



SCHOOL AT THE ZOO

2011-2012 Program Evaluation

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Program Purpose*

To offer a week-long, “hands-on”, “minds-on”, interdisciplinary experience for students of all ages using the Zoo as a “living classroom” taking advantage of students’ cognitive, kinesthetic, affective and sensory abilities. This immersive program will help students be better prepared for “college and career readiness” and will be responsible citizens in the 21st century.

Program Description *

The Louisville Zoo Education Department offers this program during the fall/winter months (August - March). Zoo educators and teachers from participating schools plan units of study in advance, making sure that there is an interdisciplinary approach using Kentucky’s Core Academic Standards as a guide. Inquiry based activities encourage students to investigate, apply thinking skills such as hypothesizing, observing, interpreting, questioning, searching for answers and relating what they are learning to their own experiences. The rigor and relevance of the program support students meeting state and national academic standards.

The day begins with a formal presentation made by Louisville Zoo educators based on specific themes followed by Zoo walks to areas that support the topic of the day. Students utilize the Zoo’s “living classroom” to expand their skills such as reading informational text when they read animal identification signs. Other activities include completing animal observation charts, using real-world math applications when learning about diets, and maps to improve their knowledge of geography. Animal training demonstrations and keeper talks give students the opportunity to meet keepers and learn what they do. Students participate in inquiry based and interactive activities that help them understand topics such as food webs and adaptations. Students are active participants when educators encourage them to ask questions, work cooperatively in group activities and use their critical thinking skills. Students keep a “Science Notebook” throughout the week where zoo conservation educators and teachers assess what has been learned. Science concepts and usage of new vocabulary are documented. At the end of the day students have a writing assignment with prompts to help them apply their new knowledge.

Participants have the experience of observing and discovering the diversity of life that exists at the Louisville Zoo and in their own backyards. They, also, are given the opportunity to connect and integrate what they are learning to their surroundings. School at the Zoo reflects the Louisville Zoo’s mission “to better the bond between people and our planet.” This connection is essential in today’s world where youth are disconnected from the natural world.

** Program purpose and program description were provided by the School at the Zoo staff.*

Evaluation Design

The research questions the School at the Zoo Program Evaluation examined are:

- 1) Was the program framework supported by research?
- 2) Did the program teach Kentucky Core Content?
- 3) Were the instructional techniques used research-based?
- 4) Was the program reaching the targeted population?
- 5) Were students learning based on a pre- and post-test?
- 6) Did students feel differently about the zoo, the environment, or animals after participating in this program?
- 7) How did teachers perceive/value the School at the Zoo Program?

In order to answer the research questions, the following primary data sources were used:

- Observation data (3 times, 75-90 minutes each),
- Interviews of zoo and JCPS staff,
- Document review (workbooks, program documents, schedules, Kentucky Core Content, etc.),
- Student pre- and post-tests,
- Student surveys,
- Student interviews, and
- Teacher surveys.

Highlights of Selected Academic Readings

Zemelman, Daniels, and Hyde (1993) list a series of best practices in science. The School at the Zoo Program incorporates almost all of these qualities. These qualities are:

- Students need opportunities to explore the significance of science in their lives (p. 94).
- Science study should involve *doing* science, i.e., questioning and discovering, not just covering material (p. 95).
- Effective hands-on inquiry involves a series of steps that build students' investigative skills (questioning, observation, organizing data, explanation, reflection, and taking action) (p. 96-97).
- Meaningful science study will aim to develop thinking, problem solving, and attitudes of curiosity, healthy skepticism, and openness to modifying explanations (p. 98).
- Science education can build a knowledge base focused on essential concepts, rather than disconnected topics or bits of information (p. 99).
- Students should explore fewer topics in depth, not skim many superficially (p. 100).
- Students grow out of misconceptions and naïve theories only by engaging in investigation (p.101).
- Learning science means integrating reading, writing, speaking, and math (p. 102).
- Students need to consider issues of application of science and technology (p. 102).

- Good science teaching involves facilitation, collaborative group work, and a limited, judicious use of information-giving (p. 103).
- Meaningful assessment of students' learning in science must promote the objectives of a good science curriculum, and not undermine them (p. 104).

Falk and others (2007) in a three year nation-wide study found that "going to AZA- (Association of Zoos and Aquariums) accredited zoos and aquariums in North America does have a measurable impact on conservation attitudes and understanding of adult visitors (p. 3)." It is important to note that the Louisville Zoo is AZA accredited. Some of the other key findings were:

- "Visits to accredited zoos and aquariums prompt individuals to reconsider their role in environmental problems and conservation action, and to see themselves as part of the solution.
- Visitors believe zoos and aquariums play an important role in conservation education and animal care.
- Visitors believe they experience a stronger connection to nature as a result of their visit.
- Visitors bring with them a higher-than-expected knowledge about basic ecological concepts. Zoos and aquariums support and reinforce the values and attitudes of the visitor.
- Visitors arrive at zoos and aquariums with specific identity-related motivations and these motivations directly impact how they conduct their visit and what meaning they derive from the experience (p.3)."

Anderson and others (2003) found that zoo visitors that spent time watching a training session with an interpreter had a more positive experience, training perceptions, and longer visitor exhibit stay times. The students participating in the School at the Zoo Program watched at least two animals, a bear and a tiger, training sessions with an interpreter.

Braund and Reiss (2006) discussed how out-of-school site visits provide "science education that is more valid and more motivating and is better at fulfilling defensible aims of school science education (p. 213)." The authors state five ways in which the out-of-classroom experiences, such as zoo visits, can improve science education. The ways mentioned are:

- Improved development and integration of concepts,
- Extended and authentic practical work,
- Access to rare material and to "big" science,
- Attitudes to school science: stimulating further learning,
- Social outcomes: collaborative work and responsibility for learning.

The authors conclude that these outings allow students to engage with science.

The research of Packer and Ballantyne (2010) was focused on finding "effective ways in encouraging visitors to adopt more environmentally sustainable practices in their everyday lives (p. 32)." These researchers found that "the greatest impact on visitors' environmental learning was the extent to which they engaged *reflectively* during their visit. Reflective engagement involved both cognitive and affective processing of the experience and focused on what visitors felt and thought...These responses

were more strongly associated with learning outcomes than the immediate but fleeting excitement of seeing the animals (p. 30).” The students in the School at the Zoo Program completed a reflective writing piece every afternoon.

Kruse and Card (2004) researched the knowledge, attitude, and behavior of students participating in a week-long zoo program on conservation education. One of their primary findings included, “...all campers were benefiting from the hands-on learning experience,... where interactive conservation presentations positively affected learning (p. 43).”

DeWitt and Osborne (2007) worked on developing a framework for visiting museums. Much of this framework is easily transferrable to visiting a zoo. The authors summarize previous research findings that support teachers visiting the site prior to the field trip, having a clear agenda with specific learning objectives, ensuring that field trip activities are aligned to the school curriculum, allowing time for students to explore, making sure that the activities take advantage of the setting, and being sure to conduct pre- and post-visit lessons. Key components of the authors’ framework include: having the perspective of the teachers, provide structure, encourage cooperative productive activity with the students and teachers, and support dialogue, literacy, and/or research skills.

Curriculum (Core Content)

The School at the Zoo Program has a content focus that is based on Kentucky’s Core Content Standards and uses academic best practices to teach these standards. The fourth grade School at the Zoo Program covered the standards in Table 1: Elementary Standards. Table 2: Observed Kentucky Science Core Content Standards shows the standards that were observed being taught. In addition to what was observed, Standards SC-06-3.4.2 and SC-08-3.4.3, which have students learn about behavioral responses to stimuli, were demonstrated as the students watched animal (bear and tiger) training sessions and later discussed in the classroom setting.

Table 1: Elementary Standards*

KY Core Content Standard Code	Standard
SC-04-3.4.1	<p>Students will:</p> <ul style="list-style-type: none"> • compare the different structures and functions of plants and animals that contribute to the growth, survival and reproduction of the organisms; • make inferences about the relationship between structure and function in organisms. <p>Each plant or animal has structures that serve different functions in growth, survival and reproduction. Evidence about the relationship between structure and function should be used to make inferences and draw conclusions.</p>
SC-05-3.4.1	Students will describe and compare living systems to understand the complementary nature of structure and function.
SC-04-3.4.3	Students will compare a variety of life cycles of plants and animals in order to classify and make inferences about an organism.

	<p>Plants and animals have life cycles that include the beginning of life, growth and development, reproduction and death. The details of a life cycle are different for different organisms. Models of organisms' life cycles should be used to classify and make inferences about an organism.</p>
SC-04-3.5.1	<p>Students will use representations of fossils to:</p> <ul style="list-style-type: none"> • draw conclusions about the nature of the organisms and the basic environments that existed at the time; • make inferences about the relationships to organisms that are alive today. <p>Fossils found in Earth materials provide evidence about organisms that lived long ago and the nature of the environment at that time. Representations of fossils provide the basis for describing and drawing conclusions about the organisms and basic environments represented by them.</p>
SC-05-3.5.1	<p>Students will describe cause and effect relationships between enhanced survival/reproductive success and particular biological adaptations (e.g., changes in structures, behaviors, and/or physiology) to generalize about the diversity of populations of organisms.</p> <p>Biological change over time accounts for the diversity of populations developed through gradual processes over many generations. Examining cause and effect relationships between enhanced survival/reproductive success and biological adaptations (e.g., changes in structures, behaviors, and/or physiology), based on evidence gathered, creates the basis for explaining diversity.</p>
SC-04-4.6.1	<p>Students will analyze patterns and make generalizations about the basic relationships of plants and animals in an ecosystem (food chain).</p> <p>Plants make their own food. All animals depend on plants. Some animals eat plants for food. Other animals eat animals that eat the plants. Basic relationships and connections between organisms in food chains, including the flow of energy, can be used to discover patterns within ecosystems.</p>
SC-04-4.7.1	<p>Students will make predictions and/or inferences based on patterns of evidence related to the survival and reproductive success of organisms in particular environments.</p> <p>The world has many different environments. Distinct environments support the lives of different types of organisms. When the environment changes some plants and animals survive and reproduce and others die or move to new locations. Examples of environmental changes resulting in either increase or decrease in numbers of a particular organism should be explored in order to discover patterns and resulting cause and effect relationships between organisms and their environments (e.g., structures and behaviors that make an organism suited to a particular environment). Connections and conclusions should be made based on the data.</p>
SC-05-4.7.1	<p>Students will:</p> <ul style="list-style-type: none"> • describe and categorize populations of organisms according to the function they serve in an ecosystem (e.g., producers, consumers, decomposers); • draw conclusions about the effects of changes to populations in an ecosystem.

	Populations of organisms can be categorized by the function they serve in an ecosystem. Plants and some microorganisms are producers because they make their own food. All animals, including humans, are consumers, and obtain their food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food. Food webs identify the relationships among producers, consumers and decomposers in an ecosystem. Using data gained from observing interacting components within an ecosystem, the effects of changes can be predicted.
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*Standards from:

<http://www.education.ky.gov/KDE/Instructional+Resources/Curriculum+Documents+and+Resources/Content+for+Assessment/Core+Content+for+Assessment+4.1/>

Table 2: Observed Kentucky Science Core Content Standards*

KY Core Content Standard Code	Standard
SC-06-3.5.1	Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.
SC-07-3.5.1	Students will: <ul style="list-style-type: none"> • describe the usefulness of fossil information to make conclusions about past life forms and environmental conditions; • explain the cause and effect relationship of the extinction of a species and environmental changes.
SC-06-4.6.2	The Sun is the major source of energy for Earth. The water cycle, winds, ocean currents and growth of plants are affected by the Sun's energy. Seasons result from variations in the amount of the Sun's energy hitting Earth's surface.
SC-07-4.6.4	Students will describe or represent the flow of energy in ecosystems, using data to draw conclusions about the role of organisms in an ecosystem. For most ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. That energy then passes from organism in food webs.
SC-08-4.6.5	Students will: <ul style="list-style-type: none"> • describe the relationships between organisms and energy flow in ecosystems (food chains and energy pyramids); • explain the effects of change to any component of the ecosystem. Energy flows through ecosystems in one direction from photosynthetic organisms to herbivores to carnivores and decomposers.
SC-06-4.7.1	Students will describe the consequences of change in one or more abiotic factors on a population within an ecosystem. The number of organisms an ecosystem can support depends on the resources available and abiotic factors (e.g., quantity of light and water, range of temperatures, soil composition).
SC-07-4.7.1	Students will compare abiotic and biotic factors in an ecosystem in order to explain consequences of change in one or more factors.

	<p>The number of organisms an ecosystem can support depends on the resources available and abiotic factors (e.g., quantity of light and water, range of temperatures, soil composition). Given adequate biotic and abiotic resources and no diseases or predators, populations (including humans) increase at rapid rates. Lack of resources and other factors, such as predation and climate, limit the growth of populations in specific niches in the ecosystem.</p>
<p>SC-08-4.7.1</p>	<p>Students will describe the interrelationships and interdependencies within an ecosystem and predict the effects of change on one or more components within an ecosystem.</p> <p>Organisms both cooperate and compete in ecosystems. Often changes in one component of an ecosystem will have effects on the entire system that are difficult to predict. The interrelationships and interdependencies of these organisms may generate ecosystems that are stable for hundreds or thousands of years.</p>

*Standards from:

<http://www.education.ky.gov/KDE/Instructional+Resources/Curriculum+Documents+and+Resources/Content+for+Assessment/Core+Content+for+Assessment+4.1/>

Academic Best Practices

Inquiry Framework

When interviewing the zoo staff and a JCPs Resource Teacher, they pointed out that when designing the program, they used the five E’s (engage, explore, explain, elaborate, and evaluate) as their framework. The engage component is often used in the morning session, where instructor’s make connections to what students already know and students are asked “what do you think” type of questions. The explore stage is where students spend a large portion of the day. This includes exploring things in the classroom setting, such as touching and examining animals, fossils, bones, pictures, animal skins, and pictures, as well as outside the classroom, such as animal and habitat observations, watching animal training sessions, taking a nature walk, and doing a survival activity. The explain stage is where the students discuss new ideas as well as make notes in their science notebook. The elaboration stage is demonstrated when the students make connections from one day to the next. During the observation, this was seen when students drew on what they learned about ecosystems and animal adaptations on previous days to make conjectures about new ecosystems and the plants and animals that grow and live there. The evaluate stage is effectively seen when the students complete a reflective journal writing activity at the conclusion of each day.

Writing Foundation

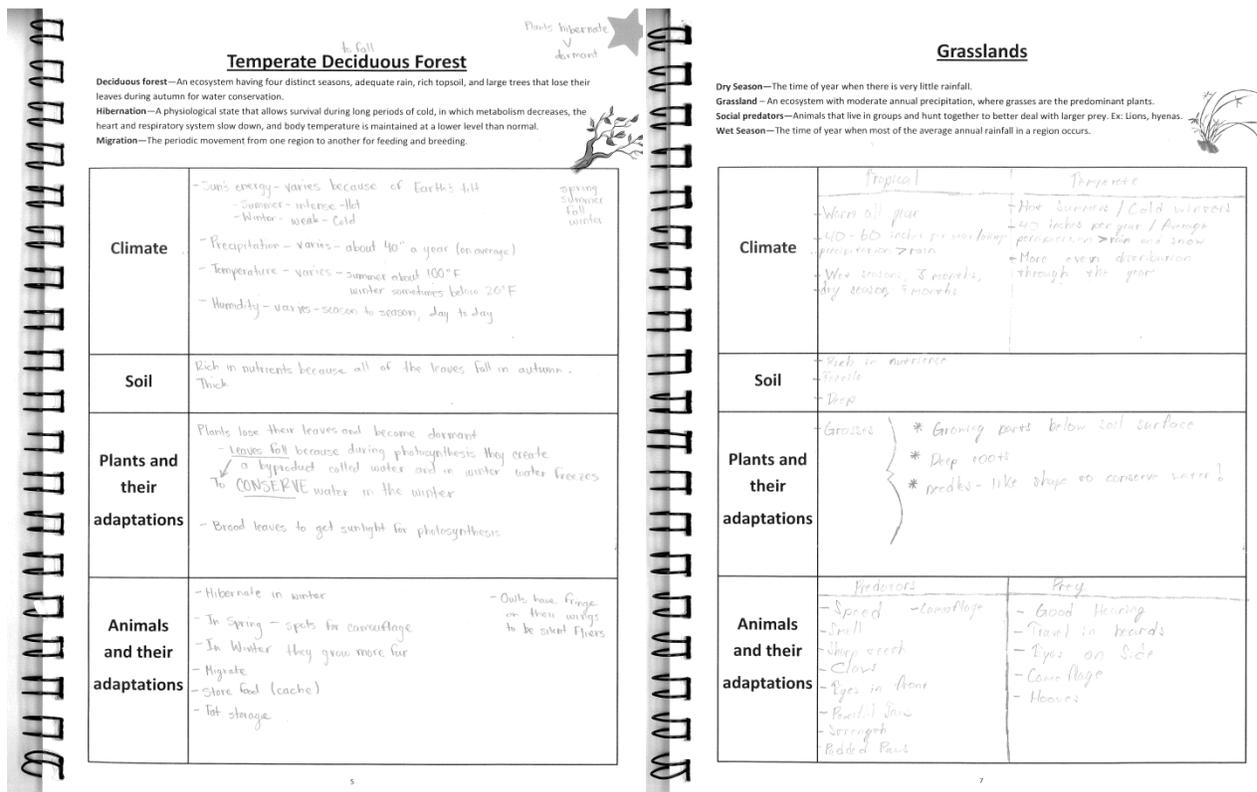
In addition to the 5 E’s, the program also has a writing focus. This focus is based on Betsy Fulwiler’s (2007) work, *Writing in Science: How to Scaffold Instruction to Support Learning*. The recommended lesson format is a science inquiry lesson followed by a science writing session. Stokes, Hirabayashi, and Ramage (2003), found that student work using this type of notebook strategies were “more sophisticated in quality, and reflective of greater rigor and a higher level of learning of both science and writing (p. ii).” The School at the Zoo Program provides all students with a notebook. These

notebooks contain introductory information (like zoo rules), introductory vocabulary, graphic organizers (charts), observation sheets, and reflective writing pages. An example of a fourth grade writing prompt is, "describe the differences between predator and prey animals. Include examples and characteristics of each." Notice this prompt is not procedural, but it has students focus on the content and use that content to draw conclusions.

Graphic Organizers

Educational best practices have found that the use of graphic organizers assist students as they learn and make sense of new concepts. Graphic organizers can take many forms, but they are primarily a way for students to organize new concepts with both linguistic and non-linguistic information (Dean and others, 2012). The seventh grade School at the Zoo Program has students complete a chart (see Figure 1: Ecosystem Graphic Organizer) each morning for the ecosystem being studied that day. The students can fill in the chart in ways which make sense to them. This chart could include new vocabulary, lists, examples, drawings, etc.

Figure 1: Ecosystem Graphic Organizer



Identifying Similarities and Differences

Researchers have found that identifying similarities and differences is a key strategy that helps students make sense of the world (Dean and others, 2012). The researchers identified four strategies in identifying similarities and differences; comparing (includes contrasting), classifying, creating metaphors, and creating analogies. Of these four types, the School at the Zoo Program used comparing and classifying extensively. For the seventh graders, each day they used the graphic organizers, as described previously, to learn about the different ecosystems, but they also used the graphic organizers to make comparisons between the ecosystems examining four components (climate, soil, plants and their adaptations, and animals and their adaptations). This method was seen during the observations. Some of the examples observed included:

- comparing the average temperature and rain fall between tropical rainforest and temperate deciduous forest,
- comparing leaves from different types of trees and how they have adapted to their climate,
- comparing soils from different ecosystems,
- discussing how classifying animals as predators or prey based on the location of their eyes,
- touching and examining the summer and winter coats of two bobcat skins, and
- comparing the padded paws of a predator to the hoofed paw of a giraffe.

Vocabulary Development

In recent years, there has been research that strongly supports the development of academic vocabulary. Marzano and Pickering (2005) report the value of direct vocabulary instruction on student's reading comprehension. They state, "Given the importance of academic background knowledge and the fact that vocabulary is such an essential aspect of it, one of the most crucial services that teachers can provide, particularly for students who do not come from academically advantaged backgrounds, is **systematic instruction in important academic terms** (p.3)." Marzano and Pickering offer a six-step process to teaching new terms. These steps are:

- 1) Provide a description, explanation, or example of the new term.
- 2) Ask students to restate the description, explanation, or example in their own words.
- 3) Ask students to construct a picture, symbol, or graphic representing the term.
- 4) Engage students periodically in activities that help them add to their knowledge of the terms in their notebooks.
- 5) Periodically ask students to discuss the terms with one another.
- 6) Involve students periodically in games that allow them to play with the terms (p. 14-15).

The School at the Zoo Program focused primarily on the first three steps, which are a teachers' way of ensuring that a term is appropriately introduced and students gain an initial understanding. The students were often provided hands-on examples and were asked for descriptions and explanations. In many cases students recorded in their notebooks a picture or graphic representation of many of the terms being taught.

During a 75 minute observation of a lesson taught during the School at the Zoo Program, there were numerous vocabulary words discussed. Some of these words were review, some were familiar words that the students were unclear of the meaning in the context used, and quite a few were new words. Table 3: Vocabulary Words used in an Observed Lesson shows a list of many of the vocabulary terms that were used. The instructor intentionally asked what words meant. For example, most students were not familiar with the word “temperate”. The instructor asked, “What does that word remind you of?” and the students offered the word “temperature”. Then the instructor asked if anyone knew what “moderate” meant. A student offered the definition of “in the middle”. Then the instructor asked them to put those meanings together to get a definition of “temperate” as “temperatures that is around the middle”. They then went on to define “deciduous” to get a basic understanding of the ecosystem to be studied that day which was the “Temperate Deciduous Forrest”.

For almost all of the new words, the instructor would show examples. For example, the instructor showed leaves in a variety of sizes and shapes when discussing “chlorophyll”, “carbon dioxide”, “transpiration”, and “photosynthesis”. When discussing the leaves, a few students were unfamiliar with what was meant by “broad leaves”. This provided an opportunity for the instructor to define the word “broad” in this context and how it applied to leaves. The students were able to observe a screech owl when discussing the terms “adaptations” and “nocturnal”. Additionally, the students were able to observe a salamander while using and learning the terms “hibernate”, “terrestrial”, “metamorphosis”, and “Jacobson Organ”.

Table 3: Vocabulary Words used in an Observed Lesson

Vocabulary Words Discussed			
Abiotic	Chlorophyll	Hibernate	Nutrients
Adaptations	Deciduous	Invertebrate	Organic
Biodiversity	Domestic	Jacobson’s Organ	Photosynthesis
Biotic	Dormant	Metamorphosis	Temperate
Broad	Ecosystem	Moderate	Terrestrial
Carbon Dioxide	Exoskeleton	Nocturnal	Transpiration

Differentiated Learning

Tomlinson and Allan (2000) discuss the value of differentiating learning based on the learner’s profile. Some of the ways they suggest differentiating this learning is through the use of space, presenting information for the different modalities of learning (auditory, visual, or kinesthetic), allowing the students to explore information through the three modalities, and allowing students to work individual or in groups. All of these suggestions are incorporated through the School at the Zoo Program. Students are allowed ample freedom to explore as they participate in the days activities (such as leaf walk). The information is presented and the students are allowed to explore through the different modalities. This was observed during the class lessons where students were allowed to touch, observe behaviors, and hear about a wide variety of animals. The zoo gives the opportunity for students to compare smells, sounds, and to feel a variety of animals. Additionally, there were numerous times when students had the opportunity to work either by themselves or in small groups.

Student Demographics

During the 2011-2012 school-year, the School at the Zoo Program served 6 public elementary schools, 4 public middle schools, 1 public alternative school, and 2 private schools. This analysis will examine the demographics and data from the public elementary and public middle schools. The alternative school data will not be examined since these were eighth graders and the private schools' data is not available. Table 4: Participating Schools list the schools that were used for this evaluation. Of the schools, Cane Run Elementary, Portland Elementary, Lassiter Middle and Moore Traditional all have an Environmental Education Program/Studies and Newburg Middle School has a Math/ Science/ Technology Program. Additionally, Table 5: Student Participant Demographics shows the student demographics, by level, of the students in the participating schools. This program served over 800 middle school and over 300 elementary public school students.

Table 4: Participating Schools

Elementary Schools (4 th Grade)	Middle Schools (7 th Grade)
Brown School	Lassiter Middle School
Camp Taylor Elementary School	Moore Traditional School
Cane Run Elementary School	Newburg Middle School
Johnstown Road Elementary	Thomas Jefferson Middle School
Lincoln Elementary Performing Arts	
Portland Elementary	Liberty (8 th Graders)*

*Not included in analysis since older students

Table 5: Student Participant Demographics

Demographic	Elementary	Middle
Gender		
Female	55%	45%
Male	45%	55%
Race		
Black or African American	47%	41%
White	43%	43%
Other	10%	16%
Exceptional Child Education (ECE)		
ECE	13%	13%
Lunch Status		
Free	68%	70%
Reduced	8%	9%
Paid	24%	21%

Student Academic Data

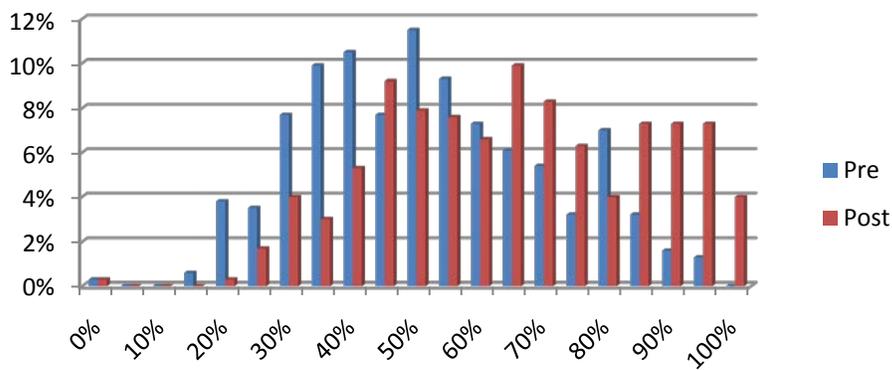
The students completed a pre-test prior to starting the School at the Zoo Program and then completed a post-test. The pre- and post-test were developed by the zoo’s education staff. There is a separate elementary and middle school pre- and post-test. (One middle school was given the elementary pre-test. This group of pre-test was excluded from the analysis.) Each test contained 20 questions; 15 multiple choice (1 answer, 3 distracters) and 5 True/False questions. The elementary school students averaged just over 13% higher on the post-test than the pre-pre-test. This is considered highly statistically significant ($t=8.27, p<.001$). Table 6: Elementary Pre- and Post Test Comparison shows the measures of central tendencies, the standard deviation, and the minimum and maximum scores on the elementary school pre- and post-tests. Figure 2: Elementary School Pre- and Post-Test Comparison shows the graph with the percent correct by the percent of students earning that score on the pre-test and the post-test. For the elementary school students, it is interesting to note the percent of students that scored 90% or higher (3% on the pre-test v 19% on the post-test).

Table 6: Elementary Pre- and Post Test Comparison

	Pre-Test	Post-Test
Mean	51.6	64.7
Median	50.0	65.0
Mode	50.0	65.0
Standard Deviation	18.8	20.6
Minimum	5.0	5.0
Maximum	95.0	100

Figure 2: Elementary School Pre- and Post-Test Comparison

**Elementary Schools
Pre- & Post-Test**



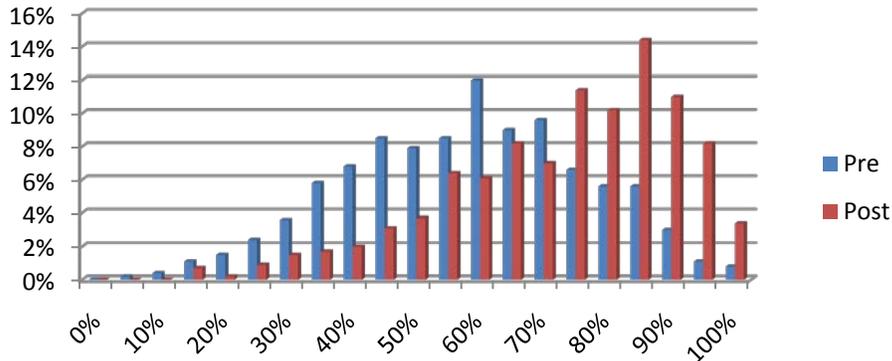
The middle school students averaged 15% higher on the post-test than the pre-pre-test. This is considered highly statistically significant ($t=14.63$, $p<.001$). Table 7: Middle Pre- and Post Test Comparison shows the measures of central tendencies, the standard deviation, and the minimum and maximum scores on the middle school pre- and post-tests. Figure 3: Middle School Pre- and Post-Test Comparison shows the graph with the percent correct by the percent of students earning that score on the pre-test and the post-test. For the middle school students, it is interesting to note the percent of students that scored 90% or higher (5% on the pre-test v 23% on the post-test).

Table 7: Middle Pre- and Post Test Comparison

	Pre-Test	Post-Test
Mean	57.9	72.9
Median	60	75.0
Mode	60	85.0
Standard Deviation	18.7	18.1
Minimum	5.0	15.0
Maximum	100	100.0

Figure 3: Middle School Pre- and Post-Test Comparison

Middle Schools Pre- & Post-Test



Student Affective Data

The students were given a pre- and post-survey dealing with their thoughts about the zoo. The pre-survey was administered prior to the students attending the School at the Zoo Program and the post-survey was given on the last day of the program. The elementary school pre-survey had five items, where students marked either “Agree” or “Disagree”, and the post survey had ten items, where students marked either “Agree” or “Disagree”. The first five items on the post-survey were the same five items on the pre-survey. For the elementary schools, there was not a statistically significance difference between the pre-survey and post survey data for four of the statements. This is primarily due to such a high percentage of agreement on the pre-survey questions (all questions had at least 88% agree with on the pre-survey). The one statement that was statistically significant ($t=2.74, p<.01$) was “I think zoos help protect plants and animals.” With the five additional questions, the highest amount of agreement was with the statements:

- I liked the activities (97.3%),
- I liked touching the animals (95.0%), and
- I liked School at the Zoo (92.3%).

The statement with the lowest amount of agreement was “I liked working in my science notebook.” Even this statement had around 3 out of every 4 students mark “agree”. Table 8: Elementary School Pre- and Post-Survey Results has the complete set of responses for all the pre- and post-survey questions.

Table 8: Elementary School Pre- and Post-Survey Results

Question	% Pre-Survey Agree	% Post-Survey Agree	Significance Level
I like to go to the Zoo	98.7	97.3	n.s.
I think zoos help protect plants and animals	93.6	98.0	p<.01
I like to learn about science	87.8	88.6	n.s.
I like to spend time outside and play	94.9	92.3	n.s.
I think animals are important to this planet	95.2	97.7	n.s.
I liked working in my science notebook	N/A	75.3	N/A
I liked the activities	N/A	97.3	N/A
I liked touching the animals	N/A	95.0	N/A
I liked the keeper talks	N/A	85.6	N/A
I liked School at the Zoo	N/A	92.3	N/A

n.s. – not significant

The middle school pre-survey had ten items, where students rated the statement on a scale of 1 to 4 (1=Strongly Disagree, 2=Disagree, 3=Agree, and 4=Strongly Agree), and the post survey had seventeen items, where students rated the statement on a scale of 1 to 4 (1=Strongly Disagree, 2=Disagree, 3=Agree, and 4=Strongly Agree). The first ten items on the post-survey were the same ten items on the pre-survey. For the middle schools, there was a statistically significance difference between the pre-survey and post survey data for six of the statements. The statements that were statistically significant were:

- “I am concerned about more animals becoming extinct”,
- “I think zoos play an important part helping protect animals and plants”,
- “I think all animals are important to this planet”,
- “I am concerned about pollution”,
- “I think science is important”, and
- “I think recycling is important.”

With the seven additional questions, the highest amount of agreement was with the statements:

- “Overall, I liked the School at the Zoo” (3.71),
- “I got to see and learn things that I couldn’t have seen and learned at my school” (3.70),
- “I liked the keeper talks and demonstrations” (3.62),
- “I liked touching the animals” (3.60), and
- “I liked the activities” (3.58).

The statement with the lowest amount of agreement was “I liked my science notebook.” Table 9: Middle School Pre- and Post-Survey Results has the complete set of responses for all the pre- and post-survey questions.

Table 9: Middle School Pre- and Post-Survey Results

Question	Pre-Survey			Post-Survey			Significance Level
	% A	% SA	AVG	% A	% SA	AVG	
I feel more positive about animals	33	61	3.53	35	61	3.55	n.s
I am concerned about animals becoming extinct	35	46	3.21	33	58	3.44	p<.001
I like to spend time outside	33	58	3.47	34	56	3.43	n.s
I think zoos play an important part helping protect animals and plants	36	55	3.42	20	76	3.69	p<.001
I think all animals are important to this planet	31	59	3.47	21	71	3.61	p<.01
I am concerned about pollution	43	40	3.18	39	46	3.28	p<.05
I think studying science is important	47	35	3.13	45	43	3.27	p<.01
My actions can make a difference in the world	43	47	3.35	36	54	3.42	n.s
I think recycling is important	38	53	3.40	33	61	3.52	p<.01
I think all living things are connected in nature	35	59	3.50	31	64	3.55	n.s
I liked the zoo classes	N/A	N/A	N/A	31	60	3.49	N/A
I liked the activities	N/A	N/A	N/A	29	65	3.58	N/A
I liked my science notebook	N/A	N/A	N/A	44	32	3.03	N/A
I liked touching the animals	N/A	N/A	N/A	22	70	3.60	N/A
I liked the Keeper talks and training demonstrations	N/A	N/A	N/A	26	68	3.62	N/A
I got to see and learn things that I couldn't have seen and learned at my school	N/A	N/A	N/A	19	76	3.70	N/A
Overall, I liked School at the Zoo	N/A	N/A	N/A	17	77	3.71	N/A

A="Agree", SA="Strongly Agree", n.s.-not significant

Student Comments

The affective survey had a question where students could leave a comment. For the elementary schools, 129 students made comments and for the middle schools, 478 students made comments. These comments are classified into nine categories (some comments were classified in more than one category). These categories are:

- General Positive (32% of comments) – these are comments that were general in nature and were positive. Some of these statements were, “loved it”, “thanks”, “awesome”, etc...
- Instructor Positive (13% of comments) – these comments were positive comments made specifically about the instructors.
- Return Trip (13% of comments) – These comments were positive comments that expressed a desire to come back or spend more time at the zoo.
- Learning/Experience (19% of comments) – These comments specifically mentioned how they learned something or about the experience (either general or specific).
- Suggestions/Negatives (9% of comments) – These comments the students expressed displeasure about some aspect of the program or a suggestion to make it better. It should be noted that many of these comments expressed a negative about something specific, but then stated that overall they liked the program.
- Favorite (4% of comments) – With this category students expressed that they had a favorite animal or place at the zoo.
- Questions (1% of comments) – These comments were questions that the students still had about the animals or the zoo in general.
- Other (4% of comments) – These are comments that did not clearly belong into one of the other categories. Typically, these comments were neither positive nor negative, but just statements.
- Volunteer (5% of comments) – These comments were from the middle school students that expressed an interest in becoming a volunteer for the zoo.

Table 10: Student Comments show a sample of the comments made by the elementary and middle school students.

Table 10: Student Comments

Category	Elementary School Sample Comments	Middle School Sample Comments
General Positive 63-Elementary 147-Middle 32%-Total	"Lots of fun." "Thanks for everything. The zoo is the best place to be." "I loved zoo school and I had one of the best times of my life" "My trip to the zoo this week has been awesome." "This has been the best week ever. I love the zoo."	"It was super fun. I loved everything here, the zoo is awesome." "I loved it but it went by fast because it was so fun." "I think the zoo was very fun and I'm glad I got to come x 1,000,000,000." "Louisville Zoo Rules!" "I loved being here with you guys. I wish this could be my real school. School at the Zoo ROCKS!"
Instructor Positive 17-Elementary 70-Middle 13%-Total	"I really like Ms. ..." "I will miss you Ms. ... and the lame jokes. I love you so much." "I had the best zoo teacher ever and helper...this was the best week ever" "Thank you for teaching us, you were very good and I liked you."	"I loved Ms. ...! She was really funny and energetic." "Ms. ... (my teacher for the week) made everything really fun to learn. She was very outgoing and funny. She made us remember things and in a fun way. I loved her!" "I love Ms. She was a wonderful teacher. Also, she helped me understand a lot." "It was more fun than I expected. My teacher and the docents really opened my eyes making me like animals a little more."
Return Trip 14-Elementary 71-Middle 13%-Total	"I loved it all and want to come again." "I want to come back next year." "I wish I could come every day to the zoo."	"I will be back as soon as I can." "Can we come back?" "This was so fun. I wish we could stay longer." "I wish I could have School at the Zoo forever." "I really want to come to School at the Zoo next year."

Learning/ Experience	"I really loved touching the animals."	"I really liked the animal training and feeding."
17-Elementary 107-Middle	"I come here a lot but this time it taught me a lot of stuff I didn't know."	"I don't come to the zoo a lot so I really liked being able to enjoy this experience."
19%-Total	"I really liked the tiger training..." "I learned a lot at School at the Zoo. When I go home I'm going to tell my friends all about it."	"I loved all the animals I saw. I have always loved the zoo, but this was a very special experience and yes I would do it again!" "I liked School at the Zoo because I got to touch animals and saw different kinds of animals that I never go to see before." "I liked to come to the zoo to learn about the animals and their adaptations." "I thought this was an amazing week and I now learned things in a perspective I couldn't learn in school." "I really like School at the Zoo because I got to observe animals up close and write observations." "I love coming to the zoo in the summer but now I got to go more behind the scenes and do things that I couldn't have done if I was coming with my family."
Suggestions/ Negative	"I would like to see more places."	"I thought we could have written less and got outside a little more..."
8-Elementary 48-Middle	"I was really cold and too much poop."	"I didn't like having to write all of the work in the science notebook."
9%-Total	"I think we walked too much..."	"I don't like not being allowed to touch the birds." "I will never have fun at the zoo when it's cold."

		<p>"Less time in classroom..."</p> <p>"The snakes and bugs were creepy..."</p> <p>"You all need to try to get some Koala's..."</p>
<p>Favorite 4-Elementary 19-Middle 4%-Total</p>	<p>"My favorites were the Black footed ferrets and the giraffes."</p> <p>"My favorite animals were the orangutans and the gorillas."</p>	<p>"My favorite part was the Glacier Run."</p> <p>"I liked seeing the tiger get trained and seeing the polar bears."</p> <p>"I loved all the animals especially the eastern and western screech owls, they're my favorite."</p>
<p>Questions 4-Elementary 5-Middle 1%-Total</p>	<p>"Could we buy an animal from the Louisville Zoo?"</p> <p>"I would like to know what the buildings are by Glacier Run."</p>	<p>"Why can't you go in with the bear, or Polar bear, or the lion, or the tiger, or the monkey or the gorilla?"</p> <p>"Why were the penguins scared of the birds?"</p>
<p>Other 6-Elementary 22-Middle 4%-Total</p>	<p>"I want to go to the pet store so bad."</p> <p>"The zoo has a lot of animals."</p>	<p>"It was nice to get out of school."</p> <p>"I think animals are cool and I'm gonna get a lot of animals when I grow up."</p> <p>"... after School at the Zoo, I really want a ferret!"</p> <p>"I hope the new polar bear finds its natural mother."</p>
<p>Volunteer N/A- Elementary 34-Middle 5%-Total</p>	<p>N/A</p>	<p>"I want to be a volunteer."</p> <p>"I can't wait until I'm 13 so I can be a volunteer at the zoo."</p> <p>"How can I sign up to volunteer?"</p> <p>"How do you become a volunteer? Is it free? Does the zoo provide transportation?"</p> <p>"Forms for teen volunteers? I'd be interested."</p>

Teacher Survey

The teachers that accompanied their students on the field trip were asked to complete an on-line survey. This survey was sent to 45 teachers. Of the 45 teachers, 28 completed the survey for a 62% completion rate. This rate is considered a good completion rate. This survey had general questions, questions specific to the curriculum, resources, and program delivery, questions relating to how effective the program was in improving teachers' personal knowledge and delivery, and an open comment section. Table 8: Teacher Survey Results has the complete survey results. Not a single teacher marked "Strongly Disagree" for any question. Only one question had less than 90% of the teachers mark "Agree" or "Strongly Agree". That question was "the writing component was good." Even this question had 85.7% of the teachers mark "Agree" or "Strongly Agree". This would lead to the conclusion that the teachers perceived:

- The Program Delivery/Presentation components were viewed favorably (98.8% marked "Agree" or "Strongly Agree" on this series of questions),
- The Curriculum components were viewed favorably (98.0 % marked "Agree" or "Strongly Agree" on this series of questions),
- The Teacher Related components were viewed favorably (97.5% marked "Agree" or "Strongly Agree" on this series of questions), and
- The overall perception was viewed favorably (99.5% marked "Agree" or "Strongly Agree" on this series of questions).

Two of the most significant responses were:

- 96.4% of the teachers marked "Agree" or "Strongly Agree" to the statement "I plan to use the School at the Zoo Program again", and
- 100% of the teachers marked "Agree" or "Strongly Agree" to the statement, "Overall, I liked the School at the Zoo Program".

Table 11: Teacher Survey Results shows the statement and the percent of teachers that marked each category, along with the average rating for each statement.

Of the 28 teachers that responded to the survey, 17 left comments. These comments were further divided into ideas/thoughts in order to classify them. There were 33 separate ideas/thoughts. Of these ideas:

- Thirteen (13) were general positive comments. Some of these comments included:
 - a) "This is the eighth year I have taken students to School at the Zoo. I look forward to it as much as my students. It is a wonderful program that cannot be matched!"
 - b) "The program was awesome. Our students loved the program and we will definitely try and go again."
 - c) "The School at the Zoo is the most wonderful program that I have had the privilege of being a part of this year and former years."

- d) "The School at the Zoo Program is a well planned, well executed educational program. We are so fortunate to be able to participate in this excellent and amazing opportunity. I believe it changes the way children and staff view the world."
- e) "They learned and enjoyed every second."
- Seven (7) comments were positive about the staff, instructors, and volunteers (docents). Some of these comments were:
 - a) "Marcelle and her staff are top notch."
 - b) "The Zoo School teachers and docents were amazing. They were knowledgeable and friendly and seemed to enjoy being around the students."
 - c) "The educators and the docents are excellent. I especially appreciate the way they listen to children and take their questions seriously. "
 - d) "We have several students who wish to volunteer at the zoo over the summer months based on their experience there and the zoo staff can be thanked for that as they are wonderful representatives of the mission of the zoo."
- Six (6) comments related to how the School at the Zoo was a great experience for the students and staff. Some of the comments were:
 - a) "I am not a science teacher, so I do not directly use the models and ideas taught at the zoo. However, I do gain insight into student learning and methods for teaching effectively."
 - b) "My students still bring up things that we learned at the zoo without prompting. They loved the experience. Seeing science in a real-life setting is always beneficial. This program provides real-life, hands-on connections. We love it!"
 - c) "...it offers great experiences for the students that they cannot get in the classroom."
- Four (4) comments related to preparing students for tests and supporting the social studies curriculum. A few of these comments were:
 - a) "Students do not get to learn about animal diversity, habitats, and ecosystems until 8th grade, but they are tested in the Spring of 7th grade. School at the Zoo definitely helps prepare students for KPREP/KCCT/KCAS."
 - b) "...the knowledge they gain is directly related to core content."
 - c) "The School at the Zoo program is invaluable to seventh grade students in several areas, including readiness for testing and augmenting social studies content, especially geography."
- Three comments were either negative or offered suggestions (it should be noted that two of these comments came from a person that also stated "Overall, the program and all of its components were exceptional." and "I would like to thank the zoo staff as a whole for a wonderful and educational program.").
 - a) One comment expressed that the seat time in the classroom was too long.
 - b) Another comment expressed that a volunteer was "NOT 'kid friendly'" and also was rude to some of the parents. (This person further stated, "All of the other helpers and staff were wonderful, helpful and very aware of how students of this age learn and act.")

- c) The last comment in this category expressed how their group went during the cold months and students were getting sick because of the bad weather. Additionally, this person thought that by Friday the students were tired.

One comment that was more in-depth and crossed multiple categories above stated (one part has been removed for student confidentiality):

"I am a HUGE fan of School at the Zoo!!! I think the instructors are EXCELLENT. I have some challenging kiddos this year - who are very difficult to motivate in the regular classroom. This program allows them to get up and out of the classroom and experience science in the real world. The best thing about the trip is that because it is so authentic, hands on, and interactive - they remember the science so well.

I have high school kids who come and visit - and almost always mention our trip to the zoo - they remember facts - it is awesome!!! One student who I taught two years ago is still encouraging others to STOP BUYING PALM OIL. She tells me that she is determined to 'save the orangutans'.

One of my most challenging students developed a relationship with Ms. At school he gets removed from class, due to disrespectful behavior, approximately twice a day. His behavior at the zoo was amazing. He volunteered, he participated, and he was respectful. He was able to relax, feel confident, and enjoy the safe atmosphere that the zoo staff provides. The docents were so kind to him. He told me just yesterday that he hopes to work with animals someday.

As a JCPS teacher - I strongly recommend that the School at the Zoo program continue for a long, long time."

Table 11: Teacher Survey Results

Question	% SD	% D	% A	% SA	% SA or A	Rating Average
Program Delivery/Presentation Questions						
The School at the Zoo Program took into account students' individual learning styles	0.0	0.0	35.7	64.3	100	3.64
The School at the Zoo Program took into account multiple intelligences	0.0	0.0	21.4	78.6	100	3.79
The School at the Zoo Program took into account diverse cultural backgrounds	0.0	7.1	25.0	67.9	92.9	3.61
This program encouraged creative problem solving skills	0.0	0.0	21.4	78.6	100	3.79
The presentations by educators were well done	0.0	0.0	14.3	85.7	100	3.86
This program encouraged higher level thinking to achieve understanding of the complexities of ecosystems	0.0	0.0	14.3	85.7	100	3.86
TOTAL					98.8%	
Curriculum Related Questions						
The School at the Zoo curriculum was relevant to the core content	0.0	0.0	7.1	92.9	100	3.93
This program will help my students with their test scores	0.0	0.0	18.5	81.5	100	3.81
The week at the zoo helped my students connect to the natural world and to conservation issues	0.0	0.0	14.3	85.7	100	3.86
My students learned the purpose of zoos	0.0	0.0	28.6	71.4	100	3.71
The notebook was useful	0.0	0.0	14.3	85.7	100	3.86
The hands-on activities were useful	0.0	0.0	14.3	85.7	100	3.86
The writing component was good	0.0	14.3	17.9	67.9	85.7	3.54
TOTAL					98.0	
Teacher Related Questions						
I was able to use what the students learned/did at the zoo back in the classroom	0.0	0.0	29.6	70.4	100	3.70
The zoo staff's lessons gave me models that I can use back at school	0.0	3.7	44.4	51.9	96.3	3.48
The zoo visit added to my own growth and knowledge as a teacher	0.0	3.7	14.8	81.5	96.3	3.78
TOTAL					97.5	
General Program Questions						
The zoo staff were helpful	0.0	0.0	14.3	85.7	100	3.86
The students enjoyed going	0.0	0.0	14.3	85.7	100	3.86
The students learned a lot	0.0	0.0	14.3	85.7	100	3.86
Time was well spent	0.0	0.0	14.3	85.7	100	3.86
I plan to use the School at the Zoo Program again	0.0	3.6	7.1	89.3	96.4	3.86
With the School at the Zoo Program, students get to see things that they can't get in a regular classroom	0.0	0.0	10.7	89.3	100	3.89
Overall, I liked the School at the Zoo Program	0.0	0.0	10.7	89.3	100	3.89
TOTAL					99.5	

(SD =Strongly Disagree, D=Disagree, A=Agree, SA=Strongly Agree)

Conclusion

The School at the Zoo Program was evaluated using observation data, interviews (zoo and JCPS staff), documents (workbooks, program documents, schedules, and Kentucky Core Content), student pre- and post-tests, student surveys, student interviews, and teacher surveys. This evaluation was focused on seven primary research questions.

Is the program framework supported by research?

The program design used two research-based frameworks. The first is the five E's (engage, explore, explain, elaborate, and evaluate). This framework guides the staff in using inquiry-based practices. The second is the use of writing. Research has shown that students have stronger outcomes in science when there is a focused writing piece.

Does the program teach Kentucky Core Content?

When examining the Kentucky Core Content Standards with the content taught at the School in the Zoo Program, there is a clear match between the two. This is confirmed with 100% of the teachers marking either "Agree" or "Strongly Agree" to the statement "The School at the Zoo curriculum was relevant to core content."

Are the instructional techniques used research-based?

There were numerous observed or documented research-based instructional strategies used. These techniques included: graphic organizers, identifying similarities and differences, vocabulary development, and differentiated instruction.

Is the program reaching the targeted population?

"Using the Zoo as a 'living classroom,' the 'School at the Zoo' program addresses the need for enhanced science education by providing hands-on learning experiences that motivate students, especially those that have difficulty in traditional classroom situations and students that come from Title I schools (Gianelloni, 2007)." Of the 10 schools that participated in this program, 8 are Title I schools and another has nearly 65% of their students qualify for free/reduced lunch. Of the student participants, approximately 75% qualify for free/reduced lunch. Both teacher and student comments indicate that many of the students would not have this type of experience if it was not offered through a program such as this.

Are the students learning based on a pre- and post-test?

Both elementary and middle school students had a statistically significant increase from the pre-test to the post-test. The average gain was approximately 15% with the percent of students scoring 90% or higher increasing from 3% to 19% for the elementary students and 5% to 23% for middle school students.

Do the students feel differently about the zoo, the environment, or animals after participating in this program?

For the elementary students, there was a statistically significant increase ($p < .01$) in the number of students agreeing with the statement, "I think zoos help protect plants and animals." For the middle school students, there was a statistically significant increase in the number of students agreeing with the statements, a) "I am concerned about more animals becoming extinct" ($p < .001$), b) "I think zoos play an important part helping protect animals and plants" ($p < .001$), c) "I think all animals are important to this planet" ($p < .01$), d) "I am concerned about pollution" ($p < .05$), e) "I think science is important" ($p < .01$), and f) "I think recycling is important" ($p < .01$)." Additionally, 92% of the elementary students and 100% of the middle schools marked "Agree" or "Strongly Agree" to the statement, "I liked the School at the Zoo."

How do teachers perceive/value the School at the Zoo Program?

When examining the teacher survey data, the teachers perceived: a) The Program Delivery/Presentation components were viewed favorably (98.8% marked "Agree" or "Strongly Agree" on this series of questions), b) The Curriculum components were viewed favorably (98.0 % marked "Agree" or "Strongly Agree" on this series of questions), c) The Teacher Related components were viewed favorably (97.5% marked "Agree" or "Strongly Agree" on this series of questions), and d) The overall perception was viewed favorably (99.5% marked "Agree" or "Strongly Agree" on this series of questions).

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- 100% of the teachers marked "Agree" or "Strongly Agree" to the statement, "Overall, I liked the School at the Zoo Program".

In conclusion, the School at the Zoo Program uses a researched-based framework, connects to the Kentucky Core Content, uses research-based instructional techniques, reaches their targeted population, shows increased learning, shows increased appreciation for the zoo, the environment, and the animals, and is highly valued by the teachers.

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