



Museum Visitor Studies, Evaluation & Audience Research

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Dinosaurs and More School Tour:
Findings from Questionnaires,
Interviews and Observations

Prepared for the
The Peabody Museum of Natural History
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EXECUTIVE SUMMARY

INTRODUCTION

This report presents the findings from an evaluation of the *Dinosaurs and More* school tour conducted by Randi Korn and Associates, Inc. (RK&A) for the Peabody Museum at Yale University in New Haven, Connecticut. Data were collected in the spring of 2004. Five data collection strategies were used to achieve the evaluation's objectives: teacher questionnaires, student questionnaires, teacher interviews, student observations, and student interviews. For the teacher and student questionnaires, there were two distinct samples: respondents who completed questionnaires before attending the tour (the "pre-tour" group) and a separate sample of respondents who completed questionnaires after attending the tour (the "post-tour" group).

The findings presented here are among the most salient. Please reference the body of the report for a more comprehensive presentation of findings.

PRINCIPAL FINDINGS: TEACHER QUESTIONNAIRES

Every second-grade teacher scheduled to take the *Dinosaurs and More* tour in the spring 2004 was sent a teacher questionnaire. Of the 74 packets distributed, 51 teachers returned completed questionnaires. As such, the return rate was 69 percent, a fairly high response rate for teacher questionnaires.

Because the focus of the evaluation was examining students' experiences on the *Dinosaurs and More* tour, the teacher questionnaires served as background information for the student data.

TEACHER CHARACTERISTICS

- ◆ Of the 51 second-grade teachers in the sample, 53 percent completed the questionnaire before the tour and 47 percent completed the questionnaire after the tour.
- ◆ Most teachers work in public schools (98 percent), and all work with mainstream students (100 percent).
- ◆ 82 percent of teachers completed two or more science courses in college, and 57 percent attended pre-service or in-service training on how to teach science.
- ◆ Using a scale from 1 ("No training in the sciences") to 7 ("A lot of training in the sciences"), teachers' mean score overall was 4.48. The score for post-tour teachers (mean=5.25) was higher than the score for pre-tour teachers (mean=4.48).

RELATIONSHIP OF TOUR TO CLASSROOM LESSONS

- ◆ On a scale from 1 ("I never incorporate science in my lessons") to 7 ("I often incorporate science in my lessons"), teachers' mean score overall was 5.59. The score for post-tour teachers (mean=6.21) was higher than the score for pre-tour teachers (mean=5.04).

- ◆ 85 percent of pre-tour teachers planned to discuss topics related to the tour. Most post-tour teachers (88 percent) discussed topics related to the tour.
- ◆ 78 percent of pre-tour teachers planned to brief students about logistics and behavior, but one-third of post-visit teachers (33 percent) did that.
- ◆ 88 percent of pre-tour teachers planned to present one or more follow-up lessons, and most post-tour teachers (74 percent) presented one or more such lessons.

EXPERIENCES WITH PEABODY MUSEUM

- ◆ 18 percent of teachers were touring with students for the first time, 42 percent had been taking students on tours for 1-4 years, and 42 percent had been taking students on tours for 5 or more years.
- ◆ Pre-tour teachers' top three expectations for the tour were: "students will learn about dinosaurs and prehistoric creatures" (78 percent); "students will learn about topics I am teaching in the classroom" (63 percent); and "students will get to touch fossils" (33 percent).
- ◆ Teachers' top three reasons for choosing the tour were: "the topic connected nicely to what I'm teaching in class" (90 percent); "my school always takes this tour" (51 percent); and "I thought it would appeal to my students" (39 percent). Pre-tour teachers (56 percent) were more likely to select the reason "I thought it would appeal to students" than post-tour teachers (21 percent).

OPINIONS OF THE TOUR (POST-TOUR TEACHERS)

- ◆ On a 7-point scale, teachers rated "Did not connect with what I'm teaching in class" (1) to "Connected nicely with what I'm teaching in class" (7) a mean score of 6.58.
- ◆ On a 7-point scale, teachers rated "Uninteresting to my students" (1) to "Very interesting to my students" (7) a mean score of 6.21.
- ◆ On a 7-point scale, teachers rated "Did not work well for my students" (1) to "Worked very well for my students" (7) a mean score of 6.17.
- ◆ On a 7-point scale, teachers rated "Not appropriate for my students' developmental level" (1) to "Very appropriate for my students' developmental level" (7) a mean score of 5.96.
- ◆ Teachers praised the tour content (38 percent) for meeting their expectations, noting that it enhanced their classroom lessons with new information and vocabulary. Some said that the tour "met expectations" (21 percent).
- ◆ Unmet expectations focused on the lack of interactive teaching methods; in particular, not engaging students by asking questions (21 percent). Other teachers complained about the noise level in the Hall of Dinosaurs and the difficulty hearing the guide (13 percent). Some teachers said the tour was not tailored to the level of their students, particularly when vocabulary was not explained (13 percent).

PRINCIPAL FINDINGS: STUDENT QUESTIONNAIRES

STUDENT CHARACTERISTICS

- ◆ Of the 931 second-grade students in the sample, 519 students completed the questionnaires before the tour and 412 students did so after the tour.
- ◆ One-half of the second graders were boys (50 percent) and one-half were girls (50 percent).
- ◆ Students ranged in age from 6 to 9 years.

MUSEUM VISITATION PATTERNS

- ◆ 64 percent of students were visiting (or had just visited) the Peabody Museum for the first time.

STUDENT ATTITUDES

- ◆ More pre-tour students (93 percent) expected the Museum to be “very interesting” than post-tour students (86 percent) found it to be.
- ◆ The regression model that predicted the rating of the Museum as “very interesting” included one significant variable: pre- or post-tour status. Pre-tour students were more likely to describe the Museum as very interesting than were post-tour students.
- ◆ More pre-tour students (92 percent) expected the Museum to be “a lot of fun” than post-tour students (86 percent) found it to be.
- ◆ The regression model that predicted the rating of the Museum as “a lot of fun” included two significant variables: pre- or post-tour status and gender. Pre-tour students were more likely than post-tour students to describe the Museum as “a lot of fun” and females were more likely than males to describe the Museum as “a lot of fun.”
- ◆ 88 percent of post-tour students said they wanted their families to visit the Peabody Museum.
- ◆ The regression model that predicted the characteristics of students who want their families to visit the Museum includes two significant variables: gender and having made a prior visit to the Museum with family. Females were more likely than males to want their families to visit the Museum, and students who had made a prior family visit to the Museum were more likely to want their families to visit.

STUDENT CONTENT KNOWLEDGE

When asked to complete the sentence: “Dinosaurs are....”

- ◆ 44 percent of students wrote a correct specific fact about dinosaurs, typically “dinosaurs are extinct” or “dinosaurs are reptiles.” Post-tour students (50 percent) were more likely than pre-tour students (40 percent) to state a fact.
- ◆ 30 percent of students wrote a general positive statement, such as “cool” or “interesting.” More post-tour students (31 percent) than pre-tour students (29 percent) used a general, positive remark.
- ◆ 19 percent of students described a general characteristic of dinosaurs, such as “big” or “huge.” Pre-tour students (24 percent) were more likely than post-tour students (12 percent) to complete the sentence this way.
- ◆ 7 percent of students wrote an incorrect statement about dinosaurs, for example “dinosaurs are mammals.” Pre-tour students did this with the same frequency as post-tour students (each 7 percent).

When asked to complete the sentence: “Dinosaurs have...,”

- ◆ 45 percent of students described a general characteristic of dinosaurs, such as “bones” or “teeth.” This type of response ranked first for both pre-tour (43 percent) and post-tour (47 percent) students.
- ◆ 37 percent of students described a specific characteristic of particular dinosaurs, such as “a long neck,” “long bones,” or “sharp teeth.” More pre-tour students (43 percent) than post-tour students (31 percent) responded this way.
- ◆ 11 percent of students described some variation among dinosaurs, such as “some have flat teeth and some have sharp teeth.” More post-tour students (15 percent) than pre-tour students (10 percent) responded this way.

When asked to respond true or false to “Dinosaurs are the only fossils scientists study,”

- ◆ 83 percent of pre-tour students and 92 percent of post-tour students answered correctly by choosing “False.” The regression model that predicted a correct answer included one significant variable: pre- or post-tour status. Post-tour students were more likely to choose correctly than pre-tour students.

When asked to respond true or false to “Bones take a long time to become fossils,”

- ◆ 89 percent of pre-tour students and 96 percent of post-tour students answered correctly by choosing “True.” The regression model that predicted a correct answer included one significant variable: pre- or post-tour status. Post-tour students were more likely to choose correctly than pre-tour students.

CLASSROOM FINDINGS

There were 50 classrooms in which teacher and student data could be linked. To study classroom outcomes, the results for the individual students in the classroom were averaged to obtain a classroom score.

- ◆ Pre-tour classrooms (mean=2.92) had more positive attitudes about how interesting the Museum is than did post-tour classrooms (mean=2.84). The regression model that predicted the classroom score on the “how interesting” item included one variable: pre- or post-tour status. A higher classroom score on the “how interesting” attitude item is associated with pre-tour status.
- ◆ There was no significant difference in the attitudes of the pre-tour (mean= 2.88) and post-tour classrooms (mean=2.83) in regard to how fun the Museum is.

When asked to respond true or false to “Dinosaurs are the only fossils scientists study,”

- ◆ Post-tour classrooms scored better than pre-tour classrooms. The regression model that predicted the classroom score included one variable: pre- or post-tour status. A lower classroom score was associated with pre-tour status and a higher classroom score was associated with post-tour status.

When asked to respond true or false to “Bones take a long time to become fossils.”

- ◆ Post-tour classrooms scored better than pre-tour classrooms. The regression model that predicted the classroom score did not include pre- or post-tour status; rather the model included two teacher variables: teacher’s museum touring history and teacher’s frequency of incorporating science in teaching. A higher classroom score was associated with teachers who have made one

or more prior school visits to the Peabody Museum and teachers who more frequently incorporate science in their lessons.

PRINCIPAL FINDINGS: TEACHER INTERVIEWS

RK&A interviewed 21 second-grade teachers whose students had attended the *Dinosaurs and More* tour. The teachers interviewed are a separate sample from those who completed questionnaires.

TEACHER CHARACTERISTICS

In general, the teachers interviewed work in public schools, teach mainstream students, and have some science training. In addition to their recent visit, most teachers have taken students on field trips to the Museum in previous years.

GENERAL MUSEUM FIELD TRIP EXPERIENCES

More than one-half of teachers said they select museums that connect with their curriculum. Two additional factors were important to teachers: the school's proximity to the museum and free or low cost admission for students.

All but one teacher usually schedules guided tours when visiting museums on field trips, mostly because tour guides were more knowledgeable about the subject matter.

About one-half of teachers used the pre- and post-visit lessons that museums provide. They tended to use museum materials that readily connected with their curriculum, were age appropriate, and easy to use in the classroom with little or no modification. Many also added that they appreciated when museums provide students with information about what they are going to see and do at the museum. Most teachers said the best way to receive museum materials would be through the mail prior to their field trip.

DINOSAURS AND MORE TOUR EXPERIENCES

Nearly all teachers said that they selected the *Dinosaurs and More* tour because it aligns with their curriculum, specifically with their unit on dinosaurs.

Overall, teachers had positive opinions of the tour; however, some offered suggestions for improving it such as including more hands-on activities and making the tour guide's language more age appropriate. Most teachers said the format and organization of the tour worked well for their students; however, some thought the tour should be more student-centered. Many teachers said the tour's content worked well for their students because it built on what they had learned in class.

STUDENT LEARNING

Many teachers said the tour gave their students a new visceral understanding of dinosaurs' size, while others said that their students gained more factual knowledge about dinosaurs. Teachers thought the field trip positively impacted students by exposing them to the Museum.

DINOSAURS AND MORE TEACHER MATERIALS

Some teachers designed and conducted a pre-visit lesson to dinosaurs; others said they felt it was unnecessary as they were already studying dinosaurs. Most teachers conducted an informal post-visit lesson with their students, and asked them to discuss or write about their experiences on the field trip.

When asked what materials from the Peabody Museum would have helped teachers plan their visit, about one-half said they would have liked information about the specific dinosaurs and animals that the students were going to see on the tour. One-quarter of teachers would have liked to receive a map of the Museum and information about the different exhibits at the Museum.

PRINCIPAL FINDINGS: STUDENT OBSERVATIONS

To develop the student interview guide, RK&A attended three *Dinosaurs and More* tours with second graders in April 2004. The students observed were a separate sample from those who completed questionnaire and interview.

Three different tour guides were observed with students. Each had his/her own way of interacting with students. Overall, students enjoyed touching specimens, asking their own questions, and listening to humorous stories.

All three tour guides covered similar content: prehistoric animals' characteristics and behaviors. The tour guide tended to relay facts rather than model how to glean information from the fossils on display. Overall, tour guides demonstrated a depth and breadth of knowledge about the content. However, two provided inaccurate information about what theories are and how scientists develop them.

PRINCIPAL FINDINGS: STUDENT INTERVIEWS

RK&A interviewed 35 second-grade students at two schools about four weeks after attending the *Dinosaurs and More* tour.

STUDENT CHARACTERISTICS

Two-thirds of students ($n=21$) were male and one third ($n=14$) were female. Their average age was 8 years old.

Twenty-three students had been to the Peabody Museum prior to the day they visited with their school. Of those, 17 had visited the Museum with their family, while six had previously visited with their school.

REACTIONS TO THE PEABODY MUSEUM

Most students said seeing animal fossils and other animal displays was their favorite aspect of the Museum. While many could not think of a least favorite aspect, some reacted negatively to the tour guides.

When asked how they would describe the Peabody Museum to a friend, about one-half of students said the Museum is a place where one can see dinosaurs and other prehistoric animals; others said that they would tell their friends that the Museum was “interesting” or “cool.”

REACTIONS TO THE TOUR

All students recalled seeing dinosaurs and other animal fossils on the tour. When prompted, about one-half of students remembered specific dinosaur facts. Most students said seeing and learning about dinosaurs was their favorite part of the tour. In general, students were positive about the tour and had difficulty thinking critically about it.

UNDERSTANDING OF CONTENT

Most students said the main idea of the tour was to explain the time period of dinosaurs or specific facts about dinosaurs. When queried further, it became unclear what students had learned about dinosaurs from the tour and what they had learned from other information sources.

Overall, teachers and students praised several aspects of the *Dinosaurs and More* tour. Teachers noted that the tour's content met their expectations, aligned well with the second-grade curriculum, and reinforced what students had learned in class. Teachers also gave high ratings to the tour's content and to the tour's format for working well for students. Furthermore, teachers appreciated that the tour guides were very knowledgeable, well organized, and able to manage the class dynamic. Most teachers surveyed and interviewed had taken students to the Museum in past years, suggesting that they are generally satisfied with the experiences the Museum provides their students. Students were amazed to see real fossils of dinosaurs, especially the articulated skeletons, and to touch real and cast fossils. They said they enjoyed asking the tour guide—"an expert"—questions. Some students also enjoyed showcasing their dinosaur knowledge by answering the tour guide's questions.

While the tour experiences were generally positive, evaluation findings also demonstrate areas for improvement. RK&A designed the study to examine a myriad of variables that impact students' experiences. This enabled RK&A to unearth some interesting differences between the pre- and post-tour samples that offer insight into the tour's effectiveness and impact. Teachers and students also explicitly offered suggestions for modifying the tour. These topics are discussed in the sections below.

DISCUSSION AND RECOMMENDATIONS

STUDY DESIGN

Student attitudes and knowledge result from a complex combination of experiences and characteristics. RK&A staff accounted for the multiple variables with the evaluation's methodology and analysis. First, RK&A staff selected separate pre-tour and post-tour samples. That is, one sample of teachers and students were asked to complete questionnaires before attending the tour and a separate sample of respondents were asked to complete questionnaires after attending the tour. This strategy allows evaluators to examine the effect that the tour had on students while maintaining the integrity of the data (i.e., talking to the same person before and after their experience would sensitize them and bias the data). Second, RK&A staff conducted regression analyses to identify which combination of variables (e.g., characteristics such as student gender, student's prior visits to the Museum, teacher's level of science training) best predicts or explains each student attitude rating and each knowledge question score. If the pre-tour students' ratings were simply compared with those of the post-tour sample using standard statistical procedures, the reader would not know whether the tour actually explained the ratings or if other variables had an effect.

In this study, the regression analyses provided important insights because there were slight differences in the pre- and post-tour samples. In terms of teacher characteristics, post-tour teachers had more science training and teach science more often than did pre-tour teachers.¹ Additionally, post-tour students were slightly older than pre-tour students, and post-tour students were also more likely to be repeat Museum visitors than were pre-tour students. The differences in the sample can be overcome because the regression analyses test each variable individually and in combination to determine how they impact student responses. When responses of each class were examined across several variables, including students' age, prior Museum visitation, and pre/post-tour status, as well as the teachers' characteristics, only the pre/post-tour status impacted students' attitudes toward the Museum. Conversely, student's knowledge was impacted by both pre/post-tour status and teachers' characteristics. Later in this discussion student attitudes and knowledge are described in greater detail.

TEACHERS' FIELD TRIP PLANNING PROCESS

Teachers in both the pre- and post-tour questionnaire samples as well as teachers who were interviewed stressed that the main deciding factor for taking a field trip to a museum is whether the museum's offerings align with their curriculum—a finding shared by other RK&A studies (RK&A, 2001; 2002a). Having the museum visit connect with the curriculum is important to teachers for two reasons: they need to justify taking students on a field trip, and they are looking for ways to reinforce and expand what they are teaching students in class.

While the Museum currently does not provide pre-tour teacher materials, most teachers surveyed and interviewed conducted a lesson to prepare students for the tour. Many were already teaching a dinosaur unit, which simultaneously prepared students for the tour's content. Most teachers also said they conducted post-tour lessons, either informal discussions about dinosaurs the students saw on their tour, or writing assignments—without any post-tour materials from the Museum. When asked for suggestions, teachers had difficulty conceiving what kinds of pre- and post-activities the Museum might provide; however, they stressed that teacher materials need to readily connect with the curriculum, be

¹ While there may be many factors attributing to this difference, one worth mentioning is the tour scheduling. For methodological and logistical reasons, RK&A staff designated post-tour teachers as those attending tours in March and early April, while pre-tour teachers were those attending tours in mid-April through May. Teachers who highly value science (i.e., the post-tour teachers) may plan their tours earlier in the spring semester than do teachers who value science less (i.e., the pre-tour teachers).

age appropriate for students, and be easy to implement in the classroom with little or no modification. Most also noted that receiving materials in the mail prior to their field trip was preferable to other media. Again, these preferred characteristics have been reiterated by teachers in other RK&A studies (RK&A, 1999; 2001; 2002a).

Interviewees suggested the Museum provide teachers with background information, such as a basic brochure with map, a list of the dinosaurs featured on the tour, an outline of the field trip day, etc. Interviewees' comments were further substantiated by questionnaire findings. The majority of pre-tour teachers said they planned to brief students about field trip logistics and behavior but a minority of post-tour teachers actually did. One reason for this difference may be that teachers lacked the materials to conduct a Museum introduction. Providing teachers with background information about the Museum and tour should be top priority, as other studies have shown that students' experiences are most positive when they are informed about the layout of the museum and field trip logistics (Bitgood, 1993; Bailey, 2000).

STUDENT TOUR EXPERIENCES

While teachers' ratings and comments about students' tour experiences were generally positive, they said two aspects could be improved: the tour's lack of interactivity and its age appropriateness. In the questionnaire, teachers' most often cited the reason for the tour not meeting expectations was its lack of interactivity. They expected tour guides to use more engaging questioning strategies and to include more hands-on experiences, a comment echoed by interviewees. In fact, some interviewees suggested that the format and tone of the tour could be more child-friendly. Teachers also questioned the appropriateness of the tour for students' developmental level, and this scale received the lowest rating of all the tour opinion scales. Even though the teachers all worked with second-graders, students' maturity and skills varied widely, and the tour was not a perfect match for some of the classrooms. Some teachers noted on their questionnaires and during the interviews that the tour guides used too high-level language for their students—a finding confirmed by the observer who noted that the tour guides often used jargon and sophisticated scientific terminology.

Students interviewed spoke positively about the tour; however it was difficult for RK&A to determine whether students were stating their honest opinions or responding as they thought they should—a behavior called “courtesy bias” (Warwick and Lininger, 1975). With this in mind, any criticism offered by students should be given more weight. A few students complained that the tour guide was too loquacious and noted that they became bored listening to the tour guide talk. Observations concur with students' comments. The observer noted that two of the tour guides tended to ask fact-based, close-ended questions about dinosaurs, such as, “What did Apatosaurus eat?” This approach disengaged students who did not know a lot about dinosaurs. In contrast, one tour guide encouraged students to set the pace of the tour and ask their own questions, keeping the attention of most students for the duration of the tour. Furthermore, students were most engaged on the tour when they could touch specimens. The tour's tone also impacted students' engagement. One tour guide interacted with students formally—much like traditional school—while the other two were more personable to students. Not surprisingly, students paid closer attention to the two guides who tried to connect with students on a friendly level. It is worth noting that a frequent student complaint about tours is a tour guide's unfriendly personality and lecture presentation style (RK&A, 1997; 2002b).

STUDENTS' ATTITUDES TOWARD THE MUSEUM

Most students expressed positive attitudes toward the Museum, rating it as interesting and fun. When students' ratings were examined across multiple variables, however, pre-tour students' attitudes were

more positive than post-tour students. In fact, when the rating of “how interesting the Museum is” was examined by individual students’ ratings and whole classes across multiple variables, only the pre/post-tour status is significant. One reason for this difference may be that pre-tour students were excited about the upcoming field trip, and anticipated having an interesting and fun experience; whereas post-tour students, having already attended the field trip, lacked the excitement generated from anticipation. Another reason may be that students’ tour experiences were not as student-centered as they could have been, as suggested by the observations and students’ and teachers’ responses. Interestingly, in another recent study, RK&A found that some adults had such negative school tour experiences at the Peabody Museum and had not visited since (RK&A, 2004). Clearly, making sure school tours are welcoming and fun—as well as informative—is important to securing positive attitudes toward the Museum and, potentially, future visitation.

An additional attitude question was asked only to post-tour students: whether they would want their family to visit the Museum. Females were more likely to want their families to visit the Museum than were males. Additionally, students who had made a prior family visit to the Museum were more likely to want their families to visit again than were their counterparts. For the gender difference, it may be that museums simply appeal more to elementary school-aged girls than boys. Or, as another study found, museum preference begins early in life, as natural history museums tend to be visited by more females than males (Korn, 1995). The second finding is less surprising, as children whose families already visit the Peabody Museum have it as a destination within their repertoire of possible leisure time activities, so it makes sense that they could see their families visiting the Museum again. Children whose families have not visited the Peabody Museum and who do not generally visit museums may have difficulty even conceiving going to the Museum with their families. A study RK&A conducted for the National Gallery of Art revealed similar findings between gender and prior family visits and a desire to revisit the Gallery with family (RK&A, 2002b).

STUDENT LEARNING

Students’ knowledge of dinosaurs and fossils greatly varied and, overall, was similar across the pre- and post-tour samples—not surprising considering the *Dinosaurs and More* tour is a one-time experience for students. However, some noteworthy statistically significant differences exist, especially when examining the classroom data. Post-tour classrooms scored higher on the true-false statement, “Dinosaurs are the only fossils scientists study,” than did pre-tour classrooms—no other variable impacted the score. One might hypothesize that seeing the diversity of fossils in the Great Hall helped post-tour classes know that this statement was false.

Interestingly, teacher characteristics—not the tour—impacted classes’ scores on the second true-false statement, “Bones take a long time to become fossils.” A higher classroom score was associated with teachers who had made one or more prior school visits to the Peabody Museum and teachers who frequently incorporated science in their lessons. This finding suggests that a general idea related to process, fossilization, rather than product, fossils, was conveyed by the classroom teacher rather than the tour. If processes such as fossilization are important to the tour, visuals or activities that give students the same visceral experience they have with the specimens will need to be added.

Students were also asked to complete the sentence: “Dinosaurs are....” Post-tour students were more likely to write a correct, specific fact about dinosaurs than were pre-tour students. This suggests that the tour was an effective way to communicate information about dinosaurs; however, it should be noted that because of the nature of the question, responses could only be analyzed by individual and not by classroom, making the teachers’ influence indeterminate. On the issue of classification, there was some confusion, even among a few post-tour students, as how to categorize dinosaurs. Students described

dinosaurs as reptiles, birds, lizards, and mammals. One reason for students' confusion may be seeing dinosaur fossils alongside other prehistoric creatures and discussing both during the tour. Furthermore, during the tour, the observer noted that the tour guides specifically said, "Dinosaurs are not reptiles." There are likely multiple reasons why students are unsure how to classify dinosaurs; therefore, if dinosaurs' lineage is important to the tour, again, visuals or activities should be used to help students grasp this difficult concept.

One last aspect of student learning should be mentioned, and while it may seem minor, for a scientific institution it is a concern. The observer noted that that two tour guides stressed that much of what scientists know about dinosaurs are "just theories," defining a theory as a "guess" or "something you cannot prove." Additionally, students were invited to make up their own dinosaur theories. Such statements reinforce key scientific misconceptions. Helping students understand the scientific process and how scientists do their work is of the utmost importance. The tour should explain that fossils and the field site are sources of data and how scientists use multiple data sources to develop theories. By accurately describing how scientists develop theories and why theories change as scientists uncover new information, the tour would support students' scientific literacy (National Academy of Sciences, 1998).

RECOMMENDATIONS

- Determine whether pre- and post-tour materials are necessary for achieving the tour's outcomes. If so, develop materials that teachers can immediately use in their classrooms with no modification. If special supplies or equipment are necessary for the activities, the Museum should provide them in the form of teacher lending kits.
- If print materials are developed, mail hard copies to teachers rather than e-mail. Revisit the delivery mechanism in a few years, as teachers' access to and preference for e-mail may change over time.
- Provide teachers with background information about the Museum and tour, including a map, schedule, and list of featured specimens.
- Modify the tour so that it is more student-friendly. Decrease the amount of lecture time and add hands-on experiences and time for students to ask their questions.
- Decrease the use of fact-based, closed-ended questions and use a more open-ended questioning strategy. For example, the docent could ask students what they notice about a dinosaur skeleton and then use students' responses as the point of departure for conveying information.
- In the current tour format, the depth and breadth of the tour guides' knowledge is clearly demonstrated. However, in future trainings, the Museum should place equal emphasis on educational theory and skills for working with children so that tour guides can be responsive to each class's unique needs.
- Market family programs to students to encourage them to revisit the Museum with their families. For example, each student could receive a printed invitation to visit the Museum during the Fiesta Latina or another family-friendly program.
- Determine key concepts for the tour and always use visuals, specimens, or activities to convey those ideas. For example, if dinosaur lineage is a key concept, students should be asked to look at the fossils on display and list characteristics that dinosaurs share with reptiles and those they share with birds and then construct a "family tree" (cladogram). Rather than simply relaying the information to students, tour guides should help students create that knowledge for themselves.

- Instruct tour guides on correct and age appropriate ways to explain what a theory is and how scientists develop them. Tour guides using an activity, like the one described above, should also model the processes scientists use to develop theories.

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INTRODUCTION

This report presents the findings from an evaluation of the *Dinosaurs and More* school tour conducted by Randi Korn and Associates, Inc. (RK&A) for the Peabody Museum at Yale University in New Haven, Connecticut. RK&A designed the evaluation to document the impact and effectiveness of the *Dinosaurs and More* school tour. The study's objectives were to determine:

- ◆ how teachers feel the Peabody currently serves their needs and the needs of their students;
- ◆ how teachers think the Peabody can better serve their needs and the needs of their students;
- ◆ the quality of the Peabody's school tours regarding the tour leaders' ability to convey content to students;
- ◆ the effects of the Peabody's school tours on students cognitively and attitudinally; and
- ◆ how to improve the overall quality and effectiveness of the Peabody's school tour program.

METHODOLOGY

To understand teachers' and students' tour experiences, RK&A used five data collection strategies to evaluate student and teacher samples: teacher questionnaires, student questionnaires, teacher interviews, student observations, and student interviews.

STUDENT AND TEACHER SAMPLES

In the winter of 2004, RK&A sent packets to every second-grade teacher scheduled to take the *Dinosaurs and More* tour in the spring semester.² A sample of teachers and students completed questionnaires *before* attending the tour (hereafter called the "pre-tour" group) and a separate sample completed questionnaires *after* attending the tour (hereafter called the "post-tour" group). This strategy allowed evaluators to examine the effect of the tour on students while maintaining the integrity of the data (i.e., talking to the same person before and after their experience would sensitize them and bias the data). For the pre-tour sample, RK&A received 27 completed teacher questionnaires and 519 completed student questionnaires. For the post-tour sample, RK&A received 24 completed teacher questionnaires and 412 completed student questionnaires.

In the spring of 2004, RK&A conducted phone interviews with second-grade teachers whose students had attended the *Dinosaurs and More* tour in the fall of 2003.

In the spring of 2004, RK&A observed a separate sample of three second-grade classes attending the *Dinosaurs and More* tour. These classes did not participate in any other aspects of the evaluation.

In the spring of 2004, the Peabody Museum contacted a few schools that had recently attended the *Dinosaurs and More* tour and had not completed questionnaires or observations. Lewin G. Joel, Jr., Elementary School in Clinton, Connecticut and Tuttle Elementary School in East Haven, Connecticut,

² RK&A designated teachers with tours scheduled between March 11 and April 7, 2004 as the post-tour sample and those with tours scheduled between April 8 and May 17, 2004 as the pre-tour sample. Each packet contained an introduction letter from the assistant director of public programs at the Peabody Museum; an instruction sheet for completing the packet; one teacher questionnaire; 30 student questionnaires (one for each student in the class); and a self-addressed, postage-paid envelope for returning the packet contents to the evaluators.

agreed to participate and secured parental agreements that allowed RK&A to interview students. On the day of data collection, 35 randomly selected second-grade students who had attended the tour were interviewed.

STANDARDIZED QUESTIONNAIRES

RK&A developed four questionnaires for the *Dinosaurs and More* evaluation: a pre-tour teacher questionnaire, a post-tour teacher questionnaire, a pre-tour student questionnaire, and a post-tour student questionnaire. The questionnaires were developed based on the tour's goals and objectives and Museum staff questions. The questionnaires included rating scales, true or false statements, and open-ended questions.

Evaluators measured student attitudes and knowledge before and after taking the *Dinosaurs and More* tour using pre- and post-tour questionnaires, respectively (see Appendix A). In addition, RK&A administered a questionnaire to teachers to provide background information for the student data and to provide teachers the opportunity to express their opinions about the tour (see Appendix B).

INTERVIEWS

RK&A conducted telephone interviews with teachers whose students had attended the *Dinosaurs and More* tour to examine their general use of museum field trips, their opinions about the *Dinosaurs and More* tour, and their need for pre- and post-visit materials. To allow teachers the freedom to discuss whatever they felt was meaningful, the interview guide was intentionally open-ended (See Appendix C)

RK&A conducted face-to-face interviews with students to uncover their memory of, opinions about, and knowledge gained from the tour. To allow interviewees the freedom to discuss whatever they felt was meaningful, the interview guide was intentionally open-ended (see Appendix D). Interviews were conducted at the school with parental consent.

Open-ended interviews produce data rich in information because interviewees talk about their experiences from a personal perspective. As such, the interview data were intended to complement and provide greater context for the students' and teachers' questionnaire responses. All interviews were tape-recorded with participants' permission and transcribed to facilitate analysis.

OBSERVATIONS

To understand how students' respond to the *Dinosaurs and More* tour and to prepare the student interview guide, RK&A conducted naturalistic observations. RK&A observed three second-grade classes attending the tour and took detailed notes about the behaviors of the tour guides and students.

Naturalistic observations provide an objective account of students' response to the tour—rather than students' and teachers' recollections. They provide detailed information about how students react to the format, tone, and content of the tour. They also suggest the range of students' responses.

DATA ANALYSIS

QUANTITATIVE DATA

The data were analyzed using SP/SS+ for Windows, a statistical package for personal computers. Appendix E lists all of the statistical analyses that were run, and gives a basic description of each statistical test that was performed. For all inferential statistical tests, a standard 0.05 level of significance was used (see Appendix F).

Frequency distributions were calculated for all variables. Cross-tabulation tables were computed to show the joint frequency distribution of two categorical variables (such as, “prior museum visit” by “pre- or post-tour group”). The chi-square statistic (χ^2) was used to test the significance of the relationship of two particular variables.

Summary statistics, including the mean (average) and standard deviation (spread of scores: “±” in tables), were calculated for the rating scales (such as, “level of science training on a 7-point scale”). To compare the means of the pre- and post-tour groups, an analysis of variance (ANOVA) was performed, and the F-statistic was used to test for significant differences in the two groups.

Stepwise regression analyses were used to examine the relationship between a dependent variable (such as, correct vs. incorrect answer on a test item) and a whole set of independent variables (such as, age, gender, past museum experience, and pre- or post-tour group). The stepwise regression procedures helped identify which independent variables, if any, comprise a “model” that predicted the dependent variable. When the dependent variable was binary (such as correct vs. incorrect answer on a test item), *logistic* regression was used and when the dependent variable was measured at an interval or ratio level (such as, a rating scale or classroom test score), *multiple* regression was used. Significant models are presented in the body of the report while the detailed statistical outputs for each model are provided in Appendix G.

QUALITATIVE DATA

Verbatim responses to interview questions, open-ended questionnaire items, and student observations were analyzed qualitatively, meaning that the evaluator studied the responses for meaningful patterns, and, as patterns and trends emerged, grouped together and interpreted similar responses (see Appendices H to L).

Data were analyzed using SPSS 12.0.1 for Windows, a statistical package for personal computers. Analyses included both descriptive and inferential methods. See Appendix B for a listing of all statistical analyses.

METHOD OF REPORTING

The data presented in this report are both quantitative and qualitative. For the quantitative data, tables and figures are regularly used to display the information to make it easily accessible. Percentages within tables do not always equal 100 owing to rounding. Interviewees’ verbatim quotations (edited for clarity) illustrate major trends in the qualitative data and to convey their thoughts and feelings as fully as possible.

Throughout the report, the findings within each topic are presented in descending order, starting with the most frequently occurring.

Findings in this report are presented in five main sections as follows:

SECTIONS OF THE REPORT:

1. Teacher Questionnaires
2. Student Questionnaires
3. Teacher Interviews
4. Student Observations
5. Student Interviews

PRINCIPAL FINDINGS:TEACHER QUESTIONNAIRES

INTRODUCTION

Since the focus of the evaluation was examining students' experiences on the *Dinosaurs and More* tour, teacher questionnaire findings served as background information for student data. As such, teacher sample sizes were small. The findings from the teacher questionnaire are presented in the sections that follow; however, the true significance of the teacher data is explored in the class regression models in section II, "Principal Findings: Student Questionnaires."

QUESTIONNAIRE ADMINISTRATION

Of the 74 packets distributed to teachers in March and April 2004, a total of 51 teachers returned a completed teacher questionnaire (see Table 1). As such, the total return rate was 69 percent, a fairly high rate for teacher questionnaires.

Table 1
Number of Packets Distributed and Returned

Sample	Number of Packets Distributed	Number of Packets Returned	Return Rate %
Pre-tour	34	27	79
Post-tour	40	24	60
Total	74	51	69

PRE-TOUR AND POST-TOUR SAMPLES

Twenty-seven teachers completed the questionnaire before the *Dinosaurs and More* tour (pre-tour group; 53 percent of the teacher sample) and 24 teachers completed the questionnaire after the *Dinosaurs and More* tour (post-tour group; 47 percent of the teacher sample) (see Table 2).

Because the sample size ($n=51$) is small, only very large statistically significant differences in the pre- and post- tour teachers can be detected. For this reason, findings of more than a 20 percent difference in the two groups are noted and discussed, even if they are not statistically significant.

Table 2
Teacher Pre- and Post-tour Samples (in percent)

Teacher Group	<i>n</i>	Total %
Pre-tour	27	53
Post-tour	24	47

TEACHER CHARACTERISTICS

This section presents teachers' characteristics, including their type of school, student population, and amount of training they had in science and how to teach science. Data are presented for the total sample and also by teachers' pre- or post-tour group status.

SCHOOL TYPE AND STUDENT POPULATION

Almost all the teachers (98 percent) work in public schools, and all of them work with mainstream students (see Table 3).

Table 3
School Type and Student Population by Teacher Group (in percent)

Type of School	Teacher Group		Total
	Pre-tour	Post-tour	
	%	%	%
Public	96	100	98
Independent	4	0	2
Parochial	0	0	0
Student Population	Pre-tour	Post-tour	Total
	%	%	%
Mainstream	100	100	100
Gifted or special education	0	0	0

SCIENCE TRAINING

Most teachers (82 percent) completed two or more science courses in college. More than one-half (57 percent) attended pre-service or in-service training on how to teach science (see Table 4).

Table 4
Science Background by Teacher Group (in percent)

Science Background	Teacher Group		Total
	Pre-tour	Post-tour	
	%	%	%
No college science course	11	13	12
One science course in college	11	0	6
Two or more science courses in college	78	88	82
Training in Teaching Science	Pre-tour	Post-tour	Total
	%	%	%
Attended pre-service or in-service training to teach science	52	66	57

Teachers rated their level of science training using a scale from 1 (No training in the sciences) to 7 (A lot of training in the sciences). Overall, teachers rated themselves just above the middle of the scale

(mean=4.84). The mean score for the post-tour teachers is 5.25 compared to a mean score of 4.48 for the pre-tour teachers. Based on this self-reported measure, post-tour teachers have significantly more training in the sciences than pre-tour teachers (see Table 5).

Table 5
Self-Rated Level of Training in How to Teach Science
by Teacher Group

Teacher Group	7-Point Scale Training in How to Teach Science None (1) / A lot (7)	
	Mean	±
Pre-tour teachers	4.48	1.31
Post-tour teachers	5.25	0.99
Total	4.84	1.22

$F=5.47$ $df=1, 49$; $p=.023$

RELATIONSHIP OF TOUR TO CLASSROOM LESSONS

This section discusses the relationship between teachers' classroom activities and the *Dinosaurs and More* tour, including teacher's frequency of incorporating science in classroom lessons, pre-tour lessons, and follow-up post-tour lessons. Comparisons are made between lessons pre-tour teachers planned to do and lessons post-tour teachers taught.

SELF-RATED FREQUENCY OF INCORPORATING SCIENCE IN LESSONS

Teachers rated how often they incorporate science in classroom lessons using a interval scale from 1 (I never incorporate science in my lessons) to 7 (I often incorporate science in my lessons). Overall, teachers rated themselves in the upper range of the scale (mean=5.59). The mean score for post-tour teachers was 6.21 compared to a mean score of 5.04 for pre-tour teachers. Based on this self-reported measure, post-tour teachers incorporate science in their classroom lessons more frequently than pre-tour teachers (see Table 6).

Table 6
Self-Rated Frequency of Incorporating Science in Lessons
by Teacher Group

Teacher Group	7-Point Scale Training in Teaching Science Never (1) / Often (7)	
	Mean	±
Pre-tour teachers	5.04	1.43
Post-tour teachers	6.21	0.83
Total	5.59	1.31

$F=12.40$ $df=1, 49$; $p=.001$

PRE-TOUR LESSONS

Pre-tour teachers described the pre-visit lessons that they planned to teach and post-tour teachers described the lessons they taught. Findings are shown in Table 7. Most pre-tour teachers (85 percent) planned to discuss topics related to the *Dinosaurs and More* tour and most post-tour teachers (88 percent) discussed topics related to the tour. Their plans and their actions are similar for this item.

Most pre-tour teachers (78 percent) planned to brief students about logistics and behavior, but one-third of post-visit teachers (33 percent) did that. When pre-tour teachers saw the survey item “brief students about logistics and behavior” as an option, it might have suggested the idea, so they selected it. Post-tour teachers didn’t have any “cue” to do so, and considerably fewer of them said they thought about it on their own.

Table 7
Pre-visit Lessons by Teacher Group
(in percent)

Pre-visit Lessons	Teacher Group		Total¹
	Pre-tour¹	Post-tour¹	
	%	%	%
Discuss topics related to tour	86	88	86
Brief students about logistics and behavior ²	78	33	57
Not planning to teach any	4	8	6

¹ Respondents were allowed more than one response, so column totals exceed 100 percent.

² $\chi^2=10.23$; $df=1$; $p=.002$

The questionnaire asked teachers to describe the topics they planned to discuss or had discussed in their pre-visit lessons. Responses were reviewed and categorized as topics (see Appendix H). Table 8 lists the topics in order of frequency. The top three pre-visit lesson topics were “dinosaurs in general” (82 percent), “fossils” (60 percent), and “eras, ages, time periods” (36 percent).

Table 8
Pre-visit Lesson Topics by Teacher Group
(in percent)

Pre-visit Lesson Topics	Teacher Group		Total^{1,2}
	Pre-tour^{1,2}	Post-tour^{1,2}	
	%	%	%
Dinosaurs, general characteristics of	86	77	82
Fossils, paleontology	68	47	60
Eras, ages, time periods	27	47	36
Geology, rocks, minerals	14	12	13
Dinosaur teeth, diet	9	12	10
Habitat, protection	9	12	10
Digs	0	12	5
<i>Age of Reptiles</i> mural	0	12	5
Reptiles	5	6	5
Birds	0	6	3

¹ Pre-tour group *n*=22 respondents; Post-tour group *n*=17 respondents; Total *n*=39 respondents.

² Some respondents wrote in more than one topic, so column totals exceed 100 percent.

POST-TOUR LESSONS

Pre-tour teachers described the number of follow-up lessons they planned to teach and post-tour teachers described the number of follow-up lessons they taught. No statistically significant difference exists in the results for pre- and post-tour teachers. Most pre-tour teachers (88 percent) planned to present one or more follow-up lessons and most post-tour teachers (74 percent) presented one or more follow-up lessons (see Table 9).

Table 9
Number of Follow-up Lessons by Teacher Group
(in percent)

Number of Follow-up Lessons	Teacher Group		Total
	Pre-tour	Post-tour	
	%	%	%
None	12	26	18
One follow-up lesson	36	26	32
Several follow-up lessons	52	47	50

The questionnaire asked teachers to describe their follow-up lesson(s). Descriptions were reviewed and categorized (see Appendix I). Table 10 lists the lessons in order of frequency. The two most common follow-up lessons were: a general discussion about the visit in which the teacher helped the students integrate content and make connections (40 percent); and journal writing and reflection about the visit (40 percent). Some teachers (20 percent) assigned a research project or report, either written or using PowerPoint software; while 15 percent of teachers developed art lessons or hands-on activities, such as painting a mural, creating a diorama, or making “fossils.” One teacher had her class watch a video about dinosaurs, and one teacher gave her students a “curriculum test.”

Table 10
Follow-up Lesson Topics by Teacher Group
(in percent)

Follow-up Lesson Topics	Teacher Group		Total ^{1,2} %
	Pre-tour ^{1,2} %	Post-tour ^{1,2} %	
General discussion about the visit, integrate content, debrief, make connections	32	53	40
Writing project, journal writing to reflect on experience	36	47	40
Research project, write report, create PowerPoint report about dinosaurs	20	20	20
Art project, hands-on project, paint a mural, make diorama, make “fossils”	8	27	15
Watch video program on dinosaurs	0	7	3
Curriculum test	0	7	3

¹ Pre-tour group *n*=25 respondents; Post-tour group *n*=15 respondents; Total *n*=40.

² Some respondents wrote in more than one lesson, so column totals exceed 100 percent.

EXPERIENCES WITH PEABODY MUSEUM

This section examines teachers’ experiences with the Peabody Museum, including the number of years they have been taking students on Museum tours, pre-visit expectations of the *Dinosaurs and More* tour, and reasons for selecting that tour.

NUMBER OF YEARS TAKING PEABODY MUSEUM TOURS

Teachers' touring experience at the Peabody Museum is presented in Table 11. Eighteen percent of teachers were touring with students for the first time, 42 percent had been taking students on tours for one to four years, and 42 percent had been taking students on tours for five or more years. The chi-square test did not indicate a statistically significant difference in the pre- and post-tour groups; however, looking at the results on a purely descriptive basis, the post-tour teachers seem to have more years of experience at the Museum. Notably, 54 percent of post-tour teachers had been taking students on tours for five or more years compared to 30 percent of pre-tour teachers.

Table 11
Number of Years Taking Peabody Museum Tours by Teacher Group
(in percent)

Number of Years	Teacher Group		Total %
	Pre-tour %	Post-tour %	
First time	22	13	18
1 - 4 years	48	33	41
5 years or more	30	54	41

PRE-VISIT EXPECTATIONS FOR THE TOUR

Using a list of five statements, pre-tour teachers identified their top two expectations for the *Dinosaurs and More* tour. Table 12 presents the findings in rank order. Pre-tour teachers' top two expectations were "students will learn about dinosaurs and prehistoric creatures" (78 percent) and "students will learn about topics taught in the classroom" (63 percent).

Table 12
Pre-Visit Expectations for the Tour
(in percent)

Pre-Visit Expectations	Pre-tour Group ¹ %
Students will learn about dinosaurs and prehistoric creatures	78
Students will learn about topics taught in the classroom	63
Students will get to touch fossils	33
Students will enjoy visiting the Museum	30
Students will be shown fossils through the ages	26
Other: students will see how large dinosaurs are	4

¹ n= 27; respondents were allowed more than one response so column totals exceed 100 percent.

REASONS FOR SELECTING TOUR

From a list of six reasons, teachers selected their top two main reasons for selecting the *Dinosaurs and More* tour. Table 13 (next page) presents the findings in rank order. Almost all teachers (90 percent) selected “the topic is connected to what I’m teaching in class,” making it the principal reason for choosing the tour. About one-half (51 percent) selected “my school always takes this tour” and 39 percent selected “I thought it would appeal to my students.” The remaining reasons were selected by fewer than ten percent of teachers overall.

Over one-half of pre-tour teachers (56 percent) selected the reason “I thought it would appeal to students” compared with post-tour teachers (21 percent). Otherwise, there were no statistically significant differences in the choices of pre- and post-tour teachers. Nevertheless, looking at the results on a purely descriptive basis, the item “my school always takes this tour” was selected by a higher percentage of post-tour teachers (63 percent) than pre-tour teachers (41 percent).

Table 13
Reasons for Selecting Tour by Teacher Group
(in percent)

Reason for Selecting Tour	Teacher Group		Total ¹ %
	Pre-tour ¹ %	Post-tour ¹ %	
Topic connected to what I’m teaching	89	92	90
My school always takes this tour	41	63	51
I thought it would appeal to students ²	56	21	37
Topic is directly related to state standards and testing requirements	12	8	10
Positive word-of-mouth about it	7	4	6
Topic appealed to me	7	0	4
Other: exhibits are educational/interesting	0	4	2

¹ Respondents were allowed more than one response, so column totals exceed 100 percent.

² $\chi^2=6.43$; $df=1$; $p=.021$

OPINIONS OF THE TOUR

Post-tour teachers evaluated four aspects of the *Dinosaurs and More* tour. Using 7-point rating scales, they rated the tour’s format, content, connection to classroom content, and appropriateness for the students’ developmental level. In response to an open-ended question on the survey, post-visit teachers described the ways the tour did or did not meet their expectations. Teachers’ open-ended responses are listed in Appendix J.

RATINGS OF THE TOUR

Using a scale from 1 (“Did not work well for my students”) to 7 (“Worked very well for my students”), post-tour teachers rated the tour’s format positively (mean=6.17; see Table 14).

Table 14
Rating of Tour Format

	7-Point Scale Did Not Work Well (1) to Worked Very Well (7)	
	Mean	±
Tour format	6.17	1.09

Using a scale from 1 (“Uninteresting to my students”) to 7 (“Very interesting to my students”), post-tour teachers also rated the tour’s content positively (mean=6.21; see Table 15).

Table 15
Rating of Tour Content

	7-Point Scale Uninteresting (1) to Very Interesting (7)	
	Mean	±
Tour content	6.21	1.35

Using a scale from 1 (“Did not connect with what I’m teaching in class”) to 7 (“Connected nicely with what I’m teaching in class”), post-tour teachers rated the tour’s connection to what they are teaching highest of the four items (mean=6.58; see Table 16). Teachers clearly indicated the tour’s content had a strong connection to their classroom teaching.

Table 16
Rating of Tour Content Connection to Classroom Teaching

	7-Point Scale Did Not Connect (1) to Connected Nicely (7)	
	Mean	±
Connection to classroom	6.58	1.25

Using a scale from 1 (“Not appropriate for my students’ developmental level”) to 7 (“Very appropriate for my students’ developmental level”), post tour teachers scored this item positively (mean=5.96; see Table 17), but it was rated lowest of the four rating-scale scores overall. Also, the standard deviation for this item is large (± 1.90), indicating that teachers had some diversity of opinion about the tour’s fit with their students’ developmental level. Even though the teachers all work with second graders, students’ maturity and skills probably vary widely, and the tour may not have been a perfect match for some of the classes.

Table 17
Rating of Tour’s Appropriateness for Students’ Developmental Level

	7-Point Scale Not Appropriate (1) to Very Appropriate (7)	
	Mean	\pm
Appropriate to students’ level	5.96	1.90

WAYS THE TOUR DID OR DID NOT MEET EXPECTATIONS

The post-tour questionnaire asked teachers to comment on the ways the tour did or did not meet their expectations. Responses were reviewed and categorized (see Appendix J). The response categories are listed in Table 18 (next page).

Most of the comments were favorable. Teachers praised the tour content (38 percent) as appropriate and interesting. They said they were pleased that it reinforced and enhanced their classroom lessons, particularly with new information and vocabulary. Teachers described the guides as “excellent” and “outstanding” (13 percent). They appreciated interactive teaching, especially “hands-on” learning opportunities (13 percent).

Other teachers offered criticisms or made suggestions to improve the tour. The most common suggestion was to incorporate more interactive teaching methods, in particular asking students more questions (21 percent). Other complaints focused on the noise-level in the Hall of Dinosaurs and difficulty hearing the guide (13 percent). Some teachers expressed that the tour was not tailored to the students’ level, particularly when vocabulary was not explained (13 percent).

Table 18
Ways Tour Did or Did Not Meet Expectations
(in percent)

Met Expectations	Total¹ %
Content: appropriate, interesting, reinforced classroom lessons, added new information, new vocabulary	38
General: non-specific favorable response, expectations met by the tour	20
Guide: excellent, outstanding teacher	13
Interactive methods: hands-on experiences	13
Level: tour given at appropriate level for students	8
Did Not Meet Expectations	Total¹ %
Method: too dry, need to ask more questions of students, be more interactive	21
Level: not tailored to developmental level of students, language too advanced, vocabulary not explained	13
Environment: too loud in Hall, hard to hear guide	13
Content: more current information, newer findings	4
Miscellaneous: guide should use laser pointer to help students focus	4

¹ N= 24; post-tour teachers were allowed more than one response, so column total exceeds 100 percent.

PRINCIPLE FINDINGS: STUDENT QUESTIONNAIRES

PRE-TOUR AND POST-TOUR SAMPLES

A total of 931 second-grade students completed the student questionnaires. The pre-tour sample consisted of 519 students from 28 classrooms, and the post-tour sample consisted of 412 students from 23 classrooms (see Table 19).

In contrast to the teacher sample ($n=51$), the student sample ($n=931$) is quite large. This sample size provides enormous statistical power and even very small differences in the pre- and post-tour students will be detected. For this reason, some statistically significant findings might seem relatively minor (for example, see the age results in the following section).

Table 19
Student Groups
(in percent)

Questionnaire	<i>n</i>	Total %
Pre-Tour	519	56
Post-Tour	412	44

STUDENT CHARACTERISTICS

This section presents the students' characteristics, including gender and age. Data are presented for the total sample and also by students' pre- or post-tour group status.

Overall, there were about the same number of boys and girls (see Table 20). Students ranged in age from 6 to 9 years. There were a few more nine-year-olds in the pre-tour group compared with the post-tour group.

Table 20
Gender and Age by Student Group
(in percent)

	Pre-Tour %	Post-Tour %	Total %
Gender			
Boys	53	47	50
Girls	47	53	50
Age ¹			
6 years	0	0	0
7 years	47	56	51
8 years	50	43	47
9 years	3	1	2

¹ $\chi^2=9.82$; $df=3$; $p=.020$

MUSEUM VISITATION PATTERNS

This section presents the students’ museum visiting patterns, including prior school visits to the Museum and prior family visits to the Museum.

The majority of students (63 percent) were visiting (or had just visited) the Peabody Museum for the first time (see Table 21). Sixty-seven percent of pre-tour students were visiting for the first time, compared with 59 percent of post-tour students. Before this school year, 26 percent had visited the Museum with a family group, 7 percent had visited with a school group, and 4 percent had visited with *both* school and family.

Table 21
Prior Peabody Museum Visits by Student Group
(in percent)

Prior Visits^{1,2}	Pre-Tour %	Post-Tour %	Total %
None, first visit ever	67	59	63
Prior visit(s) with family only	25	27	26
Prior visit(s) with school only	5	9	7
Prior visits with school and family	3	5	4

¹visits before this school year

² $\chi^2=10.79; df=3; p=.013$

STUDENT ATTITUDES

Pre- and post-tour students described their attitudes about two aspects of visiting the Peabody Museum: how interesting it is, and how much fun it is. For pre-tour students, the statement was worded “I think the Peabody Museum *will be...*” and for post-tour students, the statement was worded “The Peabody Museum *was...*” Post-tour students also described their feelings about wanting their families to visit the Museum.

Stepwise logistic regression analyses were carried out to identify the following models:

- ◆ characteristics of students who found the Museum “very interesting”;
- ◆ characteristics of students who found the Museum “a lot of fun”; and
- ◆ for post-tour students only, characteristics of students who wanted their families to visit the Peabody Museum.³

³ For the dependent variable “how interesting” the original 3-category variable was collapsed into a binary variable “very interesting” vs. “kind-of/boring.” For the dependent variable “how fun” the original 3-category variable was collapsed into a binary variable “a lot of fun” vs. “kind-of/not fun.” For the dependent variable “want to visit with family” the original 3-category variable was collapsed into a binary variable “want my family to visit” vs. “not sure/do not want my family to visit.” The independent variables tested for the stepwise logistic regression models included: age, gender, prior visit to the Museum with family, prior visit to the Museum with school, and pre- or post-visit status (however, the pre-post variable was omitted for the “want to visit with family” model).

Significant models are discussed in the narrative section, while the detailed statistical outputs for each model are provided in Appendix G.

HOW INTERESTING STUDENTS FIND THE MUSEUM

Pre- and post-tour students selected one of three possible responses that best described their attitude about the Museum: “very interesting,” “kind of interesting,” or “boring.” As shown in Table 22, most students (90 percent) selected “very interesting.” Yet more pre-tour students (93 percent) expected the Museum to be “very interesting” than post-tour students (86 percent) found it to be. The most reasonable explanation is that the pre-tour students were excited about the upcoming field trip, and anticipated having a novel, interesting experience.

Table 22
How Interesting by Student Group
(in percent)

How Interesting	Pre-Tour %	Post-Tour %	Total %
Very interesting	93	86	90
Kind of interesting	6	12	9
Not at all interesting	1	2	1

¹ $\chi^2=12.01; df=2; p=.002$

The model that predicts the rating of the Museum as “very interesting” includes just one significant variable: pre- or post-tour status. Pre-tour students were more likely to describe the Museum as very interesting than were post-tour students. None of the other variables contribute to the model (see Appendix G).

HOW FUN STUDENTS FIND THE MUSEUM

Pre- and post-tour students selected one of three possible responses that best described their attitude about the Museum: “a lot of fun,” “kind of fun,” or “not fun.” As shown in Table 23, most students (90 percent) selected “a lot of fun.” More pre-tour students (92 percent) expected the Museum to be “a lot of fun” than post-tour students (86 percent) found it to be. Again, a possible explanation is that pre-tour students were excited about the upcoming field trip, and the idea of going to the Museum was fun.

Table 23
How Fun by Student Group
(in percent)

How Fun	Pre-Tour %	Post-Tour %	Total %
A lot of fun	92	86	90
Kind of fun	7	13	9
Not at all fun	1	1	1

¹ $\chi^2=9.31; df=2; p=.010$

The model that predicts the rating of the Museum as “a lot of fun” includes two significant variables: pre- or post-tour status and gender. Pre-tour students were more likely than post-tour students to describe the Museum as “a lot of fun” and females were more likely than males to describe the Museum as “a lot of fun.” None of the other variables contribute to the model (see Appendix G).

DESIRE TO VISIT THE MUSEUM AGAIN WITH FAMILY

Post-tour students selected one of three possible responses that best described their feelings about visiting the Museum again with family: “I want my family to visit,” “I am not sure if I want my family to visit,” or “I do not want my family to visit.” Following the tour, the overwhelming majority of students (88 percent) said they wanted their families to visit the Peabody Museum (see Table 24).

Table 24
Want Family to Visit the Museum
(in percent)

Want Family to Visit Museum	Post-Tour¹
	%
I want my family to visit	88
I am not sure	10
I do not want my family to visit	2

¹n= 412

The model that predicts the characteristics of students who want their families to visit the Museum includes two significant variables: gender and having made a prior visit to the Museum with their family. Females were more likely than males to want their families to visit the Museum, and students who have made a prior family visit to the Museum were more likely to want their families to visit. The other variables do not contribute to the model (see Appendix G).

STUDENT CONTENT KNOWLEDGE

The questionnaires included four items to assess students’ knowledge of dinosaurs and fossils. Two items used a true/false format⁴ and two items used a sentence completion format. This section of the report compares the findings of pre- and post-tour students, examining differences in students’ comprehension of information presented in the tour.

Stepwise logistic regression analyses were carried out to identify the models that predict the characteristics of students who answered the true-false items correctly.⁵ Significant models are discussed in the narrative of the report, while the detailed statistical outputs for each model are provided in Appendix G.

⁴ For true-false items, a blank or non-response was coded as incorrect.

⁵ The dependent variable was “correct” vs. “incorrect” response. The independent variables tested for the stepwise logistic regression models included: age, gender, prior visit to the Museum with family, prior visit to the Museum with school, and pre- or post-visit status.

“DINOSAURS ARE ...”

Students completed the sentence: “Dinosaurs are...” Completed sentences were reviewed and similar responses were grouped together (see Appendix K). The response categories for the pre-and post-tour groups are presented in Table 25.

The top ranking response (44 percent overall) was a specific fact about dinosaurs. Fifty percent of post-tour students compared with 40 percent of pre-tour students stated a dinosaur fact. For both groups, the most common factual statement, by far, was that “dinosaurs are extinct.” Other recurrent factual statements were “dinosaurs are reptiles,” “dinosaurs are birds,” “dinosaurs are meat-eaters and plant-eaters,” and “dinosaurs are big or small”

The second-ranking response (30 percent overall) was a general positive statement, such as “cool,” “interesting,” “neat,” or “awesome.” Again, more post-tour students (31 percent) than pre-tour students (29 percent) used a general, positive remark.

The third-ranking response (19 percent overall) was to describe a general characteristic of dinosaurs, such as “big,” “huge,” or even “ugly.” Almost one-quarter of pre-tour students (24 percent) completed the sentence this way, versus just over one-tenth of post-tour students (12 percent).

The final response (7 percent overall) was to make an incorrect statement about dinosaurs, for example, “dinosaurs are mammals,” dinosaurs were the first animals to walk on land,” or an incorrect date. Pre- and post-tour students were equally likely to give this response.

Table 25
Sentence Completion: “Dinosaurs are ...” by Student Group
(in percent)

Response Categories: Dinosaurs are ...	Pre-Tour %	Post-Tour %	Total %
Specific fact about dinosaurs: extinct, classification as reptiles or birds, meat-eater, plant-eater, vary in size	40	50	44
Positive comment about dinosaurs: cool, interesting, awesome	29	31	30
General characteristic of dinosaurs: big, huge, ugly, colorful	24	12	19
Incorrect statement about dinosaurs: classify as mammals; first animals to walk on land; lived 1,500 years ago	7	7	7

$\chi^2=22.09; df=3; p=.000$

“DINOSAURS HAVE ...”

Students completed the sentence: “Dinosaurs have...” The sentences were reviewed and similar responses were grouped together (see Appendix L). See Table 26 for the response categories for the pre- and post-tour groups. Almost one-half the students (45 percent) described a very general characteristic of dinosaurs, such as “bones” or “teeth.” This type of response ranked first for both pre-tour (43 percent) and post-tour (47 percent) students.

Just over one-third of students (37 percent) described a specific characteristic of particular dinosaurs, such as “a long neck” or “long bones” or “sharp teeth.” More pre-tour students (43 percent) than post-tour students (31 percent) responded this way.

Other students (11 percent) described some sort of variation among dinosaurs, such as “some have flat teeth and some have sharp teeth.” More post-tour students (15 percent) than pre-tour students (10 percent) responded this way.

Last of all, some students (6 percent) made responses categorized as “other.” The two most common themes were: “dinosaurs have been extinct,” and “dinosaurs have fossils.” Slightly more post-tour students (8 percent) than pre-tour students (4 percent) gave an “other” response.

Table 26
Sentence Completion: “Dinosaurs have ...” by Student Group
(in percent)

Response Categories: Dinosaurs have ...	Pre-Tour %	Post-Tour %	Total %
General characteristic of all dinosaurs: bones, teeth	43	47	45
Specific characteristic of particular dinosaurs: long bones, big tail, long neck, specific kinds of protection	43	30	37
Variation in characteristics: some have flat teeth and some have sharp teeth, names that are descriptive of variations	10	15	12
Other response: extinct, fossils	4	8	6

$\chi^2=17.158; df=3; p=.001$

TRUE-FALSE STATEMENTS

Students answered “True” or “False” to the statement, “Dinosaurs are the only fossils scientists study.” As shown in Table 27, the overwhelming majority of pre-tour students (83 percent) and post-tour students (92 percent) answered correctly by choosing “False.”

Students answered “True” or “False” to the statement, “Bones take a long time to become fossils.” As indicated in Table 27, almost all pre-tour students (89 percent) and post-tour students (96 percent) answered correctly by choosing “True.”

Since both True-False items were answered correctly by almost all of the pre-tour students, they were clearly familiar with this content before visiting the Museum. Still, a significantly higher proportion of post-tour students responded correctly to both items.

Table 27
True-False Item Responses by Student Group
(in percent)

True-False Items	Pre-Tour %	Post-Tour %	Total %
Dinosaurs are the only fossils scientists study. ¹			
False - Correct response	83	92	87
True - Incorrect response	17	8	13
Bones take a long time to become fossils. ²			
True - Correct response	89	96	92
False - Incorrect response	11	4	8

¹ $\chi^2=15.85$; $df=1$; $p=.000$

² $\chi^2=15.41$; $df=1$; $p=.000$

The model that predicts a correct answer on the True-False item “Dinosaurs are the only fossils scientists study” includes just one significant variable: pre- or post-tour status. Post-tour students were more likely to choose correctly than pre-tour students. None of the other variables contribute to the model (see Appendix G).

The model that predicts a correct answer on the True-False item “Bones take a long time to become fossils” includes just one significant variable: pre- or post-tour status. Post-tour students were more likely to choose correctly than pre-tour students. None of the other variables contribute to the model (see Appendix G).

CLASSROOM FINDINGS

Certain teacher variables may be associated with the quality of students’ experiences at the Museum. In this study, the teacher and student data can be linked for 50 classrooms. By linking the data, it is possible to explore the relationship between teacher variables and key student outcomes, such as the knowledge and attitude items on the student questionnaire. For these kinds of analyses, the unit of study

is the *classroom*, not the individual student.⁶

To study classroom outcomes, the results for the individual students in the classroom are averaged to obtain a classroom score. Since classrooms are the unit of study, the small sample size ($n=50$) may not provide enough statistical power to detect small differences in the pre- and post-tour classrooms.

ATTITUDE SCALES BY CLASSROOM

This section of the report compares the pre- and post-tour classroom scores on the two attitude items about the Museum: “how interesting” and “how fun.” For these items, the classroom score is the average score of the students in the class. To obtain the classroom score, individual student scores were added up and divided by the number of students in the classroom.⁷

HOW INTERESTING STUDENTS FOUND THE MUSEUM BY CLASSROOM

Table 28 presents the classroom scores for the attitude item “how interesting.” The lowest possible score is 1.00 (boring) and the highest possible score is 3.00 (very interesting). Overall, the classroom scores range from 2.60 to 3.00, with mean of 2.89. Pre-tour classrooms scored significantly higher than post-tour classrooms: pre-tour classrooms’ mean score is 2.92 and post-tour classrooms’ mean score is 2.84.

The stepwise multiple regression analysis confirms this result. Only one variable predicts the classroom score on the “how interesting” variable: pre- or post-tour status. The other variables do not predict the classroom score (see Appendix G). So a higher classroom score on the “how interesting” attitude item is associated with pre-tour status. Findings at the classroom level are the same as the findings for individual students (see page 20).

Table 28
How Interesting by Classroom Group

Group	How Interesting Classroom Score ¹	
	Mean ²	±
Pre-tour classrooms	2.92	0.07
Post-tour classrooms	2.84	0.12
Total	2.89	0.11

¹Classroom scores can range from a low of 1.00 to a high of 3.00.

²F=8.71; $df=1,48$; $p=.005$

⁶ Statistical tests generally assume that the “units” in a sample are independent. In this study, classrooms meet the assumption of independence, but individual students do not, because many students have the same teacher, therefore the students are not independent of one another.

⁷ For the “how interesting” attitude item, students who selected “very interesting” were assigned 3 points, students who selected “kind of interesting” were assigned 2 points, and students who selected “boring” were assigned 1 point. For the “how fun” attitude item, students who selected “a lot of fun” were assigned 3 points, students who selected “kind of fun” were assigned 2 points, and students who selected “not fun” were assigned 1 point. To obtain the classroom score for each variable, individual scores were added and divided by the number of students in the classroom (adjusting for missing data). Classroom scores can range from a low of 1.00 to a high of 3.00.

HOW FUN STUDENTS FOUND THE MUSEUM BY CLASSROOM

See Table 29 for the classroom scores for the attitude item “how fun.” The lowest possible score is 1.00 (not fun) and the highest possible score is 3.00 (a lot of fun). Overall, the scores range from 2.33 to 3.00, with a mean score of 2.86. Pre-tour classrooms have a mean score of 2.88 and Post-tour classrooms have a mean score of 2.83, however the difference is not statistically significant.

The stepwise multiple regression analysis confirms this result. In fact, none of the variables in the analysis predicts the classroom score on the “how fun” item (see Appendix G). Findings at the classroom level differ from the findings for individual students. Among individual students, pre-tour students were more likely than post-tour students to describe the Museum as “a lot of fun” and females were more likely than males to describe the Museum as “a lot of fun.”

Table 29
How Fun by Classroom Group

Group	How Fun Classroom Score¹	
	Mean	±
Pre-tour classrooms	2.88	0.15
Post-tour classrooms	2.83	0.16
Total	2.86	0.15

¹Classroom scores can range from a low of 1.00 to a high of 3.00.

DESIRE TO VISIT THE MUSEUM AGAIN WITH FAMILY BY CLASSROOM

Post-tour students selected one of three possible responses that best described their feelings about visiting the Museum again with their family: “I want my family to visit,” “I am not sure if I want my family to visit,” or “I do not want my family to visit.” For this item, the classroom score is the average score of the students in the class.⁸

⁸ For the “want family to visit Peabody Museum” attitude item, students who selected “I want my family to visit” were assigned three points, students who selected “I am not sure if I want my family to visit” were assigned two points, and students who selected “I do not want my family to visit” were assigned one point. To obtain the classroom score, post-tour students’ scores were added and divided by the number of students in the classroom (adjusted for missing data). Classroom scores can range from a low of 1.00 to a high of 3.00.

The classroom scores for the post-visit classrooms are presented in Table 30. The lowest possible score is 1.00 (do not want my family to visit) and the highest possible score is 3.00 (want my family to visit). Overall, the scores range from 2.30 to 3.00, with a mean of 2.78.

Table 30
Want Family to Visit the Museum by Classroom Group

	Want Family To Visit Classroom Score ¹	
	Mean	±
Post-tour classrooms	2.78	0.24

¹Classroom scores can range from a low of 1.00 to a high of 3.00.

TRUE-FALSE ITEMS

This section of the report compares the classroom scores of pre- and post-tour groups on the two true-false items. For these items, the classroom score is the proportion of students in the classroom who answered the question correctly.⁹

Also reported are the results of stepwise multiple regression analyses of the classroom scores on the true-false items.¹⁰ Significant regression models are discussed in the report's narrative while the detailed statistical outputs for each model are provided in Appendix G.

⁹For true-false items, a blank or missing response was scored as incorrect.

¹⁰For these analyses, the dependent variable is the classroom score and the independent variables are: teachers' frequency of incorporating science in teaching, teachers' level of training in sciences, pre-visit classroom lessons, teachers' museum touring history, and pre- or post-tour status.

TRUE-FALSE ITEM: DINOSAURS ARE THE ONLY FOSSILS SCIENTISTS STUDY

See Table 31 for a comparison of pre- and post-tour classroom scores for the true-false item “Dinosaurs are the only fossils scientists study.” Post-tour classrooms scored better than pre-tour classrooms. In the post-tour classrooms, the proportion of students answering correctly was .91 compared to .83 in the pre-tour classrooms.

The stepwise multiple regression analysis confirms this finding. Only one variable predicts the classroom score: pre- or post-tour status. The other variables are not associated with the classroom score (see Appendix G). So for the true-false item “Dinosaurs are the only fossils scientists study,” a lower classroom score is associated with pre-tour status and a higher classroom score is associated with post-tour status. Findings at the classroom level are the same as the findings for individual students (see page 21).

Table 31
True-False Item “Dinosaurs Are the Only Fossils Scientists Study”
by Classroom Group

Group	True-False: Dinosaurs are the only fossils scientists study Classroom Score¹	
	Mean²	±
Pre-tour classrooms	0.83	0.12
Post-tour classrooms	0.91	0.11
Total	0.86	0.13

¹The classroom score is the proportion of students in the classroom selecting the correct answer.

²F=8.71; df=1,48; p=.005

TRUE-FALSE ITEM: BONES TAKE A LONG TIME TO BECOME FOSSILS

See Table 32 for a comparison of the pre- and post-tour classroom scores for the true-false item “Bones take a long time to become fossils.” Post-tour classrooms scored better than pre-tour classrooms. In the post-tour classrooms, the proportion of students answering correctly was 0.96, compared with 0.90 in the pre-tour classrooms.

Surprisingly, pre- or post-tour status is *not* significant in the stepwise multiple regression analysis. This analysis considers a number of variables simultaneously. In this mix, pre- or post-tour status does not predict the classroom score. However, two teacher variables are significant predictors of the classroom score: teachers’ museum touring history and teachers’ frequency of incorporating science in teaching (see Appendix G). For the true-false item “Bones take a long time to become fossils,” a higher classroom score is associated with both teachers who have made one or more prior school visits to the Peabody Museum and teachers who more frequently incorporate science in their lessons.

Table 32
True-False Item “Bones Take A Long Time To Become Fossils”
by Classroom Group

Group	True-False: Bones take a long time to become fossils Classroom Score¹	
	Mean²	±
Pre-tour classrooms	0.90	0.11
Post-tour classrooms	0.96	0.05
Total	0.92	0.09

¹The classroom score is the proportion of students in the classroom selecting the correct answer.

²F=7.39; df=1,48; p=.009

PRINCIPAL FINDINGS:TEACHER INTERVIEWS

RK&A interviewed 21 second-grade teachers whose students had attended the *Dinosaurs and More* tour. For methodological reasons, RK&A did not want to interview teachers who had completed questionnaires or whose students had been observed or interviewed. As such, RK&A randomly selected teachers from the tour schedules of October 2003 through February 2004. Telephone interviews were conducted in April and May 2004. The conversations were tape recorded with teachers' permission.

TEACHER CHARACTERISTICS

Nearly all teachers teach in public schools ($n=20$), while one teacher works in a parochial school. Most teachers ($n=16$) teach mainstream students, three teach bilingual students, one teaches special education students, and another has a mixed (mainstream, special education, and gifted) class.

Most teachers ($n=16$) have taken two or more science courses in college, while a few ($n=4$) have taken one science course and one teacher has no science training. One-half ($n=10$) also have attended pre-service or in-service training in how to teach science.

Approximately one-half of teachers ($n=10$) have taken students on field trips to the Museum for the past one to four years. One-third ($n=7$) have taken tours for five or more years, and three teachers said that this was their first field trip to the Museum.

GENERAL MUSEUM FIELD TRIP EXPERIENCES

HOW TEACHERS DECIDE WHICH MUSEUMS TO VISIT

RK&A asked teachers how they decide which museums to visit with their students. More than one-half of teachers said they select museums that connect with their curriculum (see the first quotation below). Two additional factors are important to teachers: about one-third said close proximity to the school, while another one-third said free or low cost to students (see the second and third quotations). Several others said the museum's school program offerings also impacted their decisions (see the fourth quotation).

We study dinosaurs in the second grade at our school. So it's important for [my students] to see the real-life fossils and learn a little bit more history that we might not cover in class.

Because the Peabody Museum is in close proximity to our school, we can get there within 20 to 25 minutes. They have a good exhibit of dinosaurs, and it's appropriate for the second grade.

We always choose the Peabody because they offer free programs up through February, and the students in my school are very poor. We always try to find the cheapest way to teach them.

I think [selecting a particular museum] has a lot to do with the hands-on activities that it provides. . . . Having a group leader [tour guide] that can go around and explain [the] various parts of the museum or different things about dinosaurs for example, is important.

USE OF GUIDED TOURS

All but one teacher said that they usually schedule guided tours when visiting museums on field trips. About two-thirds of teachers said that they scheduled guided tours because the tour guides are more knowledgeable about the subject and can share more information with the students than they can (see the first quotation below). Another one-third said they liked using the tour to introduce or review their curriculum unit, while a few others preferred using the tour as a way to organize their field trip (see the second and third quotations).

Sometimes the kids know more about dinosaurs than me. [It's] better to have someone more knowledgeable about fossils and dinosaurs and all the different time periods. It's much better to hear it from someone who knows exactly what they're talking about.

[I schedule tours] to reinforce the concepts that we have taught to the children. . . . We bring the children to the Museum [when] we are in the process of studying dinosaurs. If we have a guided tour, it can reinforce what we have taught the children, plus they may get other information that we haven't taught them.

I just think the structure is good for the students. It's more educational when there's structure to the field trip.

USE OF PRE- AND POST-VISIT MATERIALS

About one-half of teachers said that they use the pre- and post-visit lessons that museums provide. Many of these said they use museum materials that readily connect with their curriculum, are age appropriate, and easy to use in the classroom with little or no modification (see the first three quotations below). Many also added that they appreciate when museums provide students with information about what they are going to see and do at the museum (see the fourth quotation).

Good [museum] materials [are] something that [students] can relate to—that's related to our [classroom] lessons and something that they can complete and see the results of what they have done.

[The materials need] to be easy enough to understand and implement in the classroom [with] our time constraints. A lot of times you just don't have a lot of time, but sometimes the lessons can be so concise that you can just give them a lesson and they enjoy it and learn from it.

(What should museums consider when designing pre- and post-visit lessons?) Just things that you can actually do with students. If you're teaching a lesson for a second grader, it better be geared toward a second grader—what will interest them.

A little map . . . and step-by-step what they [are] going to do is nice, because the children . . . are going to anticipate [the field trip] and [that way] they have an idea of what's going to happen.

Many teachers said that lack of time was the biggest barrier to their use of museum pre- and post-visit materials (see the first quotation below). Other barriers included the museum lessons not aligning with their curriculum (see the second quotation) and the materials not being age appropriate or being too complicated.

Time is of the essence. There's not enough time to do everything. Sometimes you plan to do [one thing]—you'd like to spend a little more time on that—but something happens during the day and you don't get to it.

The biggest barriers to using [museum materials], is time [and] do the materials coincide with the curriculum goals—the objectives that the kids need to learn?

Over three-quarters of teachers said the best way to receive museum materials is through the mail prior to their field trip. About one-third added that they would also be willing to download materials from a Web site, while two teachers said that they would like to receive materials by e-mail.

DINOSAURS AND MORE TOUR EXPERIENCES

REASONS FOR SELECTING *DINOSAURS AND MORE*

Almost all teachers said that they selected the *Dinosaurs and More* tour because it aligned with their curriculum (see the first and second quotations below). A few teachers said that they chose the tour because they or their school had attended the tour in the past and enjoyed it (see the third quotation).

[In] February, that's when the second graders at our school learn about dinosaurs. So it would make sense [to attend the *Dinosaurs and More* tour] while we're studying them.

We have in our science curriculum [en]dangered and extinct animals, and so dinosaurs fall into that [category]. This way the children know what life was like back then.

We usually visit the Museum every year as part of the school tradition. We go there every year there and also because the dinosaur exhibit is very important for the children.

OPINIONS OF DINOSAURS AND MORE

OVERALL OPINION

All teachers interviewed attended the *Dinosaurs and More* tour with their students. Nearly all had positive opinions of the tour. Specifically, about one-half praised their tour guides (see the quotation below).

We have been going to the Peabody Museum . . . for 15 years. We always enjoy it. We always seem to get a very good guide. They're even able to answer questions from some of our brighter students. They're also able, most of the time, to control [students'] behavior and get them to listen. So we're always very pleased with it.

While teachers were generally satisfied with the tour, more than one-third offered suggestions for improving it, such as including more hands-on activities, lengthening the tour and covering

additional areas of the Museum, having the tour guides speak louder, or making the tour guide's vocabulary more age appropriate. A selection of quotations is provided below.

The . . . one thing [that] I wasn't as pleased with was I felt the level of the questioning and the way the presentation was—it was a little over the kids' heads. [The tour guide] had a difficult time explaining it, [so] maybe breaking it down a little bit more and keeping it simpler for second graders would be more beneficial.

(Overall, what was your opinion of the tour?) It was good, but [there] wasn't enough time, unfortunately. I mean I thought it was fine, [but] it's just there's not enough time to get through everything.

I would have some activity for them to do. Take them upstairs and let them try and interact with [things]. I think they need something more than just sitting and listening.

OPINION OF THE TOUR FORMAT

Most teachers said the format and organization of the tour worked well for their students. Teachers said they felt the tour pace and how the students were made to move from exhibit to exhibit kept them interested (see the first quotation below). A few teachers said their students enjoyed the hands-on activities, while a few others mentioned that the overview nicely framed the experience (see the second and third quotations). In contrast, some teachers said they thought students would have enjoyed having more hands-on activities and more free time to explore different exhibits—that is, include experiences that students enjoy.

(What, if anything, about the tour format worked well for your students?) Because it was in small parts—they went to an exhibit, discussed it, and [then] moved on to another one. The museum is pretty large, so to have it [broken down] into so many small components made it easy for them.

I think they liked the part where they were actually able to touch, feel, and experiment with different things.

When we first arrived, [the tour guide] took our group . . . [to] little room right before you enter the Museum. . . . He had them all sitting down on the floor and it was a question and answer [session]—more like a class. Basically, it was an overview of what dinosaurs ate and that they weren't scary. . . . [The students] were really attentive. Even though there were classes walking by us, people coming in and leaving, and people shouting over us, they couldn't take their eyes off of him [the tour guide]. They were very excited.

OPINION OF THE TOUR CONTENT

Nearly all teachers said the tour's content directly related to their classroom lessons about dinosaurs (see the first and second quotations below). A few teachers said they were studying prehistoric time periods in general, while a few others said that the tour content was not related to what they were teaching in class.

Yes it [the tour] was very much tied in [with] what I'm teaching. . . . I know [the tour guide] talked about the three periods within the Mesozoic era. I know they talked about fossils and the way those are uncovered. I know they talked about a variety of different dinosaurs. My

children are responsible for being able to list and identify different kinds of dinosaurs as well as extinction theories and that was also reviewed.

[Students] had learned about the different eras—an objective in our curriculum, and that was covered in the tour content, too. [Another] objective was to be able to describe dinosaurs, their height and their physical characteristics. I think the tour covered that very well, having the models there and some of the explanations from the tour guide.

Many teachers said the tour's content worked well for their students because it built on what they had been learning in class (see the first quotation below). Some others said the tour guide's delivery of the content made it understandable to students (see the second quotation). A few teachers said the Museum's *collection* was salient to students' learning; for example seeing the real fossils and the *Age of Reptiles* mural (see the third quotation).

Connections [the tour] made to [what students] had learned already in [the] classroom, like the different names of the dinosaurs and there was a certain fish that hung on the wall that we had seen in a book that we had previously read—that's the most valuable part of the tour—connecting with what students have already been studying.

I thought our tour guide was able to bring it down to the children's level [when he] discussed whether dinosaurs came from birds or reptiles. And they were able to discuss things like that with him.

Just being able to see the [the] giant mural that shows the ages of how things have changed [gave] them a really good historical view as well. . . . For kids, just seeing the huge, real dinosaurs makes a difference.

STUDENT LEARNING

RK&A asked teachers what their students had learned from their tour experiences. Many teachers said their students gleaned a new visceral understanding of dinosaurs, by seeing real fossils and realizing how big dinosaurs were (see the first quotation below). Some others said that their students gained more factual knowledge about dinosaurs (see the second quotation).

[Students] could see what we're talking about when we talk about how huge the dinosaurs were, because they could see the dinosaur skeletons there. It's always remarkable when you first take children into the dinosaur hall and they see the skeletons there—to see the look on their face when they realize just how big these animals were. So I think that that's very important to them, to see that these animals once roamed the earth, and even though we can't see [living ones] anymore, they can still see them at the Museum.

They became more knowledgeable, definitely had more facts about dinosaurs than they had prior to going there. (Such as?) Size, diet, things like that.

Teachers were also asked to describe how the tour impacted their students. Many teachers said simply visiting the Museum was valuable for students—either because their families do not attend museums or because it was a change of pace from classroom learning (see the first two quotations

below). Some teachers noted that their students had a better understanding of dinosaurs after attending the tour, while a few others said that their students now had a greater interest in dinosaurs (see the third and fourth quotations).

Many of my students are not able to visit museums. I would say 90 percent of them aren't going into the Museum of Natural History in New York or in Washington or things like that or even in the Peabody Museum. . . . I think it's very important that they have access to this wonderful resource.

It [the tour] gave them a different experience, rather than me being in the classroom teaching them about dinosaurs, going on the computer and getting research, they were actually able to go to the Museum. It was more hands on, more exciting for them.

I think it [the tour] gave them on a larger scale . . . a better understanding of dinosaurs—this is what they really looked like [and] this is where they lived.

I think it [the tour] definitely increased some of their interest in dinosaurs, and they want to learn more about them.

DINOSAURS AND MORE TEACHER MATERIALS

PRE- AND POST-VISIT LESSONS CONDUCTED

Currently, the Museum does not provide teachers with pre- and post-visit materials. Despite that, more than one-half of teachers said that they conducted a pre-visit lesson with their students. Most said that they provided students with an introduction to dinosaurs (see the first quotation below). A few said that they visited the Peabody Museum Web site with their students, and a couple of others read books about dinosaurs with their class (see the second and third quotations). Of the teachers who did not conduct a pre-visit lesson, most said they were already teaching a unit on dinosaurs in their class and felt they did not need to do a specific pre-visit lesson with their class.

We talked about different dinosaurs [and] classified them. We talked a little bit about the time, the climate of the time, things like that—nothing too in-depth but we did what we could with the resources that we had available.

We went to the Web and we previewed the Museum and the children had to do a hunt on the Web site to find different things.

We went over all the different types of dinosaurs in class and read about them with nonfiction and fiction books.

Two-thirds of teachers conducted an informal post-visit lesson with their students. Most discussed the field trip with their students, while many also had their students write about their experiences (see the quotations below). A few said their students drew pictures of what they saw on the trip.

I [asked students] their responses to what they learned, and discussed it a little further, but the field trip basically [was the] culmination [of] our [dinosaurs] unit.

They [students] wrote a little summary of what they learned—a lot of the information connected to what they learned at the Museum along with what we've done before.

TEACHER MATERIALS NEEDED

When RK&A asked teachers what materials from the Peabody Museum would have helped them plan their visit, about one-half said they would have liked information about the specific dinosaurs and animals that the students were going to see on the tour (see the first quotation below). One-quarter of teachers would have liked to receive a map of the Museum and information about the different exhibits at the Museum to decide whether there were other areas they would like their students to see (see the second quotation).

(What materials would have helped you plan your visit?) Maybe [information] about the dinosaurs that you have set up in the middle [of the Great Hall]. If I had known ahead of time exactly what dinosaurs were there and what he [the tour guide] would be talking about, I would have talked more about those [topics], so that [students] would have felt like they knew more.

It might be nice to have a map ahead of time of all the floors, because we didn't do the Egyptian room. . . . Maybe a little blurb [about] the [different areas] so we could interest the children by suggesting things like, 'Don't forget to look at the mummy'—maybe [give teachers] little questions to excite [students] to see those particular things.

When asked specifically what pre-visit materials they would have liked to have received, about one-half of teachers said a lesson about the dinosaurs featured at the Museum would have been helpful. The other teachers could not think of any pre-visit materials that the Museum should provide.

Teachers were also asked what post-visit materials they would like to receive from the Museum. About one-half of teachers would like to be provided with a quiz or worksheet about what students saw at the Museum (see the first quotation below). Some teachers did not suggest post-visit materials that the Museum should provide. A couple of teachers said they would like a writing activity related to the tour content. A couple of others said they would like to send student work to the Museum, because some guides gave the student assignments to complete as homework (see second quotation below).

(What kind of post-visit materials would you like to receive from the Museum?) Maybe . . . a worksheet or graphic organizer where they [students] could just jot down some new facts that they learned on the tour.

(What kind of post-visit materials would you like to receive from the Museum?) Something like a summary—where [students] would have to complete it and return it to the Museum. . . . [Our tour guide] asked the students lots of question, so if they answered those questions, it would be nice to send it back to [the guide] to make sure it's correct.

PRINCIPAL FINDINGS: STUDENT OBSERVATIONS

To develop the student interview guide, RK&A attended three *Dinosaurs and More* tours with second-grade classes in April 2004. The students observed were a separate sample from those who completed a questionnaire and participated in an interview—that is, none of the students observed participated in other aspects of the evaluation. Each tour was presented by a different tour guide. During the tours, RK&A staff noted tour guides' and students' behaviors. The observations are summarized in the sections below.

TOUR FORMAT

All three tours began with a welcome and introduction in a room off the Great Hall. Tour guides briefly described what would happen on the tour and provided a little history about the Peabody Museum. Two tour guides explained the process of fossilization and passed around specimens for students to touch.

Once the classes entered the Great Hall, tour guides lead students from one section of the exhibition to another. Two tour guides asked students close-ended, factual questions about the fossils on display, for example; “What is the name of this dinosaur?” and “What does the Apatosaurus eat?” Some students eagerly answered the questions, appearing to have great familiarity and interest in dinosaurs. For the most part, these students' responses were correct. Other students did not venture to answer any questions and their attention sometimes lapsed. Both of these tour guides presented a lot of information to students, leaving little time for students to ask questions. The third tour guide asked students what questions they had about the fossils on display or dinosaurs in general. Students framed their own experiences by choosing which fossils to talk about and which to bypass. Students' questions ranged from the museum display (e.g., “How did you put that skeleton together?”), to dinosaur behavior or characteristics (e.g., “Was the Stegosaurus really dumb?”), to dinosaur theories (e.g., “How did dinosaurs die out?” and “How are dinosaurs like birds?”). As the questions suggest, students had differing levels of knowledge about dinosaurs. The tour guide readily answered each question using simple language. Nearly all the students asked questions, and most students paid close attention to what the tour guide and other students were saying.

In the middle of each tour, all three tour guides stopped at a cart in the Great Hall and passed around specimens for students to touch. All students were excited to touch both real and cast fossils.

During the tour, each class circled the Great Hall and ended at the Triceratops display with tour guides thanking students for attending the tour.

TOUR TONE

The three tour guides interacted with students in different ways. One had a formal interaction with students and focused heavily on classroom management. For example, she asked students to raise their hand when responding to her questions and encouraged students to pay attention when they

started to lose focus. She maintained a serious tone throughout the tour—much like a classroom teacher—some students were comfortable with her and others were not.

The second tour guides talked quickly and in an excited manner. His energy transferred to students, and they excitedly answered his questions. He also told humorous stories about himself, paleontologists, and fossils. Students seemed to enjoy his friendly manner, by laughing at his jokes and paying attention when he spoke. His passion for dinosaurs came across clearly in how he talked about the fossils.

The third tour guide spoke softly and displayed a calm demeanor. He responded to each student's question—simple and complex—with equal sensitivity. He made each student feel important and intelligent by seriously addressing his/her question. In fact, his attitude demonstrated a genuine interest in students' questions. He allowed students to control the line of the questioning and pace of the tour, so students saw fewer specimens but discussed each one at greater length.

TOUR CONTENT

All three tour guides demonstrated a rich knowledge of the content as they presented students with an abundance of facts and answered a range of questions. During the tour, each tour guide focused on the prehistoric animals' characteristics and behavior. All three distinguished dinosaurs from the other prehistoric animals, for example noting that a mosasaur is a marine reptile and not a dinosaur. Additionally, all three stated that dinosaurs are not reptiles. Two mentioned that dinosaurs are more closely related to birds than reptiles and that some scientists classify dinosaurs as birds.

All three tour guides usually referred to a fossil on display and then cited facts about it, rather than having students' carefully look at the fossils and try to glean information from them. For example, when one tour guide asked students what *T. rex* ate, rather than suggesting that students look at the skull and try to use it as a source of information, he simply waited for the correct response. Additionally, sometimes the tour guides referred to fossils but their appearance was not explained. For example, one tour guide showed students a duckbill dinosaur jaw but did not explain the unusual appearance of the teeth—that they were continuously replaced during the animal's lifetime.

As they were talking about dinosaur characteristics, two tour guides stressed that much of what scientists know about dinosaurs are “just theories,” defining a theory as “a guess” or as “something you cannot prove.” One tour guide suggested that students make up their own theories about how *T. rex* used its short arms or why there are holes in a triceratops' frill.

PRINCIPAL FINDINGS: STUDENT INTERVIEWS

RK&A interviewed students at Lewin G. Joel Jr. Elementary School in Clinton, Connecticut and Tuttle Elementary School in East Haven, Connecticut about four weeks after attending the *Dinosaurs and More* tour. A total of 35 students were interviewed in April and May 2004. RK&A secured parental consent for all participants, interviewing students one-on-one, and the conversations were tape recorded with permission.

STUDENT CHARACTERISTICS

Two-thirds of students ($n=21$) were male and one third ($n=14$) were female. Two-thirds of students were eight years old ($n=21$) and one-third were seven years old ($n=14$).

Twenty-three students had been to the Peabody Museum prior to the day they visited with their school. Of those, 17 had visited the Museum with their family, while six had previously visited with their school. Most students had visited one or fewer times in the past 12 months ($n=19$), while two students had visited twice in the last year and another two had visited three times in the same time period.

REACTIONS TO THE PEABODY MUSEUM

FAVORITE AND LEAST FAVORITE ASPECTS OF THE MUSEUM

Two-thirds of students interviewed said seeing animal fossils and other animal displays was their favorite aspect of the Museum (see the first and second quotations below). Nearly one-third mentioned touching artifacts as their favorite part of their visit (see the third quotation). A few students said they enjoyed seeing Egyptian artifacts, while another few students said they liked the rock and crystal displays best.

Seeing the bones of the dinosaurs and seeing the turtles, the great big turtle and seeing like when we walked through, like seeing the giant squid on the ceiling. [Female Student]

Seeing the Apatosaurus (Why?) Because it was the biggest dinosaur, and it looks like [the one] I was studying about [in school]—mine was Brachiosaurus. It was a plant eater just like that [one]. My second favorite was Stegosaurus, because it has those plates on its back. My third favorite was a big turtle that had a big back. [Male student]

My favorite part was when we got inside of that craft room where we got to feel all the different skins. We got to put our hands in and we got to feel and then open the door [to see what we were touching]. I felt a big seashell, a starfish, and then I felt skin from a skunk. It was cool. [Male student]

About one-half of students did not have a least favorite aspect of their visit to the Museum. About one-quarter disliked seeing a specific animal, while another one-quarter reacted negatively to the tour guides (see the quotations below).

[When] we saw that big giant spider upstairs in the glass. (Why?) [It was] scary. [Male student]

There was this place where there was grass. I think it was grass. They had all this green stuff that looked like bushes and trees and there was a bear standing up in it. He was big, that sort of scared me. [Female student]

I didn't like sitting and listening to what the tour [guide] was saying. I was listening, but it was kind of boring. [Female student]

IMPRESSIONS OF THE MUSEUM

When asked how they would describe the Peabody Museum to a friend, about one-one-half of students said the Museum is a place where one can see dinosaurs and other prehistoric animals (see the first quotation below). Less than one-half said they would tell their friends that the Museum was “interesting” or “cool.” A few said they would mention the different things you could touch at the Museum or that one can learn things at the Museum (see the second and third quotations).

Well, I would describe [the Museum as having] a lot of dinosaurs, animals from the past, and a giant sea turtle. [Male student]

You get to touch Triceratops. I think I forgot its name but it was cool. And they showed you the egg and poop. [Male student]

It has a whole bunch of things in it. It's a very big place and you can learn a lot from it. (What kinds of things?) Dinosaur stuff, mostly a lot of animals, and things [from] the old days. [Female student]

REACTIONS TO THE TOUR

RECOLLECTIONS OF THE TOUR

RK&A asked students what they remembered about the tour they attended during their school visit to the Museum. All students recalled seeing dinosaurs and other animal fossils on the tour (see the first two quotations below). When prompted, about one-half of students remembered specific information associated with dinosaurs—either about bones, eggs, or paleontologists (see the third quotation). A few remembered seeing plant fossils but recalled less detail (see the fourth quotation).

I remember all the dinosaur skeletons. There was Stegosaurus and Brachiosaurus and a few other dinosaurs. There were fishes and a giant turtle. [Male student]

[We saw] one that was like a fish, [but it] wasn't considered a dinosaur. It was considered a swimming reptile. [Female student]

There was a guy [tour guide] and he showed us all kinds of dinosaurs. He told us about a fight that was going on with two people [Cope and Marsh] and even though the fight was bad, they found a lot of dinosaurs. [Female student]

I think we saw a fern leaf. (What did it look like?) I think it was big. [Male student]

FAVORITE AND LEAST FAVORITE ASPECTS OF THE TOUR

When students were asked to identify their favorite aspect of the tour, most students, again, mentioned seeing and learning about dinosaurs (see the first quotation below). A few students said they liked the

dinosaur eggs best, and another couple of others liked the *Age of Reptiles* mural or touching specimens (see second and third quotations).

My favorite [part of the tour] was when we saw the meat eater that was standing. It had its hands up. He [the tour guide] showed us a skull. . . . My second favorite part was when we saw the *T. rex* head. (Why is that?) Because I didn't know that . . . their head was so big. It had two holes [in it], and it was cool. [Male student]

I think the most interesting part was to be able to see the actual egg of a dinosaur and see the actual [fossil and how] the mud covered it where it hatched. [Female student]

The most interesting part was when he [the tour guide] . . . showed us the big mural. He told us there were a lot of mistakes in it [and] . . . that tomorrow we'll [know] even more, so there will be even more mistakes in it [than there are] right now. [Female student]

Most students did not have a least favorite aspect of the tour. Several said, "The guide talked too much."

SUGGESTIONS FOR IMPROVING THE TOUR

When asked what the Museum should change to make the tour better, about one-third said that there was nothing that should be changed. About one-quarter said the tour should be longer or it should include the entire Museum (see the first and second quotations below). Another one-quarter suggested that the tour should show more fossils (see the third quotation). A few students suggested that the Museum should change the dinosaur exhibit with new or mechanical dinosaurs (see the fourth quotation).

(What would you do to change the tour to make it better?) Probably [let] us stay longer. Maybe we could go in the morning and leave in the afternoon, be there all day and see the whole museum. [Male student]

Anything I would change? I would want them to show the upstairs. [Female student]

Maybe [show] more dinosaur things, fossils, things that they put together. (Like what?) Dinosaur bones put together, because I only saw three. [Male student]

If they added in like these mechanical ones and to show you [what] dinosaurs were like—that would be cool. [Male Student]

UNDERSTANDING OF CONTENT

MAIN IDEA

Most students said the main idea of the tour was to explain the time period of dinosaurs or teach specific facts about dinosaurs (see the first and second quotations below). About one-quarter said that the tour was intended to show how interesting dinosaurs are, with a few adding that the tour encouraged students to become paleontologists (see the third and fourth quotations).

He was trying to show what dinosaurs were like and the kind of world they lived in. [Male student]

Help them learn more about dinosaurs. (Like what?) That *T. rex* had 60 teeth. [Female student]

(What do you think the tour was trying to show or tell students?) That dinosaurs can be more interesting than they look. They can be a lot more interesting. (In what way?) Just all the shapes and all the things you could do with fossils. If you had fossils and you could [put them together] any way you like because nobody knows what they looked like. [Male student]

(What do you think the tour was trying to show or tell students?) To show them that dinosaurs really did exist at the time . . . and trying to get kids more interested in dinosaurs to learn more and maybe to be a paleontologist when they grow up. [Female student]

KNOWLEDGE OF DINOSAURS

To better understand what students learned on the tour about dinosaurs compared with what they were learning in school, RK&A asked students to identify their favorite dinosaur from the tour and explain their selection. Students most often named Tyrannosaurus Rex, Brachiosaurus, and Brontosaurus/Apatosaurus as their favorites. Some students said that they liked these fossils the most because they were of their favorite dinosaur (see the first quotation below). A few students said that these were their favorite fossils because they liked the dinosaurs' behavior or appearance (see the second quotation). As students talked about dinosaurs, it became unclear what they had learned on the tour versus other sources of information.

My favorite fossil was the Velociraptor fossil. That was one of my favorites; Velociraptor is my favorite dinosaur and my favorite in the Museum, my favorite dinosaur. (Why?) Because of how it's colored and of how the sharp claw, like how he jumps. When he jumps, he jumps way high in the air. Like for the *T. rex*, he would jump, he could reach his neck. [Male student]

The *T. Rex*'s face and Stegosaurus and Brachiosaurus [were my favorite fossils]. (Why?) Because one's a meat eater and Stegosaurus has a small brain. He has a small head and I like small things. I like Brachiosaurus because he's real tall and he can stand up on two feet like real people and he can roar real loud. [Male student]