explanation, but relies on intuitive modes of reasoning.

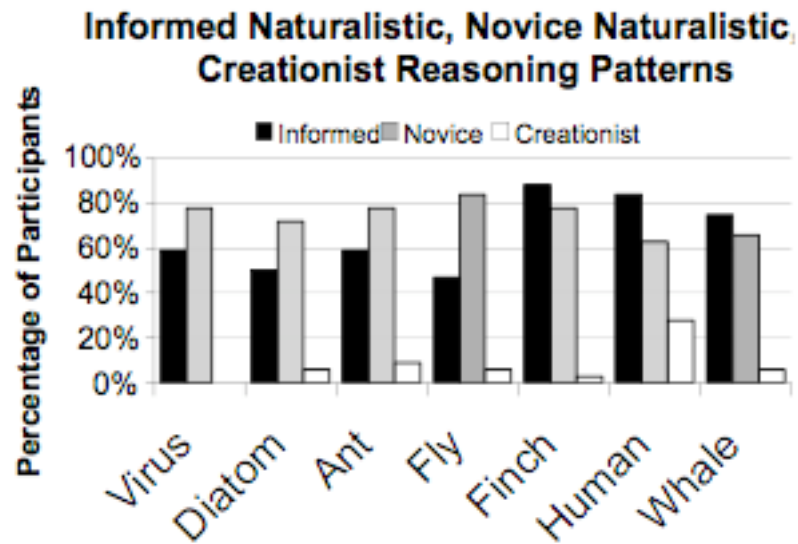
*Creationist Reasoning*: Proposes supernatural rather than natural explanations; particularly God's direct role.

(Evans et al. 2006)

The study results showed that only 28% of participants used some type of creationist reasoning pattern to explain biological change. While none of the participants interviewed utilized one of the reasoning patterns exclusively, the researchers were able to determine the dominant method used for most of the respondents. The data collected suggested that 34% of participants were “informed naturalistic reasoners”, while 53% were “novice naturalistic reasoners”. “Creationist reasoners” and those showing no dominant reasoning pattern both made up 6% of those interviewed (Evans et al. 2006).

Even more intriguing is the division of reasoning pattern by organism shown in Table 2:

*Table 2: Reasoning patterns used to explain evolutionary change (Evans, et al. 2006)*



For the smallest organisms—the virus, diatom, ant, and fly—responses elicited the most novice naturalistic reasoning patterns. This may be due to lack of educational literacy when it comes to microorganisms. Conversely, when attempting to describe methods of biological change in finches, humans and whales, more interviewees employed informed naturalistic reasoning. A possible reason for this is the widespread use of those three creatures as examples of evolutionary change in modern biology textbooks. As such, the level of naturalistic reasoning used to describe these three organisms may be bred from educational familiarity.

The most enlightening detail of the distribution of reasoning patterns utilized is that the percentage of participants who used creationist reasoning was by far the highest

for human beings—another example of how many individuals form an evolutionary viewpoint of human exceptionalism. It is clear from Figure 2 that Darwinian explanations of species development suffice for all of the organisms except for human beings.

According to the authors, only about one third of study participants were well informed about evolutionary processes. By better understanding the ways in which museum guests conceptualize and explain biological change, administrators and informal educators can more appropriately and efficaciously develop tools and curriculum that include evolutionarily related topics. As such, the information provided by *Investigating the Public Understanding of Evolution by Natural Selection* is sure to prove useful for STCs and natural history museums looking to include exhibitions and/or programs discussing evolution.

### **Summary of STC Studies**

The importance of these studies is two-fold. The first is to determine if public polls adequately reflect the attitudes of the STC visitor, and secondly to examine visitor's scientific knowledge. Simply put, these studies aim to discover what guests think about evolution, and why they think it. Once it is understood what aspects of evolutionary theory or scientific inquiry with which the public is unfamiliar, programming can be accurately designed to address the areas of ambiguity. In doing so, steps can be taken to lessen the public's illiteracy and lack of acceptance of evolutionary theory. These various studies conducted at STCs have successfully shown that museum visitors are

generally more accepting of evolution, as well as more willing to participate in programs with related scientific content. Additionally, however, STC populations are not necessarily better informed when it comes to the principles and mechanisms that comprise evolutionary theory. These two insights seem to suggest that museum audiences are both ready and willing to increase their scientific literacy through the medium of the STC.

Though studies conducted at STCs are currently few in number, they have already begun to encourage other museum sites to examine their own programming and visitor attitudes associated with evolutionary theory. Most notably, the Florida Museum of Natural History recently completed similar research at six museums across the nation. The researchers found that less than a third of museum visitors could accurately explain natural selection, the key driver of evolution (Gainesville Sun, March 30, 2007). The co-author of the study (paleontology curator Bruce MacFadden) commented that many people are hardwired to think on a short-term, human time-scale (hundreds of years) rather than on a longer geological time-scale (millions and/or billions of years). This mindset makes it more difficult to envision long-term biological change as well as the historic lineages of various species and of the earth itself. This theory is further supported by the data described below with respect to individual's thoughts on the age of the earth and relative maturity of our species, *Homo sapiens*.

## METHODOLOGY

### Subjects

Data collection took place solely at COSI, which is located in downtown Columbus, Ohio. Only adults were approached and asked to voluntarily participate in the questionnaire, and no distinction was made between teachers or chaperones accompanying school groups, daily paying visitors, or COSI members. All adult guests leaving COSI were asked to participate, regardless of their gender, age, race, ethnicity, religion, income, or any socioeconomic variable. COSI employees and volunteers were *not* asked to participate.

COSI Columbus routinely audits visitors by means of intercept interviews. The objective of these surveys is to gauge general customer satisfaction as well as to obtain a demographically representative sample of COSI's visitor population. The most recently completed guest audit took place from August 2004 thru July 2005. While the data gathered are not publicly available, information from the audit has been used herein (with COSI's permission) for purposes of demographic comparison to between two sample populations of COSI visitors. This analysis can be found at the beginning of the section entitled *Results and Discussion*.

## **Instrumentation**

The data collection format used for this project was a standard, multi-part, fifteen question survey entitled *Public Opinion and General Knowledge of Evolution and Creationism* (see Appendix). The specific wording of the questionnaire's title was deliberately chosen to elicit an immediate reaction of neutrality on the part of the researcher. The word "public" was used to assure COSI guests that the survey was aimed at no particular segment of the population, and that, regardless of their background, their responses would be included. The term "opinion" was used in an attempt to avoid any degree of offense, as well to reassure participants that their thoughts truly mattered. The phrase "general knowledge" was selected to convince COSI visitors that the questionnaire was not overly difficult, nor was it some sort of aptitude test.

In a short paragraph before the first question, participants were also informed of the questionnaire's purpose with concern to both the researcher and to COSI. Furthermore, respondents were once again assured that their responses were to be kept anonymous: "The data gathered will be used in the preparation of a Master's thesis; findings will be shared with COSI for possible use in future program development. All answers are anonymous and confidential".

The first of the survey's four pages included questions 1-5. Questions 1-3 were multiple-choice variations of the standard "evolution or creationism" question. The first query makes no mention of God, and explicitly uses the term "natural selection" when describing evolution. The second question is a replica of one used in the running Gallup poll, providing the option of God guiding human evolution. The third question, used in

both a Fox News poll (1999) and an NBC News survey (2005), is a more dichotomous query on evolution and the Biblical account of creation. Answer options to the first three questions were rotated so that neither the evolution or creation option was continually first. All survey questions (excluding 13) included an option to answer either “not sure” or “other”.

Questions 4 and 5 were factual and multiple-choice, the first concerning the age of the earth, and the second with the age of our species, *Homo sapiens*.

Questions 6-12 were entirely of the true or false configuration, and it was predominantly on page two that participant’s “general knowledge” was tested. The inspiration for question six was the first of *Public Acceptance of Evolution*’s “genetic literacy test” queries (Miller, Scott & Okamoto 2006), and was aimed at shaping the evolution question in a purely scientific manner with no specific timeframe.

Question 7 served a dual purpose. For those who had chosen any or all of the evolutionary options on page 1, this question was intended to pinpoint the percentage of evolutionists that hold the common misconception that human beings evolved directly from chimpanzees, rather than simply sharing a common ancestor. The question’s second purpose was to verify that participants were not simply choosing answers haphazardly, as 100% of respondents who held the belief that human beings were created in their present form would unequivocally deny that we had evolved from chimpanzees. Question 8 was another variation of the “evolution or creation” query, but instead hinted at generational changes, rather than modifications to the species as a whole.

Questions 9-12 evaluated a participant’s general knowledge of the specific tenets of natural selection. The key objective of these questions was to approach evolution by



natural selection by examining respondent's understanding of specific scientific constructs—the question teases out how accepting and informed respondents were with respect to the theory's basic principals. In doing so, the data can be analyzed to determine whether a particular aspect of natural selection is unacceptable to those who subscribe to a creationist doctrine, or whether the whole of evolutionary theory is somehow worse than the sum of its parts. The topics of Questions 9-12 are as follows:

9) *Survival of the Fittest*: recognition that individuals have different traits, some of which make them better at surviving and reproducing.

10) *Genetic Variation*: recognition that individuals of a particular species vary genetically.

11) *Mutation/Theory as a Whole*: recognition that the randomness of genetic mutations is not the only guiding force of evolution.

12) *Inheritance*: recognition that physical and/or genetic traits are passed down from parent to offspring.

The final three questions were directed more at public awareness and opinion of the evolution/creationism issue. Question 13 is intended to reveal whether or not the STC visitor underestimates the amount of professional support and validity of evidence for evolution. This question was modeled after similar queries in three other public polls (Harris 2005, Pew 2005, Newsweek 2004). Question 14 inquired about the amount of attention paid to the ongoing debate over the two conflicting theories. Questions 13 and 14 are the only questions on the survey that require respondents to choose from a scaled range of answers (i.e. “a lot”, “some”, “very little”), as opposed do selecting a specific value, or marking true/false. The final question asked respondents whether evolution only, creationism only, or both should be included in public school curriculum.

The fourth and final page of the questionnaire recorded demographic information. This section was prefaced with a paragraph ensuring participants that the personal information was necessary “in order to be sure that this study includes people from diverse backgrounds”. Additionally, respondents were once again assured that their answers were anonymous and confidential.

Participants were asked to report their gender, age, level of education, race/ethnicity, annual household income, and religion. In the final question, participants were asked to indicate how religious they consider themselves to be. Given a 0-5 scale, respondents were directed to circle one number, with 0 being “not religious”, and 5 indicating “very religious”. The first six questions were intentionally modeled after those on COSI’s own “exit survey” questionnaires (see description in *Data Collection* section). This was done so that simple comparisons between demographic sets could be made to ensure similar representation of the COSI visitor population as a whole.

## **Data Collection**

Data collection for this study took place daily (excluding Mondays and Tuesdays when COSI is closed to the public) at COSI Columbus from Thursday, March 1 thru Sunday, March 18. Data were gathered by means of a four-page survey questionnaire—three pages of scientific construct and public opinion questions, one page of demographic information. Per a request by COSI’s leadership team, questionnaires were only offered to COSI visitors as they were leaving the building. This data collection method is known as an “exit survey”, and is the same successful process COSI uses to gather guest

feedback on museum experience satisfaction as well as visitor's demographic information.

As all adult visitors exiting the building moved towards either the main doors or the locker area, they were approached by a data collector with a COSI nametag that simply read "Researcher".

On the whole, COSI guests are quite comfortable interacting with COSI Team Members (employees). Guests are approached throughout their visit by both employees and volunteers whose principal objective is to supplement COSI's exhibition areas with intimate interactions and personalized science demonstrations. Consequently, potential survey respondents were fairly open and willing to participate in this study.

If an individual declined the researcher's offer, they were thanked for their time and allowed to continue toward the exit. Those who choose to participate were handed a pen, along with a questionnaire attached to a clipboard. If more than one member of a group decided to participate, they were each given a survey and instructed to "please fill them out independently of one another".

## RESULTS AND DISCUSSION

### Results

Before analyzing the survey question responses of this study, it is first valuable to compare the demographic profile of this population with that of general COSI visitor profile. As detailed in the *Subjects* section, COSI's routine intercept surveys gather demographic information and gauge customer satisfaction. The variables of the COSI intercept survey data made available for comparison were that of age, level of education and race/ethnicity. A test of the means (t-test) of the two groups was not performed because the assumptions of the statistical procedure were not met. However, side by side demographic comparisons show that the sample gathered during March 2007 reflects that of the general STC visitor population. Tables exhibiting these findings can be found in the Appendix.

Table 3 (below) summarizes the actual questionnaire results from the 614 survey participants.

**Table 3:** *Evolution Questionnaire Results*

| Question 1: Which of these three statements best describes what you believe? | n (%)      |
|--|------------|
| Human beings were created in their present form                              | 241 (39%)  |
| Human beings evolved from earlier species through natural selection          | 315 (51%)  |
| Neither/not sure   | 58 (9%)    |
| Total  | 614 (100%) |

| <b>Question 2:</b> Which one of the following statements comes closest to your views on the origin and development of human beings? | n (%)      |
|---|------------|
| Human beings have developed over millions of years from less advanced forms of life   | 193 (31%)  |
| Human beings have developed over millions of years from less advanced forms of life, but God guided this process                    | 157 (26%)  |
| God created human beings in their present form  | 238 (39%)  |
| Not sure  | 26 (4%)    |
| Total   | 614 (100%) |

| <b>Question 3:</b> Which of the following do you think is more likely to be the explanation for the origin of life on earth? | n (%)      |
|--|------------|
| Biblical account of creation   | 270 (44%)  |
| Evolution  | 278 (45%)  |
| Not sure/other   | 65 (11%)   |
| Total  | 614 (100%) |

| <b>Question 4:</b> Approximately how old is the earth? | n (%)      |
|--|------------|
| Less than 10,000 years old                             | 71 (12%)   |
| Tens of millions of years old                          | 123 (20%)  |
| More than a billion years old                          | 267 (43%)  |
| Not sure   | 153 (25%)  |
| Total  | 614 (100%) |

| <b>Question 5:</b> Homo sapiens first appear in the fossil record how long ago? | n (%)      |
|---|------------|
| Less than 10,000 years ago  | 171 (28%)  |
| Approximately 100,000 years ago   | 129 (21%)  |
| Almost one million years ago  | 98 (16%)   |
| Not sure  | 216 (35%)  |
| Total   | 614 (100%) |

| <b>Question 6:</b> Over time, some microbes, plants and animals adjust, adapt and survive while other species fail to do so and subsequently become extinct. | n (%)      |
|--|------------|
| True   | 587 (96%)  |
| False  | 15 (2%)    |
| Not sure   | 12 (2%)    |
| Total  | 614 (100%) |

| <b>Question 7:</b> Human beings evolved from chimpanzees. | n (%)      |
|---|------------|
| True  | 103 (17%)  |
| False   | 393 (64%)  |
| Not sure  | 118 (19%)  |
| Total   | 614 (100%) |

| <b>Question 8:</b> Humans, in their present form, are the result of changes over time in numerous generations of predecessors. | n (%)      |
|--|------------|
| True   | 423 (69%)  |
| False  | 154 (25%)  |
| Not sure   | 37 (6%)    |
| Total  | 614 (100%) |

| <b>Question 9:</b> In any given population of animals, some individuals have traits that make them better at surviving and reproducing than other individuals. | n (%)      |
|--|------------|
| True   | 580 (94%)  |
| False  | 20 (3%)    |
| Not sure   | 14 (2%)    |
| Total  | 614 (100%) |

| <b>Question 10:</b> In any given population of animals, there is genetic variation between individuals. | n (%)      |
|---|------------|
| True  | 559 (91%)  |
| False   | 16 (3%)    |
| Not sure  | 39 (6%)    |
| Total   | 614 (100%) |

| <b>Question 11:</b> Evolution is a process of random chance alone. | n (%)      |
|--|------------|
| True   | 99 (16%)   |
| False  | 385 (63%)  |
| Not sure   | 130 (2%)   |
| Total  | 614 (100%) |

| <b>Question 12:</b> Do you believe that traits are passed down from parent to offspring? For example, would the son of a couple who both have brown eyes be more likely to have brown eyes himself? | n (%)      |
|---|------------|
| Yes, traits are passed down from parent to offspring  | 605 (99%)  |
| No, traits are not passed down from parent to offspring   | 5 (1%)     |
| Not sure  | 4 (1%)     |
| Total   | 614 (100%) |

| <b>Question 13:</b> How much attention do you pay to the debate over the theory of evolution and the doctrine of creationism? | n (%)      |
|---|------------|
| A lot   | 83 (14%)   |
| Some  | 267 (43%)  |
| Very little   | 202 (33%)  |
| None  | 62 (10%)   |
| Total   | 614 (100%) |

| <b>Question 14:</b> Do you believe there to be general agreement among natural scientists that evidence fully supports the theory of human evolution, or not? | n (%)      |
|---|------------|
| Most natural scientists believe there is conclusive evidence in favor of human evolution  | 277 (45%)  |
| Only about half of natural scientists believe there is conclusive evidence in favor of human evolution  | 84 (14%)   |
| Not very many natural scientists believe there is conclusive evidence in favor of human evolution   | 52 (8%)    |
| Not sure  | 201 (33%)  |
| Total   | 614 (100%) |

| <b>Question 15:</b> Which of the following do you believe should be taught in public k-12 classrooms? | n (%)      |
|---|------------|
| Creationism and/or Intelligent Design only  | 71 (12%)   |
| Evolution only  | 148 (24%)  |
| Both  | 347 (57%)  |
| Not sure  | 48 (8%)    |
| Total   | 614 (100%) |



## Discussion

For matters of data comparison, Questions 1 and 2 are used because of their congruence with similar public opinion polls. Table 4 (below) shows little difference between the attitudes of COSI visitors and that of the general public, with only slightly less museum guests believing that human beings were created in their present form.

**Table 4:** *COSI Responses (Question 1) vs. Pew Research Center Poll Responses (July 2006)*

| Which of these three statements best describes what you believe? | COSI<br>(n=614) | Pew Research<br>Center Poll,<br>July 2006<br>(n=2,003) |
|--|-----------------|--|
| Human beings evolved over time                                   | 51%             | 51%  |
| Human beings were created in their present form                  | 39%             | 42%  |
| Neither/not sure   | 9%              | 7%   |
| Total  | 100%            | 100%   |

However, as explained before, questions of this form (e.g. those that make no mention of God) are rarely used in polling as many respondents assume that selecting the evolutionary option implies a non-belief in God. Most surveys employ a three-option question that allows for the belief in both God and the evolutionary process. Questions of this form generally reflect a more accurate representation of the public's views and routinely elicit a higher percentage of participants accepting the evolutionary history of human beings. The results of this study echo those findings.

Table 5 (below) compares the data from Question 2 of this study with that of a recent Gallup poll, conducted in June of 2007.

**Table 5: COSI Responses (Question 2) vs. Gallup Poll Responses (May 2007)**

| <b>Which one of the following statements comes closest to your views on the origin and development of human beings?</b> | <b>COSI<br/>(n=614)</b> | <b>Gallup Poll,<br/>June 2007<br/>(n=1,007)</b> |
|---|-------------------------|---|
| Human beings have developed over millions of years from less advanced forms of life                                     | 31%                     | 14%   |
| Human beings have developed over millions of years from less advanced forms of life, but God guided this process        | 26%                     | 38%   |
| God created human beings in their present form  | 39%                     | 43%   |
| Not sure/Other  | 4%                      | 4%  |
| Total   | 100%                    | 100%  |

Question 2 shows a slightly higher proportion of COSI visitors accepting evolution than that of the general public, while the percentage of people selecting “human beings were created in their present form” remained nearly identical in both this study and the public opinion polls (for both Questions 1 and 2). It was the addition of a second evolutionary option in Question 2 that elicited markedly different results from the public poll—more than twice as many COSI guests (and nearly a third overall) believe that evolution is an entirely natural process in which no deity has acted as a guiding force.

Question 14 also generated some interesting results. Though the question is not exactly the same as those seen in various public opinion polls, the queries are similar enough to make generalizations about the prevailing attitudes of the two populations (see Table 6 below).

**Table 6: COSI Responses (Question 14) vs. Pew Research Center Poll Responses (July 2006)**

| <b>Do you believe there to be general agreement among natural scientists that evidence fully supports the theory of human evolution?</b> | <b>COSI (n=614)</b> | <b>Is there general agreement among scientists that humans evolved over time?</b> | <b>Pew Research Center Poll, July 2006 (n=2,003)</b> |
|--|---------------------|---|--|
| Most natural scientists believe there is conclusive evidence in favor of human evolution   | 45%                 | Yes   | 62%  |
| About half of natural scientists believe there is conclusive evidence in favor of human evolution  | 14%                 | *****<br>*****<br>*****   | *****<br>*****<br>*****                              |
| Not very many natural scientists believe there is conclusive evidence in favor of human evolution  | 8%                  | No  | 28%  |
| Not sure   | 33%                 | Don't know  | 10%  |
| Total  | 100%                | *****   | 100%   |

While the Pew poll shows a significantly higher percentage of people believing there is a general consensus among scientists with respect to evolution, the poll displays an even greater proportion of respondents who *reject* the idea of a scientific consensus. A full third of COSI guests are simply unsure as to whether or not there is a general agreement among natural scientists that evidence fully supports the theory of human evolution.

While COSI visitors are generally accepting of most evolutionary tenets and specific scientific constructs (see Questions 6 – 12), the data from this study suggest that there are still prevalent misconceptions about both the age of earth and the relative age of Homo sapiens. A quarter of survey respondents were simply “not sure” of the age of the earth, and a full 32% incorrectly answered either “less than 10,000 years old” or “tens of millions of years old”.

Inaccuracies of knowledge are even greater with respect to the age of our species. While 42% of COSI visitors falsely believe that *Homo sapiens* first appear in the fossil record either “...one million years ago” or “less than 10,000 years ago”, more than a third (35%) of survey participants were simply “not sure” as to the age of our species.

Certain demographic variables had considerable influence on participant responses to Question 2. The following three crosstabulations (Tables 7, 8 and 9) show that the factors of age, level of education, and annual household income have little effect on COSI visitor’s acceptance of evolution as responses are generally evenly distributed. For Table 6, the age groups of ‘45-64’ and ‘65 or above’ were combined because of the extremely low number of responses from people in the latter age bracket.

**Table 7: Question 2/COSI Guest Age Crosstabulation**

| Question 2                                      | Age          |           |             | Total      |
|---|--------------|-----------|-------------|------------|
|   | 24 and under | 25-44     | 45 or above |            |
| Human beings evolved                            | 48           | 103       | 42          | 193 (31%)  |
| Human beings evolved, God guided                | 37           | 83        | 37          | 157 (26%)  |
| Human beings were created in their present form | 42           | 140       | 56          | 238 (39%)  |
| Not sure  | 10           | 11        | 5           | 26 (4%)    |
| Total   | 137 (22%)    | 337 (55%) | 140 (23%)   | 614 (100%) |

**Table 8: Question 2/COSI Guest Education Crosstabulation**

|   | Level of Education  |              |               |                  |                          |            |
|---|---------------------|--------------|---------------|------------------|--------------------------|------------|
| Question 2                                | High School or less | Some College | Assoc. degree | Bachelors degree | Masters degree or higher | Total      |
| Human beings evolved                      | 16                  | 42           | 12            | 66               | 54                       | 193 (31%)  |
| Human beings evolved, God guided          | 12                  | 40           | 16            | 43               | 45                       | 157 (26%)  |
| Human beings were created in present form | 31                  | 71           | 27            | 63               | 42                       | 238 (39%)  |
| Not sure                                  | 4                   | 10           | 2             | 9                | 1                        | 26 (4%)    |
| Total                                     | 63 (10%)            | 163 (26%)    | 57 (9%)       | 181 (29%)        | 142 (23%)                | 614 (100%) |

**Table 9: Question 2/COSI Guest Annual Household Income Crosstabulation**

|   | Annual Household Income |           |           |              | Total      |
|---|-------------------------|-----------|-----------|--------------|------------|
| Question 2                                | Less than 30k           | 30-49k    | 50-75k    | 75k or above | Total      |
| Human beings evolved                      | 44                      | 39        | 34        | 76           | 193 (31%)  |
| Human beings evolved, God guided          | 41                      | 28        | 28        | 60           | 157 (26%)  |
| Human beings were created in present form | 36                      | 64        | 56        | 82           | 238 (39%)  |
| Not sure                                  | 9                       | 6         | 2         | 9            | 26 (4%)    |
| Total                                     | 130 (21%)               | 137 (22%) | 120 (19%) | 227 (37%)    | 614 (100%) |

The demographic variable that most clearly influenced participant’s answers to Question 2 was that of religiosity. From Table 10 (below), it is apparent that heightened levels of religiosity are associated with the belief that human beings were created in their present form; the less religious a person considered himself or herself to be, the greater the chance that they believed human beings evolved by strictly natural processes. And conversely, as religiosity *increases*, so to does one’s belief that “human beings were created in their present form”. Those that considered themselves moderately religious (e.g. selecting a religiosity level of 2 - 4) were more likely to choose the “God guided

human evolution” option in what is seemingly a personal harmonization of science and religion (Pew Research Center Pollwatch 2005, 2).

**Table 10:** Question 2/COSI Guest Religiosity Crosstabulation

| Question 2                                   | Religiosity Scale<br>(0= not religious, 5= very religious) |             |              |              |              |             | Total      |
|--|--|-------------|--------------|--------------|--------------|-------------|------------|
|  | 0  | 1           | 2            | 3            | 4            | 5           |            |
| Human beings evolved                         | 53   | 50          | 48           | 28           | 9            | 5           | 193 (31%)  |
| Human beings evolved,<br>God guided          | 3  | 8           | 28           | 58           | 46           | 14          | 157 (26%)  |
| Human beings were<br>created in present form | 1  | 6           | 19           | 59           | 75           | 78          | 238 (39%)  |
| Not sure                                     | 5  | 2           | 8            | 8            | 2            | 1           | 26 (4%)    |
| Total  | 62<br>(10%)  | 66<br>(11%) | 103<br>(17%) | 153<br>(25%) | 132<br>(21%) | 98<br>(16%) | 614 (100%) |

A final (non-demographic) crosstabulation compares responses from Questions 2 and 14. Table 11 shows that the majority of respondents who are unsure of the overwhelming scientific support and evidence for evolution are more likely to be creationists. On the contrary, those that recognize the professional backing of evolution are more likely to accept the theory. All though there is an obvious correlation, it is impossible to determine the direction of causality from present data.

**Table 11:** Question 2/Question 14 Crosstabulation

| Question 2   | What proportion of natural scientists<br>believe there to be conclusive evidence<br>supporting the theory of human evolution? |            |                  |           | Total      |
|--|---|------------|------------------|-----------|------------|
|  | Most  | About half | Not very<br>many | Not sure  |            |
| Human beings evolved                               | 134   | 21         | 4                | 34        | 193 (31%)  |
| Human beings evolved,<br>God guided                | 88  | 16         | 9                | 44        | 157 (26%)  |
| Human beings were created<br>in their present form | 44  | 42         | 38               | 114       | 238 (39%)  |
| Not sure   | 11  | 5          | 1                | 9         | 26 (4%)    |
| Total  | 277 (45%)   | 84 (14%)   | 52 (8%)          | 201 (33%) | 614 (100%) |

## Limitations

This study has a few potential limitations that bear mentioning. Most significant is the single location where the study was conducted. Unlike the *Life Changes Museum Visitor Survey* (2005), which included data from seven different STCs, COSI Columbus was the only site in which questionnaires were collected, and as such, prudence should be taken when attempting to generalize results to other STCs. However, when comparing the two surveys, it should be noted that this survey had a much greater sample size—614 vs. slightly over 100 for the museum with the greatest representation—potentially represents a more accurate survey of STCs with demographic populations similar to that of COSI.

COSI frequently welcomes traveling exhibits to temporarily neighbor and supplement their permanent exhibitions. Coinciding with the dates of the survey data collection was the exhibit *Einstein*, a traveling exhibition about “...the life and theories of one of the most famous scientists of the 20<sup>th</sup> century...” (from the COSI website). While there was no additional cost to visit the Einstein exhibit, it is possible that some guests viewed the exhibit as a motivational factor to visit COSI. Furthermore, it could be argued that those with an interest in Einstein and his many complex theories boast higher levels of education than the typical COSI visitor. However, analysis of the survey shows that the Einstein exhibit had no discernable effect on the demographic characteristics of the March 2007 sample population.

A third possible limitation of this survey was that respondents who subscribe to the Biblical account of creation were not asked whether they interpret the story as literal or metaphorical—some Biblical creationists regard each of the six days of creation as

actually representing much longer time-periods. Be that as it may, Question 4 (on the age of the earth) does much to convey how the creationist in question interprets the Biblical account.

Finally, this survey made no attempt to distinguish between sporadic museum visitors and those who were COSI members.

## **Implications**

Perhaps our most important lesson has been that even a modest effort to improve ‘evolution literacy’ of museum visitors can produce large results...the need here is so vast, and the stakes so high, that every museum can and must do all it can. (Allmon 2006, 7)

The widespread American lack of acceptance of evolution can no longer be ignored as a benign public condition. During the first of this year’s Republican presidential debates (May 3, 2007) the candidates were asked “Is there anyone on stage who does not believe in evolution?” Three of the ten men vying to become the most powerful man in the nation raised their hands. While this may be alarming, it is a position that is not unusual of either policymakers or of the general public. *Public Acceptance of Evolution* exhibited the particularly low acceptance of evolutionary theory in the United States: 14% of Americans think that evolution is “definitely true” and 55% show a “varying degree of uncertainty” (Miller, Scott & Okamoto 2006, 765). This (nearly) unique American lack of appreciation for the principle cornerstone of modern science equates to a genuine national emergency. While the democratic election process may weed out those who hold anti-evolution sentiments, the same cannot necessarily be said for public opinion polling. If, as some continue to suggest, public surveys are used as



a guidepost for implementing science-based education and programming, the percentage of Americans rejecting Darwinian evolution is sure to remain significant.

Unfortunately, there is little agreement in the scientific community as to how STCs should approach evolution (Diamond & Scotchmoor 2006, 22). The STC-unique data of this study sheds a unique light upon the ways in which informal educators can exhibit evolutionary topics. While it is true that the COSI population is aware and capable of discussing specific evolutionary principles, reticence still remains when it comes to the acceptance of the theory as a whole. Additionally, reception of temporal issues such as the age of the earth and the timescale of human biological change remains lukewarm with both those accepting evolution and those subscribing to a creationist doctrine. Finally, it appears that even science center visitors have a general underestimation of the amount of professional support and evidence for the theory. These findings show that the STC community is not necessarily uninformed about science, but may simply be ignorant about the validity of evolutionary theory itself.

One of the first steps in addressing this issue is to purge the prevalent public view of evolution as “only a theory”. This notion, in addition to those creationists who have claimed that evolution is really “just another religion” (Dennett 2006, 9), demonstrates a fundamental misunderstanding of how the scientific process strengthens and increases our knowledge of the world. Therefore, it is especially necessary for the STC to detail the components of the scientific method, from observation to prediction to hypothesis to repeated experimentation. The understanding of exactly how scientific knowledge is either experimentally verified or falsified & discarded can help to advance the public view of what constitutes a strong scientific theory. Though this is a strictly normative

view of the scientific method—and one that is not necessarily routinely followed—it is important process for scientific laypeople to understand. Coupled with an appreciation of the weightiness of empirical and newly discovered data, this understanding can lead to a wider appreciation of evolution as a theory that describes a scientific law, much like the way in which germ theory describes why we get sick. Finally, by showing STC visitors the methods and techniques scientists use to arrive at specific facts—carbon dating and stratigraphy are prime examples—the public can more readily view the age of the earth and timescale of our species as not simply professionally educated guesses.

As for the scientific constructs and components of evolution, data from COSI suggest that even those who consider themselves creationists employ evolutionary thought patterns. For example, Question 10 asked “In any given population of animals, some individuals have traits that make them better at surviving and reproducing than other individuals”. Over 94% of respondents replied “true”. This, coupled with and reinforced by similar response rates to other questions (e.g. Questions 6, 9 and 12) on specific scientific precepts, suggests that STC visitors are at very least accepting of the basic parts of evolutionary theory. Hesitation arises when the term evolution is explicitly used, and especially when suggesting that human beings are a result of its lengthy natural processes.

The human exceptionalism perspective is not impossible to work around in the informal education arena. A prime way formulating educational programming is to start by discussing demonstrable evolutionary processes that neither explicitly mention human beings or the word ‘evolution’. Contemporary examples of this include laboratory microbes that reproduce so quickly that one can literally witness natural selection as it

happens (see Richard E. Lenski's current work at the University of California, Irvine) as well as the genetic arms race of pathogen resistance to the ever-increasing strength of modern medicines. Additionally, science center programming could illustratively show how the selective breeding of livestock, dogs and genetically engineered foods is effectively man-made selection and an example of microevolution. By employing teaching methods and examples that have contemporary and observable real-world implications, STC visitors of all stripes can personally be shown that these processes explain scientific laws that continue to effect all living organisms. Attempting to embark on an evolutionary lesson from the starting point of millions of years of species-specific physiological change is putting the cart way before the horse, and would effectively alienate many STC visitors who may be much more receptive to the topic than originally thought. Instead, by starting from the point of demonstrable modern processes, one must take a much smaller step to recognizing that human beings are subject to the same scientific principles as the rest of the natural world.

Moreover, the data from this study demonstrate that STC visitors—at least at COSI—are not representative of the “low information” public (Nisbet 2005, 2) when it comes to natural concepts and scientific precepts. As has often been said in the political sphere, "You're entitled to your own opinion, but not your own facts". COSI visitors—even those that do not accept evolution—recognize that there are inarguable scientific facts. By avoiding evolutionary programming, STC administrators are inadvertently giving credence to the campaign of misinformation and the propagation of pseudoscience being perpetrated by anti-evolutionists. If dogmatic misinformation is allowed to

masquerade as fact (see the newly opened Creation Museum) without explicit STC programming to the contrary, the public's acceptance of evolution will continue to slide.

Misinformation about evolution is particularly resistant to change through traditional classroom instruction (Sundberg 1997). As such, STCs are in a unique societal position with respect to the future of American public acceptance of evolution—there is, arguably, no entity better equipped to address the problem of lack of evolutionary support. Where else can such topics be considered in a neutral and approachable educational fashion that can have broad appeal to the general public? It is the responsibility of the STC to not shy away from such topics for fear of offense, but to stridently address the public's misunderstanding of this critical issue. Additionally, evolution is a topic that should not be considered specifically the domain of the natural history museum—*all* STCs have a responsibility to further the public understanding of science. Only when the evolution challenge is unapologetically tackled head-on will the public tide of evolutionary ignorance begin to wane.

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## APPENDIX

### Demographic Comparisons

Tables 12, 13 and 14 represent the demographic information gathered by COSI plotted alongside those collected during the course of this study:

**Table 12:** Comparison of COSI Guest Age (March 2007 vs. 2004-2005 Intercept Surveys)

|                 | 24 and under | 25 - 44 | 45 - 64 | 65 and above | Total |
|-----------------|--------------|---------|---------|--------------|-------|
| March 2007      | 22%          | 55%     | 19%     | 3%           | 100%  |
| COSI intercepts | 15%          | 66%     | 19%     | 2%           | 100%  |

**Table 13:** Comparison of COSI Guest Level of Education (March 2007 vs. 2004-2005 Intercept Surveys)

|                 | High School | Some College | Bachelor Degree | Graduate Degree | Other | Total |
|-----------------|-------------|--------------|-----------------|-----------------|-------|-------|
| March 2007      | 10%         | 27%          | 29%             | 23%             | 10%   | 100%  |
| COSI intercepts | 21%         | 23%          | 35%             | 21%             | 1%    | 100%  |

**Table 14:** Comparison of COSI Guest Race/Ethnicity (March 2007 vs. 2004-2005 Intercept Surveys)

|                 | African American or Black | Asian | Hispanic | White | Other | Total |
|-----------------|---------------------------|-------|----------|-------|-------|-------|
| March 2007      | 5%                        | 7%    | 1%       | 85%   | 4%    | 100%  |
| COSI intercepts | 7%                        | 3%    | 3%       | 84%   | 3%    | 100%  |

Information on the following demographic variables was not collected during the most recent COSI intercept cycle, and as such, comparisons could not be made between that survey population and that of this study. Consequently, Tables 15, 16 and 17 represent variables unique to this study and only gathered during March 2007:

**Table 15: COSI Guest Annual Household Income (March 2007)**

|            | Less than \$30k | \$30k - \$49k | \$50k - \$75k | \$75k or more | Total |
|------------|-----------------|---------------|---------------|---------------|-------|
| March 2007 | 21%             | 22%           | 20%           | 37%           | 100%  |

**Table 16: COSI Guest Religion (March 2007)**

|            | Catholic | Protestant | Jewish | Muslim | Other | Total |
|------------|----------|------------|--------|--------|-------|-------|
| March 2007 | 20%      | 39%        | 3%     | 2%     | 37%   | 100%  |

**Table 17: COSI Guest Religiosity (March 2007)**

|            | 0 (not religious) | 1   | 2   | 3   | 4   | 5 (very religious) | Total |
|------------|-------------------|-----|-----|-----|-----|--------------------|-------|
| March 2007 | 10%               | 11% | 17% | 25% | 21% | 16%                | 100%  |

It should be noted that many respondents came to the researcher with questions and/or confusion regarding which option to mark with respect to their religion. It seemed that many participants were unaware that most Christian denominations, other than Catholicism, fall under the umbrella of Protestantism. This may explain why many



participants who responded Baptist, Lutheran, Episcopalian, etc., checked “other” instead of Protestant—hence the unusually high percentage of the “other” column.

Survey respondents were also asked their gender, and the data from this sample population exhibited a significant disparity between female (56%) and male (44%) visitors to COSI. Similar studies have corroborated that this imbalance is not unique to COSI. In *An Analysis of Differences Between Visitors at Natural History Museums and Science Centers*, it was shown that slightly more women (53%) than men (47%) visited science centers (Korn 1995, 152).

## Evolution Survey Questionnaire

### *Public opinion and general knowledge of evolution and creationism*

The data gathered will be used in the preparation of a Master's thesis; findings will be shared with COSI for possible use in future program development. All answers are anonymous and confidential.

Please circle the letter representing your choice:

- 1) Which of these three statements best describes what you believe?
  - A) Human beings were created in their present form
  - B) Humans beings evolved from earlier animal species through natural selection
  - C) Neither/Not sure
  
- 2) Which one of the following statements comes closest to your views on the origin and development of human beings?
  - A) Human beings have developed over millions of years from less advanced forms of life
  - B) Human beings have developed over millions of years from less advanced forms of life, but God guided this process
  - C) God created human beings in their present form
  - D) Not sure/Other
  
- 3) Which of the following do you think is more likely to be the explanation for the origin of life on earth?
  - A) Biblical account of creation
  - B) Evolution
  - C) Not sure/Other
  
- 4) Approximately how old is the earth?
  - A) Less than 10,000 years old
  - B) Tens of millions of years old
  - C) More than a billion years old
  - D) Not sure
  
- 5) "Homo sapiens" first appear in the fossil record how long ago?
  - A) Less than 10,000 years ago
  - B) Approximately 100,000 years ago
  - C) Almost one million years ago
  - D) Not sure

For the following six statements, please indicate if you believe the statement to be true or false:

6) Over time, some microbes, plants and animals adjust, adapt and survive while other species fail to do so and subsequently become extinct.

- A) True
- B) False
- C) Not sure

7) Human beings evolved from chimpanzees.

- A) True
- B) False
- C) Not sure

8) Humans, in their present form, are the result of changes over time in numerous generations of predecessors.

- A) True
- B) False
- C) Not sure

9) In any given population of animals, some individuals have traits that make them better at surviving and reproducing than other individuals.

- A) True
- B) False
- C) Not sure

10) In any given population of animals, there is genetic variation between individuals.

- A) True
- B) False
- C) Not sure

11) Evolution is a process of random chance alone.

- A) True
- B) False
- C) Not sure

12) Do you believe that traits are passed down from parent to offspring? For example, would the son of a couple who both have brown eyes be more likely to have brown eyes himself?

- A) Yes, traits are passed down from parent to offspring
- B) No, traits are not passed down from parent to offspring
- C) Not sure

13) Do you believe there to be general agreement among natural scientists that evidence fully supports the theory of human evolution, or not?

- A) Most natural scientists believe there is conclusive evidence in favor of human evolution
- B) Only about half of natural scientists believe there is conclusive evidence in favor of human evolution
- C) Not very many natural scientists believe there is conclusive evidence in favor of human evolution
- D) Not sure

14) How much attention do you pay to the debate over the theory of evolution and the doctrine of creationism?

- A) A lot
- B) Some
- C) Very little
- D) None

15) Which of the following do you believe should be taught in public k-12 classrooms?

- A) Creationism and/or Intelligent Design only
- B) Evolution only
- C) Both
- D) Not sure

Almost done!...

In order to be sure that this study includes people from diverse backgrounds, please provide the following information about yourself. Your answers are anonymous and the data collected will be kept confidential.

What is your gender?

Female \_\_\_\_\_

Male \_\_\_\_\_

What is your age?

24 and under \_\_\_\_\_

25-44 \_\_\_\_\_

45-64 \_\_\_\_\_

65 or above \_\_\_\_\_

What is your highest level of education?

High school graduate/GED \_\_\_\_\_

Some college \_\_\_\_\_

Associate or technical degree \_\_\_\_\_

Bachelor degree \_\_\_\_\_

Master degree or higher \_\_\_\_\_

Other \_\_\_\_\_

How would you describe your race/ethnicity?

African American or Black \_\_\_\_\_

Asian \_\_\_\_\_

Hispanic \_\_\_\_\_

Native American Indian \_\_\_\_\_

Pacific Islander \_\_\_\_\_

White \_\_\_\_\_

Other \_\_\_\_\_

Which of the following ranges includes your annual household income?

Less than \$30,000 \_\_\_\_\_

\$30,000 - \$49,999 \_\_\_\_\_

\$50,000 - \$74,999 \_\_\_\_\_

\$75,000 or more \_\_\_\_\_

What is your religion?

Catholic \_\_\_\_\_

Protestant \_\_\_\_\_

Jewish \_\_\_\_\_

Muslim \_\_\_\_\_

Other \_\_\_\_\_

Use the following scale to indicate how religious you consider yourself to be, with '0' being not religious and '5' being very religious. (Please circle one number)

0                      1                      2                      3                      4                      5  
Not religious      ←----->      Very Religious

## **COSI Stance on Evolution**

The standard verbiage that has been used in Guest Feedback responses is as follows:

Dear Guest,

Thank you for taking the time to share your comments and suggestions on your visit to COSI. Guest feedback is vital to our goal of making science fun through hands on discovery.

COSI uses the latest, most widely accepted scientific theories in all its exhibition areas. The preponderance of scientific evidence currently supports the theory of evolution and the process of natural selection. However, if this changes, and this theory (or any other theory in our exhibits, such as the age of the universe) is discredited, we certainly would change the exhibit to reflect this.

The propositions of 'Intelligent Design' or 'Scientific Creationism' have not gained widespread support in the scientific community. Science is a dynamic process in which new theories emerge as old theories fall under the weight of evidence against them. Should that occur, COSI will present the forefront of scientific progress. Meanwhile, we will continue including the theory of evolution in our exhibition areas as representing the best of current scientific thinking.

Thank you again for your comments. I hope you will return to COSI and give us the opportunity to provide an interesting and enjoyable experience for you.