Summative Evaluation of
When the Dinosaurs Were Gone
at the Science Museum of Minnesota

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Executive Summary

This research was commissioned to explore visitors' experiences in *When the Dinosaurs Were Gone*, a temporary exhibition at the Science Museum of Minnesota. As a summative evaluation, the research sought to address several issues and objectives:

1. overall impressions of the exhibition — visitors' ratings of enjoyment, interest in the information, what they liked most, and what changes they would suggest (or not want) for a traveling version of this exhibit;
2. extent of use of the exhibition — amount of time spent in the exhibition and the extent to which people stopped at specific displays or used interactive components and other interpretive media;
3. perceived themes and content of the exhibition — visitors' understanding of the messages about changes on earth over time (climate change, evolution of reptiles) and how scientists study and reconstruct the past; and
4. effectiveness of selected interpretive elements — the contributions of the large dioramas (prehistoric swamp, dig site in North Dakota) to visitors' experience and perception of messages, and an analysis of people's grasp of the concepts presented in various interactive exhibits.

Research Method

Exit interviews were conducted with visitors who were leaving the exhibition. The sample of 423 visitor groups included both weekday and weekend visitors in March and April 2001 (just prior to the closing of the temporary exhibition). In order to address all of the issues and assess visitors' understanding of complex messages, a research strategy was developed involving the use of two different interview forms and three photo-boards. The photos served several purposes: to assess the extent of use of the parts of the exhibition, to help visitors recall and talk about the exhibition, and to explore the contributions of specific elements to visitors' perceptions of the messages.

Highlights of the Findings

Visitors to science museums come for a fun, family-oriented, hands-on experience. Of course, they expect it to be educational in context, but not the kind of educational experience that they "have to work at." While they know they're not at an amusement park, sometimes it seems as though the popular museum experiences tend toward the active, razz-ma-tazz, push-the-button-and-run, sound byte kinds of exhibits. It's clear that science museum visitors want to be amazed by novel and unusual sights (e.g., dinosaurs, electricity demonstrations), and that most of them do not want to read long explanations or think too hard to understand what's displayed. This perspective forms the context for evaluating an exhibition and interpreting visitors' experiences in it.

When the Dinosaurs Were Gone presents a range of material that is very accessible to

visitors. They like seeing animals and skeletons, are familiar with and intrigued by excavations for bones and signs of ancient life, and make use of the many mechanical interactives or media that enhance the experience. As is typical of most exhibitions, visitors' patterns of use vary considerably, with about half of the visitors staying for 20 minutes or more and about half staying for less than 20 minutes.

This exhibition is effective at providing an educational experience for most visitors, even though some people did not stay very long. Also, it is impressive that the nature of the experience is so conceptual rather than just being an accumulation of assorted facts. This conclusion is grounded in the evidence for three principal outcomes in visitors' perceptions: the recognition of global change over time, learning about using science to reconstruct the past, and becoming more informed about crocodiles, the animal that is the focus of the exhibition.

Recognition of change on the planet: It is important that visitors did get a sense that this exhibition was interpreting a time period long ago, and that it wasn't about dinosaurs. With that foundation, the most common message that people take away from this exhibition was some type of long-term change — evolution, changing life forms, climate change or environmental change over time, animal adaptations or extinction. Recognizing 'change' is an interesting thoughtful outcome for people who are generally looking for fun hands-on experiences. Examples of their comments are:

> *I didn't realize we were once a tropical environment.*
> *There have been so many species that were here and are now gone or evolved*
> *into species we see today*
> *How evolution occurs; how the environment has changed in North America*
> *The changing nature of the planet and its animals and plant life*
> *How crocodiles evolved to adapt to their environment*
> *How the earth has changed in millions of years; how animals and plants*
> *evolve and change; why some animals don't survive*
> *Change in the environment and the adaptation of animals*
> *How animals have become extinct and how others have come to be*
> *Nothing is permanent; North Dakota was once swampland*

This message about change on the planet was top of mind for an impressive 56% of the random sample of visitors interviewed when leaving the exhibition (an open-ended question, limited to three messages; it was also the strongest message on an alternate interview form when people were limited to only one answer). Since some visitors may not have been as articulate in responding to open-ended questions (e.g., parents with an active two-year-old child eager to get on to something else instead of being interviewed), visitors were also presented with a list of seven possible messages, and asked whether each of these was a strong (obvious) message, a mild message, or they didn't see that message; 81% selected one of the two global change messages as 'a strong message' for the exhibition. The specific idea of *climate*

change in North Dakota was mentioned or recognized by 67% of the visitor sample (considering any of the answers they gave in any part of the interview).

Using science to reconstruct the past: While many people realized that the exhibition was representing something about the past, it was not a 'given' that they would even be *aware* of the scientific processes that helped produce an understanding of what the past was like. The usual mode of thinking is probably something like this: people dig for fossils, find bones etc., put together the skeleton, and that's cool; many people know that the excavation process involves digging in dry rocky areas, with tools ranging from picks to brushes, involving long periods of searching without finding anything significant. *When the Dinosaurs Were Gone* not only reinforces and expands their existing knowledge about the basic characteristics of the scientific work (what a dig site actually looks like, how it's done, that small pieces are what's found more so than large bones), but it also facilitates people learning about aspects of the investigation process (that it's like putting together the pieces of a puzzle, how evidence is interpreted, the idea that layers of earth are layers of time). Whether as a main message or something else that was new or surprising to visitors, they said things such as:

> *The progression of the dig and how they got to different layers.*
> *How they get to the fossils, preserving them and what they learn from them.*
> *How we figure out what the earth looked like, the fact that we don't know*
>   *everything, there are still a lot of mysteries.*
> *How scientists have learned about the behavior of animals long ago*
> *Inventions, how fossils were brought out, how jackets were made*
> *Coal has been around for 300 million years*
> *How layers of rock in the earth explain climate conditions at that time*
> *How they can unearth fossils that old and be able to identify them*
> *How they could know what the earth was like many millions of years ago*
> *Even tiny fossils can tell you a lot about the environment and many fossils are*
>   *so small*

This theme of learning about using science to reconstruct the past was mentioned as a top-of-mind idea or in response to photos of specific exhibit elements by 52% of the visitor sample. Similarly, from a list of seven ideas presented to them, 45% of visitors chose 'comparing fossil skeletons with present day animals' or 'fossil teeth can tell us about the landscape' as strong messages. This theme of how science is used to reconstruct the past was especially noticed by people who spent over 20 minutes in the exhibit.

Becoming more informed about crocodiles: The Science Museum of Minnesota is popularly known for its dinosaur exhibits. And therefore people may have expected this exhibition – with the word 'dinosaurs' in the title – to amaze them with big skeletons of impressive animals. They certainly didn't expect crocodiles. However,

part of the effectiveness of interpretation here is that people do come away with new or different knowledge about crocodiles, turtles, and some other animals, adding to their sense of how science produces interesting insights …such as the relationship of ancient crocodiles to present-day ones through an analysis of skeletons, or the mystery of why crocodile skeletons were found belly-up.

Visitors found the "amazing facts" and "questions & answers about crocodiles" interesting and surprising, for example:

> *Little amazing facts — little things people don't know but are interesting, fun to share with others.*
> *How crocodiles were on the top of the food chain, how they filtered down to a few that survived.*
> *Differences between alligators and crocodiles; the question and answer part — learned a lot I didn't know.*
> *Crocodiles — it went into all aspects: survival, reproduction, teeth.*
> *The number of crocodile eggs that were laid and how many survived.*
> *The alligator has three thousand teeth.*
> *Crocodiles can stay in the water for two hours without air.*
> *That the heart of a crocodile is similar to a human heart.*
> *Learned about the behavior of crocodiles — the things they do and why they do it.*
> *What the turtle shell looked like when it was eaten by an alligator, how strong the jaws are on an alligator.*

This theme of 'learning about crocodiles' was one of the top three "main ideas" mentioned by visitors. It was also one of the top answers to "what did you like most?" and the top answer to "what surprised you?" Analyzed across these three questions, 51% of visitors referred to the information about crocodiles. This type of interpretive information was equally accessible to different audience segments (e.g., families with preschoolers, families with school-age children, and adult-only groups).
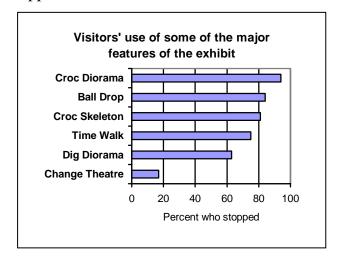

Conclusion
This summative evaluation describes and documents visitors' experiences in *When the Dinosaurs Were Gone*. Although the subject itself does not spark the imagination of audiences (its current title is about the *absence* of something they want to see!, and visitors ratings of the experience tend much more toward moderate and informative than toward fun), the exhibition seems to be reasonably engaging (half of the visitors stay for 20 minutes or more, up to about 2 hours), and it is definitely effective in communicating concepts grounded in science (evidence of change on the planet, using science to reconstruct the past). Perhaps the exhibition is effective because it is packed with hands-on interactive exhibits — exhibits that actually work, and communicate clear messages in a brief amount of time. And perhaps the exhibition is effective because an array of interpretive techniques were used to create an ambiance

that sets up a sense of place and time (entry time "tunnel," ancient swamp diorama, creative lighting and sounds). For people who understand the setting (North Dakota), the visual contrast between the ancient swamp diorama and the modern day dig diorama (arid wasteland) communicates the idea of climate change. Clearly, the design and interpretive approaches taken in this exhibition work together to create an educationally effective experience for a wide range of visitors.

A. Use of the Exhibition

This first section of the report contains information about how long visitors are spending in the exhibition, and what they are doing (e.g., using various interactive exhibits, watching videos, looking at the dioramas). The key findings are:

- The median time spent in this exhibition is 19 minutes (based on visitors' self-report, not tracking). This means that approximately half of the visitor groups stay for under 20 minutes and half spend 20 minutes or longer (up to a maximum of two hours).
- Nearly all visitors saw the crocodile dioramas, while at least three-quarters of them stopped at the ball dropping sculpture, the timeline walkway for kids, and the large fossil skeletons. Seven of the interactive exhibits were used by at least 60% of the visitors.
- The videos ("Crocodile Wars" and "Change Theatre") are fairly popular; 42% of the visitors stopped to watch one of them.

Visitors' use of some of the major features of the exhibit

Feature	
Croc Diorama	
Ball Drop	
Croc Skeleton	
Time Walk	
Dig Diorama	
Change Theatre	

Percent who stopped (0, 20, 40, 60, 80, 100)

A.1. Time spent viewing the exhibition

OVERVIEW: The range of time spent in the exhibition (visitors' estimates) was from 3 minutes to 2 hours, with an average (median) of about 19 minutes. There are no statistically significant differences among audience segments in amount of time spent (for example, first-time vs. repeat visitors, or families with children vs. adult only groups). This would indicate that the exhibition has broad appeal, something to interest a variety of types of people. Nearly everyone (96%) said they saw both exhibit areas (the first part with the crocodiles and the second part with the dig site).

Estimated time spent:[1]
(Forms A & B; n=423)

less than 10 minutes	8%
10-14 minutes	13%
15-19 minutes	27%
20-25 minutes	30%
30 minutes or longer	21%

Visitor groups that stayed less than 10 minutes were not asked about their reactions or understanding of specific exhibit content — the bulk of the interview questions. The data presented in the remaining sections of this research report deal with visitors who spent at least 10 minutes viewing the exhibition (with the exception of demographic information in section D). It is important to note that these 10+ minute visitors are demographically similar to those who spent less than 10 minutes, so these results are representative of the overall audience for this exhibit. (We don't know if the people who saw this exhibit are different from the Museum's audience as a whole).

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[1] The estimate of time spent in the exhibition is based on visitors' self-report — a measure that can be inaccurate. Experience has shown that people tend to over-estimate the amount of time they spend in exhibits, so actually, the median of 19 minutes is probably 15 minutes rather than 20 minutes. This measure is most useful in comparing different audience segments, or in comparing the experiences of people who stayed longer vs. those who stayed for a brief time.

A.2. Proportion who stopped at various displays

OVERVIEW: The most visited parts of this exhibition are the crocodile dioramas, the ball dropping sculpture, the timeline walkway, and the large fossil skeletons (crocodile and Champsosaur). Many of the interactive elements were also utilized by at least 60% of visitors (e.g., baby crocodile sounds, Champsosaur puzzle, sifting for fossils, dig site viewfinders, and living snorkel). Most exhibits were equally appealing to adult-only groups and families with children (exceptions: time walk and dig tent attracted more use by families).

Here are some photos of the exhibit. Which of these parts did you actually stop at?
(6 photos on each of three forms, A1, A2, & B)

sample size		Overall Sample	Adults Only		Families w/ kids
(n=111)	diorama / crocodiles	94%	94%		93%
(n=115)	ball dropping sculpture	84%	83%		85%
(n=162)	large crocodile skeleton	81%	78%		82%
(n=162)	'timeline walkway' for kids	75%	60%	**	89%
(n=111)	Champsosaur skeleton	73%	72%		73%
(n=162)	baby crocodile sounds	69%	71%		68%
(n=111)	Champsosaur puzzle	68%	61%		72%
(n=111)	sifting for fossils	66%	61%		69%
(n=115)	dig site diorama w/ viewfinder	63%	64%		62%
(n=115)	'living snorkel' interactive	60%	53%		66%
(n=115)	tent at dig site	53%	40%	**	66%
(n=162)	turtle shell / 'puncture proof'	48%	51%		44%
(n=111)	'Jack of Trades vs. Specialist'	42%	44%		42%
(n=115)	'crocodile jaw' interactive	40%	45%		34%
(n=162)	microscope & fossils	34%	33%		33%
(n=115)	'heat loss' interactive	32%	30%		34%
(n=162)	timeline clock	25%	21%		29%
(n=111)	timeline computer	14%	8%		16%

Asterisks (**) are used to indicate statistically significant differences (p<.05) between sets of figures. For example on this page there are two notable differences between adult-only groups and families with children under 18.

Plus signs (++) denote borderline trends (p<.10) that are not statistically significant, but may have some intuitive value in interpreting patterns of results.

Analysis of use of exhibit features (continued)

- Women were more likely than men to say they stopped at:
    - 'puncture proof' (58% vs. 41%)
    - 'timeline clock' (33% vs. 18%)
- Use of 'fossil sifting' decreased with age (83% among 14-24 year olds, 70% among 25-39 year olds, 53% among those aged 40 or older)
- Stopping at the 'dig tent' increased with level of education (41% among those without college degrees vs. 63% among college graduates)
- The 'crocodile jaw interactive' was less appealing to those with graduate schooling (47% of those with less formal education stopped vs. 16% of those with graduate school)

Proportion who interacted with staff or watched videos

OVERVIEW: The exhibit was staffed much of the time and there was a daily live alligator demonstration. The proportion of visitor groups who encountered and talked with staff was relatively small (12%). Families with children were more likely than adult-only groups to interact with staff. The proportion of visitors who said they stopped to watch one of the videos was moderately high (42%). "Crocodile Wars" was most popular, followed closely by "Change Theatre" (this one was affected by crowding — more people stopped on weekdays when the exhibit was presumably less crowded).

Did you talk with or listen to any of the staff in the exhibit?   (Forms A & B)

	Overall Sample (n=384)	Adults Only (n=162)	Family w/ Kids (n=221)
yes	12%	7%	15%
no	88%	93%	85%

What **[did you talk/hear]** *about?*
Differences between crocodiles and alligators (10 people)
Live alligator demonstration (9 people)
     Sampling of various other comments:
Told us about the history of the alligators
Periscope into the pond
Showed strength of crocodile bones
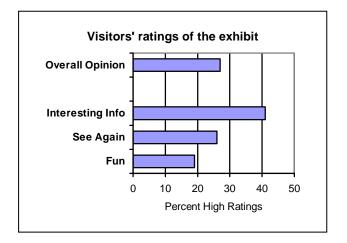*Explained randomness of the ball sculpture*
Crocodile head pressure

Did you stop to watch any videos? (Forms A & B)

		Weekday (n=80)		Weekend (n=308)
yes	42%	55%	**	39%
no	58%	45%		61%
Which ones?				
Crocodile Wars	22%	23%		22%
Change Theatre	17%	29%	**	14%
Scientists	5%	←	(not enough to analyze)	

B. Visitors' Satisfaction with the Exhibition

Visitors' ratings of several aspects of the exhibition, what they liked most, and what they would change are presented in this section. The highlights of the results are:

- Ratings of the exhibition indicate moderate satisfaction overall (62% said it was a '7' or '8' on a 10 point scale, while 27% gave a '9' or '10' rating). Visitors gave more positive ratings for 'how interesting the information was' (41% 'high' ratings).

- Visitors liked the interactive exhibits, the animal dioramas/atmosphere, and the interesting information.

Visitors' ratings of the exhibit

Rating	Percent High Ratings
Overall Opinion	27
Interesting Info	41
See Again	26
Fun	19

Percent High Ratings

B.1. Ratings

OVERVIEW: Visitors gave moderate ratings to this exhibition (27% high overall, 26% high for 'worth visiting again'). It is perceived as interesting (41%) more so than fun (19% high ratings). Some of the 'low' raters are creationists who objected to the content about evolution. Older adults and families with school-age children seemed to appreciate this exhibition the most. The information seems to be more accessible on weekdays when it's not crowded.

What rating would you give this exhibit on a scale of 1 to 10?
(n=226 for overall rating; n=162 for other ratings)

	HIGH (9-10)	MEDIUM (7-8)	LOW (1-6)
overall	27%	62%	11%
how interesting the information was	41%	47%	12%
how much it is worth visiting again	26%	41%	33%
how much fun it was	19%	60%	21%

Who gave the highest overall ratings?

48%	of those aged 50 or over
27%	among visitors in the 40's
22%	among those in the 30's
30%	among 25-29 year olds
16%	among 14-24 year olds

Who gave high ratings for 'worth visiting again'?

35%	of families with school-aged kids
21%	among families with any preschoolers
23%	among adult-only groups

Who gave high ratings for 'interesting information'?

59%	of weekday visitors gave high ratings for "interesting information"
35%	among weekend/vacation week visitors

B.2. What visitors liked most

OVERVIEW: Not surprisingly, Science Museum visitors appreciate the interactive activities the most. The animal dioramas/sounds & lighting were also well received, helping to create a feeling for what life was like millions of years ago. Visitors also found the information interesting and easily accessible.

Tell me something that you really liked about this exhibit: (Form A; n=226)

37% {	24%	hands-on, interactive
	17%	a specific interactive (e.g., puzzle, fossil sifting, bird beaks, time walk)
27% {	18%	nature dioramas, crocodiles
	10%	atmosphere, sounds & lighting
19% {	10%	information (in general), amazing facts
	9%	learning about crocodiles and alligators, crocodile facts flip board
	9%	skeletons, fossils, turtle shells
	6%	dig site, archaeology
	6%	videos
	5%	ball dropping machine
	3%	pictures, photos, visuals
	2%	dinosaurs
	2%	layout, progression
	6%	other
	1%	nothing

Representative sample of comments (*something you really liked and why?*)

The activities, the life-like models of animals: a good way to learn and be entertained
The microscope: it let me get a good look at fossils
Crocodile portion: it explained about crocodiles and how they have changed from then until now
Crocodile exhibit, flip board & video: something of my interest
How you could interact with things, experiments: gives you a way of seeing it instead of just reading it
The smell of the area: I almost felt like there was actual water in the exhibit
The hands-on stuff: for the kids it's a good way to learn
The movies — ice age and crocodile wars: I could sit down for awhile, learned how crocodiles have evolved and survived
Nothing: I'm very much a creationist, I don't believe evolution is true, it's a theory not fact
The more realistic aspects: the sounds and lighting were very realistic
The archaeology aspect: it's very interesting to me
The posters and information on the Creek itself: it was neat to learn how they found it
The alligators: because they are still here and we can see the real thing
The fossils from turtles: where it was attacked and where the teeth marks were
A lot of bits of information presented in a variety of ways: because it kept your interest

What visitors liked most (continued)

OVERVIEW: According to visitors, the essential parts of this exhibition (for a smaller traveling version) are the crocodile diorama, many of the interactive elements (e.g., Champsosaur puzzle, timeline walkway, viewfinders), the fossil skeletons, and the dig site/archaeology part. About one-quarter of the visitors also indicated that the ball dropping sculpture should definitely be kept in the exhibit.

Tell me two things that we should definitely keep in the exhibit (when a smaller version travels to other museums) (Form B; n=162)

36%	diorama with crocodiles and alligators
6%	atmosphere, sounds & lighting
9%	hands-on activities (in general)
10%	Champsosaur puzzle
7%	time walk for kids
5%	dig site viewfinders, rock layers
5%	bird beaks
3%	periscope into water
2%	heat loss
17%	other specific interactive elements
22%	skeletons & fossils
17%	archaeology part, dig site, seeing how they find fossils
23%	ball dropping sculpture
12%	information
8%	change theatre video
9%	various other answers
1%	nothing

B.3. Visitors' suggestions for changes

OVERVIEW: When asked what could be changed or omitted from this exhibition, most visitors (63%) couldn't think of anything (it is typical for at least half of the visitors to say "nothing" in response to this type of question). Among the parts that some people felt could be omitted were the timeline walkway for kids, the ball dropping sculpture, the computers, and various other interactive exhibits. A few visitors suggested that "moving animals" or "more dinosaurs" be added to the dioramas, and that the names of the animals be identified in the diorama.

Tell me one thing we could change or leave out of the exhibit (for a smaller traveling version): (Form B; n=162)

7%	timeline walkway for kids
5%	ball dropping sculpture
5%	suggestion: design differently / clarify (identify animals in diorama, time travel clock)
3%	suggestion: add something (moving animals, a Champsosaur in diorama, more dinos)
3%	computers: Fossila, timeline, scientists
2%	some of the information
1%	smell exhibit
1%	diorama
1%	dig site, tent
1%	Change Theatre video
8%	other (croc wars video, viewfinders, various other interactives)
63%	nothing

C. Perceptions of Interpretive Messages

This section contains results from a series of questions designed to assess visitors' perceptions of the main themes, as well as their comprehension of more specific messages about the location and time period represented in this exhibition. Also, visitors' understanding of six specific exhibit elements was assessed. Some highlights of the results are:

- Most visitors have reasonable top-of-mind awareness of one or more of the themes in this exhibition (life after dinosaurs, evolution, environmental change, fossils, and crocodiles). People chose 'fossils from a dig site in the Midwest' and 'the evolution of crocodiles and turtles' as the two strongest themes (from a structured list of possible messages).

- Some Science Museum visitors are focused on dinosaurs and believe that 'factors leading to the extinction of dinosaurs' was a strong message (24%) or that the exhibition contained dinosaurs (the Champsosaur misled some people).

- The immersive experience (crocodile dioramas and sound effects) helped visitors understand the time period represented (75% knew it was millions of years ago) and the idea that the climate has changed in North Dakota (67% got this message).

C.1. Overall perceptions of the themes

OVERVIEW: About half of the visitors perceived and articulated in their own words the theme of a changing earth (environmental change, evolution, adaptation/extinction). Other themes that emerged clearly were what the earth was like after the dinosaurs, learning about fossils/the process of a dig, and information about crocodiles. About 10-15% of the visitors focused on dinosaurs and how they became extinct, even though this was not a main theme of the exhibit.

What are 3 main ideas or themes that you got from this exhibit? (Form A; n=246))
What's the main idea or theme of this exhibit? (Form B; n=177)

Form A	Form B	
19%	26%	life after the dinosaurs, what it looked like millions of years ago
28%	**25%**	**evolution, changing life forms**
26%	**18%**	**climate or environmental changes over time**
9%	14%	dinosaurs, how dinosaurs became extinct
36%	13%	learn about fossils, the dig process, how they find & preserve fossils
26%	12%	crocodiles, alligators, amphibians, reptiles, Champsosaur, turtles
17%	**11%**	**animal adaptations, why they survived or not, extinction**
4%	6%	education, information, history
10%	3%	some animals have survived since dinosaur times
8%	3%	understanding the past, science, geology, research
3%	3%	timeline of history, a sense of time
14%	0	mentioned a specific exhibit
4%	0	hands-on activities for the children
8%	5%	other
2%	2%	don't know, blank
56%	**44%**	**mentioned evolution, climate change, adaptation or extinction**

Analyzed by level of education:

66%	44%	among college graduates
44%	44%	among those without college degrees

Analyzed by time spent in exhibit:

59%	40%	among those who spent at least 20 minutes in the exhibit
53%	49%	among those who spent under 20 minutes

(Note that these figures do not imply that <u>only</u> x% got a message. This is a way of seeing the relative strengths of the different messages.)

Perceptions of the main idea (continued)

Representative sample of answers:

Life after the dinosaurs:
What North Dakota was like millions of years ago
What the environment was like after the dinosaurs
What earth was like 60 million years ago
What happened when dinosaurs left the world
What the earth was like after the dinosaurs became extinct
What animals lived a long time ago, what they looked like, where they lived
Types of animals that were around long ago
To learn about what kinds of creatures lived before us and after the dinosaurs
Life from 65 million years ago

Evolution:
Evolutionary process
Evolution of time from dinosaurs on
Evolution of animals
Theories of evolution
How animals have evolved
Evolution of reptiles
How other species developed after dinosaurs became extinct
Evolution, how things have changed so much
Evolution from the very long ago past to the present

Climate/environmental change:
Change in the environment
How radically the earth changed, North Dakota was under water
Changing of the earth
Changing of the world from glaciers to today
The earth is always changing, even now
The contrast of how the Badlands used to be and how they are now
Habitat, the age of the environment and the climate changes we have been through
How the past has shown so many changes in the earth's shape

Dinosaurs:
To see how the dinosaurs became extinct and what evolved after them
History and timeline of the dinosaurs, what the environment was like a long time ago
Seeing what the earth was like when dinosaurs were alive
Extinction of dinosaurs
Dinosaurs
Crocodiles, amphibians, dinosaurs
Dinosaurs, a mood exhibit

Perceptions of the main idea (continued)

Crocodiles/amphibians:
Toads & reptiles
Alligators and crocodiles from a million years ago
Differences between alligators and crocodiles, plant and animal fossils
Survival instincts of crocodiles and alligators
A lot of information about alligators and crocodiles
The water animals and how they have adapted
Crocodiles, fish

Adaptation/extinction:
How animals became extinct and the new species that came about
How animals evolved and survived the earth's changes after the dinosaurs became extinct
How creatures have managed to survive incredible changes in the environment
How the earth has changed and how it affects all the plants & animals, whether they survive
    or don't
Crocodiles — how they have changed so they could survive yet remain similar to a million
    years ago
How animals have become extinct and how others have come to be
How the crocodile survived its environment, see how the past shaped the present

Fossils / the dig process:
How you find fossils — the actual process
All about fossils and how long ago they were found
The process of a dig
The progression of a dig and how they got to the different layers
Formation of fossils
Fossils of ancient animals
It's a lot of work to find fossils
How paleontologists find fossils and determine what they are

Perceptions of interpretive themes (continued)

OVERVIEW: When visitors were shown a list of seven messages, the themes perceived most strongly were 'fossils from a dig site in the Midwest' (71%) and 'the evolution of crocodiles and turtles' (65%). 'The ancient swamp' and 'climate change' were also seen as strong messages by slightly more than half of the sample. About three-quarters of the visitors noticed the comparisons with present day animals, and felt that this made the exhibition more interesting (data on the next page).

For each of these themes tell me if you thought it was a strong message in this exhibit, a mild message, or you didn't see it: (Form B; n=162)

	Strong	Mild	Didn't See
fossils from a dig site in the Midwest	71%	25%	4%
the evolution of crocodiles and turtles	65%	29%	6%
the ancient swamp included reptiles and mammals	54%	38%	8%
the climate of the Midwest has changed dramatically	53%	27%	20%
comparing fossil skeletons with present day animals	36%	42%	22%
factors leading to the extinction of dinosaurs	24%	52%	24%
how fossil teeth can tell us about the landscape of a place	20%	40%	40%

Who got the messages?

• College graduates were more likely to notice 'comparing fossil skeletons with present day animals' compared to people without college degrees (42% vs. 27% said "strong message").

• Women were more likely to notice 'comparing fossil skeletons with present day animals' compared to men (47% vs. 26%).

• Adult-only groups and families with preschoolers were more likely to notice 'the climate of the Midwest has changed' (58% and 62% respectively said "strong message") compared to families with school-aged children (only 38%).

• Two messages were perceived more strongly on weekdays compared to weekends: 'evolution of crocodiles' (80% vs. 60%) and 'fossils from a dig site in the Midwest' (85% vs.66%).

Perception of interpretive themes (continued)

<u>Additional analysis of the theme 'comparing fossil skeletons with present day animals'</u>

Did the present day parts of the exhibit make your experience more interesting or take away from enjoying the ancient past?

made it more interesting	72%
took away from enjoyment	6%
didn't see this part	22%

Why?
(Quotes representing the major themes in the comments are listed in descending order)
(49%)   *Cross connection between past and present made it more understandable*
(15%)   *It helps us to learn about how animals can survive or not survive their environments*
(8%)   *Some animals are still around after millions of years and that's amazing that they have survived*

Perceptions of interpretive themes (continued)

OVERVIEW: Three-quarters of the visitors were able to articulate some new or surprising information that they got from this exhibition. Visitors recalled a wide range of information, including specific facts about crocodiles, Champsosaurs, geology, and the dig process. Also, some people mentioned the larger issues of evolution/adaptation and climate change in North Dakota.

Was there anything new or surprising that you found out?   (Form A; n=226)

18%	facts about crocodiles, alligators, turtles
9%	tropical climate, swamps & crocodiles in North Dakota
7%	evolution of species, adaptation, extinction
5%	dig site nearby, fossils in North Dakota
5%	the Champsosaur, was unfamiliar with this animal
4%	about the dig process (packing, preserving, identifying fossils)
4%	geology facts (e.g., oil & coal formation, rock formation, rock layers)
3%	the sounds that baby crocodiles make, how they communicate
3%	time line, how long ago, when things happened
2%	body heat/heat loss
2%	other information about mammals/primates
2%	landscape change, glaciers, ice age
2%	insects & smells
1%	a lot, everything new to me
1%	refresher course
10%	other
23%	no, nothing, not really

Representative sample of answers

Crocodile facts:
The anatomy of crocodiles and that they store fat in their tails
Crocodiles can stay in water for 2 hours without air
How few baby alligators actually survive when they hatch
How the crocodile eats the turtle, shell and all
The strength of an alligator's jaws
All about alligators — they have 2 stomachs, can go through 3 thousand teeth in a lifetime
Crocodiles — that they are very very old
All the information about the crocodiles
Evolution, how alligators survive, how few live to be adults out of a group of eggs
Why they find crocodile skeletons upside down

Anything new or surprising (continued)

Crocodiles/swamps/tropical in North Dakota:
I didn't realize we were once a tropical environment
What kind of habitat it was then, that crocodiles & alligators were in North Dakota
That North Dakota was a swampland long ago
How North Dakota was submerged
Didn't realize that North Dakota had a swamp
How tropical this area used to be
The area of North Dakota — the place where they found all those crocodiles on a ranch
How many crocodiles there were in that particular area

Evolution/adaptation/extinction:
How adaptive animals are to their climate
Seeing the evolution from the dinosaurs, how crocodiles have changed in order to survive
*How North American animals took over & wiped out South American animals when they
    were brought together*
The different species and their adaptations to their surroundings
How the reptiles died out before the ice age came
*There have been so many species that were here and are gone or evolved into species we see
    today*

North Dakota has fossils:
The Badlands was a major fossil refuge
That the western states are so rich in fossils
A dig in North Dakota — I always thought they were in Wyoming
I didn't realize there were so many fossils in the Badlands

Champsosaur:
That Champsosaurs aren't related to crocodiles or alligators
Champsosaur — didn't know it had to breathe with its nose up
Champsosaurus — I didn't know about that before
*The thing related to snakes & lizards but it looked like an alligator, different bone structure
    than alligators*

C.2. Visitors' sense of time

OVERVIEW: The swamp dioramas and sound effects are important contributors to the feeling of going back in time, as are the fossil skeletons. Some people were surprised at how long ago it was and how some of the animals are still around today. Nearly half of the visitors (44%) knew the correct time period represented in this exhibition (surprising - were they looking at the sign during the interview?).

Which parts felt "back in time"?   (Form B; n=162)

42%	diorama, swamp, habitat, crocodiles
32%	sounds, lighting
20%	fossils, skeletons, bones
10%	time machine at entrance
7%	Badlands, dig site, rock layers in viewfinder
7%	dinosaurs, Champsosaur
4%	time walk for kids
2%	all of it
9%	other
6%	none

> Adds to more than 100% because some people gave more than one answer; also includes some relevant answers from the next question.

What else surprised you or impressed you about the sense of time in this exhibit?
(These are new comments; anything relevant to the previous question is included above)

10%	comparison with present, some animals haven't changed that much
6%	how long ago, the amount of time
4%	how old the fossils are
4%	how they can date and identify fossils
4%	animal fact (unrelated to time)
2%	how old the natural resources are
10%	other exhibits (e.g., Change Theatre, timeline computer, primates)

How long ago was it?

29%	millions of years
25%	65 million years ago
19%	60 million years ago
2%	greater than 70 million, e.g. hundreds of millions
2%	one to 59 million years
2%	thousands of years, recent, don't believe
3%	other, e.g., prehistoric
18%	don't know, not sure

C.3. Awareness of environmental changes over time

OVERVIEW: Visitors were mixed in their understanding that this exhibition represents a specific region (North Dakota, the Midwest) — 43% had a sense of the location, 21% didn't seem to understand that the swamp and dig dioramas represent the same place at different times, and the remainder of the audience thought it represents the whole world or no place in particular.

Did it seem like this exhibit was about one specific region or several different places, or no place in particular?   (Form A; n=226)

one specific region	34%
several places	46%
no place in particular	20%

Where? (if "specific region" or "several places")

35%	North Dakota, Badlands
16%	Midwest, "this area", Northwest
16%	rainforest, tropical climate, southern/Florida
9%	North America
5%	Wannagan Creek
4%	desert/prairie/arid
1%	the past and the present
8%	various other places (e.g., Africa, Australia, South America)

Coding of answers:

24%	specific: correct answer — North Dakota or Midwest
19%	several: correct answer — North Dakota & Midwest or North America
21%	several places: confused — tropical swamp/Florida & desert/ND
12%	don't know/all over/no place

Who had a sense of the location?

57%	of visitors who stopped at the <u>Champsosaur skeleton</u>
30%	of those who didn't stop there
49%	of visitors who stopped at the <u>dig tent</u>
28%	of those who didn't stop there
46%	of visitors who stopped at the <u>dig diorama</u>
28%	of those who didn't stop there

Awareness of environmental changes (continued)

OVERVIEW: Most visitors (~85-90%) expressed an awareness that changes have happened in North Dakota over the past 60 million years. The top two answers were that the climate/environment has changed (65%), and the animals have changed (40%). About one-quarter of the visitors got the subtle message that it used to be a subtropical/warmer climate.

What changes have happened there in the past 60 million years?

23%	**it's cooler now, used to be more tropical**
21%	various animals became extinct, including dinosaurs
19%	different animals, animals have changed
16%	**it's drier now, used to be swampy**
15%	**different climate or environment in general** (didn't say how)
12%	landscape changes, e.g., hills, mountains
9%	**it used to be underwater**
8%	different plants
8%	humans took over
7%	ice age, glaciers
7%	other
10%	don't know

Sample answers:

The climate went from sub-tropic to a drier and colder one
Some animals left or evolved, new species came about and migrated across the continent
No swamp, the alligator population has dropped off
Glaciers are gone
More cities, houses
The cold came & killed off dinosaurs, song birds and rodents came
Badlands now, it used to be lush and green with dinosaurs and other animals
The way things have eroded in the landscape
Weather and animals
It used to be swampy and underwater
Flowering plants were just starting to develop, now its drier and colder in the Dakotas
North Dakota was covered by ocean
Climate has changed so that it's no longer a rainforest area
No water there anymore, or at least not as much
Extinction of large animals and rising up of continental plates
Humans inhabitation, extinction of dinosaurs
I don't believe it's 60 million years old
Dinosaurs died, climate changed, different plants, different animals
All desert now, before it was like a sea, water slowly dried up & left layers of sediment

Coding of understanding of climate change
(based on answers to the above question *as well as* previous questions on the interview)

Change?   34%   spontaneously mentioned climate change in the Midwest and didn't
                            need to be told where the exhibit took place
                 33%   mentioned climate change after clarification about where it was
                 33%   no mention of climate change

What kind of change?
                 29%   mentioned change from tropical to cooler (may also have said "drier")
                 23%   mentioned change from swampy/underwater to dry (not temperature)
                 16%   mentioned climate change but didn't say how
                 33%   no mention of climate change

Who got the idea of climate change, unprompted?

     47%   of visitor with graduate school education
     38%   of college graduates
     29%   of those with some college
     20%   of high school graduates

Awareness of environmental changes (continued)

OVERVIEW: Many visitors grasped the general idea that scientists can make guesses about the likely habitat/climate by the types of plant and animal fossils they find. Some visitors (23%) mentioned that the type of soil or rock gives clues about the changes in the landscape over time. A small proportion of visitors (10%) recalled specific examples about the cypress trees or shark teeth.

Can you give any examples you saw about how scientists know what the climate was like back then?

28%	type of plants (no specifics)
23%	type of animals/which animals survived & which ones became extinct
23%	soil and rock layers
12%	studying fossils
6%	adaptations/bone structure, teeth/ tells about likely habitat
7%	tropical plants or cypress tree means there was a tropical swamp
5%	aquatic animal fossils, e.g., fish or shark teeth means there was water
2%	position of fossil when found, how deep it is located
3%	comparing fossils with present day animals
6%	other
24%	blank, don't know

Sample answers

By looking at the animals and plants that are gone now
How animals were when they found them — the habitat, how big they are
Amphibians used to live there and they need a tropical swamp
The types of fossils they found
From the type of animals and food they are, fossils of fish, herbivores, carnivores
Different animals they found, size of bodies, teeth, what they ate
*Bones & fossils — what kind of vegetation grew, it you know the plants you could figure out
    what animals were there*
They can learn by examining fossils
Different animals and plant life they found through fossils and research
Looking at the soil and the plant life
From fossilized rocks, the different layers show them clues about climate
*Rock formations, bands of sedimentary layers, where they found the fossils told about the
    land or water areas back then*
Maybe from bodies of alligators, how cold or hot it would be, how far it is buried
Found fossils of tropical plants and aquatic animals
Shapes of the animals and how they adapted
Examining the fossils and dating process

C.4. Understanding of selected exhibit elements

OVERVIEW: Among those who stopped here,
60% had a good understanding of this exhibit.

SPECIALIST VS.
JACK OF TRADES

What's the point of this exhibit?   (n=47)

60%   how bird beaks are adapted to specific food sources
19%   how they get food
 8%   how bird talons are designed to pick up food
13%   don't know

Sample of answers:
How birds' beaks adapted to their eating patterns
To show us how animals can adapt to their surroundings
See the different types of claws and how birds evolved to have the claws they do
See what kind of food you could gather if you had the different kinds of talons
How birds get their food
How genetics — body shapes & functions — determine what you can feed on
To see which beaks got food more easily
Different birds have different beak shapes, how difficult it was to pick up rocks & food
How hard it is for birds to catch different types of food; can grab bigger ones but not smaller
How birds beaks are designed for what they eat

OVERVIEW: Among those who stopped here (only n=15),
most had a reasonable understanding of this exhibit.
A few weren't sure how to use it.

TIME LINE
COMPUTER

What could people understand better from this exhibit?   (n=15)

    Don't know, my son mostly just spun it
+   *Different types of animals that were on the continent during this time period*
+   *The land was changed a little, how animals have changed over time*
+   *How it changed from swamp to desert*
+   *Land changed over years*
+   *Climates and weather and how it affects landscape*
+   *Different climate stages*
+   *Go through each time period, saw how land was compared to now, how continents moved*
+   *How the climate has changed*
+   *How things have changed, but wasn't sure what we were supposed to do with it*
+   *Not sure, the formations, how the land is*
+   *Evolution that's taken place over 60 million years, coastal changes, water changes &*
      animal species changes
+   *How the land mass changed, the shape of it, different types of animals that evolved*
+   *Elevation of western U.S. and how it has changed, the plates crashing together*

OVERVIEW: Among those who stopped at the "heat loss interactive",
73% had an appropriate understanding — mentioning something
about heat loss in mammals (35% specifically indicated that small
animals lose heat faster than large ones).

	HEAT LOSS

What's the point of this exhibit?   (n=37)

35%	small mammals lose heat faster
38%	heat loss in mammals
16%	unclear/confused/no mention of mammals/its about coffee
11%	don't know

Sample of answers
Temperature, how heat is lost
Thermal dynamics & wind, to find out which radiated more heat & which cooled quicker
Smaller mammals needed to keep warm to survive, their hearts beat faster to create warmth
Mammals needed warmth or else they died
Learning how primates adapt to heat
Small mammals cool faster
Loss of heat from animals
Hot coffee temperature loss
Explain heat loss differences

	DIG SITE

OVERVIEW: Among those who stopped here, 45% mentioned
something about rock layers (interpretation available by looking in
the viewfinder) and 47% just said it was about what a dig looks like and how it's conducted.

What could people understand better from this exhibit?   (n=72)

32%	how a dig is conducted, the work involved
26%	how landscape changed / hills, rock formation
19%	interpreting the layers of rock, rings in rocks
15%	what the dig site looks like
8%	don't know

Sample of answers:
How they conduct a dig site
How layers of rock in the earth explain climate conditions at that time
More of how the sub-layers looked from where they got the fossils
That things weren't always the way they are now
What a dig site looks like
It's like a big puzzle; you dig, find a piece, then try to figure out where it fits into big picture
The difficulties of excavating for paleontology
Feel of a dig and how they carried the fossils back
Dig site, how much work is involved
What happens at a dig site

OVERVIEW: At least 35% had a reasonable understanding of
the point of this exhibit. It is difficult to say how much the
other people got from this exhibit because their answers are somewhat general.

What could people understand from this exhibit? (n=78)

29%   how turtles have survived/adapted/evolved over time
18%   turtle shells/armor/anatomy
18%   comparing ancient and modern turtles
 9%   prehistoric turtles
 6%   how the shape of a turtle shell affects its survival
 6%   other/mostly irrelevant
14%   don't know

Sample of answers:
How animals endure and survive in their habitat
Prehistoric turtles
Round shells are good protection for the snapping turtles & could be why they're still here
Protection of the turtle shell
Anatomy of a snapping turtle
Turtle shell evolution
Turtle shell's function
About the shape of the turtle shell
Turtles were a food source for crocodiles, lived with them & are the same age

OVERVIEW: Among those who stopped at the microscope,
40% got the message that fossils tell a story.

What's the point of that exhibit?   (n=55)

40% {   27%   even tiny pieces are important, they tell a story
          13%   fossils tell about the landscape/environment
          15%   showing different types of fossils
37% {   22%   looking at/identifying fossils
           7%   other
          18%   don't know

Sample of answers:
How small and important every single fossil is
Microscopic fossils can tell a lot about a place
Fossils give us clues to the past
The different fossils — teeth, vertebra and fish scale
Fossils, comparing them
Demonstrated that the little pieces may have to be put together to understand the fossils
How fossils tell about the landscape
Gives you an idea of how scientists identify things

D. Characteristics of the Sample

This sample of 423 visitors to *When the Dinosaurs Were Gone* appears to be fairly representative of the Museum's general public audience for a March-April period, based on comparisons with previous studies.

- Most of the visitors (85%) are Minnesota residents, with 64% living in the Twin Cities metro area.

- Slightly more than half (57%) of the visitor groups contain children.

- About half of the visitors (47%) have been to the new Science Museum building before, while a large portion (38%) are "infrequent visitors" — people who have visited the old building but not the new one. Only 15% are first-time visitors — a lower proportion than in previous studies — probably due to the time of year (early spring).

D. Characteristics of the Sample

OVERVIEW: The sample for this study consists of 423 visitors who were interviewed as they were leaving the exhibition during March and April 2001. Interviews were conducted on weekdays, weekends and during school vacation week; but the preponderance of surveys (80%) represent weekend or vacation week visitors, because attendance was very light on regular weekdays. This sample is demographically similar to previous studies (e.g., the Storyline Testing for this exhibition) in terms of where people live (64% from the Twin Cities metro area), group composition (57% families with children), and level of education (56% college graduates). There are somewhat fewer first-time visitors in this sample (15%), probably due to the time of year.

Seen this exhibit before?

yes	10%
no	90%

Familiarity with SMM:

first-time visitor	15%
been before, but not to new building	38%
visited new building before	47%

Residence:

St. Paul	14%
Minneapolis	11%
suburban metro area	39%
other Minnesota	21%
near states	11%
other U.S.	4%
foreign country	1%

Group composition:

adults only	42%
family with children	57%
tour group	1%

Age of children:

preschool only	13%
school-age only	21%
preschool & school age	11%
teens only	6%
school age & teens	7%

Characteristics of the sample (continued)

Group size:

one	4%
two	39%
three	16%
four	23%
five or more	18%

Gender of person interviewed:

man	51%
woman	49%

Age:

14-17	6%
18-24	15%
25-29	14%
30's	25%
40's	25%
50's	8%
60+	7%

Level of Education:

some school	5%
high school graduate	12%
some college	26%
college graduate	37%
graduate school	19%

Ethnic identification:

white	92%
African-American	3%
American Indian	1%
Asian-American	1%
Hispanic	2%
other	1%

Day type of interviews:

weekend/ school vacation week	80%
regular weekday	20%