BLENDING FORMAL AND INFORMAL SCIENCE LEARNING ENVIRONMENTS:

LEVERAGING THE BEST OF BOTH FOR OPTIMAL STUDENT SUCCESS

by

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In presenting this professional paper in partial fulfillment of the requirement for a master's degree at Montana State University, I agree that the MSSE Program shall make it available to borrowers under the rules of the program.

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ABSTRACT

This study examined the efficacy of content-focused pre-visit and post-visit activities on student learning when paired with an out-of-classroom learning experience. San Diego Zoo Education staff provided materials for activities to be conducted in the classroom by teachers both before and after a field trip to the zoo for the *Life Cycles* program for second grade students. Data collection instruments included student artifacts and attitudinal questionnaires supported by teacher surveys and researcher observations of student participation. Students in classes using the pre- and post-visit activities were compared with students in classes who participated in a *Life Cycles* program but who did not receive the pre- and post-visit activities. Results showed students had a considerable amount of prior knowledge about animal life cycles and that they were overwhelmingly positive about their visit to the zoo. Students who completed a pre-visit activity in the classroom showed a higher percentage of participation in the educational presentation at the zoo. Teachers bringing students to the zoo did not value post-visit activities but highly valued the opportunity for their students to see live animals.

INTRODUCTION AND BACKGROUND

As an informal science educator and science writer, I am continually challenged with providing useful, relevant, and supportive programming for formal educators teaching in the classroom. During the past 27 years I have taught ocean, Earth, and atmospheric sciences in a variety of informal learning settings such as those provided by SeaWorld San Diego, Birch Aquarium at Scripps, and San Diego Zoo Global. I have developed and implemented many education programs with supporting curricula and have seen many outcomes among students, teachers, and adult chaperones during their out-of-classroom learning trips.

Depending on the commitment of the formal educator and the attentiveness of the informal educational institution, trips to the informal science setting vary from an opportunity for unsupervised students to run around willy-nilly at a public place to a structured, rigorous, content-based schedule that mirrors the formal classroom. The sheer volume of available staff, animal, and place-based learning resources, coupled with the national cry for improving student learning, would seem to dictate the obvious choice of leveraging any out-of-classroom excursion to its fullest advantage.

In San Diego County, the San Diego Zoo is a popular destination for out-of-classroom learning trips. The zoo covers 100 acres and is home to more than 3,700 rare and endangered animals. It opened its gates in 1916 and now has an annual attendance of 3.5 million visitors (San Diego Zoo Global Library, n.d.). The Education Department at the zoo offers a wide variety of programming for preK-12 teachers and their students, both on-site at the zoo and off-site at nearby schools (San Diego Zoo Global, 2012).

Dr. Harry Wegeforth, founder of the San Diego Zoo, dedicated the zoo to the children of San Diego. To honor that dedication the zoo offers schools within San Diego County free admission for self-guided field trips during the traditional school year. In addition, the Education Department at the zoo offers fee-based, grade-specific presentations and guided tours that include bus tours and behind-the scenes visits. Through the generous support from the Samuel I. and John Henry Fox Foundation and the Donald C. and Elizabeth M. Dickinson Foundation, the zoo is able to offer the *Life Cycles* program for second graders free of charge. The 2-hour program includes a 20-minute presentation in the Otto Center Auditorium followed by a 45-minute bus tour through the zoo's animal exhibits.

The second grade *Life Cycles* program has been offered for more than 60 years and is very popular with local teachers. Maximum attendance is 200 students per day, Tuesday, Wednesday, and Friday. Yearly attendance can reach 13,250 students (San Diego Zoo Global, 2012). A curriculum packet is mailed to each teacher, but completion of the suggested activities is optional.

As a member of the National Science Teachers Association (NSTA) and the past Chapter Representative of Southwest Marine/Aquatic Educators' Association, I identified with NSTA's position statement on learning science in informal environments that fully recognized the potential synergy between the informal and formal learning settings. Outlined in its five declarations, NSTA "recognizes the critical role that informal learning opportunities provide preK-12 students" (NSTA, 2012, p. 2). The position statement advocates for expanding informal learning opportunities, expanding the role of informal science institutions, promoting stronger links between formal and informal science

learning, creating better measures to evaluate and sustain the learning, and supporting the informal science educator.

With a focus on promoting strong links between schools and the out-of-school-time setting, the purpose of my study was to examine and reinforce the connection between learning experiences in the classroom and learning experiences at a science-rich institution, namely the San Diego Zoo and the *Life Cycles* program for second grade.

My primary focus question was, "Does the use of in-classroom, scaffolded instruction before and after an out-of-classroom learning experience motivate students to participate in learning and thereby improve content retention?"

Many zoos, aquariums, and science centers provide teacher guides, activity books and other resources, but how closely do these resources match the instruction in the classroom, and to what extent are the formal educators using these resources? My secondary questions were

- Will the pre-visit and post-visit activities enhance the out-of-classroom experience?
- Will completion of the pre-visit activities affect students' participation in the learning experience at the zoo?
- Will the pre-visit activities affect the teachers' experience at the zoo?
- Will the post-visit activities affect student content retention after the zoo experience?
- Will in-classroom activities increase teacher motivation to take students out of the classroom for informal education?

CONCEPTUAL FRAMEWORK

The high value of place-based or nature-based education in the context of informal learning experiences at science-rich institutions is widely recognized by informal and formal educational practitioners alike (Braund & Reiss, 2004; Falk, Dierking & Foutz , 2007; NSTA, 2012; National Research Council, 2009; Sobel, 2004). Optimizing both the science content of the experience and student motivation is key to successful learning. Strategies to attain this goal arise from three sources (Griffin, 2007). They are the informal science instructor who presents the program at the zoo, science center or aquarium; the formal educator who teaches students on a daily basis and makes the choice to engage in an out-of-classroom trip; and the student who experiences and processes the instruction. The interplay between these sources can be framed within the concept of communities, with each having a role in the effectiveness of learning (Kisiel, 2010).

Instructors at informal science education institutions (ISEIs) come from a variety of backgrounds with diverse prior knowledge associated with their personal experiences. While at the ISEI, some instructors may be starting a career while others may be retired with decades of organizational or academic experience. Interwoven into the instructors' skill set are the ISEI's goals and missions, which can be at odds with instructor beliefs. This potential opportunity for muddled messaging becomes apparent during instructor-led programming, the mainstay of ISEIs. In a survey of 345 ISEIs 89% said they had programs that were face-to-face presentations, either on-site at the institution or as outreach to the local schools (Phillips, Finkelstein, & Wever-Frerichs, 2007). In addition to face-to-face time, these programs were often supported by print material such as

guides or activity books. In spite of this large effort to reach students, the ISEI programs frequently did not meet the needs of the teachers or align with the curriculum taught in the classroom (Phipps, 2010).

In the realm of formal education, the goal of schooling is to prepare children to be engaged as valuable, contributing members of society. To compete successfully in today's global world, young adults need to be useful, productive participants. After high school they either enter the workforce or continue in academia in college and beyond. The Next Generation Science Standards (NGSS) based on the newly published *Framework for K-12 Science Education* developed by the National Research Council (2012) aims to ready students for college and careers. The framework and the NGSS are products of the ongoing effort to improve science education in U.S. public schools, which many studies have deemed to be failing (AAAS, 1989). Collaborations between ISEIs and schools have been suggested as a more holistic and viable approach to improve student achievement (Stocklmayer, Rennie, & Gilbert, 2010; NSTA, 2012).

The yearly academic agenda of formal educators often includes state and national standardized tests in addition to school or district-wide emphasis on a particular subject such as language arts, reading and literacy, or social science. Implementation of the No Child Left Behind Act of 2001 sought to raise academic scores. The push toward standardized testing and the time spent teaching to the test to raise test scores has reduced science instruction at the elementary level in many schools (Jorgenson & Vanosdall, 2002). In addition to less instruction, busy schedules, lack of financial resources and time, along with restrictions on off-campus activities hinder trips to local ISEIs. Motivated teachers want to take their students out of the classroom, but are unsure how to

do so and to what degree the experience might benefit their students (Braund & Reiss, 2006). Motivation increases if teachers know what to expect during a field trip and if the pre-visit and onsite activities offered by the ISEI aligned with state or national standards or fit into their classroom curriculum (DeWitt & Storksdieck, 2008; Kiesel, 2006).

Fostering teacher motivation to use science-rich institutions has been suggested at the pre-service teaching level. A practicum experience at a local zoo, aquarium, science center or museum has the potential to expand and enhance teacher understanding of the informal learning setting. It can demonstrate how to leverage the most out of the opportunity and pair experiences with those in the classroom (Anderson, Lawson, & Mayer-Smith, 2006).

From a sociocultural perspective, teacher-student conversations are an important source of learning for students not only during the out-of-classroom trip, but also back in the classroom during pre- and post-visit activities. Teachers asked more open-ended questions while at the ISEI while taking advantage of the opportunities presented to encourage and sustain teacher-student talk and student-student talk. A shift in authority was noted in some teacher-student discussions with more balance between the students to the teacher (DeWitt & Hohenstein, 2010). This is in contrast to the in-classroom stance in which the teacher holds all the authority. The shift came into play as both teacher and student were exploring exhibits and displays, both learning new information. Other adult-student interactions occur during out-of-school learning experiences too. Often parents or other adults accompany the students as chaperones. Depending on the level of involvement, chaperones may act as an escort or may be more fully engaged as an

educator or parent (Wood, 2010). Optimally, chaperone interaction focused on the educator role would enhance student learning, both in content and in social interactions.

Paradoxically, even though students are the primary reason for the efforts taken to visit out-of-classroom learning locations, they often have little say when choosing a destination and little input on what to explore once there. During the past 10 years, interest in pupil voice has risen, and in her doctoral study Morgan (2011) investigated the process and impact of four teachers over the course of a year as they consulted their students about teaching and learning. She found that although consulting did not fit easily into the classroom, benefits to teachers and students were evident. The biggest obstacles were constraints of the classroom including time limitations, binding bureaucracy, competing priorities and the physical structure of the school buildings (Schwartz & Stolow, 2006). Informal learning environments and ISEIs may offer relief from some of these constraints, allowing pupil voice exchanges to flow more easily.

Four factors can encourage student learning at ISEIs. Three of these factors—learning science, learning about science, and doing science—concern the fundamental ideals of science education. Holistic representations in real contexts, transferrable knowledge with constructive inquiry, and content that is jargon free and in an active voice can help students learn science. Social interactions during the out-of-classroom experience facilitates learning about science. Participation in inquiry-based activities and involvement in real projects supports doing science. The fourth factor focuses on the affective realm and includes the opportunity for free choice, experiencing wonder and delight while visiting an ISEI, and moving within an entertaining environment

(Stocklmayer, 2010). Ideally, curriculum developed by an ISEI would incorporate some or all of these factors.

Continuing to explore student motivation, a study investigating the situational interest of students identified five triggers: social involvement, hands-on, surprise, novelty, and knowledge acquisition (Dohn, 2011). A separate study examined the agendas and expected outcomes of an ISEI trip among students, teachers, and instructors and found students held peer interactions the highest, with knowledge acquisition second (Davidson, Passmore, & Anderson, 2010).

In order to maximize student learning at science-rich institutions, instructors and curriculum developers need to consider the needs of both teachers and students and create ways to extend the learning experience beyond the day-of visit. For example, teachers can coordinate student pre-visit activities by viewing the ISEI's website and using any materials it provides. Using cameras or video recorders during the visit can produce material to be reviewed, discussed and extended into a report or presentation after the visit (Cox-Petersen & Melber, 2001). When the effectiveness of pre-visit instructional material is examined, one study found that use of pre-visit material improved post-visit test scores. The study results reported that students receiving the pre-visit materials were able to answer 7.7 more questions correctly, a statistically significant improvement over the control group (Gennaro, 1981).

Overall, place-based education and partnerships between schools and ISEIs hold great promise for future K-12 science education. With interactive roles working together within a shared framework, ISEI instructors, formal educators, and students have the potential to create powerful and lasting learning experiences.

METHODOLOGY

My study took place during April and May 2013. My treatment offered six second-grade teachers in-classroom activities from the *Life Cycles* teacher guide to be used with their students before and after participating in the *Life Cycles* program at the San Diego Zoo. The student sample size for the treatment group was 129. As a control, I recruited another teacher at each school who did not use in-classroom activities with their students but participated in the on-site *Life Cycles* program only. Student sample size for the control group was 74. My research sought to examine the efficacy of the pre- and post-visit activities on increasing student participation during the *Life Cycles* program and on content retention after the visit. The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained.

To select teachers and their students for the study, I contacted teachers at 15 schools who had reserved a *Life Cycle*s program in April or May 2013. My first contact was by phone. If the teacher expressed interest or agreement, I sent an Invitation Letter by email that explained the scope and intent of the study along with teacher expectations, required tasks to be completed, and level of student participation (Appendix A). The email also included a digital copy of the student questionnaire and a digital copy of the Parent Consent and Student Assent Form (Appendix B). Teachers either agreed to participate or declined. Accepting or declining participation in the study did not affect the delivery of the *Life Cycles* program in any way.

Twelve teachers at six schools agreed to participate in the study. The schools were located in three school districts within San Diego County and represented a diverse

demographic. Student enrollment in the six schools—coded S1 to S6—represented seven ethnicities. Schools S1, S4 and S5 showed a majority of white students while schools S2 and S3 and S6 showed a majority of Hispanic students (Table 1).

Table 1
Ethnicity of Students Enrolled in Schools Participating in Study, (*N* = 203)

	% Hispanic	% White	% Asian	% Filipino	% African American	% Pacific Islander	% American Indian
S1	5	71	22	2	1	0	0
S2	49	20	4	6	3	1	0
S3	63	3	19	1	14	1	0
S4	14	35	26	17	7	1	1
S5	29	61	3	2	4	1	1
S6	67	10	3	1	16	2	1

In comparison, California average demographics are 49% Hispanic, 28% White, 8% Asian, 3% Filipino, 7% African American, 1% Pacific Islander, and 1% American Indian or Alaska Native (Great Schools, 2013). There was also an eighth category of No Response with the state average being 3%. Only S2 had an entry in this category, 17%.

My treatment was the use of in-classroom activities explained in the teacher guide produced for the *Life Cycles* program. Teachers received the booklet after they reserved a program time and date for their class. The program and the booklet's activities specifically targeted second-grade students and aligned with the California Department of Education (1998) California State Science Content Standards, Life Sciences (Appendix C). The zoo-authored teacher guide contained six activities exploring the life cycles of plants, invertebrates, amphibians, reptiles, birds, and mammals. Each lesson plan included a vocabulary list, suggested books, activity steps and a materials list (Appendix D). The last activity, *Life Cycles Match-up Activity,* offered an overview by matching labeled images of young and adult animals together (Appendix E).

For data collection, I applied mixed methods qualitative and quantitative instruments organized in three chronological phases. The three-phase sequence of data collection sought to capture the continuance of learning. The treatment teachers selected one of more of the six activities from the teacher guide (Figure 1). The control non-treatment teachers did not use any activity from the *Life Cycles* teacher guide (Figure 2).

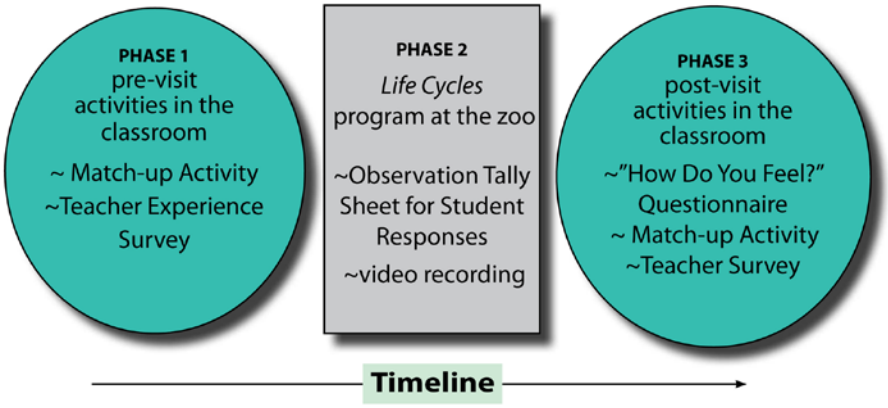

Figure 1. Chronological phases of data collection for treatment teachers, (*N* = 6).

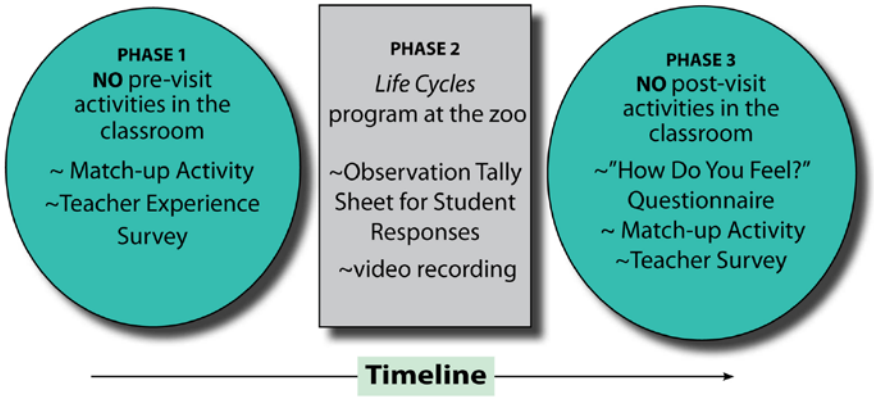

Figure 2. Chronological phases of data collection for non-treatment teachers, (*N* = 6).

In the first phase, all teachers in the treatment and non-treatment groups completed a Teacher Experience Survey (Appendix F). Administered online through SurveyMonkey, this ten-question multiple choice and short answer survey assessed teachers' current curriculum needs and past experiences with out-of-classroom learning trips. Responses were used to compile a teacher experience profile. All students in both the treatment and non-treatment groups completed the *Life Cycles Match-up Activity* in the classroom before visiting the zoo for the *Life Cycles* program. This served as an assessment and was graded for correct matches. Scores were compared to determine levels of prior knowledge. For the treatment group, the teachers selected one or more additional activities from the *Life Cycles* teacher guide, such as the *Amphibian Life Cycle Activity* (Appendix G). These activities were taught at the teacher's discretion and were not graded or collected.

The second phase focused on the level of student participation during the *Life Cycles* program at the zoo. The two-hour program had three parts, a 20-minute presentation "Roberta the Zebra" led by a zoo educator, a 10-minute live-animal touch with a skink lizard, and a narrated one-hour bus ride through the live-animal exhibits. Data collection to gauge student participation only occurred during the "Roberta the Zebra" presentation; the other two parts of the program were not observed.

Student participation was documented in two ways: First, in real time by the research observer using an Observation Tally Sheet for Student Responses (Appendix H) and, second, by video recording the "Roberta the Zebra" presentation. Observers completing the Tally Sheet in real time sought to document student participation by recording the number of hands raised in response to questions or prompts given by the

education instructor. The number of hands raised was then calculated as a percentage of the total number of students in the class. Students in treatment and non-treatment classes were distinguished from each other by using a seating chart. As the classes entered the auditorium, one class sat on the right side of the center section of the auditorium and the other class sat on the left side.

To record the presentation, an iPhone 5 was mounted on a flexible tripod. The tripod was then taped to the wall at the back of the auditorium. The video was started as the students entered and stopped as the students exited. The recording was reviewed to confirm the real time observation counts and to verify the seating chart for the classes.

Data collection continued in the third phase when the teacher and students returned to the formal classroom. Both treatment and non-treatment teachers repeated the *Life Cycles Match-up Activity* with their students. These post-visit papers were graded for correct matches and were used as indicators of improvement in content knowledge. In the classroom, students also completed an eight-question "How Do You Feel?" questionnaire designed on a four-point Likert scale represented by happy/unhappy faces (Appendix G). This instrument sought to assess student interest in learning and empathy toward animals. Responses to the questionnaire were calculated as percentages between the four points—4-very happy, 3-happy, 2-slightly unhappy, 1-very unhappy—and the mode was calculated.

Teachers received a Post-visit Teacher Survey that included multiple choice and short-answer questions in addition to ranking the *Life Cycles* program components as to the perceived value of student learning. The ranking of the six components was done on a six-point Likert scale and analyzed by mean score. These surveys were modified to target

treatment teachers (Appendix H) and non-treatment teachers (Appendix I). Both versions of the survey sought to determine if teachers were satisfied with the *Life Cycles* program, if they would be comfortable planning another trip, the value of the experience for student learning, and how the content of the program fit into their formal curricula. Teachers and students completed the three data collection instruments within a week of visiting the zoo.

After all data collection instruments were administered, the resulting completion and collection of the six data collection instruments was not consistent across schools.

- Two schools, S1 and S5, were missing non-treatment teachers and students; only one teacher from each school participated, the other two withdrew.
- The non-treatment teacher from S2 did not have the students complete the pre-visit and post-visit *Life Cycle Match-up Activity.*
- S3 teachers did not complete the post-visit *Life Cycle Match-up Activity*.
- S4 experienced transportation delays and arrived at the zoo too late to attend their 9:30 am *Life Cycles* Program in the auditorium that was to be recorded.
- All 10 teachers completed the Pre-visit Teacher Experience Survey but three teachers did not respond to the invitation to complete the post-visit survey.

Even with these inconsistencies, the triangulation of data collection instruments—both quantitative and qualitative for this study—enhanced the reliability of project outcomes. For data analysis I compared teacher surveys, student matching activity, presentation observations, recorded student participation, and student questionnaires to assess the students' motivation to learn. Pre-visit and post-visit student *Match-up Activity* papers were compared for overall scores of number of matches correct. Student

participation in the on-site program accounted for hands raised, attentiveness and focused interest. This was noted on the Tally Sheet and confirmed by observing the video. The "How Do You Feel?" Student Attitudinal Questionnaire was scored on a four-point scale with the value of 4 assigned to the happiest face and 1 assigned to the least happy face. Percent values were determined overall and then compared among treatment versus non-treatment classes. Teacher surveys gave insight into teacher skills and expectations. Overall, I looked for consistency in data collected among the treatment verses the non-treatment classes.

In addition, throughout the process of this study, peer collaboration and sharing was paramount. I discussed student artifacts and shared teacher feedback with fellow instructors and the director of the Education Department at the San Diego Zoo.

My primary focus question was "Does the use of in-classroom, scaffolded instruction before and after an out-of-classroom learning experience motivate students to participate in learning and thereby improve content retention?" The data collection instruments supported these sub-questions (Table 2).

Table 2
Data Triangulation Matrix

Secondary Focus Questions	Data Source			
	Phase 1	Phase 2	Phase 3	Phase 3
1. Will the pre-visit and post visit in-classroom activities enhance the out-of-classroom experience?	Pre-visit Teacher Experience Survey, on-line SurveyMonkey		Post-visit Teacher Survey, on-line SurveyMonkey	
2. Will completion of the pre-visit activities affect students' motivation to participate in the learning experience at the zoo?	In-classroom pre-visit *Match-up Activity*	Video and Observation Tally Sheet For Student Responses	In-classroom post-visit *Match-up Activity*	Post-visit Student Attitudinal Questionnaire-4-pt Likert
3. Will the pre-visit activities affect the teachers' experience at the zoo?		Video and Observation Tally Sheet for Student Responses	Post-visit Teacher Survey, on-line SurveyMonkey	
4. Will the post-visit activities affect student content retention after the zoo experience?	In-classroom pre-visit *Match-up Activity*		In-classroom post-visit *Match-up Activity*	
5. Will in-classroom activities increase teacher motivation to take students out of the classroom for informal education?			Post-visit Teacher Survey, on-line SurveyMonkey	

DATA AND ANALYSIS

Six schools, 10 teachers, and 203 students participated in this study. Each of the 10 teachers who participated had 10 years or more teaching experience and brought their classes to the zoo in previous years but only visited once in a school year. Sixty percent selected “seeing live animals” as the biggest benefit to students during a trip to the zoo, while the remaining 40% identified “talking with zoo educators.” No teachers selected any of the remaining five options, “learning new plant and animal information,” “learning conservation and stewardship,” “novel teacher-student interactions,” “novel peer-peer interactions,” or “learning to behave as a class in a public area.”

In the post-visit teacher survey, seven teachers rated the learning value of the six components of the *Life Cycles* program. These were the pre-visit activities, the “Roberta the Zebra” presentation, the animal touch of the skink lizard, the narrated bus tour, the optional free time to explore zoo, and the post-visit activities. Non-treatment teachers ($N = 3$) rated the pre- and post-visit activities as having the least learning value for the students with means of 2.33 and 1.66 respectively. The treatment teachers ($N = 4$), who did the activities, rated the pre-visit activities higher with a mean of 3.00, however the learning value of post-visit activities was rated even lower at 1.50. In addition, 75% of the treatment teachers said that they would not use any of the *Life Cycle* teacher guide activities after their visit to the zoo.

In both the treatment and non-treatment teacher post-visit survey, the narrated bus tour consistently rated the highest at 5.25 for treatment teachers and at 5.66 for non-treatment teachers. The next most valued component varied, treatment teachers valued

free time to explore the zoo second to the bus tour while non-treatment teachers valued the “Roberta the Zebra” presentation.

Nine of the 10 teachers led the *Life Cycles Match-up Activity* for assessing students’ prior knowledge. However, the number of pre-visit papers collected did not match the number of post-visit papers collected, 169 versus 129 respectively. S3 teachers did not repeat the activity after attending the *Life Cycles* program at the zoo; therefore these pre-visit papers were dropped from the pre-visit/post-visit analysis. From the 129 pre-visit papers collected 95% had correct matches. Of the 6 papers that had errors, 3 had the animal images *sorted* correctly into young and adult categories, but not *matched* as the activity directions instructed. For those remaining 3 papers that had errors, 1 had 12 incorrect matches out of 12 possible matches, 1 had 5 incorrect matches, and another had 1 incorrect match. Post-visit papers showed a slight improvement from 95% to 97%. Two of the pre-visit papers from S3 were corrected to zero errors. S6 had a paper correct in the pre-visit but with errors in the post-visit. Percentage of error-free pre-visit and post-visit papers is represented in Figure 3.

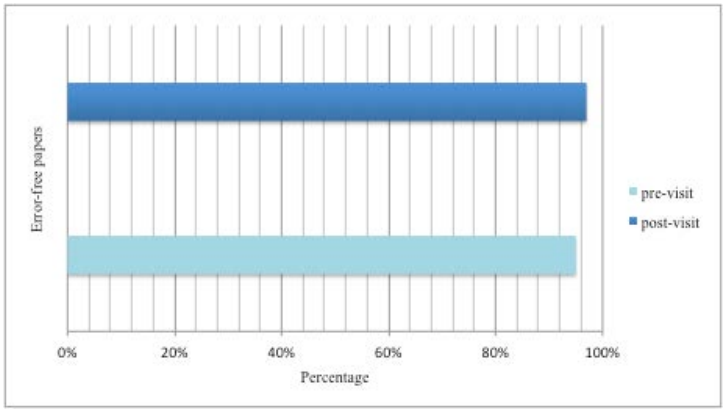

Figure 3. Error-free *Match-up activity* papers, (*N* = 129*).*

The remaining two instruments, the recording of student participation during the *Life Cycles'* "Roberta the Zebra" presentation at the zoo and the post-visit in-classroom "How Do You Feel?" Student Attitudinal Questionnaire provided additional data content.

During the 20-minute "Roberta the Zebra" presentation, there were seven opportunities for students to respond to questions or true/false prompts posed by zoo educators (Table 3).

Table 3
List of Opportunities for Student Response during "Roberta the Zebra" Presentation

code	Question or True/False Statement
Q1	Do you know what a life cycle is?
Q2	What stage are you all in?
Q3	Guess an animal that is not born alive
T/F 1	Two mammals hatch from eggs.
T/F 2	Young butterflies have the same body shape as their parents.
T/F 3	All animals start small and grow big.
T/F 4	Male deer sometimes fight, lock antlers, and push each other around in order to get a girlfriend

The calculated percentage of student response did not account for correctness as the zoo educators would often lead the students to the correct answer if the majority of the student responses were incorrect. The purpose of this data collection was to gauge student participation, which is raising a hand and trying to answer a question. Some questions or prompts elicited higher student participation than others. (Figure 4).

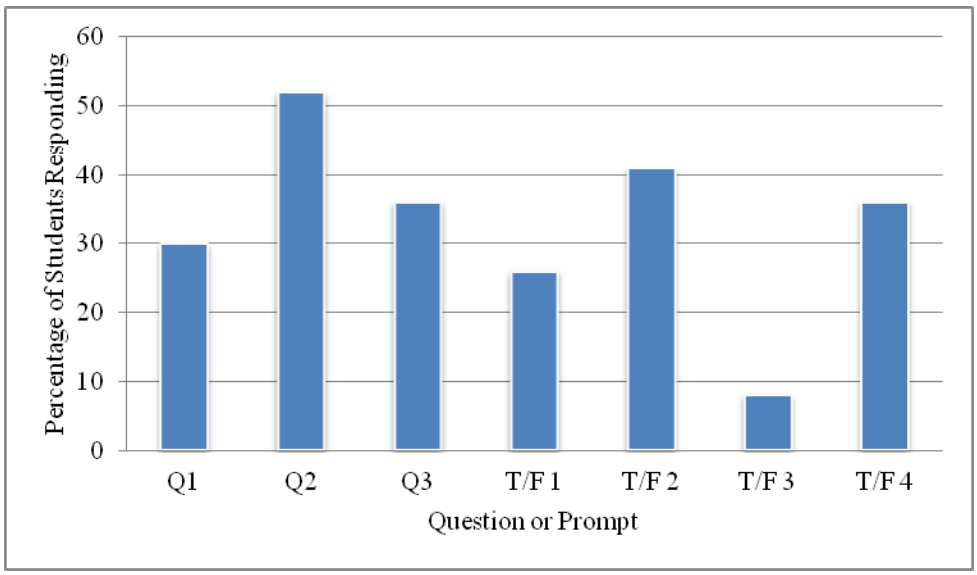

Figure 4. Percentage of students responding to seven prompts, (*N* = 166).

Unequal student participation appears when comparing treatment and non-treatment classes (Figure 5).

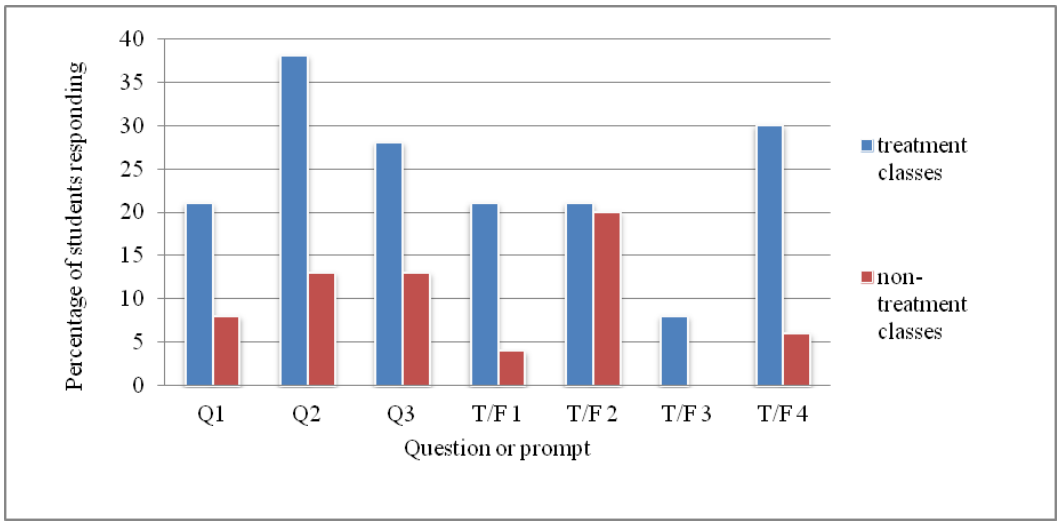

Figure 5. Percentage of students responding to seven prompts separated by treatment and non-treatment classes, (*N* = 166).

Two hundred and three students returned the "How Do You Feel" Student Attitudinal Questionnaire. Each questionnaire had eight statements that resulted in a potential total response of 1,624. However 37 students from S4 did not attend the "Roberta the Zebra" presentation and therefore could not answer the statement "I like the

things we did with Roberta the Zebra to learn about animal life cycles." From the total number of potential responses, students selected the very happy smiley face with a value of 4 65% of the time, showing a very positive attitude toward zoo animals. This mode of 4 held across all 10 classes participating in the study and across all statements on the questionnaire. (Figure 6).

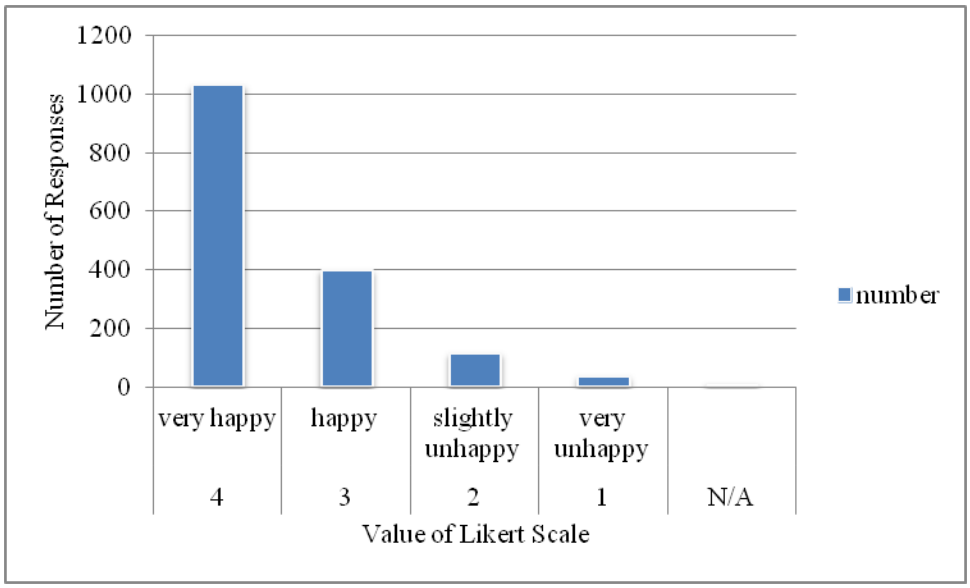

Figure 6. Total student responses from attitudinal questionnaire, (*N* = 1,587).

Of the eight statements, "I would like to visit the zoo again" received the highest percentage of very happy responses at 78%. "I liked the things we did with Roberta the Zebra to learn about life cycles" received the least at 50%. This trend remained when schools were separated into treatment and non-treatment classes. The statement that received the second highest number of very-happy-face responses was "I want to help zoo animals in trouble" with 69%.

However, some classes responded to almost all statements with the very happy face. The non-treatment class from S6 had the highest number of these responses; 58% or 14 of their 24 papers had very happy faces or 4s for six or more of the eight questions.

INTERPRETATION AND CONCLUSION

My study occurred during the California Standardized Testing and Reporting (STAR) program administered to the elementary grade levels during April and May. Even though I contacted teachers at 15 schools who had enrolled in the zoo's *Life Cycles* program, I had only 6 schools and 10 teachers respond and follow through. Many said their schedule was too hectic and they didn't have time for extra activities. This was very understandable and I sympathized with the teachers.

The Pre-visit Teacher Experience Survey shows that the teachers who did participate were highly experienced formal teachers and repeat visitors to the zoo. This I believe preselected a sample size of teachers who brought with them a certain set of skills. They were able to handle last-minute additions to their busy schedules and possibly had a more organized class management and formal curricula that covered animal life cycles. In the Pre-visit Teacher Experience Survey, one respondent noted she used the Full Option Science System developed by the Lawrence Hall of Science.

My goal was to recruit two teachers from each school, one who would teach an additional activity or activities from the *Life Cycles* program guide and one teacher who would not teach any additional activities. This would be the treatment and the complimentary non-treatment control. I sought this pairing to help equalize the variability that occurs between schools. From the six schools recruited, only one school, S6, completed all data collection instruments in both a treatment and a non-treatment situation. All others had one or more data collection instruments missing. This I believe created an incomplete data set that compromises the outcomes of this study.

Student performance on the *Match-up Activity* showed a high level of prior knowledge with only 2% of the 302 responses showing mismatches of young animals to adult or parent animals. Two of the mismatched papers were from the same student who put together her paper completely incorrectly both before and after the zoo visit. I believe this to be an outlier. Another two of the mismatched papers improved to be 100% correct in the post-visit iteration. Another five papers showed correct sorting but not matching, an indication of the students or the teacher not following the directions.

After reviewing the papers and the resulting count of correct and incorrect matches, I felt this data collection instrument was not useful in showing a gain in learned content. Therefore it is difficult to come to a meaningful answer to "Will the post-visit activities affect student content retention after the zoo experience?" The students already knew the information I was trying to assess.

When comparing teacher survey responses and student attitudinal responses the questionnaire, a mismatch appeared between the teachers' and students' perceived benefit of a visit to the zoo. In the Pre-visit Teacher Experience Survey, 60% of the respondents chose "seeing live animals" as the biggest benefit for students when visiting a zoo and in the Post-visited Teacher Survey the bus tour was the chosen activity with the highest learning value. But the number of students who selected the most happy face or a 4 on the Likert scale for "Zoo animals make me happy" was only 12%. In addition, "Zoo animals are fun to watch" received a lower percentage at 11%. The statement receiving the highest number of the happiest face at 15% was 'I would like to visit the zoo again." The lowest percentage was attending the "Roberta the Zebra" presentation at 10%. Students

may have responded this way because the bus tour through the zoo exhibits is at a distance and often the animals are not visible.

The student observation of responses during the “Roberta the Zebra” show most strongly supported the value of teaching pre-visit activities before a field trip to an informal science institution. During this study, teaching in-classroom activities was a requirement that one teacher had to do, but from reflection on the difficulty of recruiting teachers to participate at any level leads to a question about teacher motivation. Notably, treatment teachers who did pre-visit activities valued them more than the non-treatment teachers who did not teach an activity.

In conclusion, from the data gathered from the Observation Tally Sheet of Student Responses, the “How Do You Feel?” Student Attitudinal Questionnaire, and the pre-visit and post-visit Teacher Surveys, it is possible to increase student participation during excursions to ISEIs through the use of pre-visit focused activities.

VALUE

As an informal science educator who creates guides and resource booklets for formal educators, I strive to write and produce activities that are relevant and useful to the students’ learning experience at the zoo. Having an understanding of what type of activities teachers value and how they use them in the classroom is crucial. The experience of planning and implementing this study gave me some insight into teacher likes and dislikes and student learning during the *Life Cycles* program, but it is far from a complete picture. Flaws in gathering data and a very small teacher sample size compromised conclusions. I feel my efforts helped my colleagues gain valuable insight and a new perspective of our role as an ISEI for student learning.

In reflecting on the study, I have identified three areas for improvement: First, to increase teacher participation, I would approach teachers in October or November, not in the spring. The sequence of events that occurred this last spring made it necessary to ask teachers late in the year when stress is higher and additional tasks such as state testing occurs. Second, I would create a better assessment for prior knowledge and content retention. For example, instead of a static picture match, students would be asked to complete a free draw activity to explore an animal of personal interest. This could be framed within the context of the life cycle phases and open to further study by the student. Third, to assess long-term gains from a visit to the zoo, the study needs to extend the post-visit content retention assessment period. This would include a repeat of the knowledge assessment tool possibly two or three months after the visit to the zoo.

During the process of this coursework and my journey to complete it, I find myself in a completely different place, with a new job and a new setting for my study. Even through the exciting times of switching from an aquarium to a zoo, I kept focused on the outcome of the study: that is, blending the formal and informal learning environments. Interestingly, the study originally planned around a second-grade educational program on tide pool animals also applied to a second-grade educational program about the life cycles of zoo animals. The study's methodology created a three-phase template that proved flexible enough to assess the learning value of a different informal education program.

Overall, the study has shown me that teachers use activities more often before visiting the zoo than afterwards. Frontloading knowledge in this manner mimics the flipped classroom model in the formal learning environment. The flipped classroom

delivers instruction to the students before class time. This allows the time in class to be spent not on lectures but with hands-on activities. Giving information to the teachers before their visit to the zoo sets the stage for increased student learning while at the zoo. I was encouraged to see students feel good about visiting the zoo, and that many believe helping animals is worthwhile. I am renewed in the faith that class excursions to informal learning environments are worth the effort, and a vital part of a child's education.

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APPENDICES

APPENDIX A

TEACHER INVITATION LETTER

Appendix A
Teacher Invitation Letter

SAN DIEGO ZOO GLOBAL

April 30, 2013

Elementary School

San Diego, CA 92116

Dear [redacted]

We are sending you this letter in the hopes that you would be willing to participate in the proposed study on the San Diego Zoo's *Life Cycles* program. The purpose of the study is to determine the effect of pre- and post-visit activities on student learning when coupled with an out-of-classroom trip. This invitation letter serves to outline the proposed study, your involvement and responsibilities, and the rewards.

Your visit to the San Diego Zoo and participation in the *Life Cycles* program is scheduled for Friday, May 2013.

The following outlines the sequence of events for the study.

1. Pre-visit Activity
   To help assess student learning and the value of the Zoo's *Life Cycles* activity packet, we would like to have two classes from [redacted] participate, one class of students to try an activity of your choice from the packet and another class not do any activities. However, both classes need to do the easy *Match-up* puzzle. This asks students to match images of young and adult animals together in pairs on a piece of paper. I have the activity prepped and can drop it off at your school along with extra *Life Cycle* activity packets. The study will need to match the pre-visit and post-visit *Match-up* papers per student. You, the teacher, can use whatever method you prefer, except full student names. After this study you are welcome to use the *Life Cycles* activity packet in any manner that best suits your classroom.

   Also before your visit you will receive a survey through SurveyMonkey to assess your interest in out-of-classroom trips and past participation in Zoo programs.

2. Visit to the Zoo
   Please **bring the student sheets** from the *Life Cycles Match-up Activity* with you to the zoo. I will collect and give you materials to do the activity again

ZOOLOGICAL SOCIETY OF SAN DIEGO
Post Office Box 120551, San Diego, CA 92112-0551 USA Telephone (619) 231-1515

after your visit to the zoo.

During your visit to the zoo, the *Roberta the Zebra* presentation in the Otto Center will be videotaped from the back of the auditorium. No students will be individually identified. This videotape will be viewed by the study researchers (myself and my faculty advisor) and will be used to determine the level of audience participation and the types of questions asked.

3. Post-visit Activity
   After your visit, please repeat the *Life Cycles Match-up Activity* to assess student learning. (Again, no full student names on papers. Please use the same method of paper identification as previously used.) There is also a short eight-question "smiley face" questionnaire for the students that should not take more than 15 minutes. Please return activity and survey by mail in postage-paid envelope.

   Finally, you will receive a post-visit survey through SurveyMonkey again. Please complete and submit.

This study **asks for** school, parent and student permission. I have provided the permission slips for each. I can make copies and drop off at your school when I drop off the *Match-up* activity materials.

- Please distribute and collect the parent consent and student assent forms. These should be turned in by the time of your visit to the zoo. **Please note:** Participation in this study is voluntary and in no way will affect your program at the zoo. However, if less than ten students agree to participate, your class might not be the best candidate for this study. Parents are welcome to call me with any questions; my number is on the consent form.
- If possible, please have your principal sign a content permission slip. I will be happy to talk with him or her to help explain the study.

The San Diego Zoo very much appreciates your participation. For your efforts we would like to offer each teacher two admission tickets to the San Diego Zoo Safari Park and a complimentary copy of the *Panda Trek* curriculum. I can give you these on the day of your visit to the zoo.

We hope that you are able to help us in our development of curriculum; your comments are valuable. I will be following up with an email to see if you are interested.

Thank you.

Judith Coats
Interpretation Specialist
San Diego Zoo Global
Phone 619 718-3544

APPENDIX B

PARENT CONSENT AND STUDENT ASSENT FORM

Appendix B
Parent Consent and Student Assent Form

Informed Consent and Assent Form for Students in the Study Conducted at San Diego Zoo

Dear parents and students,
Thank you for considering to allow your child to participate in an educational study at the San Diego Zoo. This letter explains the study and its purpose.

This study wants to see how pre- and post-visit learning activities help students learn when they visit to the San Diego Zoo for their *Life Cycles* program with the Education Department. For this study, students will be asked to play an animal matching game in the classroom and participate in an informal paper survey using a "smiley face" scale in addition to going along on the field trip to the zoo. The extra game and survey will help us see if the students are learning new information, and if that new information is helping their day at the zoo. In addition, we will be videotaping the *Roberta the Zebra* show to observe student interactions with the zoo educators.

The identity of the schools and students involved in this study will be kept confidential. Nowhere in any report or listing will students' last names or full names or any other personally identifying information be listed.

There are no foreseeable risks or ill effects from participating in this study. All activities and data collected falls within what is considered normal classroom instructional practice. Furthermore, participation in the study can in no way affect grades for this or any course, nor can it affect academic or personal standing in any fashion whatsoever.

There are several benefits to be expected from participation in this study. This study provides additional learning opportunities for students by extending the field trip experience. Teachers receive activities to do in the classroom before visiting San Diego Zoo and follow-up activities to do after. By linking both the formal and the informal learning environments, students receive a seamless, integrated experience and are more fully prepared to take advantage of the out-of-classroom excursion.

Participation in this study is voluntary, and students are free to withdraw consent and to discontinue participation in this study at any time without prejudice from the investigator.

Please feel free to ask any questions of Judith Coats via e-mail jcoats@sandiegozoo.org, phone (619) 718-3544 or in person at San Diego Zoo Global offices located at 1455 Frazee Road, Suite 200, San Diego, 92108. You can contact Judith at any time; before, during or after the study.

I, _____ give consent to for my child to participate.

Parent signature: _____

For your child: I know I will be helping with a research study. I know this is extra and does not change my school grade. I would like to do this.

Student signature: _____

Date: _____

Formulario de Consentimiento Informado para Estudiantes en el Estudio Realizado en el Zoológico de San Diego

Estimados padres y estudiantes,
Gracias por considerar que su hijo o hija participe en un estudio educativo en el Zoológico de San Diego. Esta carta explica el estudio y su propósito.

Este estudio es para conocer cómo las actividades de aprendizaje, antes y después de su visita, ayudan a los estudiantes a aprender durante su visita al Zoológico de San Diego, para su programa "*Ciclos de Vida*" con el Departamento de Educación. Para este estudio, se le pedirá a los estudiantes que realicen un juego de parear el animal en el salón de clases y participar en una encuesta utilizando una escala de "carita alegre" adicional a su asistencia en un viaje de campo al zoológico. El juego extra y el cuestionario nos ayudara a entender si los estudiantes están aprendiendo información nueva y sí esa información los esta ayudando en su día en el zoológico. Además, grabaremos un video del espectáculo de *Roberta la Zebra* para observar las interacciones de los estudiantes con los educadores del zoológico.

La identidad de las escuelas y participantes en este estudio se mantendrá confidencial. Los apellidos o nombres completos de los estudiantes o cualquier otra información personal no aparecerá en ninguna parte del informe o listado.

No hay riesgos previsibles o efectos nocivos por su participación en este estudio. Todas las actividades y la recolección de datos están dentro de lo que se considera practica educativa normal del salón de clases. Además, la participación en este estudio no puede afectar de manera alguna las calificaciones para este u otro curso, ni tampoco afecta la postura académica o personal de ninguna manera.

Se espera obtener varios beneficios de la participación en este estudio. Este estudio provee oportunidades de aprendizaje adicional para los estudiantes, extendiendo la experiencia del viaje de campo. Los maestros recibirán actividades para realizar en el salón de clases, antes y después de su visita al Zoológico de San Diego. Mediante la combinación de ambos ambientes de aprendizaje, formal e informal, los estudiantes recibirán una experiencia integrada apropiada y estarán mejor preparados para tomar ventaja de la excursión fuera del salón de clases.

La participación en este estudio es voluntaria y los estudiantes pueden retirar su consentimiento y discontinuar su participación en este estudio en cualquier momento sin ningún perjuicio por parte del investigador.

Por favor, siéntase libre de hacer cualquier pregunta sobre Judith Coats por correo electrónico jcoats@sandiegozoo.org, o al teléfono (619) 718-3544 o en persona en las oficinas de San Diego Zoo Global ubicado en el 1455 Frazee Road, Suite 200, San Diego, 92108. Se puede comunicar conmigo en cualquier momento; antes, durante o después de este estudio.

Yo, _____ doy permiso a mi hijo para participar en este estudio.

Firma del padre o encargado:_____ Fecha: _____

Para su hijo o hija: Yo entiendo que estaré ayudando en un estudio de investigación. Entiendo que es extra y no cambia mis calificaciones escolares. Me gustaría hacer esto.

Firma del estudiante: _____ Fecha: _____

APPENDIX C

CALIFORNIA STATE SCIENCE CONTENT STANDARDS

Appendix C
California State Science Content Standards

Life Sciences

2. Plants and animals have predictable life cycles. As a basis for understanding this concept:
   a. *Students know* that organisms reproduce offspring of their own kind and that the offspring resemble their parents and one another.
   b. *Students know* the sequential stages of life cycles are different for different animals, such as butterflies, frogs, and mice.
   c. *Students know* many characteristics of an organism are inherited from the parents. Some characteristics are caused or influenced by the environment.
   d. *Students know* there is variation among individuals of one kind within a population.
   e. *Students know* light, gravity, touch, or environmental stress can affect the germination, growth, and development of plants.
   f. *Students know* flowers and fruits are associated with reproduction in plants.

Earth Sciences

3. Earth is made of materials that have distinct properties and provide resources for human activities. As a basis for understanding this concept:
   a. *Students know* how to compare the physical properties of different kinds of rocks and know that rock is composed of different combinations of minerals.
   b. *Students know* smaller rocks come from the breakage and weathering of larger rocks.
   c. *Students know* that soil is made partly from weathered rock and partly from organic materials and that soils differ in their color, texture, capacity to retain water, and ability to support the growth of many kinds of plants.
   d. *Students know* that fossils provide evidence about the plants and animals that lived long ago and that scientists learn about the past history of Earth by studying fossils.
   e. *Students know* rock, water, plants, and soil provide many resources, including food, fuel, and building materials, that humans use.

APPENDIX D

LIFE CYCLES TEACHER GUIDE

Appendix D
Life Cycles Teacher Guide

SAN DIEGO ZOO®

LIFE CYCLES PROGRAM

For Second Grade

Our world's wildlife is a natural heritage that belongs to our children. The development of an appreciation and respect for nature should begin at an early age.

In 1939, with these ideas in mind, the San Diego Zoo began offering free field trips to San Diego County second graders. We frequently review, update and revise this program in order to align it with the goals of current science education standards.

The materials contained in this packet have all been specifically designed to prepare students for their visit to the Zoo and reinforce life cycles concepts after the field trip. These materials support the second-grade life science standards referenced here:

SCIENCE CONTENT STANDARDS FOR CALIFORNIA PUBLIC SCHOOLS

Life Science, Grade Two

Plants and animals have predictable life cycles. As a basis for understanding this concept:

- *Students know that organisms reproduce offspring of their own kind and that the offspring resemble their parents and one another.*
- *Students know the sequential stages of life cycles are different for different animals, such as butterflies, frogs and mice.*
- *Students know many characteristics of an organism are inherited from its parents. Some characteristics are caused or influenced by the environment.*
- *Students know there is variation among individuals of one kind within a population.*
- *Students know light, gravity, touch or environmental stress can affect the germination, growth, and development of plants.*
- *Students know flowers and fruits are associated with reproduction in plants.*

NATIONAL SCIENCE EDUCATION STANDARDS

Life Science, Grades K-4, Life Cycles of Organisms

- *Plants and animals have life cycles that include being born, developing into adults, reproducing, and eventually dying. The details of this life cycle are different for different organisms.*
- *Plants and animals closely resemble their parents.*
- *Many characteristics of an organism are inherited from the parents of the organism, but other characteristics result from an individual's interactions with the environment. Inherited characteristics include the color of the flowers and the number of limbs of an animal. Other features, such as the ability to ride a bicycle, are learned through interactions with the environment and cannot be passed on to the next generation.*

INTRODUCTION

Just like the wheels on the second-grade bus go 'round and 'round, so do the cycles of life. Hosted by Roberta the Zebra, our program will provide your class with fun-filled activities that make the concepts of life cycles easy to understand. On the day of your field trip you will participate in a 90-minute tour led by a Zoo educator. It will include a bus ride, a fun life cycles presentation with Roberta the Zebra, and an animal encounter.

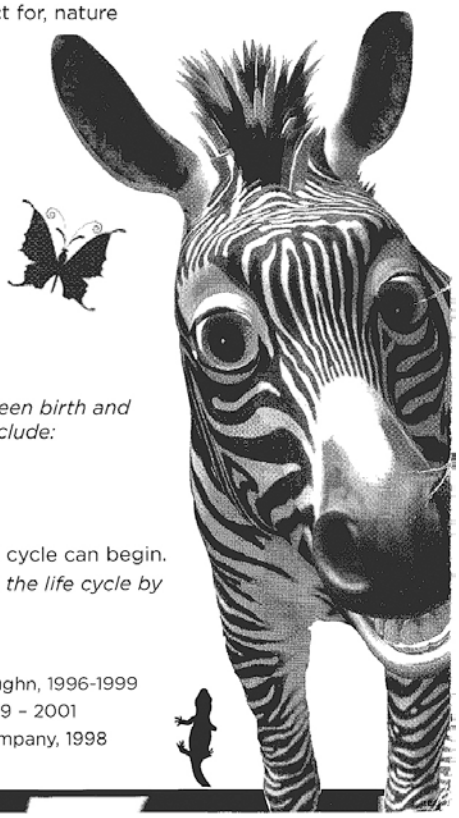
Your students' learning experiences at the Zoo will be greatly enhanced by using some or all of the activities and ideas contained in this materials packet. The packet contains activities, vocabulary definitions, suggested books, and ideas for lesson expansion. These materials are not intended to represent a complete life cycles curriculum. They can, however, serve as a supplement to your school's comprehensive science curriculum.

We suggest using pre-visit activities to prepare your students for their field trip and post-visit activities to reinforce the concepts they are learning. You may use these lessons in any order. Each activity serves to strengthen the program's theme: the sequential stages of plant and animal life.

GOALS AND OBJECTIVES

- ✔ Teachers will find the suggested activities easy to fit into the daily curriculum
- ✔ Students will be prepared for a meaningful learning experience at the Zoo
- ✔ Students will know that all living things have predictable and sequential stages of life
- ✔ Students will be able to recall similarities and differences in the life cycles of different organisms
- ✔ Students will develop an awareness of, and a respect for, nature

CONTENTS



WHAT IS A LIFE CYCLE?

A life cycle is all the stages an organism goes through between birth and death. Every living thing has a life cycle. Life cycle stages include:

- Sprouting, hatching, or being born
- Growing and changing
- Adulthood
- Reproducing (making offspring) so that another life cycle can begin.

A species survives only when enough of the adults continue the life cycle by making offspring.

SUGGESTED BOOKS

Crewe, Sabrina. *Animal Life Cycles Series*. Raintree/Steck Vaughn, 1996-1999

Himmelman, John. *Nature Upclose Series*. Children's Press 1999 – 2001

Kalman, Bobbie. *What Is a Life Cycle?* Crabtree Publishing Company, 1998

APPENDIX E

LIFE CYCLES MATCH-UP ACTIVITY

Appendix E
Life Cycles Match-up Activity

Life Cycles Match-Up Activity

In this activity, students will:

- ✔ Learn new vocabulary
- ✔ Match each adult animal with its baby (or larval form)

Materials

Copies of the vocabulary squares that are printed on the back of this page, scissors, coloring materials, construction paper, glue

Activity Steps

A. Have students cut out the vocabulary squares and color them.

B. Match the baby (juvenile or larva) with its adult.

C. Use the vocabulary squares to play a game of "concentration".
   1. Mix up the pieces and lay them out picture/word side down.
   2. Turn over only two at a time.
   3. Find and keep pairs that match.

D. Glue the matching pairs on a piece of construction paper.

Answers:

Zebra / Colt	Monkey / Infant	Kangaroo / Joey	Turtle / Hatchling
Elephant / Calf	Chicken / Chick	Sea Lion / Pup	Butterfly / Caterpillar
Goat / Kid	Swan / Cygnet	Cheetah / Cub	Frog / Tadpole

Vocabulary

- **Juvenile...** *young who are no longer babies, but not yet adults*
- **Larva...** *The pre-adult form of some animals. The tadpole is the larval stage of frogs and toads. The caterpillar is the larval state of a butterfly*
- **Metamorphosis...** *the dramatic changes in shape and behaviors of some animals. Two different examples of metamorphosis are tadpoles changing into frogs and caterpillars changing into butterflies*
- **Offspring...** *the young of an animal or plant*

Extensions

✔ The English language contains many examples of special names for the offspring of a species. Have your class develop a list of their favorite animals. Conduct research to discover the name given to the baby (juvenile or larva) of each of those species. Write a class poem that includes the adult and baby names you learned.

Suggested Books

📖 Bauer, Marion Dane. *If You Were Born a Kitten.* Simon & Schuster, 1997

📖 Greenway, Shirley. *Whose Baby Am I?* Econo-Clad Books 1990

ADULTS are called... BABIES are called...

Zebra 	Monkey 	Turtle 	Kangaroo 
Goat 	Cygnet 	Hatchling 	Elephant 
Cub 	Frog 	Sea Lion 	Chick 
Swan 	Butterfly 	Calf 	Cheetah 
Infant 	Pup 	Joey 	Colt 
Caterpillar 	Kid 	Tadpole 	Chicken 

APPENDIX F

PRE-VISIT TEACHER EXPERIENCE SURVEY

Appendix F
Pre-visit Teacher Experience Survey
Distributed by email through SurveyMonkey software
http://www.surveymonkey.com/s/JCY358Z

Please complete the following survey so we may learn how Zoo programs compliment your teaching. Participation in this survey is voluntary. Participation or non-participation will not affect your *Life Cycles* program in any way.

1. Have you participated in Education programs at the San Diego Zoo before?

- Yes
- If No, go to question 5.

2. If yes, what Zoo Education programs did you attend?

- If yes, what Zoo Education programs did you attend? Self-guided
- Guided Tours
- Life Cycles
- Once Upon a Time (K-6)
- Whodunit? (K-8)
- Inside Story (K-12)
- Dr. Harry's Time Machine (1-8)
- Critter Coverings (pre-2)

Other (please specify)

3. In a typical school year, how many times do you visit the San Diego Zoo with your class?

- In a typical school year, how many times do you visit the San Diego Zoo with your class? Only once a year
- Usually twice a year
- Usually 3 to 4 times a year
- Usually more than 5 times a year

4. What do you feel is the biggest benefit to students during a trip to the zoo?

- What do you feel is the biggest benefit to students during a trip to the zoo? seeing live animals
- talking to zoo educators
- learning new plant and animal information

- learning conservation values and stewardship
- novel teacher-student interactions
- novel peer-peer interactions
- learning to behave as a class in a public area

Other (please specify)

5. If this is your first visit to the San Diego Zoo, why did you choose it as your out-of-classroom learning trip?

*****

6. Do you use other places for out-of-classroom learning trips?

- Do you use other places for out-of-classroom learning trips? Yes
- No

7. If yes, what other places do you take your students?

8. If yes, why do you take your students to these other places?

9. How many years have you been teaching?

- How many years have you been teaching? Less than one year
- Two to four years
- Five to ten years
- 10 to 15 years
- More than 15 years

*****

10. What grade(s) have you taught?

- What grade(s) have you taught? First Grade
- Second Grade
- Third Grade

- [ ] Fourth Grade
- [ ] Fifth Grade
- [ ] Sixth Grade
- [ ] Seventh Grade
- [ ] Eighth Grade
- [ ] High School

APPENDIX G

AMPHIBIAN LIFE CYCLE ACTIVITY

Appendix G
Amphibian Life Cycle Activity

AMPHIBIAN LIFE CYCLE

The word amphibian comes from the Latin *amphibian* which means "both lives". Amphibians live underwater for the first part of their lives and then breathe air after they mature. They are the only animals with backbones that undergo metamorphosis. Amphibians have three distinct stages of life: egg, larva, and adult. Frogs, toads, salamanders, and caecilians are all amphibians. Many variations of the life cycle are found among amphibian species.

SAN DIEGO ZOO

One example from this diverse group is the frog. A frog embryo develops inside a jelly-covered egg. Upon hatching, the larva (or tadpole) looks very different from its parents. It breathes underwater using gills. The larva undergoes metamorphosis. The gills disappear and are replaced by lungs. The tail shrinks and four legs develop. The juvenile grows and changes until it looks similar to its parents. Adults are ready to start the life cycle all over again with new eggs.

VOCABULARY

- **Amphibian...** *a cold-blooded animal that begins life in the water breathing with gills and transforms into an air-breathing animal*
- **Aquatic...** *adapted to live in water*
- **Cold-blooded...** *(ectothermic) an animal whose body temperature changes with the temperature of its surroundings*
- **Egg mass...** *most female amphibians lay many eggs in mass; most are covered with a protective jelly*
- **Eft...** *the last stage of a newt's life cycle while living on land*
- **Embryo...** *an animal or plant just starting to live and grow before birth or hatching*
- **Gills...** *organs of an animal that are used to breathe oxygen from water*
- **Metamorphosis...** *the change of one form to another*
- **Tadpole...** *the larva of a frog*
- **Terrestrial...** *adapted to living on land*

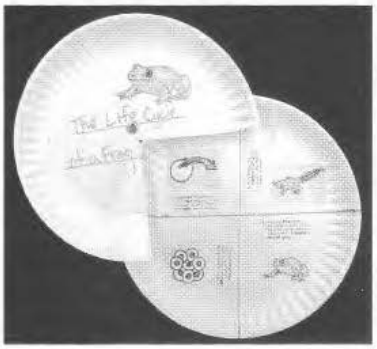
SUGGESTED BOOKS

- Jordan, Martin and Tanis. *Journey of the Red-Eyed Tree Frog*. Simon and Schuster Books for Young Readers, 1992
- Kalman, Bobbie and Langille, Jacqueline. *What is an Amphibian?* Crabtree Publishing Company, 2000
- Mazer, Anne. *The Salamander Room*. Alfred A. Knopf, 1991

IN THESE AMPHIBIAN CYCLE ACTIVITIES (SEE REVERSE SIDE), STUDENTS WILL:

- ✔ Make a circular display of an amphibian life cycle
- ✔ Demonstrate their understanding of the sequential stages of the life cycle of a frog

AMPHIBIAN LIFE CYCLE ACTIVITIES



Materials to make one life cycle wheel

2 white, 9 inch, unwaxed paper plates
1 brass brad
Reproduced sentence boxes and pictures
Scissors, pencil or pen, glue, crayons, colored pencils or markers
1/2 paper plate template (accuracy helps)

Activity Steps

A. Make a copy of the sentence boxes and pictures. Make a template using 1/2 of a paper plate.

B. Use the template to mark 1/4 of plate #1. Cut out inside the lines. Do not cut all the way to the center point. Color and decorate if you wish.

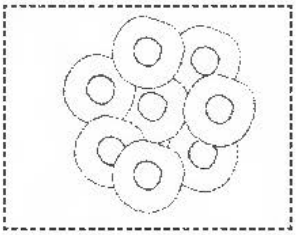
C. Use the template to mark plate #2 so that it is divided into 4 equal quarters.

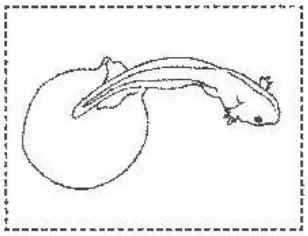
D. Cut out the sentence boxes and pictures. Match the correct picture with each sentence box.

E. Glue one matching sentence and picture in each quarter, in 1-2-3-4 order around plate #2.

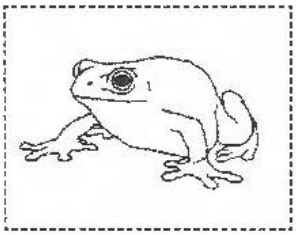
F. Place plate #1 on top of plate #2 and fasten with the brass band through the center.

G. Turn the top plate to tell the story of a frog's life cycle.

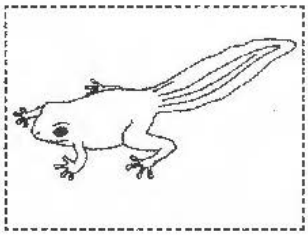




1. A female **adult frog** lays a group of tiny, soft, jelly-covered **eggs (egg mass)** in water.



2. A **tadpole** hatches out of an **egg**, wiggles its tail and swims under water with **gills**, just like a fish.



3. As it grows, the **tadpole's** tail gets shorter and four legs begin to grow.

4. A young **frog** leaves the water to grow strong legs. It lives on land and in the water. It **breathes air with lungs.**

Extensions

- Make paper plate wheels to illustrate the life cycles of birds, mammals, reptiles, fish, insects, and/or plants. Compare and contrast the different wheels to learn how life cycles are different for different animals.

APPENDIX H

OBSERVATION TALLY SHEET FOR STUDENT RESPONSES

Appendix H
Observation Tally Sheet for Student Responses

Education Department Staff
_____
_____

Date _____
Observer _____
Start Time _____am
End Time _____ am

Observation Tally Sheet for Student Interaction
During *Roberta the Zebra* show
CENTER ISLE OF OTTO CENTER

Prompt and Response	left side (32 seats)	right side (32 seats)
Do you know what a Life Cycle is?		
Hands raised		
Vocal answers		
Student picked as example		
Student answer *1=single word, 2= complete sentence, 3=answer plus added info*		
What stage are you all in?		
Hands raised		
Vocal answers		
Child picked as example		
Student answer *1=single word, 2= complete sentence, 3= answer plus added info*		
Can anyone guess an animal that is not born alive?		
Hands raised		
Vocal answers		
Child picked as example		
Student answer *1=single word, 2= complete sentence, 3= answer plus added info*		
So are we exactly the same?		
Hands raised		
Vocal answers		
Child picked as example		
Student answer *1=single word, 2= complete sentence, 3= answer plus added info*		

Education Department Staff
_____
_____

Date _____
Observer _____
Start Time _____am
End Time _____ am

Prompt and Response	left side (32 seats)	right side (32 seats)
T/F mammals that hatch from eggs?		
Thumbs up		
Thumbs down		
Vocal answer		
Student answer *1=single word, 2= complete sentence, 3= answer plus added info*		
T/F Butterflies have same body shape		
Thumbs up		
Thumbs down		
Vocal answer		
Student answer *1=single word, 2= complete sentence, 3= answer plus added info*		
T/F All animals start small and grow big		
Thumbs up		
Thumbs down		
Vocal answer		
Student answer *1=single word, 2= complete sentence, 3= answer plus added info*		
T/F Male deer fight to get a girlfriend		
Thumbs up		
Thumbs down		
Vocal answer		
Student answer *1=single word, 2= complete sentence, 3= answer plus added info*		

Education Department Staff
_____
_____

Date _____
Observer _____
Start Time _____am
End Time _____ am

Prompt and response	left side (32 seats)	right side (32 seats)
Roberta's snack has a Life Cycle?		
Hands raised		
Vocal answers		
Student picked as example		
Student answer *1=single word, 2= complete sentence, 3=answer plus added info*		
Additional comments		
_____		
_____		
_____		
_____		

Additional overall comments

APPENDIX I

"HOW DO YOU FEEL?"
STUDENT ATTITUDINAL QUESTIONNAIRE

Appendix I
"How Do You Feel?"
Student Attitudinal Questionnaire

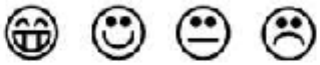
_____

How do you feel?

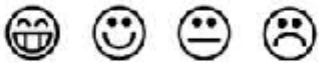
Participation in this survey is voluntary and participation or non-participation will not affect your grade in class in any way. You can do this if you want.

Read the sentences below and color in the face that best matches how you feel.

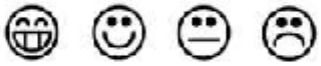
1. After learning about life cycles at school, I wanted to meet the real animals at the zoo. .



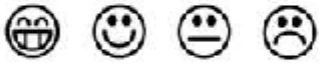
2. I liked the things we did with Roberta the Zebra to learn about animal life cycles



3. Zoo animals make me happy.

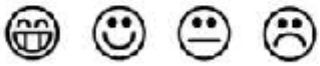


4. Zoo animals are fun to watch.

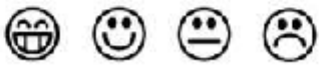


5. I want to help zoo animals that are in trouble.

6. I wish more people would take care of animals that are in trouble.



7. I would like to learn more about zoo animals and their young.



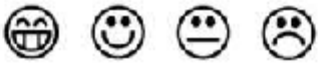
8. I would like to visit the zoo again.

_____

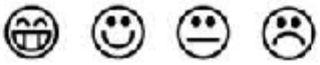
¿Cómo te sientes?

La participación en esta encuesta es voluntaria y participar o no participar no afectará su calificación en esta clase de ninguna manera. Puedes hacer esta encuesta sí tu quieres.
Lea las oraciones debajo y colorea la carita que mejor describa como te sientes.

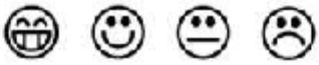
1. Después de aprender sobre los ciclos de vida en la escuela, quiero conocer los verdaderos animales en el zoológico.



2. Me gusto las cosas que hicimos con Roberta la Zebra para aprender sobre los ciclos de vida de los animales

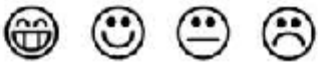


3. Los animales del zoológico me hacen feliz.

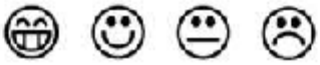


4. Ver los animales del zoológico es divertido.

5. Yo quiero ayudar a los animales del zoológico que están en problemas.

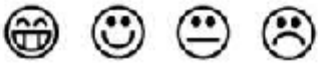


6. Deseo que más gente cuide a los animales que están en problemas.



7. Me gustaría aprender más sobre los animales del zoológico y sus crías.

8. Me gustaría visitar el zoológico otra vez.



APPENDIX J

POST-VISIT TEACHER SURVEY
TREATMENT TEACHERS

Appendix J
Post-visit Teacher Survey
Treatment Teachers
Distributed by email through SurveyMonkey software
http://www.surveymonkey.com/s/FT2NJYG

Please complete the following survey so we may learn how Zoo programs compliment your teaching. Participation in this survey is voluntary. Participation or non-participation will not affect your *Life Cycles* program in any way.

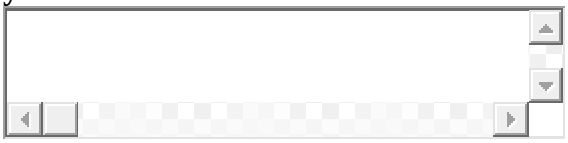
1. Which activities from the Life Cycles activity packet did you use before your visit to the zoo?

- [ ] Which activities from the Life Cycles activity packet did you use before your visit to the zoo? Plant Life Cycle Activities
- [ ] Invertebrate Life Cycle Activities
- [ ] Reptile Life Cycle Activities
- [ ] Amphibian Life Cycle Activities
- [ ] Bird Life Cycle Activities
- [ ] Mammal Life Cycle Activities
- [ ] I did not use any of these

2. Which activities from the Life Cycles activity packet did you use or plan to use after your visit to the zoo?

- [ ] Which activities from the Life Cycles activity packet did you use or plan to use after your visit to the zoo? Plant Life Cycle Activities
- [ ] Invertebrate Life Cycle Activities
- [ ] Reptile Life Cycle Activities
- [ ] Amphibian Life Cycle Activities
- [ ] Bird Life Cycle Activities
- [ ] Mammal Life Cycle Activities
- [ ] I didn't use and/or don't plan on using

3. How does the Life Cycles program align with the curriculum or textbooks that you use in the classroom?



4. Do you feel the pre-visit activities better prepared your students for learning during the Life Cycles program at the zoo? Why or why not?

5. Please rank the following in terms of learning value for the students from 1-most valuable to 6-least valuable.

pre-visit activities in the classroom

Roberta the Zebra presentation in Otto Center

animal touch when exiting Otto Center

narrated bus tour through the zoo to see animals

free time to explore zoo

post-visit activities in the classroom

6. Do you feel the curriculum packet helped you AS A TEACHER better prepare for the trip to the zoo?

7. Would you feel comfortable bringing your class to the zoo again?

- Would you feel comfortable bringing your class to the zoo again? Yes
- No

8. If yes, would you use the activities again?

- Yes
- No
- Maybe

9. Does this experience make you feel more comfortable taking your students to another place for an out-of-classroom learning trip? If so, why.

10. Please add any additional comments here.

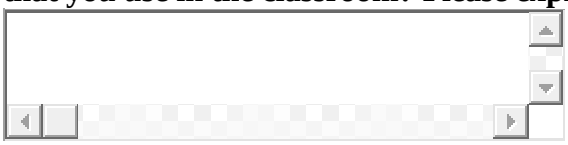
APPENDIX K

POST-VISIT TEACHER SURVEY
NON-TREATMENT TEACHERS

Appendix K
Post-visit Teacher Survey
Non-treatment Teachers
Distributed by email through SurveyMonkey software
http://www.surveymonkey.com/s/FCGQ7CP

Please complete the following survey so we may learn how Zoo programs compliment your teaching. Participation in this survey is voluntary. Participation or non-participation will not affect your *Life Cycles* program in any way.

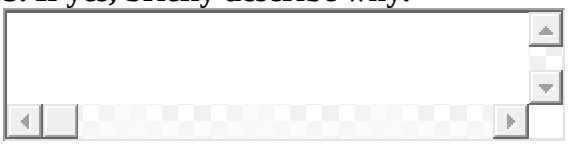
1. How does the Zoo's Life Cycles program align with the curriculum or textbooks that you use in the classroom? Please explain.



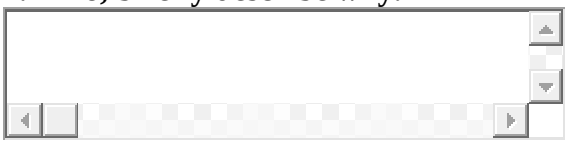
2. Did you feel the Life Cycles program was appropriate for your students?

- Yes
- No

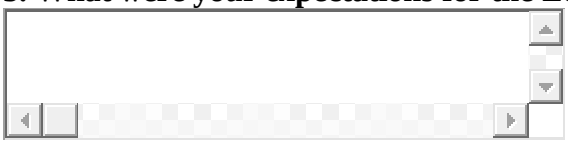
3. If yes, briefly describe why.



4. If no, briefly describe why.



5. What were your expectations for the Zoo's Life Cycle program?



6. Did the Life Cycles program meet your expectations?

- Did the Life Cycles program meet your expectations? Yes
- No

7. Please rank the following in terms of learning value for the students from 1-most valuable to 6-least valuable.

pre-visit activities in the classroom

Roberta the Zebra presentation in the Otto Center

animal touch while exiting Otto Center

narrated bus tour around the zoo to see animals

free time to explore zoo

post-visit activities in the classroom

8. Would you have liked to have used the pre- and post-visit activities for plants, invertebrates, reptiles, amphibians, birds and mammals suggested in the Life Cycles activity packet?

- Yes
- No
- Don't know

9. Does this experience make you feel more comfortable taking your students to another place for an out-of-classroom learning trip?

10. Please add any additional comments here.