NATURAL RESOURCES AND ENVIRONMENTAL SCIENCES PROJECT

Recommendations for the Flint Hills Discovery Center

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I. Introduction

With the recent unveiling of the Flint Hills Discovery Center's master plan, several key ideas were absent. This proposal addresses some primary themes that were excluded from the center's conceptual design. These include educational programs discussing archeology, prairie chickens, ecological events, educational outreach, programming, funding, and public partnerships. By providing appropriate information about our individual proposals, which are based around the promotion of the Flint Hills region, specifically the Konza Prairie, we will present a viable argument for incorporation of these subjects into the Flint Hills Discovery Center's master plan.

II. Project Statement

In starting this project, we were not sure the direction we would take. We originally began by detailing prairie research done by Kansas State University. With more discussion with Bob Workman, Flint Hills Discovery Center Director, we realized this wasn't practical. As a group, we picked out subjects that both the Flint Hills Discovery Center and we as students found valuable.

All of our proposals address and expand on the needs of the community that can be fulfilled through the Flint Hills Discovery Center. Meeting these needs requires support and partnerships with the area schools, Kansas State University, individuals, and other organizations willing to donate time or effort in supporting the Discovery Center and its emphasis on the tallgrass prairie in the Flint Hills region. This will enable the Flint Hills Discovery Center to reach more members of the community and be more successful as a museum (Workman).

Before explaining detailed proposals, it is important to gain an understanding of the Flint Hills region, the Konza Prairie, and the Flint Hills Discovery Center. Once an understanding is conveyed, individualized proposals will follow.

III. The Flint Hills

A. Tallgrass Prairie

The tallgrass prairie once covered more than 140 million acres or 400,000 square miles of North America, and spanned from Kansas to Indiana and from Texas to Canada.

B. Flint Hills Prairie

Most of the tallgrass prairie was plowed under for agricultural production throughout the United States. However, the shallow and rocky soil in the Flint Hills was not ideal for plowing. This makes it one of the few places the tallgrass prairie still survives (Tallgrass Prairie National Preserve). This Flint Hills prairie encompasses 50,000 km² (Location and Habitats) and spreads across east central Kansas from northern Kansas to Oklahoma.

C. Geologic Formation

Two hundred to three hundred million years ago chert (commonly called "flint") and limestone began to form on the Permian Sea floor. During this period oceans rose and fell multiple times creating different types of aquatic environments. The oceans were shallow and warm which supported many invertebrates, fishes, and amphibians.

Figure 1: Konza Prairie.
Taken from Blair.

Animals and plants took calcium

carbonate out of the water and secreted it to form shells and skeletons. These organisms included oysters, corals, sponges, sea urchins, plankton, and algae. When these organisms died, they dropped to the ocean floor. The calcium carbonate accumulated for millions of years. The limestone and shale sediments seen in the Flint Hills today show us a cross section of that landscape. It is estimated that it takes 200 years of deposition to create one inch of limestone (Tallgrass Prairie National Preserve).

After the Permian Period, the Flint Hills still had a long period of rising and falling sea levels, land movement, and crust shifts. During this time, the Rocky Mountains, responsible for weather patterns over the Flint Hills, rose. Between 8,000 and 20,000 years ago, the softer shales and limestone eroded and created valleys and watersheds. The limestone with chert remained to form hilltops. This left chert to create rocky soils (Tallgrass Prairie National Preserve).

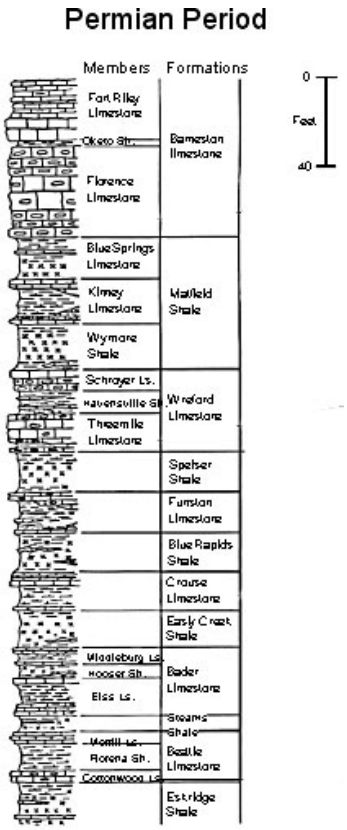


Figure 2: Permian Period.
Taken from Tallgrass Prairie National Preserve.

D. Ecology of Flint Hills Prairie

Prairie was originally the continent's largest continuous ecosystem, and supported an enormous quantity of plants and animals. The Flint Hills prairie has a natural cycle of weather, fire, and grazing (Blair; Briggs; Johnson). The weather, caused by the Rocky Mountains, creates

Figure 3: Konza Prairie Spring Burn.
Taken from Blair.

an area too wet for a desert, but too dry for forests (Tallgrass Prairie National Preserve). The fire created an environment where grasses dominate. Fire can come from lightning or can be set deliberately by humans to drive wildlife or maintain grasslands (Biotic Regions in Kansas).

Vegetation responds to soil type, water availability, and natural processes such as grazing and fire. The Flint Hills prairie is a wetter prairie compared to western prairies and steppe prairies. The Flint Hills prairie supports Indian grass, switch grass, little bluestem, and big bluestem grasses (Tallgrass Prairie National Preserve; Ritter).

There are over 500 species of other plants. Eighty percent of the foliage is grass from 40 to 60 species. The other 20% of vegetation is made up of over 300 species of forbs or flowers (Tallgrass Prairie National Preserve). Grasses range in height from two to eight feet (Ritter).

The Flint Hills prairie grasslands support a wide variety of animal life. Bison roamed the grasslands until hunted to near extinction by settlers moving west (Ritter). Nearly 150 species of birds, 39 species of reptiles and amphibians, and 31 species of mammals exist in the Flint Hills prairie as well (Tallgrass Prairie National Preserve).

Figure 4: Bison on Konza Prairie.
Taken from McLauchlan.

E. Background

Early hunter-gatherers were very connected to the prairie landscape. Chert was a very common material and used for stone tools and as weapon points for thousands of years (Tallgrass Prairie National Preserve). Suitable quality flint was often quarried in the Flint Hills on easily accessible outcroppings (Tallgrass Prairie National Preserve).

The nutrient-rich soil beneath the grasslands drew farmers to these regions. Most of the tallgrass prairie has been replaced by agriculture (Ritter). Less than 4% of its original area remains and because of this, it is an endangered ecosystem. However, flint-filled soils were difficult to cultivate. This led to ranching and grazing practices that dominated the land use for over 125 years. In many ways, today's ranchers and prairie residents have reliance on the land. Grazing animals such as bison or cattle are a necessary component of prairie ecology. However, overgrazing can diminish the leaf area that conducts photosynthesis and alter the next year's growth of plants (Tallgrass Prairie National Preserve; Owensby).

F. Environmental Factors

The present Flint Hills prairie has been impacted by several different environmental factors. These include airborne pollution, climate change, urban sprawl, water quality, and agriculture. Increased carbon dioxide and ozone have alter the ability of plants to produce protein and therefore reduce forage quality (Owensby). Increased nitrogen deposition has caused riparian areas to have more woody species than before the industrial revolution (McLauchlan). Urban sprawl, along with agriculture has broken up the prairie biome making the Flint Hills the last stand and the prairie biome less resilient to disturbances (Briggs; Tallgrass Prairie national Preserve). Regarding water quality, prairie streams are more susceptible to eutrophication through increased nutrient runoff and nutrient-laden sediment deposition than forest streams (Dodds). Runoff of pesticides also play a role in water quality (Tallgrass Prairie National Preserve). Concerning agriculture, poorly managed cattle can cause grasses to become less productive and increase the rate of erosion on pastures (Owensby; Tallgrass Prairie National Preserve).

IV. The Konza Prairie

A. Location

Figure 5: Konza Prairie Map.
Taken from Konza Prairie Biological Station.

Owned by the Nature Conservancy and Kansas State University, Konza Biological Station is located in the Flint Hills of northeast Kansas; 10 km south of the city of Manhattan (39^{o} N', 96^{o} 35'W) (Konza Prairie Biological Station).

B. History

Konza Prairie was established in 1971 as an ecological research station on the tallgrass prairie. After many haggling efforts over land and ownership, a station was finally set up and named Konza Prairie Research Natural Area for the Kansa Indians, which later was changed in 2000 to Konza Prairie Biological Station. The area's founder and first director was Dr. Lloyd Hulbert. The idea of burning watersheds began in 1972 and the grazing plans were put into action after 8,616 acres were obtained and it was decided that cattle and Bison both could be used (Konza Prairie Biological Station).

C. Aesthetics

The Konza Prairie Preserve contains a wide variety of ecosystems, all housed on 8,600 acres (The Nature Conservancy of Kansas). The key vegetation of the 8,600 acres is predominantly native tallgrass prairie, dominated by perennial warm-season grasses of big bluestem, little bluestem, and switchgrass. The prairie is also highly diverse in additional species including cool season grasses, composites, leguemes, and other forbs (Konza Prairie Biological

Station). Today it has been documented that over 600 flora species exist on the Konza Prairie, and many grow to heights of three feet or greater. One can see the stunning wildflowers on the prairie from April to June, but flowers are at their best during May (The Nature Conservancy). As important as the flora is the fauna. Konza Prairie Biological Station is home to many species of fish, reptiles, amphibians, and mammals as well as more than 200 species of resident and migratory birds (The Nature Conservancy). One such mammal would be the American Bison (*Bos bison*). The bison was once and still is a principal grazer of the natural ecosystem. As a result, the bison affects the population or presence of both plant and animal life coexisting on the prairie (Caldwell; Jeff). Another key species found on Konza would be the Greater Prairie Chicken (*Tymoanuchus cupido*), a characteristic bird of the tallgrass prairie and its ecosystem (KEEP Konza).

In addition to the native prairie, Kings Creek, a natural prairie stream originating on the station runs throughout most of Konza Prairie. The creek is mostly contained in forest dominated by bur and chinquapin oaks and hackberry which occurs in bands along the major stream course and covers approximately seven percent of the preserve area (Konza Prairie Biological Station).

D. Programs

The Konza Environmental Education Program (KEEP) was established in 1996 at the Konza Prairie Biological Station. It has a mission to spread knowledge of the prairie and its importance as a research and conservation ecosystem. The program field trips for school children and activities like the Greater Prairie Chicken viewing. They run projects including a docent program, student participation in research (SLTER), teacher workshops and much more. The education component of the Konza Prairie is run largely on grants and relies on volunteers (docents) to aid in running the program.

E. Research

There are more than thirty research projects currently at Konza prairie (Konza Prairie Biological Station). They cover areas from soil to evolution of grassland organisms and more. A few examples include: ecology, evolution, and genomics in changing environments run by Johnson, L.C., B.K. Sandercock, M.A. Herman and A. Joern, and environmental impacts of wind power development on population biology of greater prairie-chickens run by Sandercock, B.K., and S.M. Wisely. There are also ongoing projects such as RaMP (Rainfall Manipulation Plot) that require long term ecological research (LTER) of the prairie. The projects are supported by a variety of people and organizations. The National Science Foundation is a common sponsor among others such as the Kansas Department of Wildlife and Parks and the Department of Education.

F. Art

Adults and children alike take in the beauty of the prairie and reflect it in various art forms including paintings, poems and pictures. Noticing the beautiful quiet Kings Creek, Jen-Kuang Chang took a photo (Figure 6) while inspired by the phrase in Henry Lawson's poem "The Song and the Sigh." The phrase is

> And the creek of life goes winding on,
>
> Wandering by;
>
> And bears for ever, its course upon,
>
> A song and a sigh."

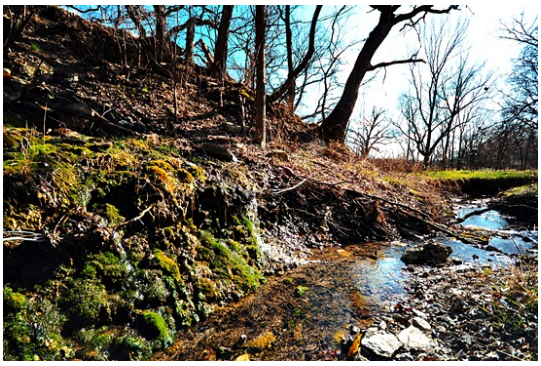


Figure 6: Kings Creek Konza Prairie.
Taken from Jen-Kuang Chang.

Lisa Grossman is a painter captivated by the vast openness of the prairie.

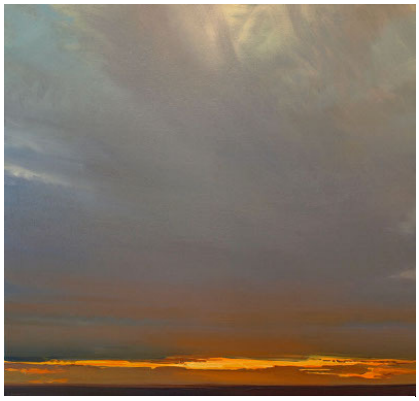


Figure 7: Lisa Grossman Painting.
Courtesy of Lisa Grossman.

V. The Flint Hills Discovery Center

The theme of the Flint Hills Discovery Center is to explore the complexity of how people and the land shape each other. Their mission statement is to inspire people to celebrate, explore, and care for the Flint Hills, and is designed to incorporate an audience of all ages. The Flint Hills Discovery Center is a cooperation between the City Commission of Manhattan and Verner Jonhson and Associates. Bob Workman is the director working with the City Commission to develop this project. This is a project to stimulate downtown redevelopment, tourism, and local economies. The museum will display the geographic, geologic, natural, and cultural elements of the Flint Hills. Currently the museum is undergoing a dynamic development process, but exhibit details are available from The Discovery Center Master Plan. The museum consists of large areas like the Flint Hills room, Prairie Winds Gallery, and an observation deck. There are also many hands-on exhibits for visitors to experience like the mini tornado, upside-down forest, and limestone structures. The Flint Hills Discovery Center will be an excellent source to educate visitors about the tallgrass prairie ecosystem and the importance of its conservation (Comprehensive Master Plan; Workman).

VI. Proposals

A. Ecological Events Exhibit

The Flint Hills Discovery Center's Master Plan has laid out designs for a variety of galleries and exhibits, covering a variety of topics. The addition of a Temporary/Mobile exhibit that displays research done on the tallgrass prairie could complement the theme of the Discovery Center. This is an exhibit that could be used at the Discovery Center site temporarily, stored for future uses, or moved to other locations for educational community outreach purposes.

This type of exhibit would accomplish many goals of the Discovery Center, as well as provide a connection with the Konza Prairie ecological research site. One of the main goals is to visually display some of the core research that is currently being done at the Konza Prairie Biological Research Station. This station is one of 26 sites in the world dedicated to ecological research known as Long-Term Ecological Research (LTER). Connecting the Konza LTER site with the Flint Hills Discovery Center will aid in the visual representation and understanding of core research done on the tallgrass prairie. This exhibit will visually display the complexity and interconnections of the tallgrass prairie ecosystem. Ultimately, this exhibit will educate visitors of all ages. It will enable them to learn how the ecosystem works and what influences play crucial roles in the management of the tallgrass prairie.

The influences on the prairie will be reflected in similar displays at the Discovery Center with an addition of Konza Prairie ecological research. By creating a mobile exhibit we can reach a widespread and diverse audience. The design of the exhibit will have to incorporate current research and human interaction. Ideally, the mobile exhibit would be able to break down fit into

a van, and the Discovery Center would have the ability to travel to other locations for special events.

The current research covers three main variables that are the most significant on the tallgrass prairie: fire, grazing and climate, and how these variables are interconnected to create a unique tallgrass ecosystem. The design should also visually display the cyclical events of these influences on the tallgrass prairie. These events could be displayed as a four-panel process with a panel designated for each of the three variables, and a fourth panel designed to display their interconnections. This panel system could be incorporated into a 3D display for a temporary exhibit in the discovery center, or a mobile exhibit to use for educational and community uses.

The most influential variable that develops and maintains the tallgrass prairies is fire (Gibson 182). Fires are natural occurrences on the prairies and were also practiced by Native Americans. Implementing spring burns in different frequencies on the prairie assists in its conservation for several reasons. The most important effect of fire is the development of diverse grasses that can be grazed. Spring burns are used to increase plant productivity, thus increasing cattle and bison productivity (Briggs). Late spring is the best time to burn because it develops dominant grasses like Big Bluestem and Indian Grass. Late spring burning will provide the highest forage production for cattle, increasing the overall animal productivity, benefiting local ranchers (Owensby). Bison have been observed up to three times more frequently on watersheds that were burned in the spring (Briggs 13). Bison were observed to select grazing patches based on the dominance of warm season grasses that develop in the spring and summer and the species richness created by the spring burns (Briggs 13). Fire also assists in the conservation of the tallgrass prairie by reducing woody vegetation encroachment (Johnson). These trees deplete the nutrients in the soils, decreasing the grass biodiversity and overall plant production (Johnson).

Another important influence on the tallgrass prairie ecosystem is the grazing of livestock. Grazing began on the prairie with bison herds and Native Americans. During this time, Native Americans used burning techniques to attract buffalo herds to certain grazing areas. Buffalo grazing has since been replaced with cattle grazing, but some areas still maintain bison populations. Cattle provide humans with a food source, beef, which is the main economic driver for the region. If cattle grazing is managed properly, it can maintain and preserve the prairie ecosystem, ensuring the best variety of plant biodiversity and net primary production. The complexity and nutrient content of the grasses will increase the net gain of the grazing livestock, which benefits local economies (Owensby). Grazers are needed for conservation and economic importance, and are keystone components that regulate many important aspects of grasslands (Craine 772).

The third major influence on the prairie ecosystem is the climate. The tallgrass prairie is unique because of its seasonality and climatic factors. The precipitation range and rainfall patterns are major contributing factors in the tallgrass ecosystem. With less rain it would eventually become a steppe or desert environment, with more rain it would become a deciduous forest. Climatic factors are of primary importance in determining the distribution and composition of warm and cool season grasses (Gibson 182). Growing season precipitation is one of the main drivers in creating a grassland ecosystem that has optimum nutritional value that benefits both the cattle and ranchers (Craine 773).

The previous three driving factors should be displayed separately, with a final display incorporating their cyclical events and outcomes on the ecosystem. The prairie cycle begins with spring burns and seasonal precipitation, which influences the biodiversity and composition of

grass species. The plant composition then influences grazing patterns, which affects the tallgrass communities and ecosystem properties (Briggs 16).

There are several local organizations that could be contacted about funding for this project. The Nature Conservancy owns part of the land at the biological research station. There is also the Northern Flint Hills Audubon Society located in the local area. Both of these organizations are focused on prairie stewardship and would be excellent organizations to partner with the Discovery Center.

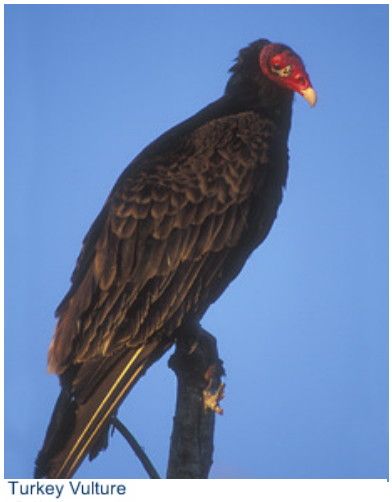
This type of exhibit and the Konza Prairie research will help develop the Discovery Center's theme. The mobility of the exhibit will increase awareness of the Discovery Center itself while educating a variety of audiences. Connecting the biological research station with the Discovery Center would be a great way to incorporate current tallgrass prairie ecological research.

B. Temporary Exhibit

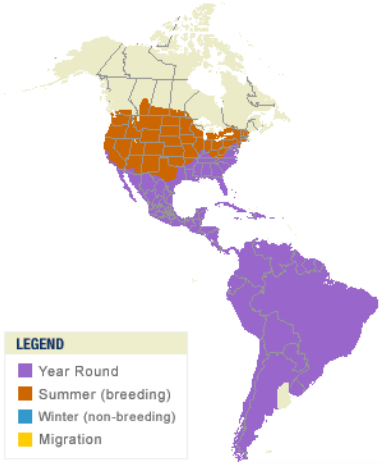
This temporary exhibit introduces the public to the wonders of birds. When you ask a group of individuals, "What animals do you picture in the tallgrass prairie?", the answer will more than likely be deer grazing on the horizon, or bison foraging in the distance. This exhibit will introduce information about the diversity of bird species that is both fun and interactive. The goal of this proposal is to have adults and children come away with the fundamental knowledge of birds in the tallgrass prairie. Participants can take what they have learned from this exhibit and apply it to the great outdoors. It is important to encourage visitors of the Discovery Center to take information learned and apply it. This proposal will cover three topics for the exhibit: bird identification, the uniqueness of the booming prairie chicken, and migratory birds.

1. In the Field

Bird identification is fun; in a way it is like a game. Bird species come in a variety of shapes, sizes, and colors. There are species that soar high in the sky, while some species live on the prairie floor. Some birds sing beautiful songs like the meadowlark, while species like the turkey vulture hiss. This portion of the exhibit will be visual, as the identification of certain species will be displayed. Bird species identified will include the Eastern and Western Meadowlark, the Grasshopper Sparrow, the Greater Prairie Chicken, the Dickcissel, the Red-Tailed Hawk, and the American Kestrel. Along with the display, bird field guides will be offered to visitors to be used the next time they visit the tallgrass prairie.



Turkey Vulture
Cathartes aura



Map by Cornell Lab of Ornithology
Range data by NatureServe

Turkey Vulture
Cathartes aura

Adult Description:
Large, broad-winged, soaring bird
Small, red, unfeathered head
Plumage is a dark brown except for the paler flight feathers
Spend most of its time soaring

Habitat:
Feeds off of carrion, small mammals, insects, fish, and some fruit
Prefers rangeland and areas of mixed farmlands and forests
Roosts in large community groups

Sound Identification:
Normally a silent bird, although does hiss at carcasses, roosts, and nests.

IUCN Conservation Status: Least Concern. Overall North American populations have increased in the past few decades as the breeding range has expanded northward

Cool Facts:
The vulture's primary defense to warn off predators is to vomit
Vultures often defecates on its own legs to cool itself down

Figure 8: Fact Sheet.
Taken from Cornell Lab of Ornithology.

Figure 8 is a fact sheet that will be a part of the display and the take home field guide. The map on the fact sheet may not be present for all of the birds identified, as the turkey vulture migrates and uses the tallgrass prairie as a breeding ground.

Bird calls will also be incorporated into the design of the display so visitors will be able to identify birds through song. The field guide will also include a sound identification section to help assist with the vocalizations, for example, a black capped chickadee sounds like it is saying "phe—be, phe—be".

Along with the display, visitors will be able to identify three bird species that are considered to be the core of the avian community in this region (Dickcissel, *Spiza americana*; Grasshopper Sparrow, *Ammodramus savannarum*; and Eastern Meadowlark, *Sturnella magna*). (With, K.A., et al). In recent studies, it was proposed that grassland birds are in a steep decline throughout many regions of the world. In North America bird species once considered common species have now declined by greater then 50%. Reasons for the decline are largely due to the widespread practice of converted grasslands to agricultural production (With, K.A., et al). Eastern Meadowlarks and Grasshopper sparrows have declined globally by 72% and 65% respectively over the past forty years; the Dickcissel was exhibiting a "stable" population trend, but now is in jeopardy (Butcher and Niven). Estimates show that currently the Eastern Meadowlark is declining by 12-24% a year. The Grasshopper Sparrow is declining by a 27-67%, with the Flint Hills only supporting 15% of the total population. The Dickcissel, a species that once had a stable population, is exhibiting the most rapid rate of decline in this region with an estimated annual loss of 19-29% (With, K.A., et al). It was proposed that populations can only be conserved, assuming normal distribution of fecundity if 80% of the adult populations survive in the upcoming years (With, K.A., et al). Today, grassland bird populations do not seem to appear

to be regionally viable in the largest remaining tallgrass prairie landscape (With, K.A., et al). It has been observed that due to land management practices and climatic conditions, problems are rapidly contributing to grassland bird declines in this region. Due to the decrease in burn management, and climatic change that interact with grazing practices, bird s are no longer able to adapt to the changing dynamics of the ecosystem (With, K.A., et al).

2. The Booming Prairie Chicken

The Greater Prairie Chicken (*Tympanuchus cupido*) is a bird that calls The Great Plains home. Due to habitat loss, the prairie chicken population has been declining since the 1980's (Clifton, A.M.; Krementz D. G). Estimates show that in 1997, Greater Prairie Chicken populations were at one million. In 1980 populations were at 500,000, and in the late 1990's populations were between 200,000 and 250,000 (Johnsgard). Today's numbers are still declining. The National Audubon Institute, in partnership with The World Conservation Union, listed the Greater Prairie Chicken on the "red watch list". The "red watch list" is essentially a list of threatened birds that occur in the United States and are of highest national concern (Gregory, B.S., Daniel, N. K., et al). Today, states that are currently supporting the prairie chicken population include Nebraska, Kansas, South Dakota, North Dakota, Illinois, Iowa, Missouri, Colorado, Oklahoma, Wisconsin, and Minnesota with Nebraska, Kansas, and South Dakota supporting the greatest number of birds (Clifton, A.M.; Krementz D. G). The uncultivated prairies of the Flint Hills support the core population of greater prairie chicken.

Figure 9: Greater Prairie-Chicken. Taken from Cornell Lab of Ornithology.

In Kansas there are two species of prairie chicken. The Greater Prairie Chicken (*Tympanuchus cupido*) is found within the Great Plains region of the Midwest. The Lesser Prairie Chicken (*Tympanuchus pallidicinctus*) is an upland grassland bird that lives within the shortgrass prairie of southwestern Kansas, southern Colorado, Oklahoma, Texas and New Mexico (USDA NRCS). There are many people who confuse the appearance of the Greater Prairie Chicken with that of the Lesser Prairie Chicken. Adult Greater Prairie Chickens are approximately sixteen to eighteen inches in length and weigh approximately two pounds. The bird has a barred feather pattern of brown, buff, black, and white colorations. Near the ear are feathers that are called pinnae or "ear feathers" and are erected during sexual displays. Located directly underneath the pinnae are areas of bare skin also known as typannm or "air sacs". These yellow and orange sacs are inflated during sexual displays (Bidwell, Terry, Fuhlemdorf, Sam., et al). The Lesser Prairie Chicken is very similar to that of the Greater Prairie Chicken. Some differences include a pinkish tympannm of the Lesser Prairie Chicken, instead of yellow. The plumage of the Lesser Prairie Chicken is usually paler and is heavily barred compared to that of the Greater Prairie Chicken (USDA NRCS).

Figure 10: Lesser Prairie-Chicken
Taken from Cornell Lab of Ornithology.

Prairie chickens live in family groups known as leks (Clifton, A.M.; Krementz D. G). Leks are located on elevated, open, grasslands where vegetation is short, visibility is good, and booming can be well heard (Bidwell, Terry., Fuhlemdorf, Sam., et al). Booming is the sexual display the males use to attract a female for mating. Booming traditionally takes place on the

shorter grasses of the leks, but close enough to taller grasses that males can escape if threatened (Bidwell, Terry., Fuhlemdorf, Sam., et al). Leks are dominated by a dominant male; young males typically establish peripheral territories (Bidwell, Terry., Fuhlemdorf, Sam., et al). Females that visit the booming grounds will mate with the most dominant male in the lek. However, one or two males perform as much as ninety percent of total copulations in lek, with clutch sizes between eleven to fourteen eggs (Bidwell, Terry., Fuhlemdorf, Sam., et al). Peak booming activity usually occurs from sunrise until two hours after sunrise, with males usually booming earlier in the season (Clifton, A.M.; Krementz D. G). Booming comes to a halt when early-season cattle grazing begins (Clifton, A.M.; Krementz D. G).

Continuous research on both the Greater Prairie Chicken and the Lesser Prairie Chicken are vital to determine how we can help these species. Research published in 2002 used mark-resight techniques to count the current population numbers of Greater Prairie Chickens (Clifton, A.M.; Krementz D. G). Lek surveys, a common method used to provide an index for a population of prairie chickens, were used by state agencies to monitor prairie chicken populations (Clifton, A.M.; Krementz D. G). Lek surveys were performed twice between the months of March to April, as researchers drove a 16-km route and stopping every 1.6 km to listen three minutes for booming (Clifton, A.M.; Krementz D. G). This process was repeated many times to gain a proper count of the total bird population. A constraint observed in this study was the difficulty of being in the right place at the right time (Clifton, A.M.; Krementz D. G).

Mark-resight techniques are commonly used, as population estimates are based off the resightings of marked animals and the number of unmarked animals counted on each survey (Clifton, A.M.; Krementz D. G). Population counts were taken at two sites; the first in Chase

County, Kansas on the Tallgrass Prairie National Preserve, a mostly unplowed site with 4,400 ha of prairie. The second study area was Lips Ranch, a locally owned ranch 12km west of the Tallgrass Prairie National Preserve (Clifton, A.M.; Krementz D. G). Seven leks were observed on each site, with total population estimates being around sixty-to-eighty prairie chickens (Clifton, A.M.; Krementz D. G). Simulation analysis was used in a program called NOREMARK (White 1996). This program was used to estimate the number of transmitters, estimate occasions, and proportion of the population that needed to be marked to produce a population estimate (Clifton, A.M.; Krementz D. G). With the use of simulations, the researchers conducted fifteen surveys, and were able to put transmitters on twenty to thirty percent of the population. (Clifton, A.M.; Krementz D. G). Using mist netting and funnel traps, fifty-five prairie chickens, both male and female, were captured in seventy days. In 2001, transmitters were placed on seven females at both sites, and in 2002 transmitters were placed on three females and ten males at the Tallgrass Prairie National Preserve (Clifton, A.M.; Krementz D. G). In the discussion, it was mentioned that mark-resight procedures are highly variable, thus some of this data can be misleading. The reason behind this is due to accurately counting the exact numbers the prairie chickens in a population (Clifton, A.M.; Krementz D. G).

As we have read, habitat loss is the main reason for the decline in numbers of both the Greater Prairie Chicken and the Lesser Prairie Chicken. We need to ask ourselves what we can do to stop this. With the increase in agriculture size, pesticides and herbicides cause a decrease in habitat and food sources (Bidwell, Terry., Fuhlemdorf, Sam., et al). The main concern on the prairie is proper grazing and land management. Over grazing has contributed greatly to the loss of habitat quantity and quality, but can easily be reversed by the rancher if properly educated about when to put their cattle out to pasture (Bidwell, Terry., Fuhlemdorf, Sam., et al). Proper

land management becomes an issue with lack of burning. Burning allows for re-growth of the prairie and without it, woody vegetation takes over the prairie. These studies reveal factors that are contributing to the loss of habitat for the prairie chicken (Bidwell, Terry., Fuhlemdorf, Sam., et al).

3. Birds in Migration

This portion of the exhibit will show the flight patterns of migratory birds and their pathways to breeding and wintering grounds. A migration route is a concept that refers to the general movement of many animal species and not to an exact course that is followed by an individual bird (Migration of birds). As for the migration route, it is broadly defined as two points between two distances; a winter, and summer ground. A common mistake with migration routes is that people believe that birds follow the exact route every time, without trailing off. This is untrue (Migration of birds). There is considerable variation in routes that are chosen by different birds. This exhibit will display various bird species that migrate in and out of the Flint Hills.

Today there are six defined pathways that migrating birds follow. The Atlantic Oceanic Route passes over the Atlantic Ocean from Labrador and Nova Scotia to the Lesser Antilles and then to the mainland of South America. This route is followed by shorebirds such as the American Golden-Plover (Migration of birds). The Mackenzie Valley-Great Lakes-Mississippi Valley Route, extending from the Mackenzie Valley past the Great Lakes and down through the Mississippi Valley is the longest migration route in the Western Hemisphere. This route is more than 3,000 miles across and goes to the northern regions of Kotzebue Sound, Alaska, and continues as far south as Argentina (Migration of birds). The Mississippi Valley route is followed by vast numbers of ducks, geese, shorebirds, blackbirds, sparrows, warblers, and

thrushes. The Great Plains-Rocky Mountain Route originates at the Mackinzie River Delta in Alaska. This route moves southward through the Great Plains from breeding ranges in Alaska and Canada. This route is used by Sandhill Cranes, White-fronted Geese, and smaller races of Canada Geese (Migration of birds). The Pacific Coast Route is considered to be the least traveled of all routes. Many species on this route breed along the coast of southeastern Alaska and either do not migrate or make relatively short journeys (Migration of birds). The fifth route is the Pacific Ocean Route that is used by that Pacific Golden-Plovers, Bristle-thighed Curlews, Ruddy Turnstones, Wandering Tattlers, and other shorebirds (Migration of birds). The Pacific Ocean route is an elliptical route that moves southward through islands in the central Pacific and northward along the Asiatic coast (Migration of birds). Lastly is the Arctic Routes. Bird species that follow this route are chiefly parallel, and the route may be considered a part of the Atlantic or Pacific Coast routes (Migration of birds). These routes are heavily followed by gulls, geese, and ducks. In this proposal our main concern will be both the Mississippi and the Great Plains-Rocky Mountain route; many birds stop and use the Great Plains as breeding and resting grounds.

Some birds have a very narrow range to cover, depending on what the bird needs to survive. Habitat conditions also play a role on which pathway the bird may follow (Migration of birds). For example, the Harris' Sparrow is a bird that uses the tallgrass prairie as its winter home. Breeding in the northern portions near the shores of the Hudson Bay, the Harris Sparrow eventually moves southward in a narrow path to live in its wintering grounds, which includes southeastern Nebraska, northwestern Missouri, eastern Kansas, and Oklahoma (Figure 11) (Migration

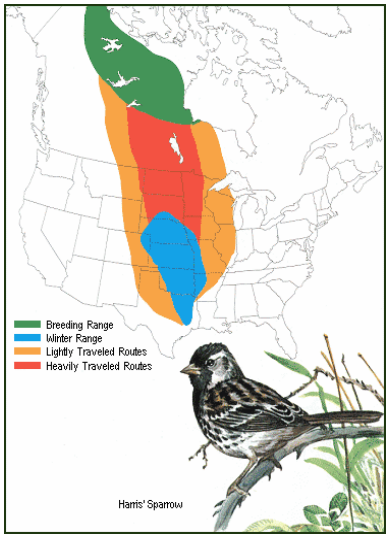


Figure 11: Harris' Sparrow.
Taken from Northern Prairie Wildlife.

of birds). The Harris' Sparrow preferred habitat is a coniferous forest-tundra transition, and its breeding region of choice is the shrubby patches within grasslands (Migration of birds).

When birds begin to move southward for migration, the migration route usually includes the full width of the breeding range. This is the exact reason researchers say that birds do not follow the exact migration route (Migration of birds). The Scarlet Tanager is a perfect example of a bird that uses its breeding ground in convergence to its migration route. Starting its 1,900 mile-wide breeding range in the eastern deciduous forest between New Brunswick and Saskatchewan, the bird eventually moves southward in the fall (Migration of birds). The Scarlet Tanager uses a good portion of the Great Plains and eastwards into areas of the Great Lakes, Maine, and down into Tennessee as its breeding range (Figure 12). After breeding season in the fall, they leave the United States and travel southward into areas of Honduras and Costa Rica (Migration of birds). This species winters heavily in forested areas of northwestern South America, including parts of Columbia, Ecuador, and Peru (Migration of birds).

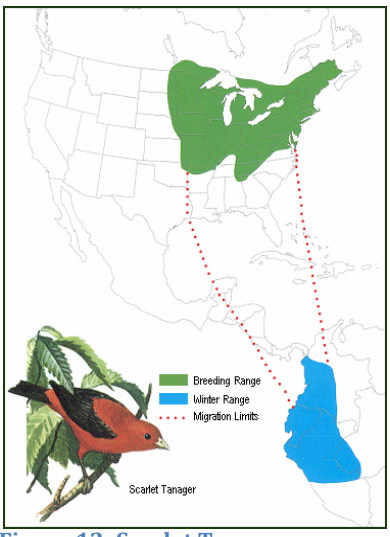


Figure 12: Scarlet Tanager.
Taken from Northern Prairie Wildlife.

Another example that uses the Great Plains and the tallgrass prairie as a breeding ground would be the Rose-breasted Grosbeak. The Rose-breasted Grosbeak leaves the United States through a 600-mile stretch by using a narrow migration route through eastern Texas and Apalachicola Bay, and moves southward into the Gulf of Mexico. It winters in portions of

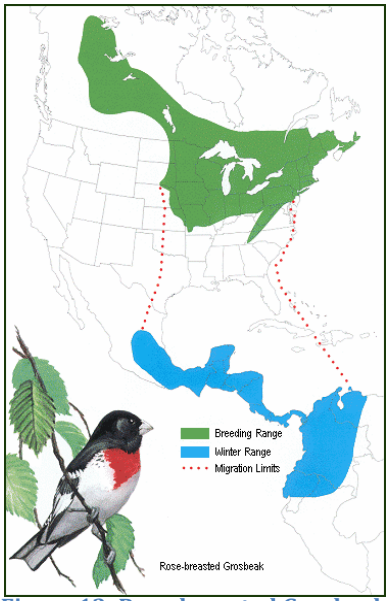


Figure 13: Rose-breasted Grosbeak.
Taken from Northern Prairie Wildlife.

southern Mexico and continues migrating southward into portions of South America (Figure 13) (Migration of birds). An example of a wide migration route would be that of the American Redstart. Using most of the central and northern portions of North America as breeding grounds, it uses the width of its breeding ground to migrate south. These birds use all of the Gulf of Mexico to cross and pass from Florida to Cuba and Haiti, making their pathway approximately 2,500 miles wide (Figure 14) (Migration of birds).

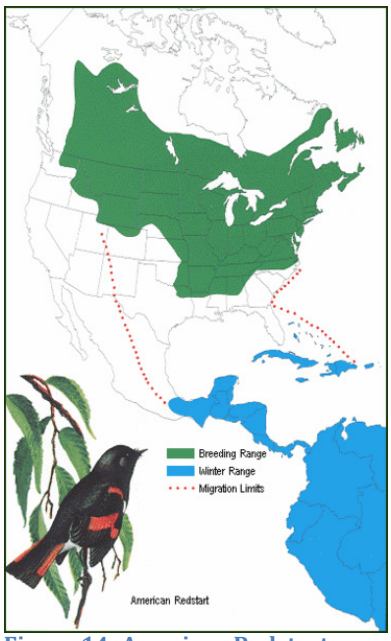


Figure 14: American Redstart.
Taken from Northern Prairie Wildlife.

In the Flint Hills, spring begins in March, and is considered the best time to observe bird migrations. The Nature Conservancy defines March 21 as the date birds begin the transition from their winter grounds into their summer homes and breeding grounds. Also at this time, the Nature Conservancy celebrates its "Top Five Must–See Migrations in Kansas". Kansas is home to some of the best birding opportunities in the Midwest (Nature Conservancy). With less than four percent of the tallgrass prairie remaining in the world, the Flint Hills of Kansas is home to a great number of migratory birds. Some unique summer resident species may call the prairie grasses their home including the Henslow's Sparrow, the Grasshopper Sparrow, the Lark Sparrow, the Field Sparrow and the Eastern Towhee (Nature Conservancy). Migration of these species begins in the month of April and continues through May (Nature Conservancy). The Nature Conservancy is very adamant in protecting the Flint Hills, as it owns the Flint Hills Preserve, the Tallgrass Prairie Preserve, and also owns a large portion of the Konza Prairie Biological Station, which it co-manages with Kansas State University (Nature Conservancy). Another top five species to look for are the warblers. These

beautiful birds can be seen migrating throughout the state from mid April into late May, with a majority of the species staying the summer and breeding. These species are mostly found along the eastern portion of Kansas, as they nest in woodland habitat (Nature Conservancy). Lastly, owls are also on the top five lists as they are considered a unique species of the grasslands of Kansas. The Burrowing Owl, a little owl, is closely tied to the habitat of the prairie dog (Nature Conservancy). The Burrowing Owl coexists with the prairie dog as it uses the prairie dog's burrows to raise there own young (Nature Conservancy). The Burrowing Owl can be seen in the tallgrass prairie from the month of May into the late months of October, and unlike other owls, this bird is diurnal, as it stays awake during the day (Nature Conservancy).

C. Funding/ Partnerships

With the recent unveiling of the Flint Hills Discovery Center's master plan, several key ideas were absent in the plans. Among these omitted ideas were the implementation of various art displays, and also partnerships or collaborations with localized organizations structured around the Flint Hills.

Art gives the opportunity to express science in a visual manner. The audience is given the chance to discover in a visual, interpretative way what the researcher or scientist is discussing or studying. By incorporating art into the Flint Hills Discovery Center, the exhibits will become more engaging and interesting to the viewer. For example, a current proposed exhibit explains the importance of several different species of tallgrasses, such as big bluestem, Indiangrass, and switchgrass. Often, if the viewer of an exhibit recognizes that the display is mainly presenting fact-based information, they will not stay longer than necessary to glance at the images, and perhaps read a few words. However, if an art work depicting the grasses was included in an exhibit, another dimension would be added, and the viewer may be encouraged to stay longer.

Complementing the center's exhibits with art provides an opportunity for collaboration with local artists and organizations. The Discovery Center will not have a curatorial position, so acquiring collections of art for display is not possible. Nevertheless, creating a relationship with local artists who are inspired by the Flint Hills region will provide an adequate supply of individual works of art that can be shown together with the proposed scientific exhibits. Recently, at the Strecker-Nelson Gallery in Manhattan, Kansas, twenty-six women artists presented their works based solely on the Flint Hills region (Smith). This exhibit represents the crème de la crème of the women artists inspired by the Flint Hills region and more specifically, the Konza Prairie. The artists and the individual work(s) that I propose to be utilized for the purpose of this art and science collaboration include:

- Oscar Larmer (landscape)
- Judy Love (horizon)
- Carol McCall (skyscape)
- Doloris J. Pederson (Vistas of the Prairie landscapes)
- Brian Slawson (Gray Day)
- Rodney Troth (Strata 44)
- Barbara Waterman Peters (Scenic)
- Donna Carrington (Tallgrass Prairie Park)
- Mark Feiden (Early Spring in the Flint Hills, Prairie Fire 1 and 2, Farmer Township Pasture)
- Clive Fullagar (Flint Hills Fall and Konza Path)
- Lisa Grossman (Blaze-Yellow and Konza Darkness Sketch II)
- Edward Sturr (Konza Pairie-Hand Colored Prints)
- Judith Mackey (Burning of the Flint Hills and Red Buffalo)

The amount of funding available to artists to fund their activities, as well as the display of their personal work is limited. However, some agencies do allow the opportunity for organizations to garner interest in the arts by providing them with the necessary capital. There are some grants available to fund my proposal. The Kansas Arts Commission has several grants available, with the primary requirement being that the organization has at least three years of

operations. However, there are several smaller grants available that do not require a time of operation.

- Arts-in-Communities Project Mini-Grant Program
- Miscellaneous grants for $2000 or less

These grants will allow the Discovery Center to experiment with my proposal without a monetary loss. When the center has experienced three years of operations, the following grants become available through the Kansas Arts Commission:

- Operation Support Grant Program
- American Masterpieces Kansas
- Kansas Arts on Tour Presenter Program

Several other organizations and associations offer grants and other means of funding that can be used by the Flint Hills Discovery Center to display artists work with science exhibits (Page). These include:

- Graham Foundation for Advanced Studies in the Fine Arts
- Kansas Humanities Council
- National Science Foundation: Informal Science Education Grant
- Institute of Museum and Library Services Grants
- Kansas Department of Commerce (Tourism Division)
    - ❖ Attraction Development Grant
    - ❖ Tourism Marketing Grant

Each of the above grants has numerous requirements that must be satisfied before approval and after reception of the grant. The grant process for each includes a detailed grant application on why the Discovery Center should be considered for the grant, and how the funds would be allocated once the grant is received. Also, private donations or personal endowments may become available with the opening and publicity of the Discovery Center. Interest must be fostered in the surrounding community in order for funds to materialize.

The long-term success of the Discovery Center will be guaranteed with the collaboration of local organizations and businesses. The organization that would most likely be a perfect fit

would be the Audubon of Kansas society. The Audubon of Kansas society has over 5,000 members, and several thousand dollars of grant possibilities through the local chapters. The Northern Flint Hills Audubon Society would be extremely interested in creating small-scale projects, displays, or providing funding to the Discovery Center. There also exists a substantial possibility of future endowment if the interest of the members of the Northern Flint Hills Audubon Society is piqued (Yeager). There are several other local chapters of the Audubon of Kansas that are located in the Flint Hills that are interested in supporting the Discovery Center. These include:

- Burroughs Audubon Society (Kansas City, MO)
- Jayhawk Audubon Society (Lawrence, KS)
- Smoky Hill Audubon Society (Salina, KS)
- Topeka Audubon Society (Topeka, KS)

D. Education and Programming

1. Introduction

Programming is a vital part of any well-run museum or center because it draws the community in by acting as a learner, teacher and worker at the facility. Many people have misconstrued ideas about science or about certain science theories. Most people do not know how to apply science to daily living and some are even scared of it. This is where the Discovery Center's programs come in. They provide the information, materials and educational goal for the participants to experience with hands-on lessons. "There is plenty of evidence that our abilities to see and understand–which are closely linked–develop from infancy by actively handling and interacting with objects. Also, by playing games, and accepting challenges of new possibilities" (Why Are Hands). There is a need for a variety of ways to connect to each individual to show them how their life can benefit from the tallgrass prairie. The mission statement directly

acknowledges this need by “Inspiring people to celebrate, explore and care for the Flint Hills”. Looking at various programming there are these three areas of focus. The first area includes programs that are linked to current or past research in the area, next are programs with a specific focus on education, and finally, those with the goal to bring together the community by community-based programs. Programming also meets many of the needs of the vision statement. It will be flexible in its response to the needs of the public. It will provide the sense of ownership through volunteer and program design by the community. It also has the potential to bring in money to drive down the need of taxpayer money. These are just a few of the visions that it addresses.

2. Research-based

Research-based programs work with current research, or may look into minor research of its own. Research-based programs may link to educational-based programming, but there is a clear focus of research goals or research influence that makes the program fall under the research category. The importance in linking to research is to create partnerships, especially that of Kansas State University. It creates opportunities in funding and exhibits, and adds credibility to the true scientific focus of the Discovery Center. The Discovery Center is a key part in the vision by “developing continuously changing exhibits and programs that are based on the latest and best scholarship and research” (Flint Hills Discovery Center Comprehensive Master Plan).

Kansas’ climate is a topic that could be used for a research-based workshop working with the research program called RaMP (Rainfall Manipulation Plot) out at Konza Prairie. This research program involves precipitation, which is one of the two key factors of climate. A rainout shelter is where the research is done on the timing of precipitation. The researchers look at the effects on vegetation and soil by varying the timing of rainfall (Fay).

A family-friendly design to research-based programming would assure each family member's undivided learning time and bring in more participation, but a children's research-based program should be offered at the same time. The children will learn about precipitation and temperature by conducting experiments such as "Making It Rain" and "Making a Thermometer" (Wicker).

The Discovery Center would benefit from a partnership with Kansas State University's College of Education. The college could help by supplying volunteers and implementing the program (and possibly helping in the design). The Discovery Center aids college students by offering experience working with children. Contact the science methods instructor Bette Grauer (785-532-6757 or 620-245-6545 (cell) grauerb@ksu.edu) to set up this partnership.

Various grants are available for specific programming focus. When considering the research-based programs, the Science Education Partnership Award (SEPA) program funds innovative educational programs. "Such projects create partnerships among biomedical and clinical researchers and K-12 teachers and schools, museums and science centers, media experts, and other educational organizations." (West Virginia). This grant would be ideal for a research based program on water quality and its environmental impacts. Water quality is always a pertinent issue especially for our future well-being.

Programming costs such as technology and kitchen appliances will not be included in any estimates due to the assumption they will be built into the center. Also, cost elimination is possible through donations or community assistance by collection of materials for any and all programming. Costs of supplies for programs focusing on research may include:

- Advertising costs
- Possible transportation costs
- Art supplies
- Chemicals such as rubbing alcohol

- Various testing subjects like food

3. Educational-based

This programming may include after school programs, workshops, or demonstrations; anything that has a specific learning goal for its audience and is conducted in a manner so interest is stimulated. Unique hands-on experiments will aid these programs significantly. Programs should be designed for all ages and specifically designed for the age of the audience. This will set it apart from community-based programming by addressing the specific needs of an age group. It is important to develop exhibits and programs that authentic and interesting (Flint Hills Discovery Center Master Plan). Education and research can often be tied together but many programs that are based on exhibits will not have current research for backing. The "Wind People" exhibit is meant to show "graphic images and reproduction bison draw visitors into this topical area to explore the importance of bison to the tallgrass prairie ecosystem and to regional Native Americans" (Flint Hills Discovery Center Master Plan). This is to educate the public and is not calling for further research, so an educational program design would complement this exhibit. The exhibits will have a lot to show on prairie life; making it a topic for programming including hands-on opportunities or actions to enhance what the audience sees in the exhibits.

"Kinder Nature" provides a program for very young children where the audience goes on a hike to look for shapes on the prairie in birds, bugs and all animals they see, as well as the food source and shelter different animals use (Kinder Nature). It could be held at Konza Prairie The "Wide Horizons Nature Program" is a class offered at Manhattan High School that designs and gives presentations to local schools and would be a wonderful partner for educational-based programming.

Another class, called “Botany”, should be designed for high school students and focus on the grasses and plants of the prairie. There is currently no botany class offered at Kansas State University due to lack of instructors. The UFM allows anyone to apply to set up a class and deliver it and would be a partnership with opportunities in locations and funding ((785) 539-8763, or e-mail at info@tryufm.org). Another source of funding is the “Lorrie Otto Seeds for Education”. It is a grant set up specifically for projects that focus on the enhancement, development, and appreciation for nature using native plants and has a high level of student involvement (Wild Ones). The “Botany” class will use the Flint Hills prairie as a main source of hands-on education, and use community members with extensive knowledge on botany of the prairie as instructors.

Supplies and costs for these programs include:

- Art supplies
- Microscopes and other lab materials
- Transportation
- Possible additional Botany class materials

4. Community-based

These programs may be festivals, a day of activity, campouts, or rare programming like “yoga under the stars”. This type of programming is all about the community and meets a variety of needs. “It celebrates the diversity and depth of people’s experiences in the region and reaches out to and welcomes every member of the community” (Flint Hills Discovery Center Comprehensive Master Plan). The Discovery Center should host an event called “Prairie Bonanza” and inspire the community to be involved with the projects, research, and education. Establish the institution as a leader in the connection between the Flint Hills and the community. Showcase the Discovery Center exhibits and build the fair around the themes they set up. Provide the community the opportunity to establish an identity as a prairie community and drive

that sense of ownership (Flint Hills Discovery Center Comprehensive Master Plan). Community-based programming is more than educational programming because the surrounding areas as a whole are being addressed. And while research may be a part of the program event, the focus tends to be on involvement and what the community desires, more than the outcome of a research project. The idea for Prairie Bonanza stems from Earthplace where they host a Green Earth Fair (Earthplace). When planning this event, tie in a community group for support and provide that group with something in return to show dedication to community involvement and support that flows both in and out of the Center. Supplies needed for the fair that should focus on the exhibits in place at the Discovery Center include:

- Children's Craft booths
- Live small prairie animals
- Skins, bones of animals
- Art booths
- Discovery Center information
- Food vendors
- Recycling and waste containers
- Announcer's stage

5. Archeology

Archeology is the study of past cultures based on what they leave behind. For the Flint Hills, this primarily includes studying tools and remains of pottery. People have lived in the Flint Hills for more than 13,500 years. They used chert, also known as flint, until it was replaced by metal in the 16th century brought by French and Spanich traders (Drass, Ritterbush). The Paleoindian Period was from 13,500 to 8,000 years ago. These nomadic hunters and gathers traveled long distances for stones, food, and water. There are identified by the type of spear points they made. From 8,000 to 2,000 years ago was the Archaic Period. During this period, people continued to hunt and gather. They used chert to make tools such as knives, gouges, and different kinds of spear points. They also began firing clay objects as well. From 2,000 to 500

years ago was the Ceramic Period. During this period, people made base camps, started cultivating crops, and using bows and arrows.

With this said, Prehistoric-Plains people heavily relied on chipped chert for tools. It is hard and can be chipped or flaked to form a sharp edge. These stones were chipped into many different styles of projectile points, knives, scrapers, drills, and other tools over thousands of years. This process is called flintknapping and was important to the culture of the people who inhabited the area.

6. Flintknapping

When considering how flintknapping could be incorporated into programming, it would be logical to have an experienced flintknapper show others how to flintknap. This would give them insight into the culture 500 to 13,500 years ago (Drass, Ritterbush). However, it is too dangerous to have inexperienced people try to learn the technique in large groups. This is due to flying sparks from the chert, and the chance of cutting your hand. In addition, it is also a difficult technique to perform and results in participants often become frustrated. Experienced flintknappers can be contacted through the Kansas State Historical Society (Ritterbush).

7. Archeology Programming

The most preferred type of programming for archeology education is to do hands-on activities (Ritterbush). In addition, Bob Workman stated that this would be ideal implement partnerships (Workman). This could include activities the Kansas Anthropological Association (KAA) facilitates (Kansas Historical Society). Their outreach programs include sharing stories of artifacts at elementary schools, artifact identification days, ceramic decoration, and field school courses (Kansas Anthropological Association Newsletter). Hands-on activities involving artifacts from the Flint Hills would allow participants to get a sense of how people lived and the tools

they used. A majority of youth also prefer this type of activity over a lecture or a movie (Youth Survey). The drawback is participants become more focused on the object being shared rather than the culture of the people from which the artifacts originated (Ritterbush).

8. Archeology Funding Sources

Possible funding sources include the National Endowment for the Humanities (NEH), Kansas Humanities Council, and Kansas State Historical Society (National Endowment for the Humanities, Kansas Humanities Council). NEH is an independent grant-making agency of the United States government that supports research, education, preservation, and public programs in the humanities (National Endowment for the Humanities). Their "Challenge Grant" is the most applicable to the purpose of the Flint Hills Discovery Center (National Endowment for the Humanities). The Kansas Humanities Council creates, sponsors, and promotes humanities programs across Kansas (Kansas Humanities Council). Heritage Grants within the Kansas Humanities Council would be most ideal for outreach programs. These grants are intended to connect people with ideas and to support projects that engage people with the humanities (Kansas Humanities Council). The Heritage Trust Fund of the Kansas State Historical Society could provide opportunities for funding as well (Heritage Trust Fund).

9. Programming Conclusion

Programming is an important piece of the Discovery Center and its mission. This Discovery Center should showcase the exhibits through educational programming and use volunteer partnerships and simple events and projects that draw on programs already in place, such as research. Community involvement is one of the most important objectives, therefore programming should be well organized and one of the top priorities of the Discovery Center.

VII. Conclusion

This project has allowed us gain an understanding of the Flint Hills Discovery Center. The Discovery Center will be a valuable asset to the local and state community. It will serve to educate and involve citizens; it will encourage tourism and community spirit.

In addition, this project has enabled us to see how the Discovery Center can be improved. Several proposals for exhibits and programs have been discussed in this report to help the Discovery Center be more successful in meeting the needs of the community. Each proposal gives individualized ideas the Flint Hills Discovery Center can use and benefit from. They are only a small sample of the ideas Kansas State University has to offer from its many departments and disciplines. The university can aid the Discovery Center in achieving its goals. This would not only increase and enhance the university's image among local and visiting citizens, but allow the university to have students involved with public education and outreach. We hope this project will serve as a starting point for a formal discussion and planning regarding a partnership between the university and the Discovery Center.

Appendix

Research-based Detailed Programs

One option is to provide a series of workshops on Saturday mornings. Begin this by setting up a monthly theme that all activities are based on for that month. Decide the basic factors like the age group to involve and the people implementing the programs. An example will be the month of May and the theme Kansas Climate. Now every Saturday in May the workshop topics will be related to Kansas Climate. A workshop will be designed where adults, ages 16 and up, can work with the research program called RaMP (Rainfall Manipulation Plot) at Konza Prairie. This research program involves precipitation, which is one of the two key factors of climate. The workshop participants will set up the basic project. This involves constructing a rainout shelter where research is done on the timing of precipitation. The participants will look at the effects on vegetation and soil from varying the timing of rainfall. (Fay) They will talk with researchers on their findings and discuss future activities. The participants will have a handout on the goals and procedures of the study to reference during future workshops. Since this is a research based program, after learning the basics, the participants would be doing research on their own.

Meanwhile, there will be a children's workshop occurring at the same time, encouraging a family friendly design, but allowing each age group independent learning time. The children's workshop will focus on the same theme, Kansas Climate, but the children will learn first about precipitation and temperature, our two factors of climate. This workshop is best for children ages 7-10. Before the hands-on experiments, the instructor will discuss climate factors with the children, using lots of questions and pictures. The experiments the children will do with the aid of the teachers include "making it rain." In this experiment, using water and ice, we create

moisture inside a jar and can see the water droplets. This is the same thing that happens in the atmosphere. Warm, moist air rises and meets colder air high in the atmosphere. The water vapor condenses and forms precipitation that falls to the ground. The second experiment is about temperature. It uses alcohol and water in a bottle covered with straw. As the two liquids mix, it expands as it warms. This makes the mixture no longer able to fit in the bottom of the bottle. As the alcohol expands, the colored mixture moves up through the straw. If the bottle were to get extremely hot, the mixture would come up through the top of the straw. This resembles a thermometer. (Wicker) The other children's workshops for the month would deal with global climate change, comparing climates to other parts of the world, and understanding the difference between climate and weather.

Figure 15: Bottle Program.
Taken from http://i.ehow.com

Education-based Detailed Programs

The first example is for the very young learner, preschool and kindergarten and their parents. This example comes from a site called Kinder Nature. The class is designed as a hike to look for certain things on the prairie. The kids will need to cut out shapes before they start the hike. They will look for different shapes in prairie plants, animals and more. As they go on the hike and look for shapes, the instructors will point out birds, bugs and animals as well as the food sources and shelters that different animals use. (Kinder Nature)

Another class can be designed toward high school students and would focus on the grasses and plants of the prairie, Botany. This Botany class should be constructed in a way that the students will use the prairie as their classroom, finding and identifying species on the prairie and breaking down the parts of plants using simple equipment.

Community-based Detailed Programs

Our example is a fair, called Prairie Bonanza that will last for half a day. The idea stems from Earthplace (http://www.earthplace.org/calendar/index.html) where they host a Green Earth Fair. For the fair, we will need crafts to entertain the children. Prairie grass art is a simple and fun way to draw attention to the prairie grass species. The kids can glue designs or try to weave bracelets and then have a fun test of their knowledge of the grasses they used to make the art. Also we need to bring awareness to the animals of the prairie. Bison and birds may be difficult to bring in, but a live species like a turtle or frog would draw their interest. Also to help educate about animals, have pelts or bones for the children to touch. This is all about bringing awareness and knowledge of the prairie. Use an exhibit's theme, like birds of the prairie and have the children listen to the sounds and match that to the bird. Have information readily available about the programs you are offering at the center. Choose vendors that would help support the Discovery Center or show an interest in the prairie. Think about art, recycling on the prairie, restoration of the prairie, research on the prairie, etc. Visitors will also want food and drink, so keep sustainable practices in mind and minimize your waste and offer recycling!

If we look at placing this event downtown it will bring in people to those businesses and they may be willing to help support your event. Use the local sponsors. Placing it close to shops and eating establishments will limit what you need to provide which is a good thing for a low budget. This way the vendors you bring in can be unique and offer things the town does not see. Partner with an organization or local group like the Sunset Zoo where the zoo can have the opportunity to help you. The Discovery Center can offer a partnership in programming at the zoo in return. This will help build an image of cooperation and care for the community.

Works Cited

Bidwell, T., Fuhlendorf, S., Harmon, S., Horton, R., Manes, R., Rodgers, R., Sherrod, R., Wolfe, D., Ecology and management of the greater prairie-chicken in Oklahoma. n.d. 21 Apr. 2010. http://www.okrangelandswest.okstate.edu

Biotic Regions in Kansas. University of Kansas. n.d. 15 Apr. 2010. http://www.ksr.ku.edu/libres/mammals_of_kansas/regions.html

Blair, John. "Long-term Research on Grassland Dynamics at the Konza Prairie Biological Station." Kansas State University, Manhattan, KS. Feb. 16 2010. Guest Lecture.

Briggs, John M. et al. "Interactive Effects of Fire, Bison Grazing and Plant Composition in Tallgrass Prairie." *American Midland Naturalist*. 129. 1(1993): 10-18.

Briggs, John M. "The Konza Prairie Biological Station." Kansas State University, Manhattan, KS. 26 Feb. 2010. Guest lecture.

Butcher, G.S., Niven, D. K. Combining Data from the Christmas bird count and the breeding bird survey to determine the continental status and trends of North America birds. National Audubon Society, New York, NY. 2007. 21 Apr. 2010. http://www.audubon.org/birds/stateofthe birds

Butcher, G.S., Niven, D. K., Panjabi, A.O., Pashley, D.N., Rosenberg, K.V. The 2007 watchlist for United States Birds. The National Audubon Institute. 2007. 21 Apr. 2010. http://www.audubon.org/news/pressroom/WatchList2007

Caldwell, Jeff. "Mammals shown to affect prairie's entire ecosystem." Jun. 2002. 18 Apr. 2010. www.k-state.edu

Clifton, A.M., Krementz D.G., 2006. Estimating numbers of greater prairie-chickens using mark-resight techniques. The Journal of Wildlife Management. 70.2. 479-484

Craine, Joseph M. et al. "Consequences of Climate Variability for the Performance of Bison in Tallgrasss Prairie." *Global Change Biology*. 15. 3(2008): 772-779.

Earthplace. The Nature Discovery Center Calendar of Events. n.d. 19 Apr. 2010. http://www.earthplace.org/calendar/index.html

Drass, Mary. "Florence-A Chert." Oklahoma Univiersity. n.d. 17 Apr. 2010. http://www.ou.edu/cas/archsur

Fay, Philip A.; Carlisle, Jonathan D.; Knapp, Alan K.; Blair, John M.; Collins, Scott L. "Altering Rainfall Timing and Quantity in a Mesic Grassland Ecosystem: Design and Performance of Rainfall Manipulation Shelters." *Ecosystems* 3.3 (2000): 308-319.

"Flint Hills Discovery Center Comprehensive Master Plan." n.d. 28 Apr. 2009. http://www.ci.manhattan.ks.us/

Gibson, David J., and Lloyd C. Hulbert. "Effects of Fire, Topography and Year-to Year Climatic Variation on Species Composition in Tallgrass Prairie." *Vegetatio*. 72. 3(1987): 175-185.

Heritage Trust Fund. Kansas State Historical Society. n.d. 30 Mar. 2010. http://www.kshs.org/resource

Johnsgaurd, P.A. 2002. Grassland grouse and their conservation. Smithsonian Institution Press, Washington, D.C., USA.

Johnson, Loretta. "Ecological Consequences of Juniper Expansion into Midwest Grasslands." Kansas State University, Manhattan, KS. 25 Mar. 2010. Guest Lecture.

Kansas Anthropological Association Newsletter. 22.1 Jan 2010.

Kinder Nature. Life on the Prairie. Story County Conservation Board, 2004. Apr. 19 2010. http://kindernature.storycounty.com

Kansas Historical Society. Interview by Kate Glanville. 29 Apr. 2010.

Kansas Humanities Council. 2006. 30 Mar. 2010. http://www.kansashumanities.org/

Kings Creek Konza Prairie. 2009. 18 Apr.2010 http://www.jkchang.com

Konza Environmental Education Program. 16 Feb. 2010. 18 Apr. 2010. http://keep.konza.ksu.edu

Konza Prairie Biological Station. 2010. 18 Apr. 2010. http://www.kpbs.konza.ksu.edu

Lisa Grossman. 2004. 18 Apr. 2010. http://www.lawrenceartscenter.com

Location and Habitats. Konza Prairie Biological Station. n.d. 15 Apr. 2010. http://kpbs.konza.ksu.edu/location.html

McLauchlan, Kendra K. "The Flint Hills Grasslands: Two Biogeographic Projects." Kansas State University, Manhattan, KS. 23 Feb. 2010. Guest Lecture.

Migration of birds, routes of migration. Aug. 3, 2006. 22 Apr. 2010. http://www.npwrc.usgs.gov/resource/birds

National Endowment for the Humanities. n.d. 30 Mar. 2010. www.neh.gov

Owensby, Clenton E. "Grazing Stockers in Tallgrass Prairie." Kansas State University, Manhattan, KS. 30 Mar. 2010. Guest Lecture.

Page, Beverly. Personal Interview by Luke Massoth. 24 Mar. 2010.

Preserve. n.d. 21 Apr 2010. http://flinthillsofkansas.blogspot.com

Ritter, Michael E. The Physical Environment: an Introduction to Physical Geography. University of Wisconsin: Stevens Point. 2006. 12 Apr. 2010. http://www.uwsp.edu/geo/faculty/ritter

Ritterbush, Lauren. Personal Interview by Kate Glanville. 22 Mar 2010.

Smith, Bill. Flint Hills of Kansas. Dr. Bill Smith, 18 Apr. 2008 Prairie National http://flinthillsofkansas.blogspot.com

Tallgrass Prairie National Preserve. National Park Service U.S. Department of the Interior. 26 Apr. 2010. 29 Apr. 2010. www.nps.gov/tapr

The Cornell Lab of Ornithology. 2010. 26 Apr. 2010. http://www.birds.cornell.edu/netcommunity

The Lesser Prairie Chicken. Sep. 1999. 21 Apr. 2010. ftp://ftp-fc.sc.egov.usda.gov

The Nature Conservancy. 2010. 18 Apr. 2010. http://www.nature.org

USDA National Resources Conservation Services. Sep. 1999. 26 Apr. 2010.**Error! Hyperlink reference not valid.**

West Virginia Health Sciences and Technology Academy (HSTA) Student Design Public Health Clinical Trials. Science Education Partnership Award. National Center for Research Resources, 2 Mar. 2010. 19 Apr. 2010. http://www.ncrrsepa.org

Why are hands-on science centers needed? The Exploratory, 2000. 19 Apr. 2010. http://www.exploratory.org.uk/philosophy

Wicker, Crystal. Make it Rain. Weather Wiz Kids. 2010. 19 Apr. 2010. http://www.weatherwizkids.com/experiments

Wild Ones. The Lorrie Otto Seeds for Education Grant Program. Seeds for Education-Grants for School Gardens and Community Nature Areas, 2009. 19 Apr. 2010.http://www.for-wild.org/seedmony.html

Workman, Bob. Personal Interview. 9 Feb. 2010.

Yeager, Patricia. Personal Interview by Luke Massoth. 27 Mar. 2010.

Youth Survey. Personal Interviews by Kate Glanville. 24 Mar. 2010.

With, K.A., King, A.W., Jensen,W.E. 2008. Remaining large grasslands may bit be sufficient to prevent grassland bird declines. Biological Conservation.141. 3152-3167.