ALIGNING LEARNING EXPERIENCES THAT COMPLEMENT SCIENCE EDUCATION AT A LOCAL NATURE PARK

A Professional Paper

by

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ABSTRACT

Young children need to be exposed to outdoor science experiences designed to support their understanding of observed phenomena, encourage the development of essential process skills, promote body and brain health, and enhance their exposure to and appreciation of the natural environment. Elementary teachers have the opportunity to nourish children's curiosity and eagerness to investigate and discover. Nevertheless, insufficient resources, time constraints and increased pressures on high levels of achievement on standardized tests, limit outdoor learning experiences for students.

In this study, I conducted semi-structured interviews with open-ended questions with professionals and practitioners, who perform key roles in imparting and promoting science education in the College Station/Bryan area. I interviewed pre-service and in-service elementary teachers, facilitators encouraging integration of informal and formal education, and program administrators in order to assess current educational approaches to science education, needs, best practices, and instructional expectations.

Using a qualitative method of content analysis, and the software NVivo10, a total of 123 discrete observations were coded and sorted into themes. Data analysis revealed common challenges that hinder educators' efforts to provide quality science education. Among those is the difficulty of finding outdoor places within city limits that provide experiential learning opportunities aligned to state standards, and that meet instructional, budget, time, and space requirements. Instructional expectations identified are learning stations, materials and knowledgeable facilitators.

I propose a community-school collaboration model to promote healthy habits in children, nurture their curiosity, and expand their scientific knowledge. In this model, educators, learners, and community partners cooperate to provide rich outdoor learning experiences at Wolf Pen Creek Park by facilitating Project Wild, Project Wild Aquatic and Growing Up Wild learning activities. Correlating Project Wild activities to the existing interpretive signs and resources found at the park could provide experiential learning opportunities, and allow science concepts be more meaningful and tangible.

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1. INTRODUCTION

1.1 Science at the elementary level

Our increasingly diverse, globalized, and complex society is witnessing rapid changes like never before (Bybee, 2010). Advances in science and technology are transforming the world through dramatic developments in all fields particularly medicine, engineering, electronics, and communication. The challenges of competing in a technology-based global market along with increasing world-class scientific innovations, demands for highly skilled workforce, and pressure of economic competitiveness are redefining the skill set that will enable students to participate in and contribute to today's society.

In order to respond to this challenge, the education system needs critical reforms to meet the growing demand for scientists and engineers (Bybee, 2010). Careers in the fields of science and technology are essential for the economy, offer better salaries, and workers are less likely to become unemployed. Nevertheless, in North America, the growing number of workers that are engaged in research has maintained a slow growth in comparison to rapidly developing economies, such as South Korea and China (NSB, 2012).

According to Bybee (2010), the primary global concerns are to sustain innovation by both scientists and engineers, create a highly skilled workforce, and develop scientifically and technologically literate citizens. The United States must respond to this trend by accelerating, broadening, and deepening efforts to reform science and technology education. These two must become a priority because their contributions will provide the basis for higher levels of student achievement in knowledge, values, and abilities required for the 21st century. Increasing and improving scientific literacy in order to develop a deep and diverse scientific workforce is crucial to respond to the 21st century goals and maintain The United States' position of leadership in the global market.

Organizations such as the National Science Foundation (NSF), the National Research Council, and the American Association for the Advancement of Science (AAAS) have made significant commitments to improving science education in the United States (National Research Council, 2012). The interest in reforming science instruction has led to a large and growing body of research on teaching and learning science, as well as millions of dollars invested in developing innovative K–12 curricula, building teachers' skills, and reforming the systems that support science teaching and learning (Minner et al., 2010).

The National Research Council (2012) recognizes that understanding science and engineering, now more than ever, is essential for every American citizen, and a rich science education has the potential to capture students' sense of wonder, spark their desire to continue learning, and choose careers in science and technology. However, the percentage of students who are motivated by their in-school and out-of-school experiences to pursue careers in science is currently inadequate for the nation's needs. Strengthening science education is a priority, and this national trend has created a widespread call for a new approach to K-12 science education in the United States. Chittenden and Jones (1999) argue that the momentum toward reform of science education brings pressures on schools and teachers to evaluate or otherwise account for children's learning in science starting at early grades.

According to Saçkes et al. (2011), children develop fundamental understandings of observed phenomena and essential science process skills during their earliest years. Therefore, science instruction in the early years can provide the necessary opportunities for young children to develop basic understandings of the natural occurrences through fundamental process skills such as observing, inferring, and exploring.

Since basic understandings begin to develop as early as infancy, science education in early childhood is crucial in the acquisition of skills needed for science learning. Researchers suggest that science education should begin in preschool. For instance, Lind (1999), argues that children entering preschool and kindergarten use exploration as their first approach when dealing with new situations. In addition, they

begin to apply basic concepts to collecting and organizing data to answer questions, which requires skills in observation, counting, recording, and organizing.

Supporting the argument that small children should be exposed to science education, Eshach and Fried (2005), list the following ideas as some of the reasons to introduce science at early ages. Children naturally enjoy observing and thinking about nature, which is essential to help students acquire the skills needed for inquiry learning. In addition, students who are exposed to science at early ages tend to develop positive attitudes towards this subject. Another reason to stress science education at early grades is that early exposure to scientific phenomena leads to a solid basis of understanding of the scientific concepts studied at later grades. The use of scientifically informed language influences the eventual development of concepts. Finally, children are able to understand fundamental concepts, reason and develop scientific thinking when provided with rich and engaging science education.

More and more the world is shaped by revolutionary new technologies. This generation is living in an age of constant scientific discovery, which requires scientifically literate citizens who can use science to improve their own lives, cope with an increasingly complex technological world, and make informed decisions regarding the applications of science and technology. Science, engineering, and technology permeate nearly every facet of modern life, and they hold the key to meeting many of the world's most pressing challenges. This global trend has created an urgent call for a new approach to K-12 science education in the United States. Quality science experiences in the early years can provide the necessary opportunities for young children to develop knowledge of science concepts along with problem-solving and critical-thinking skills to lay a solid foundation for the subsequent development of scientific concepts they will encounter throughout their academic lives in order to become scientifically literate citizens. Understanding the importance of science, being able to evaluate and make informed decisions on public matters in addition to having the knowledge and skills relevant to technical and scientific aspects of living and working in an advanced scientific and technological society, are fundamental abilities needed in the 21st century.

1.2 Inquiry-based science learning

Innate curiosity and desire to explore the unknown has propelled humanity to major scientific discoveries. From birth onward, humans have intrinsic motivation to know and discover, to be active, inquisitive, and curious (Ryan and Deci, 2000). In fact, research on children's motivations to learn reveals that young children are full of curiosity and passion for learning (Raffini, 1993).

According to Ryan and Deci (2000), what makes young children particularly ready for science and the ideas of science is the pleasure they take in nature, through playing, collecting, and observing. Their intrinsic motivation (Ryan and Deci, 2000) and their "sense of wonder" (Carson, 1999) predispose children to learn science. Ryan and Deci (2000) argue that this is one of the most important arguments against neglecting science at early ages, and they also stress that educators must preserve that sense of wonder, which is directed mostly towards the natural world. Science content and skills fit naturally with the way young children explore and try to make sense of their surroundings; therefore, early science experiences can capitalize on children's motivation to explore, be highly engaging and consistently interesting to young throughout their school years (Saçkes et al., 2011).

Children enter school with the cognitive capacity to engage in science learning. They have the intellectual capability to learn science, have rich knowledge of the natural world, demonstrate causal reasoning, and are able to discriminate between reliable and unreliable sources of knowledge (National Research Council, 2007). However, children are in danger of losing their interest when they are not provided with rigorous curriculum and instruction to support science learning, (Eshach and Fried, 2005). Moreover, children will not be able to develop fundamental scientific knowledge and skills (Hadzigeorgiou, 2002). A study carried out by Paris et al. (1998) found that third grade students were more enthusiastic about learning about biology than older students. Their findings may indicate either the general enthusiasm of younger students about learning science or the decreasing motivation for learning science among older students.

According to the National Research Council (2012), the main goals of science education are to cultivate students' scientific habits of mind, develop their capability to engage in scientific inquiry, and teach them how to reason in a scientific context. The latest framework for K-12 science education developed by the National Research Council (2012) was based on a rich body of research on science teaching and learning. Previous studies including Science for All Americans and Benchmarks for Science Literacy (1993) developed by the American Association for the Advancement of Science (AAAS), and the National Science Education Standards (1996) developed by the National Research Council, also sought to identify the major goals for K-12 science education.

After nearly two decades of efforts to define foundational knowledge and skills for K-12 science and engineering, the National Research Council concluded that K-12 science and engineering education needs to focus on a limited number of core ideas and concepts. It also needs to be designed so that students continually build on their knowledge and abilities over multiple years. Moreover, science and engineer education must support the integration of knowledge and abilities with the practices needed to engage in scientific inquiry and engineering design (National Research Council, 2012).

According to the National Research Council (1996), "Inquiry refers to the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Inquiry also refers to the activities of students in which they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world" (p. 23).

In all inquiry-based approaches to science teaching, the National Research Council expectation is that students will engage in scientific practices. It is through direct experience of those practices that they comprehend scientific concepts and appreciate the nature of scientific knowledge (National Research Council, 2000). The National Science Education Standards released by the National Research Council in 1995, provide valuable insights into the ways that teachers might sustain the curiosity of students and help them develop the sets of abilities associated with scientific inquiry.

The National Research Council stresses that students who use inquiry to learn science engage in many of the same activities and thinking processes that scientists do. The challenge is, however, to create an educational system that exploits the natural curiosity of children, so that they maintain their motivation to be life-long learners (National Research Council, 2000).

In order to clarify the concept and encourage teachers to use scientific inquiry in their daily science instruction, researchers in the United States and abroad have investigated the effects of inquiry instruction. The overall findings of the research by Minner et al. (2010) indicate that having students actively thinking about and participating in the process of investigation increases their science conceptual learning. Also, the authors conclude that hands-on experiences with scientific or natural phenomena are associated with increased conceptual learning.

Furthermore, Paris et al. (1998) evaluated the effects of an extracurricular science program called “Hands-on biology”, a partnership among museum staff, teachers in local schools and a university. In this study, students in grades 3, 4, and 5 were actively involved in inquiry-guided experiences during a 6-week period. The curriculum was designed to match state-mandated educational objectives and to foster hands-on experiences. The results of this study indicated that Hands-on biology fostered more positive attitudes about participating in science activities. It also showed students’ significant learning gains on problem-solving questions, which indicates that they improved fundamental thinking skills. Scores on weekly quizzes improved and revealed good retention of basic information of the curriculum. In addition, students involved in the program showed more enthusiasm towards science activities. Teachers appreciated the variety of inquiry-based activities, observed positive responses in their students and noticed increased analytical thinking. According to the authors, an important implication of this study is the need to integrate more hands-on, inquiry-based science activities in the science curriculum.

The National Research Council describes the following as core components or “essential features of classroom inquiry’’ (National Research Council, 2000, p. 25). (1)

Learners are engaged by scientifically oriented questions. (2) Learners give priority to evidence, which allows them to develop and evaluate explanations that address scientifically oriented questions. (3) Learners formulate explanations from evidence. (4) Learners evaluate their explanations in light of alternative explanations, particularly those reflecting scientific understanding. (5) Learners communicate and justify their proposed explanations. Furthermore, Lederman (2010) explains that scientific inquiry extends beyond observing, inferring, classifying, predicting, measuring, questioning, interpreting and analyzing data. She defines inquiry as systematic approaches used by scientists in an effort to answer questions of interest. In her definition, inquiry includes not only science processes, but also the combining of these processes with knowledge, reasoning and critical thinking to develop deep scientific knowledge.

The various definitions of scientific inquiry and inquiry-based learning involve active participation in science learning which encourages students to participate in active exploration, where students ask questions, observe, analyze, explain, draw conclusions, and ask new questions. According to the National Institutes of Health (2005), students are successful in making their own discoveries when there is active, collaborative learning directed toward scientific inquiry. Students are active thinkers who construct their own understanding from interactions with phenomena, the environment, and other individuals. This point of view is based on the theory of constructivism, which recognizes the need for students to express their thinking, interact with objects, organisms, substances, and equipment in order to develop experiences on which to base their thinking, and make connections between their learning experiences and the real world.

The National Institute of Health (2005) affirms that only when students learn science by engaging in the practices of science they are involved in true inquiry. Based on the fact that children have a natural tendency to enjoy observing and thinking about their surroundings, an innate sense of wonder and an intrinsic motivation to know, young children should be exposed to and involved in science practices. Otherwise, children will lose interest and fail to acquire the scientific knowledge and skills much needed in this

era of rapid advances in science and technology. In order to nourish their natural curiosity and acquire the principles and concepts of science, reasoning and procedural skills of scientists, students need to devise and carry out investigations, and understand why such investigations are significant. Through inquiry-based science instruction students and teachers can actively participate and learn about the nature and content of science. Scientific Inquiry will enhance students' understanding of scientific concepts and procedures allowing them to achieve the goal of becoming scientifically literate.

1.3 Health benefits from contact with the outdoors

Being outdoors is important to our health. Research provides extensive evidence of the numerous social, psychological, and physical benefits of outdoor activities and contact with green environments. According to Pretty (2007) cited by Muñoz (2009) "the outdoors includes public and private outside spaces, most often incorporating some degree of the "natural," where people can engage with nature" (p. 6). The concept of outdoors includes urban green spaces such as domestic and communal gardens, urban parks, open countryside, forest, coastal and mountain areas.

According to Nielsen and Hansen (2007) cited by Townsend and Weerasuriya (2010), environmental psychologists have studied the health effects of contact with nature since the early 1980. Kuo (2010) lists the benefits that contact with nature provides to our health. They include healthier social behavior, better cognitive functioning, proactivity, effective patterns of life functioning, self-discipline, impulse control, and greater resilience in response to stress. She also reports enhanced recovery from surgery, and improved immune system functioning as a result of contact with greener environments. Pretty et al. (2009) affirms that significant mental health and physical challenges arising from inadequate diets and sedentary lifestyles could be addressed by increasing physical activity in natural places.

Research shows there are several positive effects of contact with nature and time spent outside. These effects include improvements of attention deficit hyperactivity disorder (ADHD), children's motor development as a consequence of outdoor play, and

alleviation of anxiety and depression (Muñoz, 2009). A study published in The American Journal of Public Health in 2004 found that exposure to ordinary natural settings can reduce symptoms of ADHD significantly more than activities conducted in other settings (Kuo and Taylor, 2004). Similarly, a study in The Journal of Attention Disorders in 2009 found that a 20-minute walk in a park elevated attention performance in children with attention deficits (Taylor and Kuo, 2009).

Researchers have found a connection between outdoor activities and children development. A study carried by Fjortoft (2004) with 5- to 7-year-old kindergarten children, investigated the impacts of playing in a natural environment (forest and fields next to the experimental kindergarten) on motor development. In this study, children showed a statistically significant increase in motor fitness when provided with a natural landscape in which to play. Overall, physical activity in the natural setting improved all the motor abilities tested, except for flexibility. The findings of this study points to the outdoors as an influential factor in children's motor development.

Similarly, the systematic review of scientific studies conducted by Coon et al. (2011) compared the effects on physical and mental wellbeing of young adults after participating in physical activities in outdoor and indoors environments. In this study, exercising in natural environments was associated with greater feelings of revitalization and positive engagement, decrease in tension, confusion, anger, depression, and increased energy. Greater enjoyment and satisfaction with outdoor activities was also reported. Although the review showed positive effects on mental wellbeing immediately following exercise in nature, which are not seen following the same exercise indoors, the investigators emphasized the need for further research in this area.

Moreover, research literature concerning outdoor activities and obesity in children is abundant. Childhood overweight and obesity have become a worldwide concern. In the United States, it is considered a national health crisis (White House Task Force on Childhood Obesity, 2010). A study conducted by Ogden et al. (2010) provides the most recent estimates of high body mass index (BMI) among children and adolescents. The National Health and Nutrition Examination Survey 2007-2008,

measured heights and weights on 3,281 children and adolescents (2 through 19 years of age) and found that 11.9% were at or above the 97th percentile of the BMI-for-age growth charts, 16.9% were at or above the 95th percentile, and 31.7% were at or above the 85th percentile of BMI for age.

Overweight is defined as a BMI at or above the 85th percentile and lower than the 95th percentile, and obesity is defined as a BMI at or above the 95th percentile for children of the same age and sex (Barlow and the Expert Committee, 2007). Therefore, according to the report by Ogden et al. (2010), one in every three children (31.7%) ages 2-19 is overweight or obese.

Overweight and obesity are serious medical conditions associated with a wide range of debilitating and life threatening ailments. Flegal et al. (2005) estimated deaths associated with overweight in the United States in the year 2000 and found that obesity (BMI >30) was associated with 111,909 excess deaths. Furthermore, about 215,000 people younger than 20 years had diabetes (type 1 or type 2) in the United States in 2010 (Centers for Disease Control and Prevention, 2011). Olshansky et al. (2005) affirms that observed trends in obesity threaten to diminish the health and life expectancy of current and future generations; furthermore "with obesity occurring at younger ages, the children and young adults of today will carry and express obesity-related risks for more of their life-time than previous generations" (p. 1141).

According to Muñoz (2009), greater amounts of physical activity are beneficial to children and play an important role in tackling the levels of childhood obesity. Time spent in outdoor settings is associated with increased physical activity, and therefore, children's use of the outdoors can potentially fight the negative health outcomes of obesity. Mackett and Paskins (2005) show that the place where children tend to be least active is at their own home; hence, when engaged in activities outside, their levels of physical activity are higher, which contributes significantly to their health.

Community access to green areas can also have significant positive effects on the health of dwellers (Grahn and Stigsdotter, 2003). A study of 8 European cities by Ellaway et al. (2005) assessed features of residential environments and the likelihood of

being physically active and not being overweight or obese. The authors found that in places with more greenery and less graffiti, people were more likely to take exercise and thus reduce obesity. In this study, they affirm that "for respondents whose residential environment contains high levels of greenery, the likelihood of being more physically active is more than three times as high, and the likelihood of being overweight and obese is about 40% less" (p. 612). Additionally, statistical analysis of the responses in a study conducted by Croucher et al. (2008) suggest that greater distance from home to green spaces was a better predictor of higher stress levels and obesity in respondents aged 25 or below.

Additional research studies in regards of health benefits to children from contact with the outdoors were compiled by Charles and Loge (2012) and the National Wildlife Federation (2012). They include better retinal vascular diameter in children who engaged in more outdoors physical activity than in children who engaged in more screen time; increased levels of vitamin D, as a consequence of exposure to sunlight, helping protect children from future bone problems, heart disease, diabetes and other health issues; better social interactions, and positive children's emotional development.

Modern life has brought positive scientific and technological advances but it has also led to sedentary ways of living that have negative health outcomes. Sedentary behaviors resulting from the overuse of electronic devices such as cellphones, video games, DVDs, and computers reduce the time children and adolescents are engaged in physical activities (Stanford School of Medicine, 2007). A survey conducted by the United States Environmental Protection Agency (EPA) found that people in the United States spends approximately 90% of their time indoors (United States Consumer Product Safety Commission). In addition, there is an emerging concern that children are less likely to be physically active and have experiences that involve interactions with nature. Nowadays, children spend most of their time inside their homes, schools, and community settings in human-made environments. A recent study on health-risk behaviors among youth and young adults found that nearly one-third (31.1%) play video or computer games for 3 or more hours on an average school day (Centers for Disease

Control and Prevention, 2012). Moreover, a national survey by the Kaiser Family Foundation found that the time kids spend consuming media (music, T.V., computers, video games, movies, etc.) has increased in the past 5 years from 6 hours and 21 minutes to 7 hours and 38 minutes each day. In addition to lack of physical activity, children who use media frequently are more likely to report getting fair or poor grades than other children (Rideout et al., 2010).

The National Association for Sport and Physical Education (NASPE) recommends that all children should engage in at least 60 minutes of physical activity per day and discourages periods of more than 2 hours of inactivity (White House Task Force on Childhood Obesity, 2010). However, an increasing amount of evidence is showing that many children are not meeting the NASPE recommendations. Children today are spending much time engaging in indoor activities including heavy use of media, increasing the likelihood of health problems caused by inactivity.

Encouraging young children to participate in activities outdoors is important for their physical, mental and social development. There is an abundant amount of literature discussing the connection between spending time indoors and health issues. Growing evidence shows that access to the outdoors and natural environment can significantly improve mental and physical health problems, is beneficial to children's development of strength, balance and coordination, can alleviate ADHD symptoms, and promotes positive social interactions. Furthermore, children's physical activity in outdoor environments has also been found essential to tackle childhood obesity, which is becoming a public health problem worldwide.

1.4 Inquiry-based science in outdoors settings

Exposing children to natural environments and encouraging outdoor activities is fundamental for their mental and physical wellbeing. However, since the late 1970s, children's playtime has decreased by 25% and outdoor activities by 50% according to a study conducted by the Institute for Social Research at the University of Michigan (Juster et al. 2004 cited by Barros et al. 2009). Currently, many school districts

experience pressure to achieve higher scores on standardized tests, and as a consequence, many children are given less free time and fewer physical outlets at school (Blank, 2005).

Roth et al. (2003) studied the activities that take place during the school day and how students spend their time in school. In their research, 21% of teachers reported that their students did not have any time for recess during the day, which on average lasts 6 hours and 35 minutes. In addition, the study found that minority students had less exposure to recess and enrichment activities than white students. In fact, one third of the African American students had no recess; which according to the authors is due to tougher standards and the time on academics required to achieve those (Roth et al. 2003). Additionally, according to Charles and Louv (2009) in a review of available statistics by the Georgia State University and the University of Pennsylvania, Jarrett and Waite-Stupiansky affirmed that “officially having recess and actually having recess are two different issues,” and that “recess time is often cut because of academic pressures or as punishment for bad behavior.”

In order to take concrete steps to help children grow up healthy, the interagency Task Force on Childhood Obesity reviewed available research, and consulted experts to produce a set of recommendations to solve the problem of childhood obesity. The recommendations by the White House Task Force on Childhood Obesity (2010) include an urgent call for elementary schools to provide plenty of opportunities for outdoor and hands-on experiences for young learners, promote physical activities and outdoor education. This is important for optimum body and brain health, and also enhances children’s exposure to and appreciation of the natural environment.

There is an urgent need for an educational reform to instill in students the skills they need to contribute to today's science and technology-based society. Creating scientifically and technologically literate citizens and a highly skilled workforce requires not only rigorous academic standards and high achievement, but also an educational system that encourages components conducive to creating physically and mentally healthy students. Creating an educational framework that exploits the natural curiosity of

children to maintain their motivation for learning not only during their school years but throughout life, while offering a straining core curriculum to ensure high levels of achievement, and promote venues to encourage outdoor and hands-on experiences for young learners to contribute to both mental and physical health is without a doubt the most pressing challenge for most school districts.

A great deal of learning takes place outside the school setting, often referred to as informal learning environments. In fact, successful informal science learning experiences not only increase knowledge and understanding of science, but also further inquiry, enjoyment, and a sense that science learning can be personally relevant and rewarding. In addition, interaction with the natural world, promotes the development of knowledge about nature and science, and promotes science interests and skills (Fenichel and Schweingruber, 2010).

Teaching inquiry-based science in outdoors settings offers an opportunity to build on children's intrinsic curiosity and their need to interact with real objects and events. Learning in out-of-school settings takes greater meaning because it commonly involves groups of learners interacting with real elements (Resnick, 1987). The outdoors "serves as a natural setting for purposeful student learning and critical teacher reflection" (Bourne, 2000, p. 9). For instance, a study of 40 schools with a comprehensive educational framework that used the environment as an integrating context for learning, found several benefits of using socio-cultural environments as the contexts for learning, including a river, a forest, city park, garden, asphalt playground, among others. The observed benefits included: better performance in reading, writing, math, science, and social studies, reduced discipline and classroom management problems, increased engagement and enthusiasm for learning and greater pride and ownership in accomplishments (Lieberman and Hoody, 1998).

Additionally, a study conducted by The American Institutes for Research (AIR) measured the impacts of weeklong residential outdoor education programs for at-risk sixth graders in California. This study found that children who attended outdoor science school not only showed statistically significant positive gains in self-esteem, conflict

resolution, relationships with peers, problem solving, motivation to learn, and behavior in class, but also raised their science scores by 3 points (27%). Furthermore, the increase in science knowledge was maintained 6 to 10 weeks following the program participation (American Institutes for Research, 2005).

A similar study by the North American Association for Environmental Education (NAAEE) was based on a collection of case studies of schools in Texas, North Carolina, Wisconsin, Minnesota, Kentucky, and Florida that are using the environment to motivate students to learn. The study provides evidence that compared to the traditional educational system, environmental-based education improves academic performance across the curriculum. The study shows that students improved their scores in reading, mathematics, and social studies, had better classroom discipline, and also learn to "do science" rather than just "learn about science" (NEETF, 2000). According to the authors, "using nature as an outdoor laboratory helps create conditions conducive to learning. Students' natural interest in the environment motivates them to learn and understand the complexities of their world" (NEETF, 2000, p. 4).

In spite of the many advantages of providing students with outdoor scientific inquiry experiences, research shows that many classrooms do not include explicit attention to the teaching and learning of scientific inquiry and that many educators experience difficulties in creating classroom environments that help students develop adequate understandings of scientific inquiry (Lederman, 1992). For instance, Hurd et al. (1980) affirms that biology teachers lecture more than 75% of the time, leaving little time for inquiry. Furthermore, in a study conducted by Costenton and Lawson (1986), the authors found several reasons that prevent teachers from implementing inquiry-based activities. Among the top 10 reasons are the amount of time they need to spend developing good inquiry materials, the energy needed to maintain the level of enthusiasm through the day, the requirement to cover district curricula, the difficulty of reading materials and the uncertainty of how the activity will develop. The authors argue that teachers who do not understand what is scientific inquiry and lack the knowledge

and skills to incorporate inquiry in their science activities are left with little choice but to teach facts in a less effective expository way.

Inactivity is a major risk factor for childhood health problems. The daily overuse of media added to the reduced time committed to outdoor activities, are significantly affecting children's development. A substantial body of research has proven that outdoor and nature experiences are an important part of the developmental process for children. Outdoor education enhances the learning of academic subjects, and promotes inquiry science by exposing children to relevant and meaningful materials and settings. Since studies on childhood activities increasingly show that children have less and less time outdoors in nature, efforts need to be directed to ensure children are encouraged to spend more time engaging with nature and given opportunities to learn in outdoor settings. Taking inquiry-based science instruction outdoors is a valuable means to address children's learning needs. It offers a unique opportunity to engage students in scientific investigation, sharpen critical-thinking skills, increase awareness of the importance of basic research and engage students in questioning, exploring, investigating, manipulating, problem solving, communicating, reinventing and understanding, which are not only hallmarks of childhood but also the processes of scientific inquiry.

1.5 Community- school collaboration for science learning

At a time of national concern about the state of instruction in the country, public education moved towards a new standards-based accountability system in the 1990's to ensure that all students met high standards of performance (Bodilly et al. 2004). After the implementation of the No Child Left Behind Act (NCLB) of 2001, the standards-based accountability provisions have shaped the work of public school teachers and administrators (Hamilton et al., 2007). Underlining this shift are the beliefs that student performance is cumulative and influenced by the entire school, and that improving student performance will require collective responsibility (O'Day, 1999 cited by Goertz, 2001).

Henderson and Mapp (2002) affirm that family and community connections with schools make a difference in student achievement and success. In addition, Adelman & Taylor (2008) assert that when schools are an integral part of the community, they become more effective, which contributes to an enhanced academic performance, fewer discipline problems, higher staff morale, and improved use of resources.

Among different levels of interaction, collaboration is the most complete and integrated, which requires higher levels of inter-organizational connections (Bodilly et al., 2004). Collaboration among schools and community involve building strong relationships to connect resources in order to enhance effectiveness. Collaborators include not only families and schools but also agencies and organization that provide programs and services as well as entities that share facilities such as community gardens, parks, libraries (Taylor and Adelman, 2000), and other facilities that can be used for recreation, learning, enrichment, and support (Center for Mental Health in Schools, 2005).

Despite the fact that schools are located in communities, they are usually isolated from them. Many families have no connection to each other and to the schools their children attend, even though they share common goals related to education and socialization of their children. For this reason, Taylor and Adelman (2000) affirm that across the nation, efforts to increase parent and community involvement in schooling have been escalating in recent years. In addition, Henderson and Mapp (2002) argue that the evidence that supports the benefits of schools, families and community working together to support learning is consistent, positive, and convincing. They sustain that as a result of school and community partnerships, children tend to do better in school, stay in school longer, and like school more.

According to the National Research Council (2009), programs for science learning take place not only in schools but also in communities. Nevertheless, efforts to improve academic performance in science are usually directed to schools and focus on strategies such as improving science curriculum and enhancing teacher training. The potential for science learning in non-school settings is overlooked or underestimated

even though non-school science programs can influence academic achievement for students, and expand participants' sense of future science career options. In addition, the National Research Council (2009) affirms that "informal science learning experiences are believed to lead to further inquiry, enjoyment, and a sense that science learning can be personally relevant and rewarding."

With the support and sponsorship from the National Science Foundation (NSF), the National Research Council's committee on Learning Science in Informal Environments, examined the potential of non-school settings for science learning, and made specific recommendations about how to organize, design, and support science learning. Among those, the committee recommends the development of informal environments for science learning through community-educator partnerships. The committee also emphasizes the importance of informal environments such as museums, nature centers, botanical gardens, community parks, and everyday activities like gardening, hiking, fishing, or walking in the park, where opportunities for science learning abound (The National Research Council, 2009).

The following are examples compiled by Fenichel and Schweingruber (2010) that demonstrate how schools and communities' collaborative efforts can enhance science learning and help children understand that learning is not restricted to schools because opportunities to engage with science exist all around them.

The Gulf of Maine Research Institute (GMRI) is a non-profit marine science center located in Portland, Maine. LabVenture! is an informal science program, aligned with the school science curriculum, available at no cost to all 5th and 6th grade students. LabVenture! gives students the opportunity to enter to a state-of-the-art research facility, work with scientific instruments and use scientific skills to answer exciting real-world problems. The case study of the LabVenture!, referenced by Fenichel and Schweingruber (2010), reports that much of the learning that takes place is related to the development of inquiry skills. Responses to an online survey indicated that 74% of the students in the research sample said they learned about conducting scientific investigations by observing, forming hypotheses, collecting evidence, and analyzing

their results. In addition, the area of learning mentioned most frequently by the students was working as part of a research team. The teachers in the research study mentioned that the experience reinforced the 5th and 6th grade science curriculum, which included the study of weather, environmental sciences, ecology, watersheds, and estuaries.

Another example of collaboration between schools and the community to maximize learning opportunities for students is the Lake Washington Watershed Internship Program. Through collaboration among the city of Bellevue, Bellevue's five high schools, the Pacific Science Center, and the Mercer Slough Environmental Education Center, 27 students from local high schools meet once a week throughout the year to learn about the watershed, conduct hands-on experiments, and work to restore the creek beds around Mercer Slough. The students develop not only environmental science background, but also teaching and presentation skills by mentoring elementary students about their local environment. This partnership between formal and informal science settings is successfully helping students become informed stewards of their local community.

Paris et al. (1998) also studied an innovative model of how community agencies can collaborate for the benefit of young children. The authors evaluated the effects of an extracurricular science program called "Hands-on-biology", a collaborative partnership among museum staff, teachers in local schools, and a university, designed for students in grades 3, 4, and 5. During a 6-week period, students were actively involved in inquiry-guided experiences following a curriculum intended to match state-mandated educational objectives and to foster hands-on experiences. Significant learning gains on problem-solving questions, and high scores on weekly quizzes demonstrate the feasibility and value of collaboration designed to provide innovative science curriculum and inquiry-based experiences for students.

These examples illustrate the potential of collaboration between formal and informal settings to maximize learning opportunities for students. Partnerships between schools and community resources can also increase motivation to learn and provide ways to engage hard-to-reach-students using relevant, realistic materials and settings

(Ramey-Gassert, 1997) while delivering key instruction away from the pressure inherent in the formal school environment.

Nowadays that schools, school districts, and states are responding to the current push for performance based accountability, while at the same time experiencing reductions of school budgets and overburdened teachers, partnerships that combine the resources of schools and community agencies can provide cost effective and pedagogically sound support for students and teachers. Universities, for example, can involve undergraduates in school outreach programs. Local educational institutions, such as nature centers, community gardens or local parks, can involve their creative staff members and physical resources, such as outdoor spaces, specimens and discovery boxes. In addition, community volunteer staff or "amateur experts" might be available to support science learning experiences.

Regardless of the many challenges, encouraging collaboration for informal education to be effective in supporting formal education, and strengthening networks of relationships among schools and local institutions is essential to enhance learning, promote inquiry, and expose children to relevant, and meaningful materials and settings. This shared responsibility for educational excellence for all children is a new vision much needed for educating the future citizens of the 21st century.

2. BACKGROUND

2.1 The City of College Station

The City of College Station is located in Brazos County in the Central Texas region. The city covers an area of approximately 50 square miles and is centrally located near three of the ten largest cities in the United States: Houston (100 miles), Dallas (200 miles), and San Antonio (200 miles) (City of College Station, 2002b) (Figure 1). The City of Bryan borders College Station to the north, and together they make up the Bryan-College Station metropolitan area, commonly known as "Aggieland" in reference to the term Aggie, the official Texas A&M student body nickname since 1949 (TAMU, 2012).

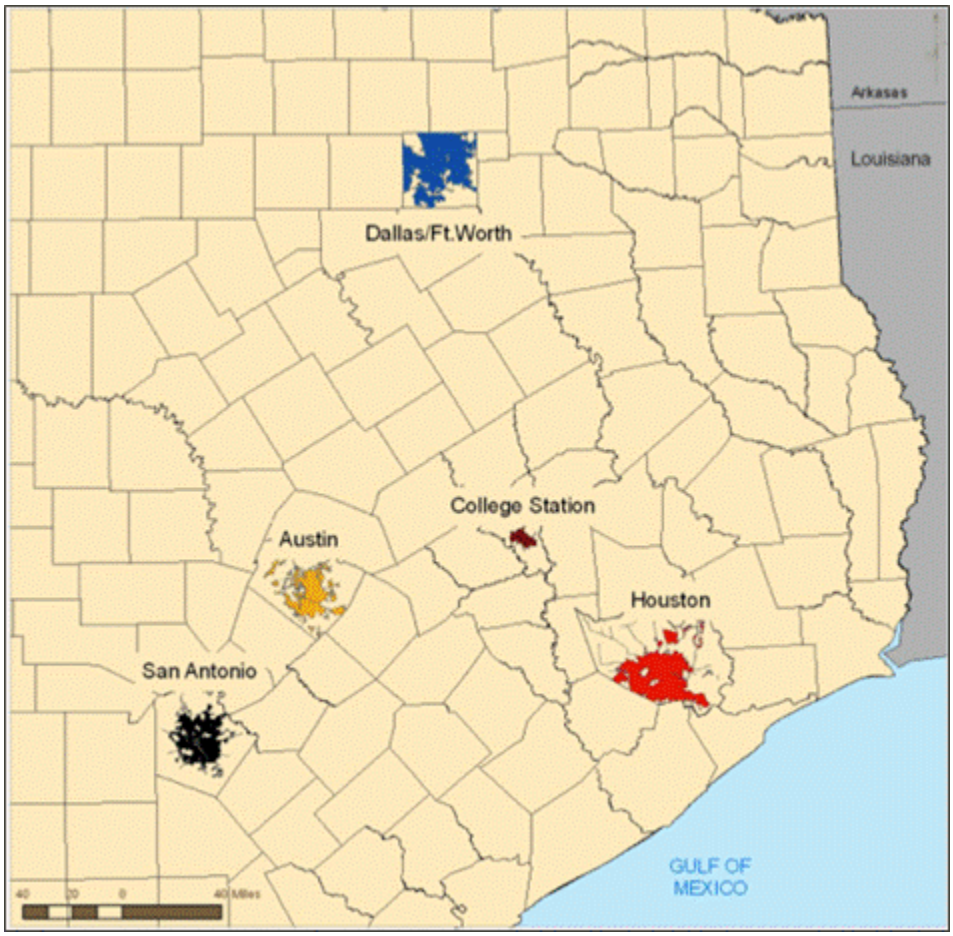

Figure 1. The Texas Triangle and College Station (City of College Station, 2010b).

The history of College Station as a community is linked to the foundation of Texas A&M University (formerly the Agricultural and Mechanical College of Texas) in 1876. The City of College Station was incorporated in 1938 as a result of a petition to the board of directors of Texas A&M, by 23 men representing the interests of the town and the campus (City of College Station, 2010b).

The 2000 census recorded the population of Brazos County at 152,415, including 67,890 residents of College Station and 65,660 residents of Bryan. The city's population estimate as of January 2011 was 94,640 (City of College Station, 2011). The population numbers of College Station include Texas A&M University students that live within the city limits. Since the 1990 census, College Station's growth has continued to increase. In fact, the 20-year population estimate is about 134,000 inhabitants in the year 2030 (City of College Station, 2010b).

Since its inception in 1938, College Station has engaged in city planning. A Comprehensive Plan was adopted in 1997; however, in order to reflect the vision and aspirations of the residents and respond to the specific opportunities and challenges facing the City, the Comprehensive Plan has undergone numerous updates and amendments. In 2006, the City Council initiated the process of updating the Comprehensive Plan and two public hearings for formal adoption were held in May of 2009. "The College Station Comprehensive Plan: 2009-2030 is a statement of the community's vision for the future and provides strategic direction to guide change, providing for growth while maintaining a high quality of life" (City of College Station, 2009).

2.2 College Station Independent School District

The College Station Independent School District is a public school system in the Brazos County. It was known as the A&M Consolidate ISD until its name changed in 1980 (City of College Station, 2003). Before College Station became a city, children attended rural schools around the area. These were typically one or two-room school buildings with multiple grades in one building and one teacher for all students. Rural

schools in the area included Union Hill, Wellborn, Rock Prairie, Shiloh, Peach Creek, and Minter Springs Common School Districts. Faculty and staff members of Texas A&M University lived in housing on campus, and their children were either informally tutored or attended neighboring districts.

In 1909, the State of Texas granted a charter for an independent school district to encompass the Texas A&M College campus, but the number of students needed to support a school was insufficient. Children from the surrounding school districts of Wellborn, Union Hill, and Shirock, were encouraged to attend school on the college campus (City of College Station, 2006). In 1920, the new school opened with 304 students. In 1928, the surrounding school districts officially dissolved and merged with A&M College Consolidated Independent School District (City of College Station, 2003). The A&M College Consolidated School was housed on campus until 1940. It was designed to be one of the best of its time. Highly qualified teachers were hired for each grade level, and the student-teacher ratio was kept low, approximately 25 to 35 students per grade level (City of College Station, 2006). In 1948, a new high school was built, and in 1949, it absorbed the Peach Creek and Minter Springs Common School Districts (City of College Station, 2003). A new A&M Consolidated High School was opened in 1955, and the old traditional school became the A&M Consolidated Junior High School. The City of College Station acquired the land in a land trade from the College Station Independent School District in 1980, and a year later the building was completely renovated (City of College Station, 2012d).

Currently, College Station Independent School District encompasses 15 campuses including 3 high schools, 4 middle or intermediate schools and 8 elementary schools. According to its core principles, the district believes that each student can be a critical thinker, problem solver and possess the knowledge and skills to be a productive and responsible citizen in a global market place. The district also affirms that the education of each student is the responsibility of the school district, the student, the family and the community (CSISD, 2012a).

2.2.1 Academic Performance

According to the Academic Excellence Indicator System (AEIS) report distributed by the Texas Education Agency (TEA), the CSISD total enrollment for the 2010-2011school year was 10,360 students. The student/teacher ratio was 14.2, and the district accountability rating was Academically Acceptable, which is the third highest possible rating in the Texas Education Agency's accountability system. In the 2009-2010 school year, the total enrollment was 10,061 students, the student/teacher ratio was 13.9, and the accountability rating was Academically Acceptable.

In the 2010-2011 school year, the percentage of schools by accountability rating was 15.4% exemplary campuses, 30.8% recognized schools and 53.8% academically acceptable. For the 2009-2010 school year, TEA reported 23.1% exemplary campuses, 61.5% recognized and 15.4 % academically acceptable schools (TEA, 2011; CSISD, 2012a).

2.2.2 Academic Performance in Science

The Texas Education Agency reported that College Station ISD TAKS (Texas Assessment of Knowledge and Skills) passing rate for science (all grades) in 2011 was 90%, which indicated a two-percentage point drop from the previous school year. The percentage of students passing the science test at the state level in 2011 was 83% (CSISD, 2012b).

Beginning in spring 2012, the TAKS test was replaced by the State of Texas Assessment of Academic Readiness (STAAR). The new STAAR test changes the way process skills are assessed. It allows for a more integrated and authentic assessment of content areas by evaluating process skills in context. The questions in the new STAAR test include a higher number of open-ended questions, greater cognitive complexity level, more emphasis on critical thinking, problem solving, and application of concepts rather than isolated skills. The Texas Education Agency will define performance standards and apply them to raw-score results in December 2012, and the results

indicating scale scores and performance level/passing standards will be sent to schools districts in January 2013 (TEA, 2012a).

Raw scores for the spring 2012 STAAR science were released during the summer of 2012. Raw scores indicate the percentage of correct answers and can only be interpreted in terms of a particular set of test questions. The statewide preliminary results for the spring 2012 STAAR 5th grade science shows 78% of correct items in the matter and energy category, 79% of correct items in the force, motion and energy category, 71% of correct items in the earth and space category, and 70% of correct answers in the organism and environment category (TEA, 2012b).

The reporting categories for the 2011 TAKS 5th grade science differ from the STAAR test. The 4 categories tested in the science TAKS test were nature of science, life sciences, physical sciences and earth sciences. The statewide results for the spring 2011 TAKS 5th grade science in English show a passing score of 87% of the total number of students that tested. The percentages of correct answers by categories are the following, 87% of correct answers in the nature of science category, 88% of correct items in the life sciences category, 87% of correct items in the physical science category, and 85% of correct items in the earth sciences category (TEA, 2012c).

2.3 Parks and Recreation

Since the establishment of the City's first park, Thomas Park, in 1938, the location and design of parks and open spaces in College Station have influenced neighborhoods and the pattern of the city itself (City of College Station, 2011).

In 1997, the non-profit organization, Brazos Greenways Council, was formed and it constituted a pillar in developing partnerships and creating a vision for the community's greenway system. The Greenways Master Plan, "A Network of Greenways for College Station," was adopted two years later. The Greenways Master Plan not only defined greenways for College Station and the surrounding areas, but also classified and prioritized greenway corridors and provided guidance on the development of greenway trails (City of College Station, 2012b). Since the adoption of the first Greenways Master

Plan in 1999, College Station has made significant advancements towards establishing a network of greenway corridors across the community (City of College Station, 2009).

The Parks and Recreation Department (PARD) is the City's agency dedicated to providing park and recreational opportunities. The PARD mission is "to provide a diversity of facilities and leisure services that are geographically and demographically accessible to our citizens" (City of College Station, 2009). Currently, the City has over 1,300 acres of parklands, 500 acres of greenways providing several nature trails, walking and biking paths, athletic fields, pavilions, pools, playgrounds, recreation centers, etc. There are 51 parks, classified as follows: 34 neighborhood parks, 8 community parks, 7 mini parks, 2 regional parks, and 1 arboretum. There are also approximately 3 miles of paved trails (City of College Station, 2009).

In 2003, the City implemented the Recreation, Parks, and Open Space Master Plan with the purpose of updating the 1999 Greenways Master Plan and building upon the 1997 City's Comprehensive Plan. On January 28, 2010, the City adopted the Bicycle, Pedestrian and Greenways Master Plan, which was built upon the previous Sidewalk Master Plan of 1994, the Bikeway and Pedestrian Master Plan adopted in 2002, and the Greenways Master Plan of 1999. It was later amended on June 10, 2010. The purpose of this plan is to provide information and guidance to "implement the community's desire to create a bikeable, walkable, and environmentally aware and active city" (City of College Station, 2010a). Furthermore, in July 14, 2011, the Parks and Recreation Master Plan was amended in order to address the city's needs for the next ten years and provide guidance, goals, strategies, and actions on how to best address those needs. The 2009-2030 Comprehensive Plan's goal for the City's future parks and recreation system sought to ensure the continued protection and enhancement of leisure and recreation opportunities through parks, greenways and the arts (City of College Station, 2011).

2.4 Wolf Pen Creek Corridor

Brazos County is made up of numerous streams that flow into 2 major waterways: the Brazos River, forming the western county boundary and the Navasota

River, forming the eastern boundary. A network of waterways exists throughout College Station. The largest is Carter Creek with Wolf Pen Creek, Bee Creek, Lick Creek, Spring Creek, and Alum Creek flowing into it (Figure 2). Within the College Station City limits, there are approximately 3,962 acres of 100-year flood areas and an additional 235 acres of 500-year flood areas associated with these waterways (City of College Station, 2010a, 2010b).

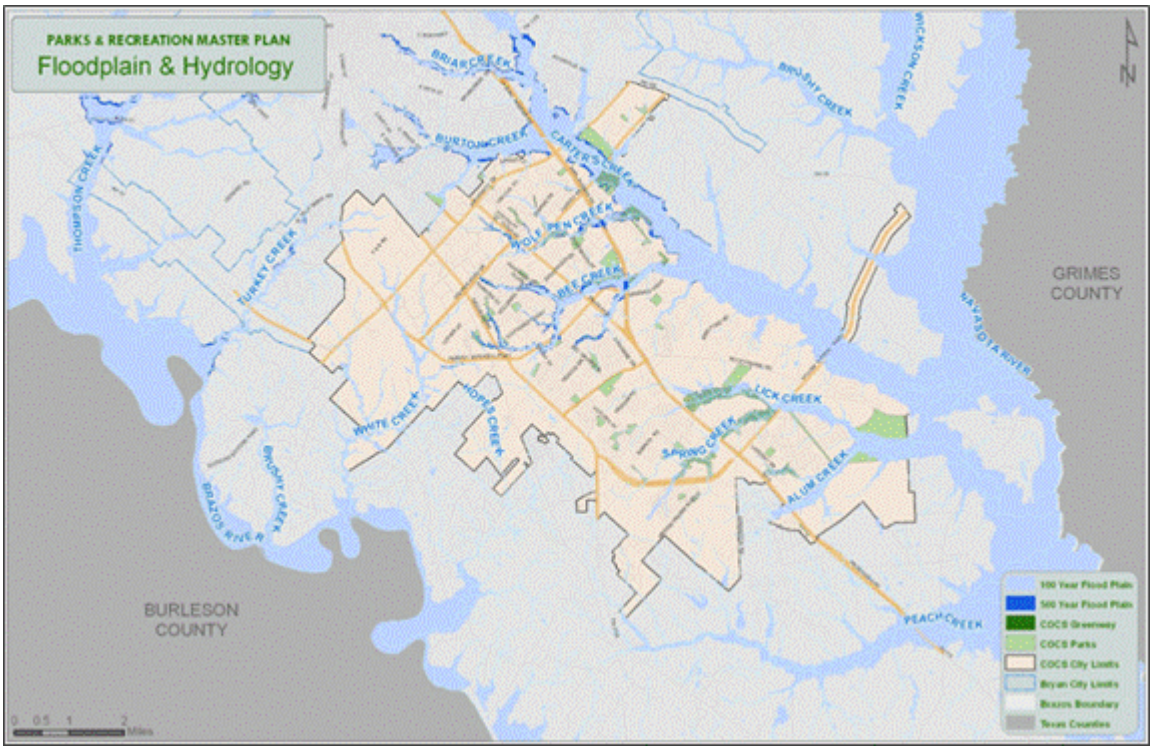

Figure 2. Floodplain and Hydrology (City of College Station, 2011).

Wolf Pen Creek originates on Texas A&M campus, parallels Harvey Road after exiting the University Golf Course, and flows east into Carter Creek, approximately 2.5 miles downstream (City of College Station, 1999, 2012c). In 1987, the City Council discussed a conceptual idea for Wolf Pen Creek and solicited proposals for a Corridor Study. Through collaborative efforts between the Parks, Engineering and Planning Departments, a conceptual approach for the development of Wolf Pen Creek was prepared and submitted. The City Council adopted the Wolf Pen Creek Corridor Master Plan in 1988 (Figure 3), and established a Tax Increment Finance District to enhance

future financing. The Wolf Pen Creek Zoning District was established as part of the plan to develop public spaces and combine parks, arts, and commerce by linking a variety of private and public facilities together with an urban greenway (City of College Station, 2010c).

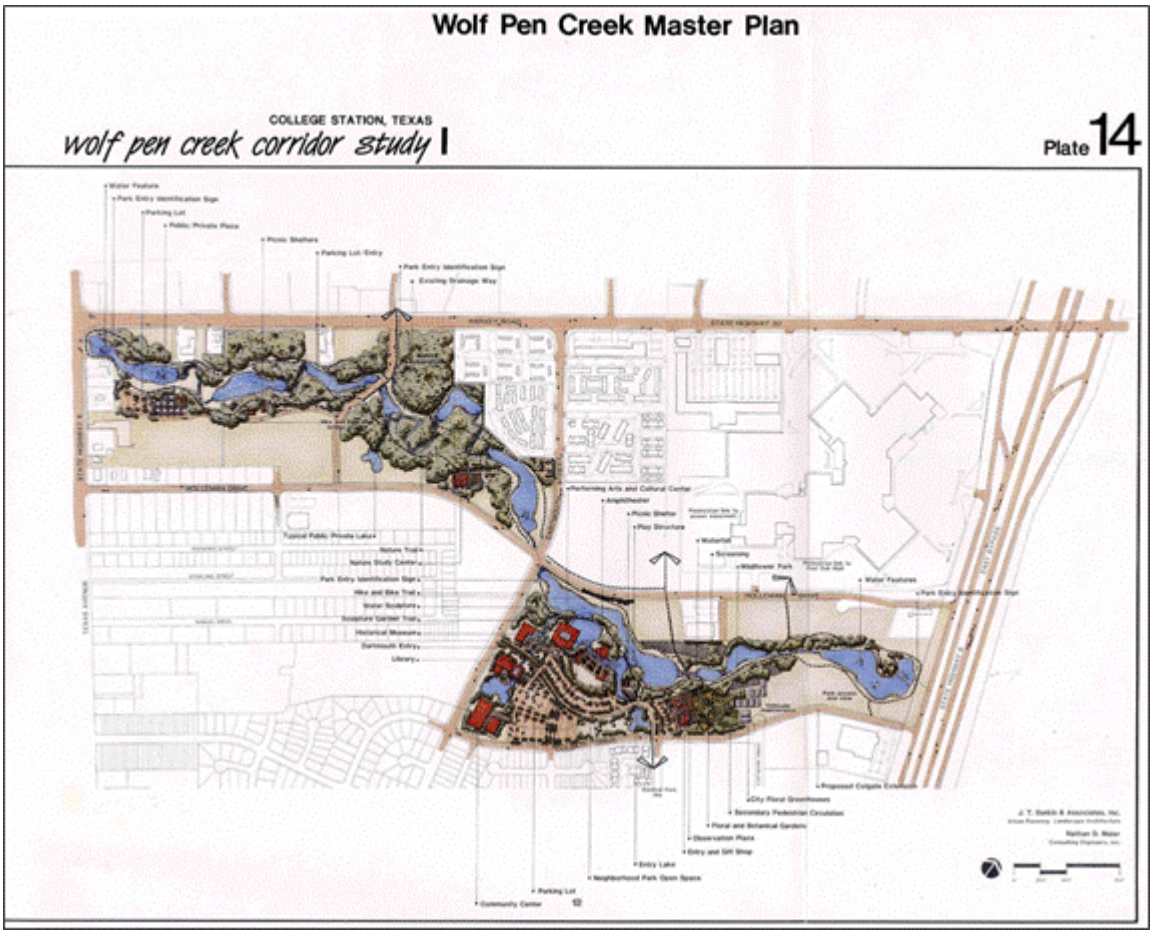

Figure 3. Wolf Pen Creek Master Plan 1988 (City of College Station, 2008).

The Wolf Pen Creek Corridor Master Plan sought to promote urban development and recreational opportunities along Wolf Pen Creek, manage drainage in relation to storm water and prevent soil erosion whilst preserving as much of the creek's plants and wildlife as possible (City of College Station, 2010c). The stated goal of the master plan is "to develop a comprehensive plan to recognize the interrelationships of drainage, erosion, recreation, commercial development and residential as they apply to the Wolf Pen Creek Corridor from Texas Avenue to the East Bypass, as well as to create a

community attraction for College Station residents and out-of-town guests" (City of College Station, 2008). In 1989, the City incorporated the development policies of the master plan onto the City's Comprehensive Master Plan.

In December of 1991, the first phase of the Master Plan started with the construction of Wolf Pen Creek Park and Amphitheater. The construction was funded by various sources, including a grant from the Astin Trust and a grant from the Texas Parks and Wildlife Department. Construction was completed in 1993. A Grand Opening Gala was held at the Amphitheater on May 28, 1992 (City of College Station, 2008, 2012c).

In 1997, the Brazos Greenways Council was formed to create a vision for the community's greenway system. Greenways included corridors along streams (and their floodplain and/or riparian area) designated for the protection of open space and greenway trails. A year later, a Wolf Pen Creek focus group held several meetings to develop ideas, revise and update the Wolf Pen Creek Master Plan (Figure 4). A revised master plan was adopted by the City Council on July 9, 1998 (City of College Station, 2008).

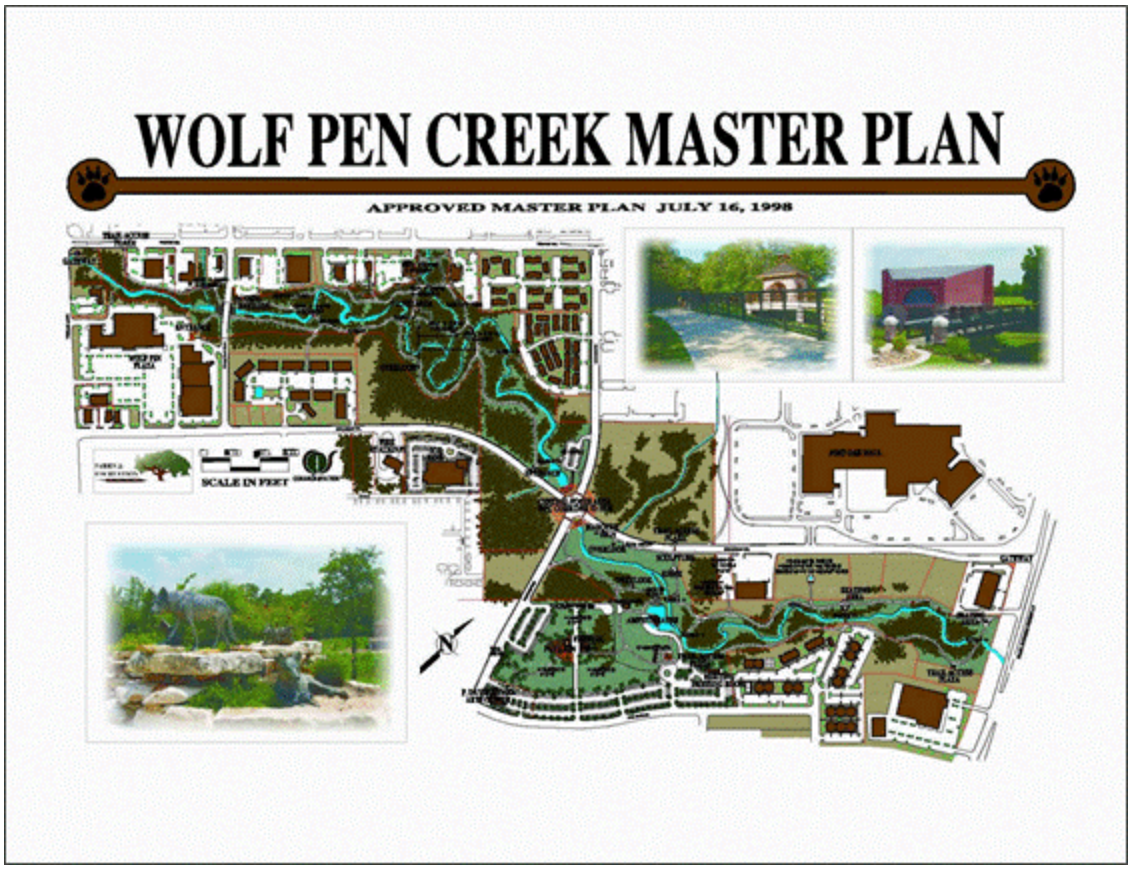

Figure 4. Wolf Pen Creek Master Plan 1998 (City of College Station, 2008).

In 1999, the City adopted the Greenways Master Plan, which defined greenways for College Station and urged the City to acquire greenways, such as Wolf Pen Creek, to be used as flood control areas, as well as for parks and multi-modal transportation corridors (City of College Station, 2002b). Since then, the City has been actively involved in acquiring, regulating, maintaining, and promoting the use of greenways in College Station, and Wolf Pen Creek has been the subject of considerable planning along with substantial public and private investment. Several trail systems were planned in conjunction with other greenway projects throughout the city. In October of 2000, the City held a design workshop to encourage people with different backgrounds to develop specific ideas on how the Wolf Pen Creek area will be developed.

A trail system for Wolf Pen Creek between Texas Avenue and Dartmouth (upper trails) was approved in 2001, and a year later, the City Council approved a contract for

the construction of the Wolf Pen Creek lower trail system (City of College Station, 2008). Walking and biking trails with two observation decks and landscaping were completed in 2003 (Figure 5). In 2007, a disk golf course, a small-scale outdoor facility for concerts and parties called the Plaza, and a small indoor facility suitable for meetings and banquets called the Green Room, were added to Wolf Pen Creek Park (City of College Station, 2012c). The same year, Texas A&M Mays Business School students and volunteers installed an interpretive signage along the trails.

Currently, Wolf Pen Creek Park is classified as a community park. It covers an area of 47.17 acres and provides amenities such as an amphitheater with a 2,000 square foot stage, a lake, a playground, rest rooms, and a picnic pavilion (City of College Station, 2012c). Wolf Pen Creek Park offers a variety of outdoor recreation experiences including walking, and picnicking. The Amphitheater offers outdoor entertainment such as concerts, plays, and festivals. Since its opening in 1993, it has hosted over 400 events, and 600,000 guests. With a trail system of approximately 2 miles and ample entertaining opportunities for the community, Wolf Pen Creek has become a popular venue for children, adults, and wildlife enthusiasts. It is a “destination for family fun in Bryan-College Station” (Inside College Station, 2010).

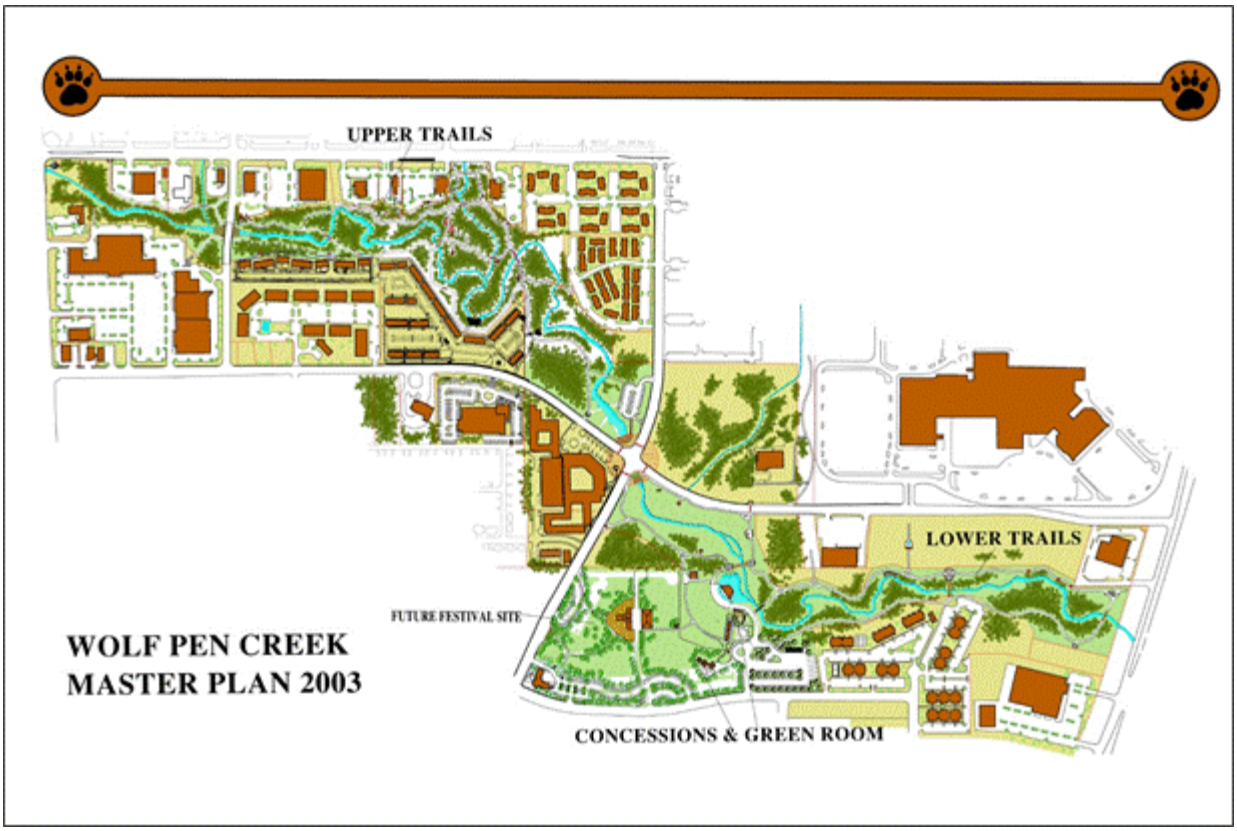

Figure 5. Wolf Pen Creek Master Plan 2003 (Vanecek, 2012).

2.5 Wolf Pen Creek Interpretive Signage

A trail is a track, route or pathway with strong connections to the natural environment, open space and cultural heritage. Self-guided trails and signs are standard means of promoting leisure opportunities. They also provide educational experiences, improve recreational access, encourage responsible visitor behavior and understanding of the local environment, promote the history and heritage of the area, and add to the region's tourism potential. Interpretation signs are panels that deliver educational material about a natural or cultural feature on a trail, and are used for points of interest on self-guided trails, scenic lookouts and roadside parking bays (Drew et al., 2003).

The Wolf Pen Creek Corridor offers a trail system of approximately 1.5 miles, landscaping, benches, observation decks, trees, kiosks, emergency phones, and an interpretive signage. All these features along with the facilities at Wolf Pen Creek Park

offer a variety of recreation, leisure, and learning opportunities for College Station residents and visitors.

The City's White Paper on Resource Conservation and Sustainability states that the interpretive signage along the Wolf Pen Creek trails provides beneficial information about local plant and animal species, wetlands, and greenways. According to this guide, the interpretive signs represent an educational component, and a small step towards enhancing responsible behavior regarding the creeks, parks and greenways within the community (City of College Station, 2012a).

The Wolf Pen Creek design workshop conducted in October 2000 recommended preservation of the natural environment and an interpretive signage along the trail corridor. The Wolf Pen Creek Oversite Committee was informed about this project during a meeting on April 29, 2002. Furthermore, on May 23, 2002, the City Council discussed the solicitation for a matching grant from the Texas Parks and Wildlife Department, for the purchase and installation of interpretive signs on the Wolf Pen Creek trail system. According to the meeting agenda, funds from the National Recreation Trail Fund in Texas would support the design, construction and installation of an educational interpretive signage along the trail in the Wolf Pen Creek Corridor.

During the meeting, the positive impact of the proposed signs was discussed. Some of the benefits of developing the interpretive signage included: enhancing the greenways education program, instructing citizens and visitors on how nature works in urban environments, the impacts of urbanization, plant and animal habitats, wetland and riparian area benefits, and promoting the value of natural resources (City of College Station, 2002a). Funding for the interpretive signage was made possible through parkland dedication funds. In 2007, College Station Parks and Recreation employees, Texas A&M Mays Business School students and volunteers installed the interpretive signs along the trails.

The diverse ecosystem present in the Wolf Pen Creek Corridor and a variety of plant and animal life are depicted in the interpretive signage along the trail system. There

are 10 different 24x36-in panels covering a variety of topics including cavity-nesting species, aquatic turtles, riparian habitats, migratory and nocturnal species, among others.

"Welcome to the Creek" is the title of 3 welcome and introduction panels that provide general information about the Wolf Pen Creek Corridor and the amphitheater. They include the length of the 4 trails, a map indicating their location, and the site of various points of interest. They also include a brief history of the creek, the development of the park, the people responsible for its maintenance and acknowledgment to the people and institutions that made possible the installation of the interpretive signage (Figure 6).

Figure 6. Wolf Pen Creek Welcome Sign (Walker, 2011).

"Cavity Nesters" is a sign about 3 species of hole-nesting birds and a mammal that inhabit the cavities of trees along Wolf Pen Creek. The species mentioned in the interpretive sign are the eastern flying squirrel (*Glaucomys volans*), the downy

woodpecker (*Picoides pubescens*), the eastern screech owl (*Otus asio*) and the red-bellied woodpecker (*Melanerpes carolinus*). The information about each one of the species include their common and scientific names, and a summary of the animal's physical characteristics, habitat, distribution, social organization, behavior, adaptations, breeding seasons, and diet. It also explains some of the benefits and dangers of living in tree holes and how these species provide pest control services to the corridor. In addition, this panel clarifies the reason why dead or deteriorating trees, known as snags, are left standing along the corridor as long as they do not represent a danger to the community.

"Terrapin Station" is the title of the panel that provides information about 8 different aquatic turtles. The fresh-water turtles depicted in this panel are the smooth soft-shell turtle (*Trionyx muticus*), the pallid spiny soft-shell turtle (*Trionyx spiniferus*), the Metter's river cooter (*Pseudemys concinna*), the Mississippi mud turtle (*Kinosternon subrubrum*), the red-eared slider (*Trachemys scripta*), the Mississippi map turtle (*Graptemys pseudogeographica*), the alligator snapping turtle (*Macroclemys temminckii*), and the common snapping turtle (*Chelydra serpentine*). This panel presents basic material about reptiles, specifically about aquatic turtles, and provides a brief description of each one of the 8 species aforementioned.

The board "Life in the Creek" explains the meaning of a riparian habitat and the significance of Wolf Pen Creek not only as a community resource but also as an essential habitat for wildlife. It explains how creeks, streams, and other riparian areas are necessary to provide valuable habitat for plants and animals in urban environments. They represent passageways for safe movement of wildlife, and are fundamental to reduce flood peaks, enhance water quality, soil stability, and groundwater replenishment. The panel also lists a variety of wildlife that lives along the creek.

"Have You Seen Us?" is a panel that exposes the significance of indicator species to assess the health of an ecosystem. The species portrayed in this board are the Houston toad (*Bufo houstonensis*), the American beaver (*Castor canadensis*), the American goldfinch (*Carduelis tristis*), and the North American river otter (*Lontra*

canadensis). This board describes the home range and habitat of these species and explains how the construction of Wolf Pen Creek and trail system disturbed the environment causing many species to migrate; however, as the ecosystem recovers from disturbance, the number of these indicator species is expected to increase.

The panel called “Just Passing Through” provides information about migratory pathways and migratory species. It also explains how corridors such as Wolf Pen Creek provide essential habitat for migratory species that move through the Brazos Valley. The North American migration flyways are depicted in this panel and 4 migratory birds are described. They are the Baltimore oriole (*Icterus galbula*), the broad-winged hawk (*Buteo platypterus*), the western tanager (*Piranga ludoviciana*), and the Swainson's hawk (*Buteo swainsoni*).

The “Going with the Flow” panel covers the rationale for the City of College Station to develop Wolf Pen Creek Corridor following the natural pattern of the creek. It explains the use of gabions along the banks of the creek by the City engineers to prevent erosion. It states that leaving the natural flow of the creek helps prevent non-point source pollution. In addition, this panel explains a variety of ways the public can become active in protecting the waterways. It also provides interesting facts about water resources.

“Uninvited Guests” is the title of the panel that explains what are invasive species, and also why they are detrimental to native species. In this panel, 4 invasive species are shown as an example of how human actions contribute to the spreading of exotic species. The species displayed are: the Mediterranean house gecko (*Hemidactylus turcicus*), native to western India to Somalia, the Mediterranean basin to Spain, Morocco and the Canary Islands; the house sparrow (*Passer domesticus*), which competes with native songbirds for nesting sites and habitat; the nutria (*Myocastor coypus*), native to South America; and the European starling (*Sturnus vulgaris*), brought to the United States by the American Acclimatization Society with the purpose of introducing birds mentioned in the works of William Shakespeare.

“High Above Wolf Pen Creek” is a sign dedicated to birds of prey or raptors, such as the black vulture (*Coragyps atratus*), the turkey vulture (*Cathartes aura*), the

red-tailed hawk (*Buteo jamaicansis*), the Cooper's hawk (*Accipiter cooperii*), the red-shouldered hawk (*Buteo lineatus*), and the Mississippi kite (*Ictinia mississipiensis*). This panel provides a brief description of each of these species, and the main hunting strategies: perching, hovering, stooping, flycatching, and pursuing. It also displays a silhouette of the birds to show how their wings are shaped.

The panel "When the Sun Goes Down" is about nocturnal animals. It explains some animal adaptations for living and hunting at night, such as a bat's echolocation and the enlarged eyes of owls to allow them to see in limited light. The board also gives some information about each one of the following species including their common and scientific names, physical characteristics, habitat, distributions, and behavior. The species depicted in this panel are the Virginia opossum (*Didelphis virginiana*), the eastern pipistrelle (*Pipistrellus subflavus*), the barred owl (*Strix varia*), and the green treefrog (*Hyla cinerea*).

Complementing the large panels, there are 13 signs describing plants that can be found along Wolf Pen Creek. These 12x12-in panels provide common and scientific names, a brief description of the species, distribution, habitat, propagation, management, uses, and, in some cases, an interesting fact about the plant. The species portrayed are: mistletoe (*Phoradendron*), roundleaf greenbrier (*Smilax rotundifolia*), American hackberry (*Celtis occienntalis*), resurrection fern (*Pleopeltis polypodiodes*), Spanish moss (*Tillandsia usenoides*), eastern red cedar (*Juniperus virginiana*), post oak (*Quercus stellata*), water oak (*Quercus nigra*), yaupon (*Ilex vomitoria*), poison ivy (*Rhus toxicodendron*), winged elm (*Ulmus alata*), Mexican plum (*Prunus Mexicana*), and American beautyberry (*Callicarpus americana*).

In addition to the ecosystem, wildlife and plant panels, there is a special sign called "The Wolves" placed near a bronze sculpture of a family of wolves called "Wilderness Awakened," located on the Holleman Drive side of the park. This statue was designed by artist Payne Lara and placed in Wolf Pen Creek in 2001 (City of College Station, 2011). The sign provides a brief history behind the name Wolf Pen Creek, the occurrence of wolves and coyotes in early Brazos County, and the reasons for

the population decline. In addition, it explains how the Payne Lara's sculpture pays tribute to the wild heritage of the area, and the magnificence of the species.

College Station has experienced substantial growth and change since the adoption of its first Comprehensive Master Plan in 1997. As development increased, the loss of open space also increased, which required the City to plan strategically to balance growth and land development with the protection of greenways. As the population in College Station continues to grow in the next decades, the demand for natural resources (such as clean water and clean air) will also escalate. The City will need to balance the expansion of public services and the preservation of natural resources and open spaces.

Greenways, such as Wolf Pen Creek Corridor, will continue to provide functional, aesthetic, economic, environmental and social benefits to the community. Among these benefits are floodplain mitigation, erosion control, stormwater management trails, recreation, alternative modes of transportation, protection of wildlife and plants, increased real estate values to adjacent properties and tourist revenue. Supporting a better understanding of the benefits of greenways among residents and visitors will require education and promotion.

The interpretive signs along the trails (Figure 7) contribute to a better understanding of the ecosystem and the rich biodiversity of the area; therefore, the City will need to take advantage of local resources to enhance their use. Providing educational opportunities about greenways and their benefits as well as encouraging the protection and maintenance of the greenways system will have a significant and positive impact on the people in the community. A successful and effective greenways system will ensure not only the provision of basic needs for the City but also open space, natural resources and preserved heritage sites that will secure a continuing high quality of life for future generations.

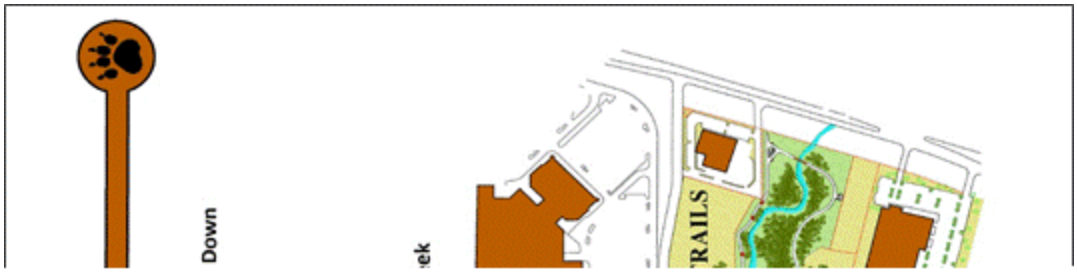

Figure 7. Estimated Location of Interpretive Signs.

3. PROBLEM

Education is the backbone of the country's development, and it is vital to long-term prosperity. In light of the importance of science and technology in the world today, there is an urgent need for quality science experiences that can provide the necessary opportunities for young children to develop the knowledge of science concepts along with problem-solving and critical-thinking skills they need to become scientifically literate citizens. An inquiry-based approach to science teaching can nourish children's natural curiosity and desire to explore, and offer a unique opportunity to engage students in scientific investigation. Moreover, an increasing amount of literature shows that taking inquiry-based science instruction outdoors is a valuable means to address not only children's learning needs, but also tackle the most pressing health issues affecting children today.

School districts in the state of Texas are facing pressing challenges nowadays. School administrators and teachers must overcome statewide funding cuts along with increased accountability standards by developing new strategies that will allow them to continue providing high levels of education with fewer resources.

The City of College Station Parks and Recreation has developed a trail system with interpretive signage at Wolf Pen Creek Park. The trails are a natural asset for informal educational opportunities, with a mix of plant and animal life typically found in urban corridors within greenway systems. However, the Wolf Pen Creek signs are under-utilized for educational activities (S. Walker personal communication, July 14, 2011). Wolf Pen Creek Park interpretive signage represents an educational resource within city limits, which local schools could benefit from as an outdoor classroom that facilitates rich inquiry-based learning opportunities.

3.1 Methods

With the purpose of assessing current approaches to science education, instructional expectations, needs, and best practices, I conducted semi-structured

interviews with open-ended questions with professionals and practitioners in College Station (Dillman, 1978; Leech, 2002).

Subjects were contacted by e-mail, telephone and in person, to explain the goal of the interview, request their consent to participate, and arrange a convenient time and place for a meeting (Laforest, 2009). The interviews lasted between 20 and 40 minutes. Interview mediums included several modalities in order to enhance participation. Due to geographical limitations, 2 interviews were conducted via e-mail and 1 via telephone. Open-ended questions were outlined, and the interviews were conducted with an open framework, which allowed for focused, conversational, two-way communication. Participants were allowed freedom to express their views in their own terms (Cohen, 2006). Interviews were audio-taped and partially transcribed, since the thematic analysis did not merit full transcription. All responses were kept confidential in compliance with ethical standards of the Institutional Review Board. All participants were asked to provide written consent prior to be included in the study.

I identified and contacted individuals who perform key roles in imparting and promoting science education in the community using the key informant approach (Marshall, 1996b). I determined the number of participants using the judgment sample technique (Marshall, 1996a), and snowball sampling (Goodman, 1961), in which subjects recommend useful potential candidates for the study. I included leaders in the following stakeholder groups.

(1) <u>In-service elementary school teachers.</u> The snowball approach was used to identify self-contained and science teachers at the elementary level in College Station and Bryan Independent School Districts.

(2) <u>Pre-service teachers in a professional development program.</u> A professor of science education in the Teaching, Learning and Culture department of Texas A&M University (TAMU TLAC) was asked to recommend student teachers who would be interested in participating in the study.

(3) <u>Facilitators encouraging integration of informal and formal education.</u> A network of informal educators within the community was contacted through

the Brazos Valley Museum of Natural History, Brazos Valley Chapter of Texas Masters Naturalists, and Project Wild.

(4) Program administrators. Using the snowball approach, key administrators were identified through College Station ISD, College Station Parks and Recreation, and TAMU TLAC.

Interview recordings were partially transcribed, and analyzed to determine (1) needs, (2) instructional expectations and (3) best practices, as identified by members of the stakeholder network.

I included the following open-ended questions in this study to capture participant's views on current outdoor learning opportunities in the community.

Q1. What is your current level of involvement in education, whether it is formal or informal education?

Q2. Are there outdoor learning opportunities for elementary students in the community?

Q3. What programs or initiatives that offer outdoor learning opportunities are currently in place?

Q4. How could formal and informal education complement each other?

Q5. What role do you think local nature parks should play in education?

Q6. What do you think are the teachers' and students' expectations of local nature parks?

Q7. Do you consider important that external educational opportunities be aligned to the Texas Essential Knowledge and Skills?

Q8. What kind of professional development do teachers need to facilitate outdoor learning?

I used a qualitative method of content analysis to tag by code names text segments referencing distinct ideas. I used NVivo 10, a computer software program to link codes and their associated text passages. I grouped together codes similar in nature to define themes: Needs, Expectations, Best Practices. I created an additional theme,

"Stakeholder" to compile information about the respondent's background and area of expertise.

3.2 Results and Discussion

I contacted a total of 29 participants, and 15 responded (6 in-service teachers, 1 pre-service teacher, 4 program administrators and 4 facilitators); which represents a response rate of 52%. The analysis of the 15 interviews produced a total of 123 discrete observations across the data set. I sorted and coded the observations according to textual content into 10 distinct categories, which I grouped into 4 themes, namely: Stakeholders, Needs, Expectations, and Best Practices.

3.2.1 Stakeholders (n=15; 12.2% of total number of responses)

Using the key informant technique, 15 individuals who occupy a position of responsibility imparting and promoting science education in the community were interviewed. Leaders in the following stakeholder groups participated in the study.

In-service elementary school teachers. A total of 6 elementary school teachers were identified using the snowball approach. All participants were self-contained or science teachers in elementary schools in the College Station and Bryan Independent School Districts. Their area of expertise was early childhood education. The participants had experience teaching science at the elementary level and in the majority of the cases, they were part of the Science Leadership Team.

Pre-service teachers in a professional development program. An undergraduate student of the Teaching, Learning and Culture department of Texas A&M University (TAMU TLAC) was interviewed. The participant was pursuing a Bachelor of Science degree (B.S.) with a certification in 4-8 Math and Science.

Facilitators encouraging integration of informal and formal education. A total of 4 informal educators within the community, who play an important role in promoting science learning for preK–12 students and beyond were detected. These individuals strive to support knowledge-sharing, and collaboration in the field of informal science

education and learning through a variety of science-rich institutions and programs, such as The Brazos Valley Museum of Natural History, The Brazos Valley Chapter of Texas Masters Naturalists, KidzClub and Project Wild.

Program administrators. Using the snowball approach, 4 administrators in College Station ISD, College Station Parks and Recreation, and TAMU TLAC were detected and interviewed. The participants had experience education pre-service science teachers, developing science curriculum and after-school programs for preK–12 students and beyond.

3.2.2 Needs (n=47; 38.2% of total number *of responses)*

A large percentage of the qualitative items (38.2%) described the community needs or requirements as related to science education opportunities for students. This section includes challenges or difficulties the respondents found critical, and that hinder their efforts to provide quality science education. The total number of observations (47) was coded according to their content into the following 4 categories.

Challenges in science education. Analysis of the observations in this category revealed three major challenges in science education. The first challenge is the teachers' level of comfort with the science content. Informants conveyed a general impression that many teachers are not familiar with the science content they have to teach, and therefore, rely heavily on worksheets and scripted lessons. One informant mentioned that teachers are intimidated by science because they do not receive enough science specific course work during the elementary teacher training, and consequently, do not feel comfortable with the subject. The lack of confidence in their ability to teach science, leads many teachers to avoid experimentation and field observations when teaching science. Despite the fact that at the elementary level many of the science objectives are geared towards experimentation and observation in an outdoor setting, the majority of the science lessons are taught indoors. A participant declared, "So many teachers demonstrate rather than let the children do it and experience it. Letting kids experience things is not for everyone."

In addition to the educator's comfort level in teaching science, the lack of background knowledge that students bring to the classroom hinders their understanding of science concepts. Most participants affirmed that children do not spend enough time outdoors, lacking valuable observation opportunities that are essential to gain deep scientific knowledge. One of the respondents asserted, “Children today suffer experiential deficit. So many things we teach in school are alien to them because they have no experience to attach knowledge learned in school to.” Another interviewee affirmed, “A lot of kids don’t know what is there in their own backyard.”

Added to the teachers’ subject confidence and the student’s lack of prior knowledge, deficiency of adequate materials and resources needed to teach science also represents a challenge in science education at the elementary level. Institutions that promote informal science education, such as museums, are also limited in the number of materials or resources they can take to schools for teaching purposes. Therefore, supplies needed for observation and experimentation, are also a limiting factor for high quality and effective science teaching.

Challenges in outdoor science education. There is a wide range of positive outcomes related to outdoor science education; however, an analysis of the interview responses showed three main difficulties that prevent elementary school children from participating in these type of rich and rewarding educational experiences. The first challenge is the limited financial resources that school districts allocate for outdoor experiences. Schools have to adjust to tight budgets by cutting back on fieldtrips. The interviewees declared that bus transportation costs are very high; hence, fieldtrips are restricted.

In addition to budget limitations, finding an appropriate location that can accommodate a large group is problematic. Some of the informants stated that in most cases all sections of the grade level have to go on the same day, which means, the fieldtrip site needs to accommodate at least 120 students. Another concern is that some places do not provide enough activities for a full-day fieldtrip. One respondent affirmed, “When you get kids out of school, you have to take them out for a long period of time,

the problem is having enough for a full-day fieldtrip." Another informant declared, "They don't take all kids the same day, and don't want the kids the whole morning, just for a couple of hours." For teachers, finding an educational site within their allocated budget that provides not only rich experiential learning opportunities, but also enough space for all students in the same grade level, an appropriate location for the school buses to park, space for kids to eat lunch, use the restroom, and have free play time, has become a real challenge.

The third challenge is related to the teacher's "fear" to teach kids in outdoor settings. This concern is connected to the teachers' level of comfort when teaching science. In an outdoor setting, teachers are "out of their comfort-zone," as one respondent suggested, which requires a great deal of preparation and logistics. One interviewee claimed, "It is a lot of work, it is challenging." Another participant declared, "A teacher doesn't want to not-know the answer when a kid asks a question." Not only financial restrictions but also the science content, preparation and arrangements needed to provide outdoor experiences hinders the opportunities to provide out of the classroom science experiences for kids at the elementary level.

Places for outdoor learning in the community. When asked about well-known places in the community and organizations that provide science experiences for children, most participants mentioned Texas A&M University botanical garden and The Brazos Valley Museum of Natural History as main destination for elementary students. Although, these places offer mostly indoor activities, students are able to experience an out-of the classroom learning and hear from a variety of experts. One respondent suggested that there are places in the community suitable for outdoor learning, but they are not well advertised; thus, the person interested "has to go and look for it." In addition, a few participants mentioned programs that offer science learning opportunities not necessarily for elementary students but for the community in general, including Master Naturalist, Junior Master Naturalist, and Master Gardener.

Professional Development. Regarding the need for professional development to facilitate outdoor learning experiences, one interviewee suggested that it should be a

required session during the 6 days of mandatory training teachers receive before school starts. Another teacher stated, “Teachers need to be able to identify plants and animals that would be seen and be able to explain their interdependence on the environment. Food chains, habitat, and camouflage would play a role too. Also, training in recycling, reducing wastes, etc. plays an important role in nature parks. Training on different types of pollution such as air and water and how to reverse or minimize damage to the environment would be useful. On a higher level, preparing slides to look at under scopes and what students can find in soil and water would be good too.”

Key informants generally considered that guidance from a knowledgeable person at the site would be enough to provide successful outdoor learning to students. Most teachers interviewed believed that the site that offers outdoor activities should provide facilitators to lead the activities or a detailed manual and materials that teachers could follow. One administrator considered important that teachers understood that they do not need to know all the answers. He felt that “teachers think that their job is to tell kids what the answers are. They need to know the difference between telling and teaching. They don’t teach kids how to figure out the answer, how to find the answer, how to be curious. Teachers need to have a way to train kids how to systematically observe nature, natural things, rather than just read stuff out of a book. So many teachers are afraid of that, because they think they are not going to know the answer. And that's O.K., too. They can go now and find the answer. Find resources and look for answers.” The crucial point for most respondents was to know the expectations and know what information to convey and how they are going to be supported to deliver the content, so that “it is not just a walkthrough but an educational experience.”

3.2.3 Best Practices (n=33; 26.84% of total number of responses)

The theme Best Practices encompasses responses that describe "what works" in science education. Based on their professional knowledge, experience, and empirical evidence, participants provided information and insight on how to deliver instruction intended to strengthen the effectiveness of elementary science teaching and learning.

The observations (33) within this theme were coded according to their content into the following 3 categories.

Successful science activities. Analysis of the interview responses uncovered several practices that participants considered characteristics of high quality teaching and learning in the sciences. Participants considered that hands-on, experiential outdoor activities, exploration, observation and discovery are key features of meaningful science teaching and learning. One participant affirmed, “What we are trying to stress here is the inquiry-based. Having them figure things out, not just telling them what to do.” In addition, responses revealed that using experiential methods, and having students use their senses help them make connections, build character, blend adventure with academics, and encourage an early appreciation for science, which, according to one respondent, “will certainly have an impact not just into college but well beyond.”

Successful science activities in outdoor settings. Regarding science instruction in outdoor settings, the majority of the informants considered important to complement the teaching of scientific concepts with hand-on activities. Through first-hand observation and participation “we make the students think about those concepts in a more fun and interactive way,” declared one participant. Another interviewee mentioned, “You get the theory in the formal education, then bring them out and let them see it for themselves. It can reinforce the formal aspect of education.” Additionally, “Incorporating both sides (formal and informal education) can really help the educational experience,” another respondent asserted.

Classroom management was also mentioned as an essential feature of effective teaching in outdoor settings. An interviewee sustained, “You have to systematically get them outside. They need to learn how to observe and discuss things. They need to learn a whole new set of behaviors.” A key informant claimed that “the structure has to be there, otherwise it’s not very productive, we are not moving in one direction. Structure needs to be there, but it shouldn’t overwhelm the passion and the interests.”

Children are very curious, they like to play, and have a short attention span. In order to take full advantage of a learning outdoor environment, children need to get

involved in the activities. One respondent suggested, “Give them a goal to work towards.” Additionally, “When you get kids out there in the field, they get curious, they get excited and it makes them go home and tell mom and dad about it. When they talk about it at home, that takes them to the next level of understanding,” a participant asserted. Children that are involved in the activities through observation, experience and hands-on activities, are able to make connections and get motivated about science, which according to one informant, “it doesn’t just spark their interest, it sparks their passion. It can really emphasize the principles that you get in the formal setting.”

TEKS alignment. The Texas Essential Knowledge and Skills or TEKS are the K-12 state-mandated curriculum guidelines for Texas public schools. The TEKS detail the curriculum or objectives required for every content area at every grade level. State-mandated standardized tests measure the achievement of specific knowledge and skills outlined in the TEKS. Respondents were asked specifically about the necessity of aligning external educational opportunities to the Texas Essential Knowledge and Skills.

The majority of respondents considered very important that outdoor activities designed for elementary students cover the objectives required at their specific grade level. One of the informants stated, “When there is alignment the level of understanding goes up. If they see the connection, they see its worthiness. When activities are not aligned, there is confusion.” All in-service teachers agreed on the importance of covering their specific grade level objectives when participating of outdoor activities. Statements such as “We are pushed for time, so we cover what we have to cover and no extras,” “We really don’t have time to play anymore,” and “If we are supposed to learn this, then this is what we are going to learn,” demonstrate how valuable instructional time is, and how critical it is that external opportunities maximize the limited time teachers have to cover the TEKS. A different opinion was voiced by the pre-service teacher who stated that “not everything we teach has to be based on the TEKS because students should get an overall setting of science, not just what the state wants them to know for the state exam.”

The state-mandated standardized test was another reason most of the participants supported alignment between outdoor activities and the TEKS. A school district administrator sustained that "if we designed experiences based on the TEKS, then by the time they reach the tested grade level, they would have the experiences to help them be successful in the state assessment." Another administrator declared, "Until your kids are making a hundred percent on that test, all of them, then your job is to teach that material. It's really critical." Proving kids with the opportunity to experience science in an outdoor environment is fundamental to enhance their understanding, and according to the majority of participants, the outdoor experiences need to be supported by the knowledge and skills required at a particular grade level. As one interviewee indicated, "Observations are absolutely critical in science, but never do an observation that is not in a context that you are required to teach."

3.2.4 Expectations (n=28; 22.76% of total number of responses)

This section summarizes respondents' educational expectation of a community nature park in supporting science education. This theme was coded into 2 categories. The first category "Science at a nature park," covers what respondents considered valuable science opportunities that a nature park can provide, while the category "Logistics" includes the expected management or coordination of resources, people and supporting activities needed to guarantee meaningful outdoor learning experiences.

Science at a nature park. For young children, abstract thoughts and concepts are difficult to grasp because they learn about the world by experiencing it through their senses. The type of activities that most of the participants identified as valuable experiential learning opportunities include the use of all senses, so that children are immersed in the science by seeing, hearing, manipulating, tasting, and smelling. As one of the respondents avowed, "Giving kids authentic experiences is a foundation or framework that helps them learn the more abstract things we teach in school. It gives them experiences that help them become better learners."

In addition, providing meaningful opportunities to “see something they don’t see in their every-day life,” “listen to a different person,” and “get them out of the 4 classroom walls,” are some of the means children can take advantage of a nature park to discover science in a very real way. Observation of nature, collection of data, listening, questioning, searching, drawing, and writing, will allow students “construct their understanding,” “make a bigger impression,” and “get excited about science and school,” which will ultimately “lead them to success and inspire them to excel even more.” The general view of the nature park is that it can be a valuable resource to provide quality science-based outdoor learning experiences, and play a vital role in elementary education.

Logistics. Coordinating an outdoor experience can take a great deal of effort, especially with time and budget constrains. The respondents mentioned various key features that an outdoor destination needs to provide in order to be appealing to educators. Enough space for school buses, space where children can eat lunch, bathroom facilities, an area large enough to accommodate an entire grade level, activities for a full day or half day, materials, and knowledgeable facilitators are some of the requirements that an outdoor learning destination must meet in order to attract teachers.

Most of the participants conveyed that the best approach to deliver outdoor experiences is having stations throughout the park, so that grade level can be broken into small groups. Many considered essential having staff members that are familiar with the area to facilitate the activities and provide support answering questions. Many interviewees avowed the need for facilitators from Texas A&M, student teachers, park staff or informal educators from the community that are knowledgeable of the place to support the delivery of the activities. The participants mentioned some programs that offer volunteer services in the community and could support the delivery of the activities. Among this programs are the Master Naturalist, Master Gardener, and Texas A&M Leadership and Service Center.

Another possibility mentioned by the informants was having a detailed guide or manual that teachers can follow while delivering the activities. In addition, they find

very advantageous having information about the place and activities before hand, so that teacher and students have clear expectations of the experience and can engage in discussions in the classroom to build their background knowledge.

4. SOLUTIONS

4.1 Community- school collaboration

Education at the elementary school provides the foundation where children acquire the critical thinking and problem solving skills they need to be successful. In these times of tighter budgets and higher expectations for student achievement, collaboration among formal and non-formal educators, institutions of higher education, professional associations, conservation organizations, and many other organizations that support schools, teachers, and students, can enhance the capabilities of schools and communities, promote an efficient use of local resources and link outdoor learning opportunities with the standards and benchmarks schools employ.

College Station has experienced substantial growth and change. As it has been in the past, the City is committed to ensuring that the rich resource heritage, and the high quality of life provided for its citizens are sustained for future generations.

In the College Station/Bryan area, many organizations and institutions provide education, outreach, and service through hundreds of knowledgeable volunteers, who are dedicated to enriching the local communities in which they live and work. Among these are the Texas Master Naturalist Program, Texas Master Gardener Program, the Texas A&M Leadership and Service Center (LSC), and the College Station Parks and Recreation Department. In addition, there are informal educators, retirees, and other community members that are willing to volunteer their time and expertise to support the delivery of outdoor learning experiences.

A collaborative approach between educators, learners, and community partners in College Station could not only alleviate the pressures of today's education system, but also help students connect to the places in which they live and learn to guarantee them the best education possible.

4.1.1 Texas Master Naturalist Program

The Texas AgriLife Extension Service and Texas Parks and Wildlife coordinate The Texas Master Naturalist program, which develops teams of "master volunteers," who provide educational and outreach services intended to improve management of natural resources and natural areas within their communities. Master Naturalists complete a minimum of 8 hours of advanced training and provide a minimum of 40 hours of volunteer service every year. The Texas Master Naturalist was established in 1998, and since then it has trained 6,000 volunteers in 42 local chapters across the state. Volunteers have provided over 1,226,173 hours of service and reached more than 2 million youth, adults and private landowners (Texas Master Naturalist, 2012).

The Texas Master Naturalist Brazos Valley Chapter is located in Bryan/College Station. The mission of this program is "to develop a corps of well-informed volunteers who provide education, outreach, and service dedicated to the beneficial management of natural resources and natural areas within our community" (Texas Master Naturalist Brazos Valley Chapter, 2012).

4.1.2 Texas Master Gardener Program

The first Master Gardener programs started in the 1970s as an extension program in Washington State. In Texas, the program started in 1978 in an extension horticulture training at A&M University (Texas Master Gardener Program, 2012). The Brazos County Master Gardeners is an educational and volunteer program affiliated with the Brazos County office of the Texas A&M AgriLife Extension Service. Members go through comprehensive training and share their benefiting Brazos county citizens and organizations. In 2011, Brazos County Master Gardeners reported more than 4,400 hours of service to the community. Service hours include educational projects, development of community gardens and demonstration gardens, consultations to civic groups, exhibits, and educational programs with youth in gardening efforts (Master Gardeners Association, 2012).

4.1.3 Texas A&M Leadership and Service Center (LSC)

The mission of the Texas A&M University Leadership and Service Center is to strive to empower TAMU's students and staff to become effective leaders and active citizens. The center encourages students to engage in meaningful learning experiences through intentional programs, services, advising and advocacy. AggieServe is an online outreach project established to connect non-profit organizations and community agencies in the Bryan and College Station area with Texas A&M students, faculty, and staff

Community agencies such as non-profit organizations, pre-school/day cares, youth serving and youth mentoring organizations, senior citizen facilities, environmental groups, museums and organizations request TAMU service-learning students for long-term (generally one semester-long, 2 to 6 hours per week, per student) service opportunities, and/or for one-time/short-term projects (Texas A&M Student Activities, 2012).

4.1.4 College Station Parks and Recreation Department

The College Station Parks and Recreation Department (PARD) is the City's agency dedicated to providing park and recreational opportunities for citizens and visitors. The City's plan for the future of parks and recreation seeks to ensure the continued protection and enhancement of leisure and recreation through parks, greenways and the arts. In addition, the PARD pursues to enhance the greenways education program by instructing citizens and visitors on how nature works in urban environments, the impacts of urbanization, plant and animal habitats, wetland and riparian area benefits, and promoting the value of natural resources.

The interpretive signage along the Wolf Pen Creek trails not only provides beneficial information about local plant and animal species, wetlands, and greenways, but is also an educational component that local schools could take advantage of and utilize as an outdoor setting to facilitate experiential learning opportunities. Administrators at Wolf Pen Creek Park are committed to developing science experiences and encourage outdoor activities along the Wolf Pen Creek trails, which could expand

the classroom knowledge of children by utilizing local resources available to the community (S. Walker personal communication, July 14, 2011).

4.1.5 Informal Educators and Volunteers

Supporting and expanding science literacy requires a combination of resources, expertise, timeframes, and learning designs. Informal educators from the community, retirees, and community members in general that are willing to volunteer their time and knowledge, are also a valuable resource to support the delivery of sound outdoor learning experiences. Incorporating volunteers from the community could not only enrich the overall learning experience for students but also offer an opportunity to exchange experience and expertise between formal and informal educators promoting an environment of sustained collaborations.

4.2 Project Wild Curriculum

Project Wild is an interdisciplinary conservation and environmental education program developed by the Western Regional Environmental Education Council (WREEC) and the Western Association of Fish and Wildlife Agencies (WAFWA), and launched in 1983 (Council for Environmental Education, 2009). This program was created as a response to the need for Environmental Education programs, with the purpose of developing awareness, appreciation, knowledge and action skills related to natural resources (Greene, 1992).

The primary audience of this program is K-12 educators; however, informal educators and people involved in pre-service training can greatly benefit from this instructional resource (Council for Environmental Education, 2009). Project Wild is the most common environmental education training used in teacher preparation programs. A study developed by Crosby (1991), found that after participating in a Project Wild workshop, the attitudes toward teaching science and environmental education of pre-service elementary teachers significantly improved.

This program is most often used for in-service training (Heimlich et al., 2004 cited by Nelson, 2010). In fact, educators feel comfortable using Project Wild resources because of the simplicity of using the materials, adaptability, and the training prior to implementing the activities (Heimlich, 2002 cited by Nelson, 2010). Project Wild uses developmentally appropriate and meaningful activities than can be integrated into any school curriculum program (Crimm et al., 2008).

Project Wild activities are correlated to national standards in science and environmental education (Council for Environmental Education, 2009). In Texas, activities are correlated to TEKS standards, which make it easier for instructors to use them as part of a standard-based curriculum. The educational materials provided by Project Wild rely on hands-on, minds-on instructional techniques and encourage problem-solving and decision making skills. Project Wild mission is to help student learn "how to think, not what to think" (Council for Environmental Education, 2007, p.viii).

Classroom teachers and other educators, university faculty, resource agency personnel, private conservation groups and other community representatives, collaborated in the creation of the materials. The Project Wild guide contains 124 activities focused on terrestrial wildlife, habitat and ecological concepts. The Project Wild Aquatic guide contains 48 activities emphasizing aquatic wildlife and habitats (Texas Parks and Wildlife, 2012). Growing Up Wild is an early childhood program that contains 27 activities tailored to ages 3 to 7 (Council for Environmental Education, 2011). Scientists, curriculum specialists, and environmental experts reviewed these materials for content accuracy, educational soundness, and balance. Project Wild educational resources are provided to educators through a 6-hour workshop, which highlights selected activities and how these activities can be integrated into existing curriculum or programs (Council for Environmental Education, 2007).

4.3 Field lessons at Wolf Pen Creek Park

Responding to a growing convergence of research indicating that children need to spend more time engaged in physical activities in outdoor settings in order to learn and grow into healthy, responsible, and engaged citizens, the White House Task Force on Childhood Obesity (2010) recommended that elementary schools should provide plenty of opportunities for outdoor and hands-on experiences for young learners, and promote physical activities and outdoor education, which is important for optimum body and brain health, and also enhances children's exposure to and appreciation of the natural environment. However, the use of opportunities for outdoor learning and field lessons is reduced by limited resources, time constraints and an increased pressure on high levels of achievement on standardized tests (Butler and Parlo, 2007).

In College station, Wolf Pen Creek Park offers not only an array of outdoor recreation experiences including walking, and picnicking, outdoor entertainment such as concerts, plays, and festivals, but also a rich environment where science learning experiences can be developed. Since the interpretive signage contribute to a better understanding of the ecosystem and the rich biodiversity of the area, they represent a valuable tool to instruct visitors on how nature works in urban environments, the impacts of urbanization, plant and animal habitats, and the value or local natural resources.

I proposed the development of an inquiry-based science program "in the field" that can not only enrich the school curriculum but also get kids outside and contribute to healthy lifestyles through outdoor activities, and experiences in the natural world. A coordinated and collaborative approach to science education at Wolf Pen Creek can support schools, help districts tackle budget constraints, and provide students with the skills and experiences needed to be successful. Enabling formal and non-formal education providers to better correlate their programs and resources with school needs can ensure College Station students the best opportunities for a high quality education.

Aligning Project Wild, Project Wild Aquatic and Growing Up Wild learning activities to the existing "outdoor classroom" at Wolf Pen Creek Park can promote an awareness, understanding and appreciation of the natural world through quality

educational experiences. These activities can supply kids with rich experiential learning opportunities and educators with instructional activities, aligned to the Texas Essential Knowledge and Skills that enhance the understanding of science.

Wolf Pen Creek Park is centrally located, and has resources available to educators, either formal or informal. There is information on the trails, the riparian areas, the water way, the natural resources, an edge habitat, mammals and plants, staffing, classroom space, and staff members that can be Project Wild (PW) and Project Wild Aquatic (PWA) and Growing Up Wild (GUW) trained to assist teachers in facilitating PW, PWA and GWU activities. Wolf Pen Creek Park can also facilitate communication with Project Wild, Project Wild Aquatic and Growing Up Wild trainers to provide certification for teachers interested in receiving training to be able to facilitate activities at their schools (S. Walker personal communication, July 14, 2011).

Students from College Station ISD as well as other school districts, day care centers, homeschoolers, clubs, after-school programs and visitors in general could benefits from the a collaborative approach between educators, learners, and community partners working towards a common goal.

4.4 Community- school collaboration model

The conceptual model of community-school collaboration that I propose in this study shows how local resources can effectively support the delivery of outdoor science experiences to school children in the community (Figure 8). In this framework community organizations come together, create partnership, and cooperate to respond to a specific need in the community taking advantage of the existing opportunities.

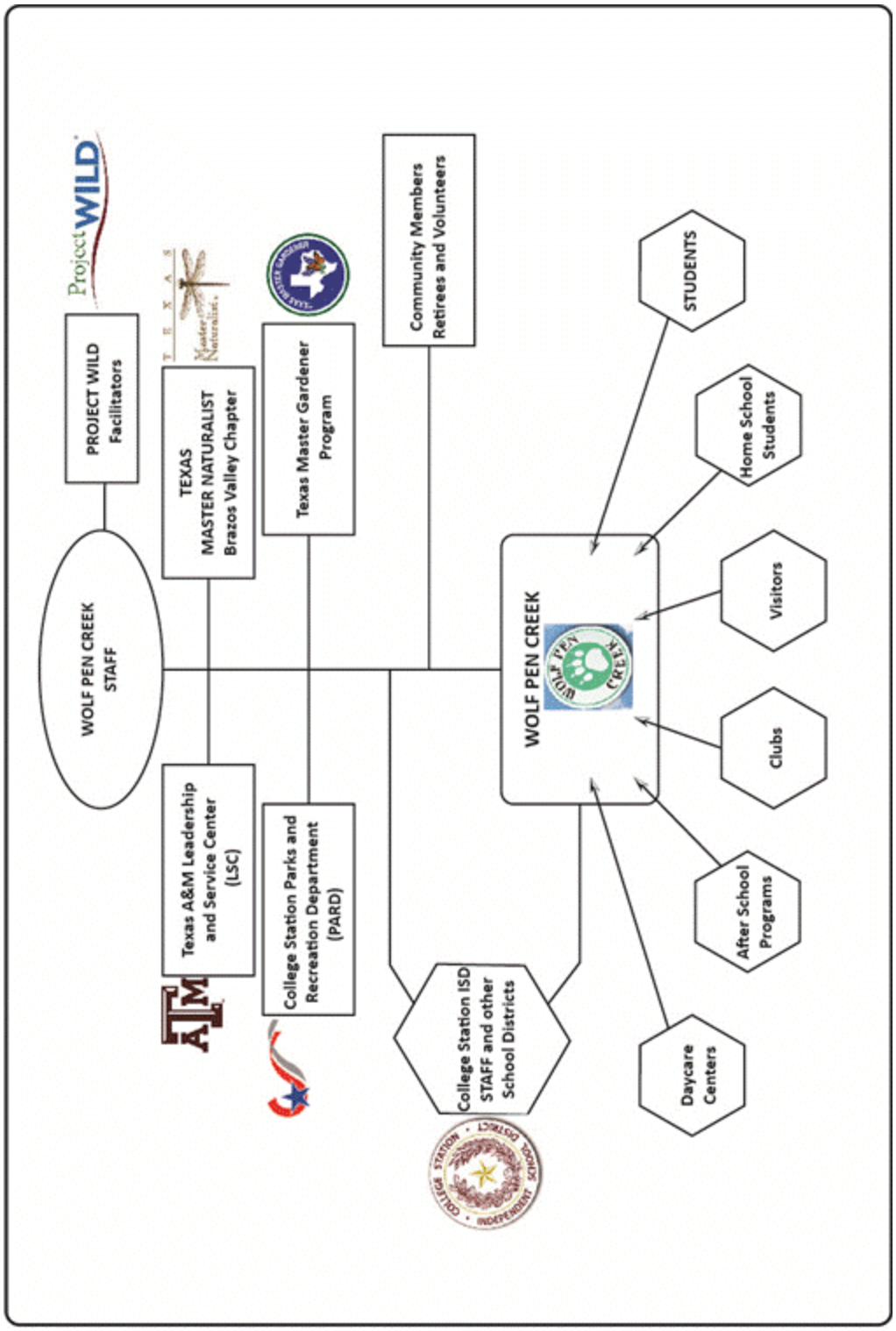

Figure 8. Proposed Community-School Collaborative Model.

In this collaborative framework, Wolf Pen Creek staff would be the collaboration coordinator, and would establish channels of communication to bring together a network of volunteers from the Texas Master Naturalist Program, Texas Master Gardener Program, the Texas A&M Leadership and Service Center (LSC) and other community members. Best practices for implementing a collaborative framework would be as follows.

1. Identified volunteers will need to attend a Project Wild (PW), Project Wild Aquatic (PWA) and Growing Up Wild (GUW) professional development workshop to be able to deliver the activities at Wolf Pen Creek. The coordinator, who maintains communication with Project Wild facilitators, will arrange a workshop for the volunteers. Wolf Pen Creek staff will also be trained to be able to assist in the delivery of the activities.
2. The coordinator will maintain communication with educators from College Station ISD and other school districts to identify elementary teachers interested in receiving PW, PWA and GUW professional development to organize a workshop for them.
3. Trained volunteers will communicate their availability to provide outdoor lessons at Wolf Pen Creek. The coordinator will maintain an updated roster of volunteers and their schedules.
4. Having an established network or trained volunteers, Wolf Pen Creek Staff can begin advertising available dates for field lesson through the City of College Station website and begin receiving groups of student from College Station ISD, other school districts, daycare centers, after school programs, homeschoolers, and other visitors.
5. The coordinator will establish a volunteer and customer feedback system to provide direct and timely information related to the facilitator's and customer's experience in order to evaluate the success or failure of the activities, and improve the program.

5. CONCLUSIONS

1. There is a general concern that children do not spend enough time outdoors, lacking valuable experiantial opportunities that are essential to gain deep scientific knowledge and develop healthy life habits.
2. Limited financial resources for out-of-school experiences, and insufficiency of materials needed to teach science are pressing challenges in education at the elementary level.
3. The lack of confidence in their ability to deliver science content, leads many teachers to avoid outdoor experimentation and field observations.
4. Finding an educational outdoor place within city limits that provides rich experiential learning opportunities, and meets space and time requirements is a current challenge for elementary educators.
5. Learning stations, materials and knowledgeable facilitators that support the delivery of outdoor activities are essential components to provide valuable outdoor learning.
6. External learning opportunities should maximize instructional time by aligning outdoor activities to state mandated standards required for every subject at every grade level.
7. Wolf Pen Creek Park and the interpretive signage along the trails are local resources that can offer quality science-based outdoor learning experiences to school children through experiential activities, exploration, observation and discovery.
8. In the College Station/Bryan area, informal educators from the community willing to volunteer their time and expertise, as well as organizations and institutions that provide education, outreach, and service through knowledgeable volunteers can be valuable resources to support the delivery of outdoor learning experiences. Among these organizations are the Texas Master Naturalist Program, Texas Master Gardener Program, the Texas A&M Leadership and Service Center (LSC), and the College Station Parks and Recreation Department.

9. Project Wild, Project Wild Aquatic and Growing Up Wild curriculums use developmentally appropriate and meaningful activities correlated to national and state standards to promote awareness, understanding and appreciation of the natural world through quality educational experiences.
10. Correlating Project Wild, Project Wild Aquatic and Growing Up Wild learning activities to the existing interpretive signage and resources found at Wolf Pen Creek Park could provide kids with rich experiential learning opportunities and educators with instructional activities to enhance the understanding of science.
11. The proposed collaborative approach between educators, learners, and community partners can promote healthy habits in children, nurture their innate curiosity to explore natural areas, and expand their knowledge bringing science concepts to life.

6. RECOMMENDATIONS

1. Enhance formal-informal collaboration between College Station ISD and volunteer organizations such as the Texas Master Naturalist Program, the Texas Master Gardener Program, the Texas A&M Leadership and Service Center (LSC), and informal educators from the community to deliver Project Wild Project Wild Aquatic and Growing Up Wild learning activities at Wolf Pen Creek Park.
2. Identify volunteers from the Texas Master Naturalist Program, the Texas Master Gardener Program, the Texas A&M Leadership and Service Center (LSC), and informal educators from the community willing to receive training to be able to facilitate the activities at Wolf Pen Creek Park.
3. Identify teachers from the school districts willing to receive training to be able to facilitate the activities at Wolf Pen Creek Park and in their classrooms.
4. Identify effective channels of communication to connect Wolf Pen Creek Staff, volunteer organization and the school districts to coordinate fieldtrips at Wolf Pen Creek Park.
5. Establish a volunteer and customer feedback system to provide direct and timely information related to the facilitator's and customer's experience in order to evaluate the success or failure of the activities, and improve the program.
6. Design and execute a research study to evaluate long-term impact of Project Wild, Project Wild Aquatic and Growing Up Wild activities at Wolf Pen Creek Park on student's mastery of science concepts.
7. Design and execute a research study to evaluate the impact of Project Wild, Project Wild Aquatic and Growing Up Wild activities at Wolf Pen Creek Park on student's awareness, appreciation, and knowledge of local natural resources.
8. Design and execute a research study to evaluate the impact of Project Wild, Project Wild Aquatic and Growing Up Wild activities at Wolf Pen Creek Park on teachers' attitudes and comfort level related to facilitating outdoor activities and delivering science content.

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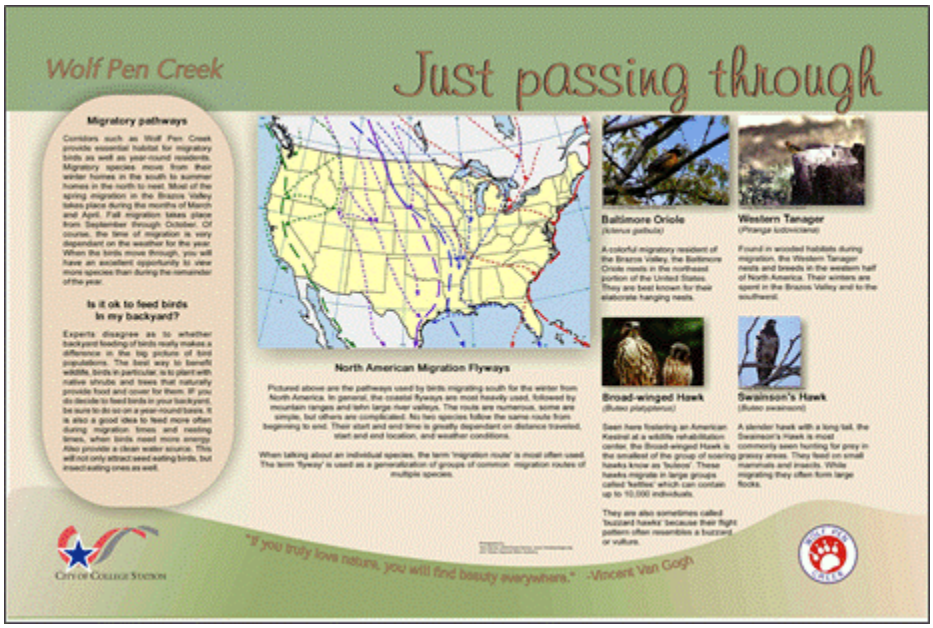
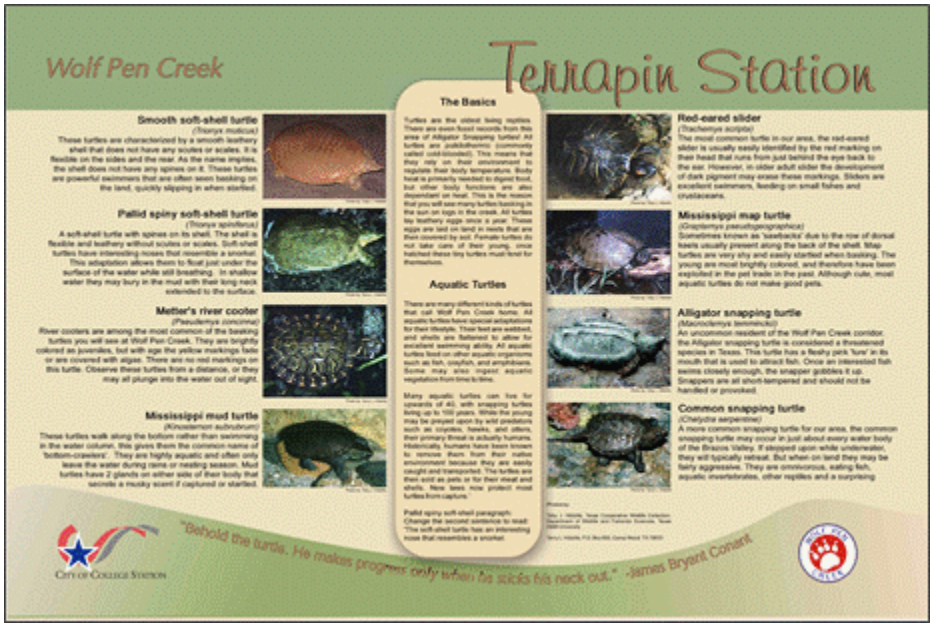
APPENDIX A

Interpretive Signs Examples.

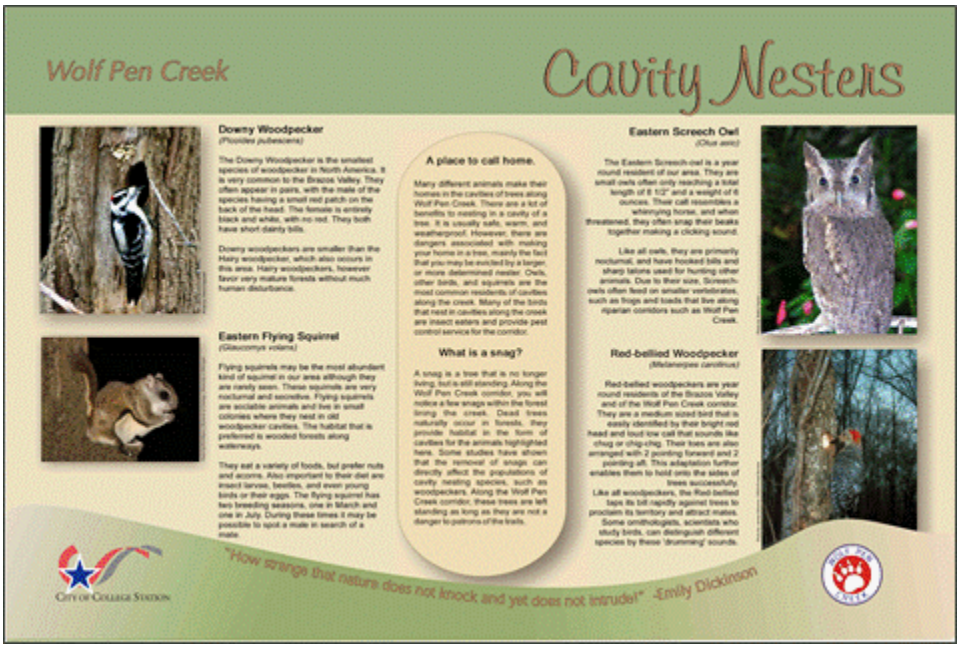


Interpretive Sign: Just passing through.

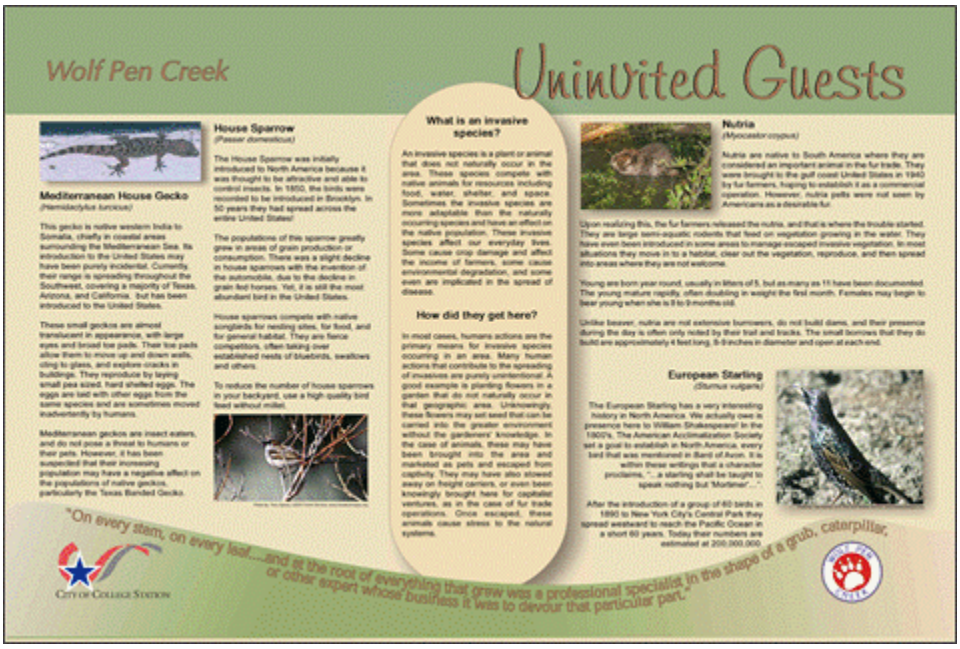


Interpretive Sign: Terrapin station.

Interpretive Sign: When the sun goes down.



Interpretive Sign: Cavity nesters.



Interpretive Sign: Uninvited guests.

Interpretive Sign: Have you seen us?

APPENDIX B

Project Wild, Project Wild Aquatics and Growing Up Wild activities correlated to Wolf Pen Creek Signs and TEKS.

Sign	PW, PWA & GUP Activities	Grade level (s) / Description	Science TEKS
"Welcome to the Creek"	GUW. First Impressions	K-2: Children combine movement and math to show how they think and feel about animals.	K.4 B: Scientific investigation and reasoning: use tools and models to investigate. K.2 A,B,C,D,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 1.2 A,B,C,D,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.2 A,B,D: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers.
	PW. First Impressions	K-2: Students respond to a variety of images to study contributions of a range of animals.	K.2 A,B,C,D,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. K.4 B: Scientific investigation and reasoning: use tools and models to investigate. 1.2 A,B,C,D,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.2 A,B,D: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers.
	PW. Habitrekking	3: Students go outside to conduct an investigation requiring observation, interpretation, and data-gathering skill; then they prepare and present their findings.	3.1 A: Scientific investigation and reasoning: classroom and outdoor investigations practices. 3.9 A: Students go outside to conduct an investigation requiring observation, interpretation, and data-gathering skill; then they prepare and present their findings. 3.4 A,B: Scientific investigation and reasoning: use tools and models to investigate. 3.2 A,D,F: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers.
	PW. Interview a Spider	5: Students use interviewing, researching, and writing techniques to gather information about the natural history of a wildlife species.	5.10 A: Organisms and environments: relationships, systems, cycles.

	PW. Wildlife is everywhere	K-3: Students search their surroundings for evidence of wildlife.	K.10 A: Organisms and environments: characteristics. K.1 A,B: Scientific investigation and reasoning: classroom and outdoor investigations practices. K.2 A,B,C,D,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. K.4 A,B: Scientific investigation and reasoning: use tools and models to investigate. 1.1 A,B: Scientific investigation and reasoning: classroom and outdoor investigations practices. 1.2 A,B,C,D,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 1.4 A: Scientific investigation and reasoning: use tools and models to investigate. 2.1 A,B: Scientific investigation and reasoning: classroom and outdoor investigations practices. 2.2 A,B,C,D: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.4 A: Scientific investigation and reasoning: use tools and models to investigate. 3.1 A: Scientific investigation and reasoning: classroom and outdoor investigations practices.
	PW. Beautiful Basics	K-2: Students list and organize needs of people, pets, and wildlife.	K.2 A,B,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. K.4 B: Scientific investigation and reasoning: use tools and models to investigate. K.9 B: Organisms and environments: needs of living things. 2.2 A,B: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.9 A: Organisms and environments: basic needs.
	GUW. Wildlife is everywhere	K-2: Children make observations and understand that wildlife is all around us.	K.4 A,B: Scientific investigation and reasoning: use tools and models to investigate. K.2 A,B,C,D,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers.

			K.10 A: Organisms and environments: characteristics. K.1 A,B: Scientific investigation and reasoning: classroom and outdoor investigations practices. 1.4 A: Scientific investigation and reasoning: use tools and models to investigate. 1.1 A,B: Scientific investigation and reasoning: classroom and outdoor investigations practices 1.2 A,B,C,D,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.4 A: Scientific investigation and reasoning: use tools and models to investigate. 2.1 A,B: Scientific investigation and reasoning: classroom and outdoor investigations practices. 2.2 A,B,C,D: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers.
	PW. Microtrek Treasure Hunt	5: Students go outside on a "treasure hunt" for wildlife.	5.10 A: Organisms and environments: relationships, systems, cycles. 5.2 A: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 5.1 A: Scientific investigation and reasoning: classroom and outdoor investigations practices.
	PW. What's Wild	K-2: Students locate, classify, and construct collages made from pictures of wild and domesticated animals.	K.2 A,D,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. K.4 B: Scientific investigation and reasoning: use tools and models to investigate. K.9 B: Organisms and environments: needs of living things. 1.2 A,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 1.9 B: Organisms and environments: relationships and life cycles. 2.2 A,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.9 A,C: Organisms and environments: basic needs.

	GUW. What's wild	K-2: Children engage in stories comparing the lives of a wild and a tame animal then sort animals into categories.	K.2 A,D,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. K.4 B: Scientific investigation and reasoning: use tools and models to investigate. K.9 B: Organisms and environments: needs of living things. 1.2 A,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 1.9 B: Organisms and environments: relationships and life cycles. 2.2 A,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.9 A,C: Organisms and environments: basic needs.
"Cavity Nesters"	PW. Everybody needs a home	K-2: Students draw a floor plan of their house and compare their needs with those of other animals.	K.2 A,B,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. K.4 B: Scientific investigation and reasoning: use tools and models to investigate. K.9 B: Organisms and environments: needs of living things. 2.2 A,B: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.9 A: Organisms and environments: basic needs.
	PW. My kingdom for a shelter	5: Students create a model of a shelter used by an animal.	5.10 A: Organisms and environments: relationships, systems, cycles.
	PW. More over rover	5: Students play a game in which the object is to identify characteristic animals found in several ecosystems and to match those animals to the environment in which they live.	5.10 A: Organisms and environments: relationships, systems, cycles.

	GUW. Who lives in a tree?	K-2: Children develop an awareness of trees and some of the animals that call them "home."	K. 9: Organisms and environments: needs of living things. K.8 A: Earth and space: patterns. K.10 A: Organisms and environments: characteristics. K.2 A: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. K.4 A,B: Scientific investigation and reasoning: Use tools and models to investigate. 1.8 C: Earth and space: patterns. 1.2 A: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 1.4 A: Scientific investigation and reasoning: Use tools and models to investigate. 2.4 A: Scientific investigation and reasoning: Use tools and models to investigate. 2.2 A,C: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.9 C: Organisms and environments: basic needs.
"Terrapin Station"	PWA. Are you me?	K: Using picture cards, students match pairs of juvenile and adult aquatic animals.	K.10 C: Organisms and environments: characteristics
	PWA Mermaids and manatees	5: Students describe aquatic animals using a narrative style of writing that, in turn, is the basis for a drawing or painting done by other students.	5.10 A: Organisms and environments: relationships, systems, cycles.
"Life in the Creek"	PW. Grasshopper gravity	K-3: Students observe, handle, and describe live grasshoppers or crickets.	K.9 B: Organisms and environments: needs of living things. K.4 A,B: Scientific investigation and reasoning: use tools and models to investigate. K.2 A,C,D,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. K.1 A,B: Scientific investigation and reasoning: classroom and outdoor investigations

			practices. 1.9 C: Organisms and environments: relationships and life cycles. 1.4 A,B: Scientific investigation and reasoning: use tools and models to investigate. 1.2 A,C,D: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 1.1 A,B: Scientific investigation and reasoning: classroom and outdoor investigations practices. 1.10 A: Organisms and environments: characteristics. 2.1 A,B: Scientific investigation and reasoning: classroom and outdoor investigations practices. 2.2 A,C,D: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.4 A: Scientific investigation and reasoning: use tools and models to investigate. 2.9 A,C: Organisms and environments: basic needs 2.10 A: Organisms and environments: characteristics 3.1 A: Scientific investigation and reasoning: classroom and outdoor investigations practices. 3.4 A: Scientific investigation and reasoning: use tools and models to investigate. 3.10 A: organisms and environments: survival.
	PW. Ants on a Twig	5: Students observe and demonstrate ant behavior.	5.9 A: Organisms and environments: interactions. 5.2 A: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 5.1 A: Scientific investigation and reasoning: classroom and outdoor investigations practices. 5.10 A: Organisms and environments: relationships, systems, cycles.
	PW. Habitat Lap Sit	5: Students physically form an interconnected circle to demonstrate components of habitat.	5.9 A: Organisms and environments: interactions.

	PW. Oh! Deer	5: Students portray deer and habitat components in a physical activity.	5.9 A: Organisms and environments: interactions.
	GUW. Oh! Deer	K-2 Children explore the parts of habitat in a physical activity.	K.3 A: Scientific investigation and reasoning: critical thinking and scientific problem solving. K.2 A,D: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. K.9 B: Organisms and environments: needs of living things. 1.9 B: Organisms and environments: relationships and life cycles. 1.2 A,D: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 1.3 A: Scientific investigation and reasoning: critical thinking and scientific problem solving. 2.10 A: Organisms and environments: characteristics. 2.9 A,C: Organisms and environments: basic needs. 2.2 A,D: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.3 A: Scientific investigation and reasoning: critical thinking and scientific problem solving.
	GUW. Ants on Parade	K-2: Children go outside to observe ant behavior and learn insect characteristics.	K.1 A,B: Scientific investigation and reasoning: classroom and outdoor investigations practices. K.4 A,B: Scientific investigation and reasoning: Use tools and models to investigate. K.9 B: Organisms and environments: needs of living things. 1.4 A: Scientific investigation and reasoning: use tools and models to investigate. 1.3 C: Scientific investigation and reasoning: critical thinking and scientific problem solving. 1.1 A,B: Scientific investigation and reasoning: classroom and outdoor investigations practices. 2.4 A: Scientific investigation and reasoning: use tools and models to investigate.

			2.1 A,B: Scientific investigation and reasoning: classroom and outdoor investigations practices. 2.2 A,C,D,E,F: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers.
	PW. Environmental Barometer	K-3: Students go outside to observe and count or to estimate wildlife in an area; they repeat the same procedures in another setting to compare findings and, as an option, make a school "environmental barometer."	K.9 B: Organisms and environments: needs of living thing. 1.2 A,B,D,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.2 A,B,D: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.9 B,C: Organisms and environments: basic needs. 3.2 F: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 3.9 A: Organisms and environments: characteristics, patterns, system.
	PW. Too Close for comfort (indoor)	K-3: Students experiment with physical distance and levels of comfort in humans, estimate appropriate distances between humans and wildlife under various conditions, hypothesize about indicators of animal discomfort, and summarize reasons to avoid animal discomfort through crowding.	K.2 A: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. K.1 B: Scientific investigation and reasoning: classroom and outdoor investigations practices. K.3 A: Scientific investigation and reasoning : critical thinking and scientific problem solving. K.9 B: Organisms and environments: needs of living things. 1.2 A: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 1.1 B: Scientific investigation and reasoning: classroom and outdoor investigations practices. 1.3 A: Scientific investigation and reasoning: critical thinking and scientific problem solving. 2.1 B: Scientific investigation and reasoning: classroom and outdoor investigations practices. 2.2 A: Scientific investigation and reasoning: classroom and outdoor investigations

			questions & answers. 2.3 A: Scientific investigation and reasoning: critical thinking and scientific problem solving. 2.9 A: Organisms and environments: basic needs. 3.2 A: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 3.9 A: Organisms and environment: characteristics, patterns, systems.
	PWA. Blue-ribbon niche	5: Students create a variety of representations of wildlife that can be found in riparian zones.	5.9 C: Organisms and environments: interactions 5.10 A: Organisms and environments: relationships, systems, cycles.
	PWA. Riparian retreat	5: Awareness of a riparian zone is created through the use of a simulated field trip and artwork.	5.9 A,C: Organisms and environments: interactions.
	GUW. Aqua charades (indoor)	K-2: Children explore the importance of water for people, animals and plants.	K.7 C: Earth and space: earth materials, rocks, soils, water. K.10 B: Organisms and environments: characteristics. K.4 A,B: Scientific investigation and reasoning: use tools and models to investigate. K.3 A: Scientific investigation and reasoning: critical thinking and scientific problem solving. K.2 A,B,C,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. K.9 B: Organisms and environments: needs of living thing. 1.2 A,B,C: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 1.4 A,B: Scientific investigation and reasoning: use tools and models to investigate. 1.3 A: Scientific investigation and reasoning: critical thinking and scientific problem solving. 2.10 B: Organisms and environments: characteristics.

			2.4 A: Scientific investigation and reasoning: use tools and models to investigate. 2.3 A: Scientific investigation and reasoning: critical thinking and scientific problem solving. 2.2 A,B,C: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.9 A: Organisms and environments: basic needs.
	GUW. Wildlife water safari	K-2: Children discover water sources for local wildlife and create a field notebook	K.7 C: Earth and space: earth materials, rocks, soils, water. K.4 A: Scientific investigation and reasoning: use tools and models to investigate. K.9 B: Organisms and environments: needs of living things. K.2 A,B,D,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 1.7 B; Earth and space: earth materials, rocks, soils, water. 1.2 A,B,D: Scientific investigation and reasoning : classroom and outdoor investigations questions & answers. 1.4 A: Scientific investigation and reasoning: use tools and models to investigate. 2.9 A: Organisms and environments: basic needs. 2.2 A,B,D; Scientific investigation and reasoning : classroom and outdoor investigations questions & answers. 2.4 A; Scientific investigation and reasoning: use tools and models to investigate.
"Have You Seen Us?"	PW. Shrinking Habitats	5: Students simulate a process of land development.	5.9 A: Organisms and environments: interactions.
	PW. Classroom carrying capacity	K-3: Students sit unusually close to each other and describe the results.	K.2 A: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. K.3 A: Scientific investigation and reasoning: critical thinking and scientific problem solving. K.9 B: Organisms and environments: needs of living things. 1.1 B: Scientific investigation and reasoning: classroom and outdoor investigations practices.

			1.2 A: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 1.3 A: Scientific investigation and reasoning: critical thinking and scientific problem solving. 2.2 A: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.3 A: Scientific investigation and reasoning: critical thinking and scientific problem solving. 2.9 A: Organisms and environments: basic needs. 3.9 A: Organisms and environments: characteristics, patterns, systems.
	PW. How many bears can live in this forest?	5: Students become "bears" to look for one or more components of habitat during this physically involved activity.	5.10 A: Organisms and environments: relationships, systems, cycles.
"Just Passing Through"	PW. Migration barriers (indoors)	5: Students draw murals showing deer migration routes and the consequences of developing a highway through an area.	5.10 B: Organisms and environments: relationships, systems, cycles.
	PWA. Sockeye Scents	3-4: Students participate in map and simulation exercises that help them understand the migration of the sockeye salmon.	3.3 A: Scientific investigation and reasoning: critical thinking and scientific problem solving. 3.9 C: Organisms and environments: characteristics, patterns, systems. 3.10 A: Organisms and environments: survival. 4.3 A: Scientific investigation and reasoning: critical thinking and scientific problem solving. 4.10 A: Organisms and environments: survival.

	PWA. Migration Headache	5: Students portray migrating water birds traveling between nesting habitats and wintering grounds.	5.9 C: Organisms and environments: interactions
	PWA. Hooks and Ladders	5: Students simulate the Pacific salmon and the hazards faced by salmon in an activity portraying the life cycle of these aquatic creatures.	5.9 A,C: Organisms and environments: interactions
"Going with the Flow"	PWA. Marsh Munchers	K-3: Students use body movements and pantomime to simulate the feeding motions of marsh animals.	K.2 D: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. K.9 B: Organisms and environments: needs of living things. 1.9 C: Organisms and environments: relationships and life cycles. 1.2 D: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.2 D: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.9 C: Organisms and environments: basic needs. 3.9 B: Organisms and environments: characteristics, patterns, systems.
	PWA. Silt. A Dirty word	3: Students create a model to simulate changes to a stream and its water flow when silt, sand or both are added to the system.	3.9 A,C: Organisms and environments: characteristics, patterns, systems. 3.2 A,D,F: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers.
	PWA: Aqua Words (indoor)	K-1: Students brainstorm water words, make word trees with those words, and write poetic statements about water.	K.7 C: Earth and space: earth materials, rocks, soils, water. 1.7 C: Earth and space: earth materials, rocks, soils, water.

"High Above Wolf Pen Creek"	PW. Quick-Frozen Critters	5: Students play an active version of "freeze tag."	5.9 A: Organisms and environments: interactions. 5.10 A: Organisms and environments: relationships, systems, cycles.
	PW. Muskox Maneuvers	5: Students simulate muskoxen and wolves in a physical activity.	5.10 A: Organisms and environments: relationships, systems, cycles. 5.9 A: Organisms and environments: interactions.
	GUW. Bird Beak Buffet	K-2: Children learn about the special functions of bird beaks.	K.4 B: Scientific investigation and reasoning: Use tools and models to investigate. K.3 B; Scientific investigation and reasoning: critical thinking and scientific problem solving. K.10 A: Organisms and environments: characteristics. K.2 A,D,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 1.10 A: Organisms and environments: characteristics. 1.2 A,D,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 1.3 B: Scientific investigation and reasoning : critical thinking and scientific problem solving. 2.10 A: Organisms and environments: characteristics. 2.2 A,D,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.3 B: Scientific investigation and reasoning: critical thinking and scientific problem solving.
"When the Sun Goes Down"	PW. Surprise terrarium	1-4: Students observe a live animal that uses camouflage techniques.	1.1 A,B: Scientific investigation and reasoning: classroom and outdoor investigations practices. 1.2 A: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 1.9 B: Organisms and environments: relationships and life cycles. 1.10 A: Organisms and environments: characteristics. 2.1 A,B: Scientific investigation and reasoning: classroom and outdoor investigations

			practices. 2.2 A: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.10 A: Organisms and environments: Characteristics. 3.1 A: Scientific investigation and reasoning: classroom and outdoor investigations practices. 3.9 A: Organisms and environments: characteristics, patterns, systems. 3.10 A: Organisms and environments: survival. 4.1 A: Scientific investigation and reasoning: classroom and outdoor investigations practices. 4.10 A: Organisms and environments: survival.
	PW. Thicket Game	1-4: Students become "predator" and "prey" in a version of "hide and seek."	1.10 A: Organisms and environments: characteristics 2.10 A: Organisms and environments: characteristics 3.3 C: Scientific investigation and reasoning: critical thinking and scientific problem solving. 3.10 A: Organisms and environments: survival. 4.3 C: Scientific investigation and reasoning: critical thinking and scientific problem solving. 4.10 A: Organisms and environments: survival.
	PW. What bear goes where	1-4: Students construct posters of three different bear habitats.	1.2 D: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 1.10 A: Organisms and environments: Characteristics 2.2 D: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.10 A: Organisms and environments: characteristics 3.2 C: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 3.10 A: Organisms and environments: survival. 4.2 C: Scientific investigation and reasoning: classroom and outdoor investigations

			questions & answers. 4.10 A: Organisms and environments: survival.
	PW. Color Crazy (indoors)	1-4: Students create colorful representations of wild animals.	1.2 A: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 1.10 A: Organisms and environments: Characteristics. 2.2 A: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.10 A: Organisms and environments: characteristics. 3.10 A: Organisms and environments: survival. 4.10 A: Organisms and environments: survival.
	PWA. Fashion a fish	K-4: Students design a fish adapted for various aquatic habitats.	K.10 A,B: Organisms and environments: characteristics. 1.10 A; Organisms and environments: Characteristics. 2.10 A: Organisms and environments: characteristics. 3.10 A: Organisms and environments: survival. 4.10 A: Organisms and environments: survival.
	GUP. Hiding in plain sight	K-2: Children play a game of hide and seek to learn about important adaptations in many wild animals	K.2 A,E: Scientific investigation and reasoning : classroom and outdoor investigations questions & answers. K.3 B: Scientific investigation and reasoning: critical thinking and scientific problem solving. 1.9 C: Organisms and environments: relationships and life cycles. 1.10 A: Organisms and environments: characteristics. 1.2 A: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.3 B; Scientific investigation and reasoning: critical thinking and scientific problem solving 2.2 A: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers.

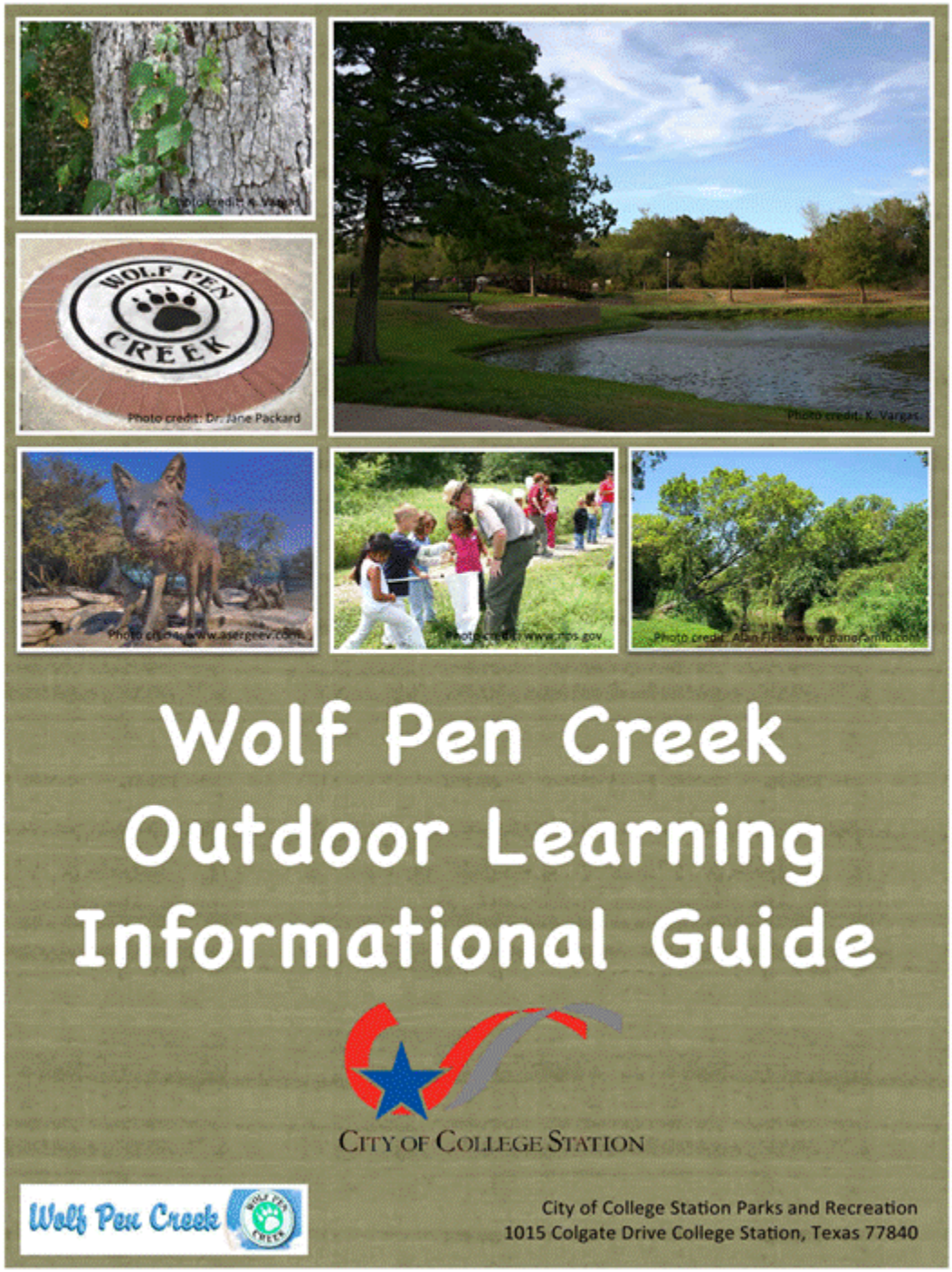
	PW. Seeing is Believing!	1-4: Students use kaleidoscopes, binoculars or telescopes, and fisheye mirrors to imagine what animals might have such vision. Students then make posters showing these animals.	1.4 A: Scientific investigation and reasoning: use tools and models to investigate. 1.2 A,C,D,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 1.1 A,B: Scientific investigation and reasoning: classroom and outdoor investigations practices. 1.10 A: Organisms and environments: characteristics. 2.4 A: Scientific investigation and reasoning: use tools and models to investigate. 2.2 A,C,D,E,F: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 2.1 A,B: Scientific investigation and reasoning: classroom and outdoor investigations practices. 2.10 A: Organisms and environments: Characteristics 3.1 A: Scientific investigation and reasoning: classroom and outdoor investigations practices. 3.2 A,C,D,F: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 3.4 A: Scientific investigation and reasoning: use tools and models to investigate. 3.10 A: Organisms and environments: survival. 4.1 A: Scientific investigation and reasoning: classroom and outdoor investigations practices. 4.2 A,C,D,F: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 4.4 A: Scientific investigation and reasoning: using tools and models to investigate. 4.10 A: Organisms and environments: survival.
Plant signs	GUW. Looking at leaves	K-2: Children practice their observation skills by comparing leaves.	K.2 A,C,D,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. K.1 A: Scientific investigation and reasoning: classroom and outdoor investigations practices K.4 A,B: Scientific investigation and reasoning: use tools and models to investigate.

			K.10 A: Organisms and environments: characteristics. K.5 A: Matter and energy: properties and patterns. K.3 B: Scientific investigation and reasoning: critical thinking and scientific problem solving. 1.2 A,C,D: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 1.10 A: Organisms and environments: characteristics. 1.5 A: Matter and energy: properties and patterns. 1.4 A: Scientific investigation and reasoning: use tools and models to investigate. 1.1 A: Scientific investigation and reasoning: classroom and outdoor investigations practices. 2.4 A: Scientific investigation and reasoning: use tools and models to investigate. 2.1 A,B: Scientific investigation and reasoning: classroom and outdoor investigations practices. 2.2 C,D: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers.
	GUW. Seed need	K-2: Children explore seeds as food for people and animals and learn how animals spread seeds	K.9 B: Organisms and environments: needs of living things K.3 A: Scientific investigation and reasoning: critical thinking and scientific problem solving K.2 A,B,C,D,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. K.1 A,B: Scientific investigation and reasoning: classroom and outdoor investigations practices. K.10 A,B,D: Organisms and environments: characteristics. 1.2 A,B,C,D,E: Scientific investigation and reasoning: classroom and outdoor investigations questions & answers. 1.3 A: Scientific investigation and reasoning: critical thinking and scientific problem solving. 1.1 A,B: Scientific investigation and reasoning: classroom and outdoor investigations practices.

			2.10 B: Organisms and environments: characteristics 2.3 A: Scientific investigation and reasoning: critical thinking and scientific problem solving. 2.2 A,B,C,D,E: Scientific investigation and reasoning : classroom and outdoor investigations questions & answers. 2.1 A,B: Scientific investigation and reasoning: classroom and outdoor investigations practices. 2.9 A: Organisms and environments: basic needs.

APPENDIX C

Wolf Pen Creek Outdoor Learning Informational Guide



Welcome to Wolf Pen Creek Corridor!

Photo credit: www. activerain.com

We look forward to working with educators to provide exciting and educational outdoor experiences for their students at Wolf Pen Creek Corridor.

During this trip you will have the opportunity to experience an environment characteristic of a riparian corridor. Students will participate in a wide variety of engaging outdoor learning activities aligned with state standards to maximize their critical thinking and develop an understanding of scientific concepts.

What is a Riparian Area?

A riparian area is a zone bordering a body of water such as Wolf Pen Creek. The interactions between the land and water create a habitat for plants and wildlife. It is not only essential for creatures and plants that live in these habitats, but it also plays a significant role in maintaining water quality, which people need to live.

Riparian areas are important to sustain the ecological health of a stream, provide erosion and flood control, and prevent sediment pollution. A continuous corridor of natural vegetation along the creek does many things to help keep a healthy, stable stream ecosystem, making the riparian corridor very important.

Learning about Wolf Pen Creek Corridor, the riparian plant community, and the sensitive species of native animals that dependent upon our local riparian habitat will help us protect it and keep all benefits it provides to our community.

About Wolf Pen Creek Corridor

Photo credit: K. Vargas

Wolf Pen Creek originates on Texas A&M campus, and flows east into Carter Creek, approximately 2.5 miles down stream.
The City adopted the first Wolf Pen Creek Corridor Master Plan in 1988 to promote urban development, recreational opportunities, manage drainage, and preserve the creek's plants and wildlife.
Since then, it has been the subject of considerable planning and substantial public and private investment.

Photo credit: www.asergeev.com

Today, you can find an amphitheater that attracts hundreds of visitors every year, walking and biking trails, observation decks, a disk golf course, a playground area, rest rooms facilities, and a picnic pavilion.

In 2007, community volunteers, Texas A&M students, and City employees installed interpretive signs along the trails to enhance the greenways education program, instruct citizens and visitors on how nature works in urban environments, and to promote the value of local natural resources.

Outdoor Experiences: Our Approach

Photo credit: www.asergeev.com

We aim to encourage discovery and ignite passion for nature. Our approach is a collaborative model between educators, learners, and community volunteers to promote experiential connections with the natural environment, and expand knowledge by bringing science concepts to life.

Photo credit: K. Vargas

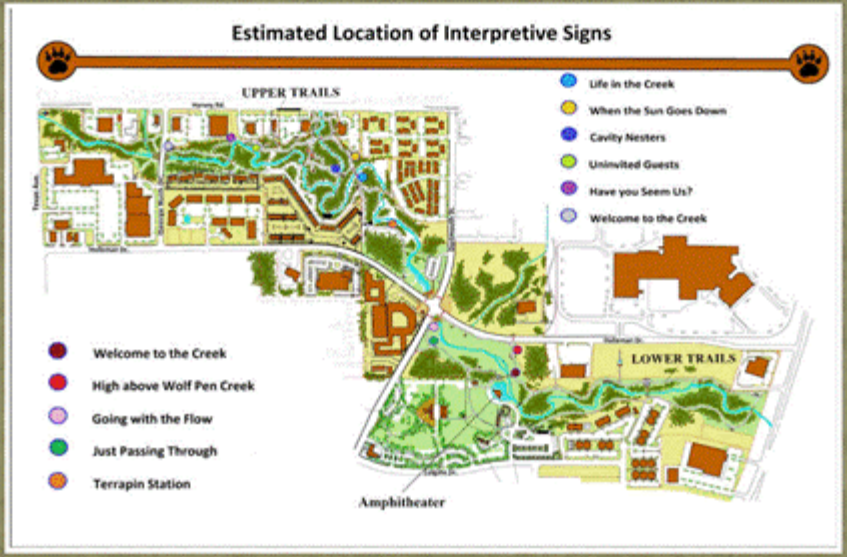
We deliver Project Wild, Project Wild Aquatic, and Growing Up Wild learning activities that are correlated to grade level Science TEKS and the interpretive signage found along the trails at Wolf Pen Creek.

Learning Stations

During the field day, students will be engaged in hands-on learning at different stations. Teaching Trunks are available with all materials needed to satisfy the curriculum objectives.

Volunteer guides will lead groups of students facilitating the activities, discussion and investigations. Stations are located along the trails and are designed to address content goals and scientific inquiry outcomes.

Photo credit: www.stacylewis.com



Students will rotate through five stations at approximately 30-40 minute intervals. After the third rotation, student will break for lunch, and continue with the remaining two stations afterwards. The following is a suggested schedule for a 4-hour field trip.

- *9:00-9:20: Buses arrive/Welcome*
- *9:20-10:00: Station 1*
- *10:00-10:40: Station 2*
- *10:40-11:20: Station 3*
- *11:20-12:00: Lunch / Restroom break*
- *12:00-12:30: Station 4*
- *12:30-1:00: Station 5*
- *1:00 - 1:15 Dismissal*

The program can accommodate a maximum of 25 students per station and is targeted to grades K-5.

Facilities: *Trails, interpretive signs, amphitheater, green room, playground area, restrooms.*

Pre and Post Field Trip Activities

Materials are available with pre and post-visit activities to help educators and students prepare for their outdoor nature exploration, and reinforce their experience after their visit. A downloadable Teacher's Guide is available at our website. It includes suggested literature to build background knowledge, vocabulary, concepts, and key questions as well as classroom activities.

Field Trip Check List

Please follow the following suggestions to ensure a safe, enjoyable and productive visit to Wolf Pen Creek Park.

Before Your Visit

- *Clarify educational goals.*
- *Select and deliver pre-visit activities with your class.*
- *Explain behavioral expectations to your students.*
- *Prepare nametags for all students.*
- *Plan to arrive no later than 9:15 am.*

Photo credit: www. durwoodynature.org

During Your Visit

- *Certain distractions hinder a meaningful learning experience for students. We strongly discourage the use of toys, cellphones and cameras during the visit. Large, heavy, and wheeled backpacks are also discouraged.*
- *Make sure students are accompanied by an adult at all times.*
- *Remind students to stay on the paths or the area where the activity is being delivered.*
- *Students need to pick up their trash, and respect green areas, plants and wildlife.*
- *Encourage students to ask questions, observe collect evidence, and form opinions.*

After Your Visit

- *Please take time to complete an evaluation and return it to Wolf Pen Creek Park. We also welcome student letters.*
- *Encourage follow up family visits to Wolf Pen Creek following the field trip to give your students the opportunity to share what they have learned.*
- *Download the Teacher's Guide available at our website to reinforce and build upon your students' experience.*

We look forward to seeing you at Wolf Pen Creek!

City of College Station

City of College Station Parks and Recreation

1015 Colgate Drive College Station, Texas 77840