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ELEMENTARY EDUCATORS RESOURCE GUIDE
TO HERPETOLOGY IN MINNESOTA BRIDGING THE GAP
BETWEEN THE CLASSROOM AND NATURE CENTER EXPERIENCE

by

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A capstone submitted in partial fulfillment of the requirements for the degree of
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CHAPTER ONE

Introduction

Inspiration and Motivation

When I first started down my career path as an interpretive naturalist, I did not think that snakes would be the topic that I most enjoyed. My love of snakes began when I was an environmental education intern and was offered the opportunity to hold a six-foot-long Gophersnake. The other interns were apprehensive so I volunteered to be first. He hissed at me as I was told to expect from this particular snake, but otherwise snake handling was not such a big deal. The big snake curled around so I could hold him in both of my arms and feel his cool scales slithering across my skin. I felt my mind go quiet as I focused on supporting this incredible animal. Eight years later and now I am the one coaxing snakes into the hands of new naturalists and watching their eyes light up. I firmly believe that an enthusiastic and openly comfortable educator handling a live animal provides the perfect scenario for fostering new learning opportunities and making unforgettable memories.

Elementary schools lacking access to a nearby nature center or similar environmental education resource have few options for interpretation centered on reptiles and amphibians. Formalized classroom settings often do not allow for much time outside during the school day as educators strive to adhere to state standards. In contrast, environmental educators such as naturalists and park interpreters develop flexible, outdoor activities for students which can easily include themes of reptiles and amphibians. This juxtaposition seemed like an opportunity for information sharing that could result in adaptable, fun curriculum that is useful both indoors and

out. I set out to investigate *how can I create an elementary educator resource guide to herpetology in Minnesota bridging the gap between the classroom and nature center experience?*

The activities and games collected in the resulting resource guide can easily be adapted to fulfill state standards and allow educators to take their lessons outside. This resource guide aims to supplement existing curriculum while adhering to Minnesota's science standards to make lesson planning easier. Formal educators would benefit from this collection of resources when choosing new activities to develop into classroom curriculum about reptiles and amphibians.

In this first chapter, I will describe the rationale and context for using this curriculum in elementary schools across the state of Minnesota. The primary goal for this resource guide is to improve educator and student accessibility to engaging environmental education opportunities through herpetology (the study of reptiles and amphibians). It is intended for elementary educators throughout the state of Minnesota and nearby Midwestern states with similar biomes, ecosystems, and species represented. Finally, I share my personal inspiration that motivates the development of this project. Much of my motivation comes from the people and experiences that have inspired my interest in environmental education, animal care, and herpetology.

Rationale

Many nature centers have a variety of native reptiles and amphibians for students to meet and maybe even learn how to handle safely under direction from an interpreter. Unfortunately, not all classrooms have easy access to such a resource where they can interact with live animals. When live animals are not available, educators should have options for activities and lessons that can be experienced without assistance from a nature center. This resource guide provides environmental education activities, games, and supplemental materials that could be adapted for a school forest, backyard, or local park.

When the opportunities for students are available, having facilitated, hands-on experiences with ambassador animals can begin to foster a deep bond with nature and create inspiration for future environmental stewards. Ambassador animals live in captive conditions under human care so that they can be better understood, demonstrate wild behaviors, display physical adaptations, and represent their wild counterparts (International Wolf Center, 2018). From my experience as a naturalist, the programs where I have been interpreting with live ambassador animals have been some of the most memorable ones according to student comments during and after their field trips. My personal interest in educating with ambassador animals has motivated me to investigate environmental education activities that can be taught in flexible settings. It made me wonder: *how can I create an elementary educator resource guide on herpetology in Minnesota bridging the gap between the classroom and nature center experience?* Investigation of this question culminated in a resource guide of activities, games, and various other curriculum components for educators to use in a diverse array of teaching settings. My hope is that this resource guide provides interesting and engaging options for educators who are developing their own herpetology-themed curriculum. It includes opportunities for educating through inquiry (a teaching method based on student-developed questioning and exploration of concepts) and creating personal experiences. Some of the activities help to foster better understanding and eventual empathy towards reptiles and amphibians. It has been shown that a child's animal-directed empathy can be generalized to human-directed empathy (Ascione, 1996). Finally, these resources share the goal of changing or improving students' attitudes and perceptions about reptiles, amphibians, and the study of herpetology. I want to stress supplementing these activities with direct animal interactions for your students that are facilitated by an environmental educator. Possibilities for free or

inexpensive interpretive programming with live animals could include local nature centers, state park interpretive centers, or local volunteer organizations such as a herpetological society.

Herpetology is an area often overlooked by educators. Myths of reptiles and amphibians being slimy and unpleasant may be a factor influencing some educators' avoidance of herpetology. However, I believe that reptiles and amphibians (particularly snakes as they are so easy to care for) should be staple interpretation animals for educators in classrooms and nature centers alike. Most native reptiles and amphibians require relatively simple care as classroom pets or as captive ambassador animals for interpretive programs. Additionally, there are programs to assist teachers in adopting reptiles and amphibians as classroom pets. The Minnesota Herpetology Society is one such adoption program which also provides basic education on the animal's care. A new classroom pet is an educational opportunity for both the teacher and students to research their new companion and better understand its needs.

Whether a classroom is discovering herpetology through the daily care of a classroom pet or through visiting ambassador animals at their local nature center, I advocate for studying and interacting with these fascinating creatures. Reptiles and amphibians can be examples for teaching many scientific principles. Students can compare and contrast amphibian and reptile life cycles, study food webs, or learn about the ecological needs of herpetofauna in their native habitats. The first Painted Turtles basking in the sun from on a submerged log or the first Chorus Frog mating calls to be heard over the everyday sounds of the city show us signs of the seasons changing. Paying close attention to these signs helps to teach observation skills and train students to use their eyes and ears to notice some of the first events of spring. These can herald an exploration into the cycle of seasons. An educator-guided expedition into a school garden, a

nearby forest, or even a student's own backyard provides ample opportunities for improving observation skills, focusing the senses, and calming minds while challenging established myths.

Closely observing a live animal creates a great opportunity for inquiry learning and building knowledge from experience. There are so many stories that spread myths and misconceptions by telling students what they should think even before they have established their own experiences. Before touching any live animals students will try to describe to me how all reptiles are cold, slimy, or creepy. I have observed many students who do not even know the difference between a salamander and a lizard. They sometimes assume that salamanders are not an amphibian at all. Knowledge of physical characteristics for reptiles and amphibians can be learned through observation and comparison of live animals. Students can connect their prior knowledge with the observations that they are making from a live animal interaction. This educator-facilitated discussion may also be a good way to determine what your students think they know, what knowledge is accurate, and what opinions and attitudes they hold towards reptiles and amphibians.

Goals For An Adaptable Elementary Educator Resource Guide

Whenever I see a student's face beaming while they carefully handle a live animal it feels like they are creating a special memory. Most people remember the first time they ever held a snake. Sometimes they can even describe the color, pattern, or texture of the snake's scales many years after the experience. I want to pursue this project to create more of these special memories. I want to learn about how these hands-on, unique experiences with environmental education animals foster empathy towards animals and humans.

Even a small level of empathy for herpetofauna would be a drastic improvement over the predominantly negative attitudes displayed towards these animals. In my opinion, it seems so

many people are deathly afraid of snakes and would rather hit one with a shovel than leave it alone to fulfill its ecological duties. Such graphic, violent fear prevents the possibility of new learning. Sensational stories of encounters with snakes only inspire more people to react adversely to snakes and other herpetofauna. I have seen too many photos of dead, mangled snakes on Facebook identification groups that turned out to be harmless and beneficial.

This curriculum project aims to help improve the reputation of reptiles and amphibians. Hopefully improved knowledge and observation of these animals will lead to fewer of them dying unnecessarily by human hands and uninformed decisions. As educators it is our job to dispel myths and prevent the spread of misinformation. We can teach students about the important roles that these animals play in their ecosystem and corresponding food webs. Ultimately students will benefit greatly from a good interpreter who is able to narrate relatable analogies that foster meaningful and empathetic connections. One of my goals is to fill this need for adaptable curriculum activities that can bridge the gap between enthusiastic interpreters at nature centers and the students learning in their classrooms, school forests, and backyards. Through improving public educational opportunities and bringing more hands-on animal experiences to elementary students I hope to make that goal a reality. This resource guide is influenced by the recurring theme of developing a student's connection with nature in hopes of inspiring these future environmental stewards to be ecologically aware of herpetofauna. Personal connections to specific natural spaces can foster a desire to conserve these special places.

My connection to specific natural spaces in Minnesota has been built through personal experiences working with local nature centers, the Minnesota Herpetological Society, the Minnesota Department of Natural Resources, and the Minnesota Naturalists Association. Sharing my ideas for the creation of this project led me to talking with other educators and herpetologists

in these organizations. I collected resources to share with educators across Minnesota in hopes of inspiring more herpetology programs for elementary students.

Games and activities seemed like the best fit to practice illustration of ecological themes in herpetology. They allow students to roleplay animals to practice empathetic attitudes towards both animals and their fellow students. There are even suggestions for citizen science opportunities in this resource guide as a way to connect older elementary students to social action and build more in-depth curriculum projects. Student involvement in citizen science projects can improve understanding of herpetofauna and contribute to scientific data collection. By finding, photographing, and sometimes carefully measuring wild herpetofauna, students will contribute data that is used by real researchers and wildlife conservationists. Additionally, the longer activities in the resource guide are able to address multiple state science standards as a way to make these outside activities relevant to classroom teachers.

Illustrating how science standards can be addressed through these activities builds a connection between the lessons taught at nature centers and those taught in the elementary classroom. Looking at the curriculum-based activities used at nature centers where I have taught and comparing them to source materials in Project WET, Project WILD, and similar activity guides has helped me to formulate ideas for my own program formats. During my various experiences as a naturalist I have collected ideas for adaptable games and activities able to fit herpetology themes. Nature centers tend to keep activities low-budget, low-maintenance, and highly adaptable. Each of these activities are flexible in some way to adapt for unique settings from gymnasiums or playgrounds to school forests or local parks. The aim of the games and activities, whether implemented inside or outside, is to provide inquiry and experiential learning opportunities, foster empathy development through interactions with animals, and hopefully

improve student attitudes and perceptions of herpetofauna. My personal experiences with environmental education have culminated in an empathetic approach to facilitated interactions with live animals.

Personal Journey from Curious Student to Environmental Educator

As a child I dreamed of becoming a wildlife veterinarian, but during college that focus shifted to environmental education. This shift was largely influenced by an internship opportunity with a local nature center. The perks of being a naturalist encompassed exploring with students outdoors in all weather conditions, learning or observing something new almost every day, and caring for ambassador animals. Those ambassador animals included reptiles, amphibians, birds of prey, and farm animals. The animal care coordinator at the nature center was incredibly passionate about not only having a diversity of native animals in our programs, but also ensuring that kids had opportunities to touch and observe these animals up close. Ultimately, the passion of my naturalist role models won me over. During the past eight years I have been a naturalist I have volunteered frequently for hands-on opportunities to teach with ambassador animals even outside of work. It seemed like hands-on programs tended to lead to more student engagement and inquiry-focused questioning, especially when snakes were involved.

If only it was possible to show more classroom teachers and naturalists how much of a positive impact that hands-on animal programs can have for students. Snakes are relatively easy to care for and could feasibly be used as educational animals in more classrooms. One of the original inspirations for this curriculum project came from tracking public program attendance while working as a seasonal naturalist with the Minnesota Department of Natural Resources. That summer, every program that I presented with a snake theme drew in dramatically more

visitors than programs with other natural history themes. During a typical two hour program where I interpreted at my snake-themed nature cart with a live Western Foxsnake, I interacted with about 200 visitors (compared to only 40 visitors for an animal skull nature cart). The snake nature cart consisted of a small display tank depicting an example habitat, real shed snake skins to touch, snake finger puppets, information sheets on the species of snakes that could be found in the state park, and the live snake that I held in my hands for visitors to touch. Nearby, I had snake-themed crafts that seemed to appeal to visitors of all ages. Even adults joined their children to craft and color. Collectively, it created a welcoming environment around the visitor center fireplace. Visitors could choose to approach my table where I held a young adult, three-foot-long Western Foxsnake, or start off with some crafts while they mustered up the courage to take a closer look or even touch the live snake. Visitors approached me with an array of emotions. Some cringed visibly and said “yuck” while others seemed eager to touch. One of the most meaningful moments to me was when a toddler’s courage to touch the snake convinced an apprehensive adult to do the same. Whenever I have these incredibly fulfilling, engaging moments during my teaching experiences, I am able to create stories that I can share with others to help them overcome their own fears and apprehensions. These memories have showed me that students and adults are capable of dramatically changing their opinions of snakes after meeting a friendly snake and enthusiastic interpreter.

A few interpreters in particular have influenced how I relate to reptiles and amphibians during environmental education programs. The animal care coordinator at one of my favorite nature center jobs shows her enthusiasm and passion for educating with live animals whenever she teaches programs. She was one of the first people I met that genuinely appreciated snakes.

She taught me how to handle the animals at the nature center respectfully and calmly, meanwhile sharing each ambassador animal's life history and ecology.

Another of my fellow naturalists often tells the story of how his parents used to be so afraid of snakes that they would kill them whenever they found them in their yard. As a child he would sneak snakes inside for "sleepovers" and learn more about them before releasing them back to the wild. After seeing their son's interest and curiosity piqued by these slithery serpents, his parents decided to leave the snakes in their yard alone or to safely move them out of the way rather than harm them. From his personal story, I learned to be compassionate of children's fear of snakes. I try to show them it is okay to be scared at first, but not okay to be so scared you want to kill anything that is different or hard to understand. We plant the seeds of empathy towards animals and other people through these interactions.

A third naturalist friend of mine interprets with a wide variety of live snakes and a few other reptiles and amphibians for her outreach programs around the greater Twin Cities area. She has a contagious enthusiasm for snakes. Students are frequently encouraged to hold snakes and observe them up close and personal at her programs. Students attending her programs are sometimes also invited to monthly meetings of the Minnesota Herpetological Society (MHS) where they can learn more about herpetology or even adopt herpetofauna as pets. She was one of the people who first invited me to attend MHS meetings which eventually led to my membership and increased involvement with the society.

As a non-profit organization, the mission of the Minnesota Herpetology Society is to educate the public in proper care of captive reptiles and amphibians. Additionally, the society seeks to educate the public on the ecological importance of herpetofauna and promote their conservation in the wild (Minnesota Herpetological Society, 2018). Members of the society have

proven to be a wealth of specialized knowledge. Many society members are also active volunteers seeking to fulfill the mission of public education often through hands-on public outreach programs with live animals. Students that are interested in herpetology may find the MHS monthly meetings to be a fun way to learn more about both native and exotic herpetofauna. Additionally, they can ask questions of experienced herp keepers and foster or adopt new animals surrendered to the society. The MHS represents a valuable learning resource for educators and students alike. Those that are truly interested in learning more about herpetology in Minnesota and around the world are highly encouraged to seek out organizations such as the MHS or other local herpetology societies.

My involvement with the MHS has helped satisfy a desire for lifelong learning opportunities. Over my first few years with the society I had increased my volunteerism and involvement, so I decided to run for election on the Board of Directors. After my first year on the board and networking with members, I decided to run for a named board position and became the Vice President. This meant a lot more responsibility, but also more of a voice in the direction that the society was heading. My hope is that the organization can help support Minnesota educators in providing resources for herpetology-themed curriculum by publishing this resource guide as a public document.

Summary

Snakes and other cold-blooded education animals inspired me throughout my career as a naturalist and ultimately led to my choice of this project. Informal environmental educators are constantly absorbing curriculum ideas from other nature centers to adapt for their own uses. Formal educators worry about meeting state standards and their students are lacking in time outdoors during their school day. Creating *an elementary educator resource guide to herpetology*

in Minnesota bridging the gap between the classroom and nature center experience crosses these two worlds of environmental education into one resource guide. It sets up the opportunity for information sharing and more widespread use of herpetology curriculum. Making the curriculum activities accessible to all schools, regardless of their amount of green space, allows educators to adapt these resources for their unique school setting. To further explore the guiding question behind this project I investigated studies on experiential and inquiry learning strategies, methods for interpreting with live animals to foster empathy development, and measurement of student attitudes and perceptions towards animals.

The chapters that follow detail research surrounding the rationale of this project, the process of creating the resource guide, and also discuss the author's learnings and future aspirations from the capstone journey. The supporting research is covered in the following chapter as a review of literature. Next, the author provides an explanation of how the project was completed, the intended audience, and the context within which the resources are intended. Finally, the author discusses conclusions of the research and project writing process. This includes highlights of the author's learnings, explores implications and limitations of the project, and recommends future research. The literature review follows.

CHAPTER TWO

Literature Review

Overview of Literature Review

To rationalize the need for an experiential learning and inquiry-based resource guide on herpetology in Minnesota, a review of literature follows. Inquiry and experiential learning are common teaching strategies in environmental education at nature centers. These educational methods teach students to guide their own learning through exploring topics that are interesting and engaging within a hands-on setting. Educating with animals is one method to interpret experiential learning to students and has the added benefit of fostering the growth of empathy towards animals and humans. The overarching goal of these types of environmental education programs and activities is to change and improve student attitudes and perceptions towards reptiles and amphibians. The author set out to investigate the rationale behind creating *an elementary educator resource guide to herpetology in Minnesota bridging the gap between the classroom and nature center experience*.

Importance & Benefits of Environmental Education

Environmental education holds countless benefits for a wide age range of students. Young children that are allowed time for free play and exploration in nature have better gross motor skill development and ability to assess risk. Children that spend more time out in green spaces tend to lead healthier, more physically active lives and have improved attention, mental health, and emotional regulation. Adults that spent more time outdoors as children tend to have

stronger ecological awareness, pro-environmental attitudes, and more connectedness to nature (Gill, 2014).

Environmental education fosters students' learning in how to become stewards of our planet's wellbeing. David Sobel (2013) defines ecophobia as being a fear of ecological problems, while the opposite is ecophilia, or fostering engagement in nature. If we want to grow environmental values in the next generation, then we have to nourish the human need for taking in natural experiences. Sobel reasons that environmental education should start as early as preschool with developmentally appropriate activities (Sobel, 2013). The National Association for the Education of Young Children defines developmentally appropriate practice as "matching the learning environment—the physical set-up, materials, schedule, curriculum, teaching methods and so forth—to the developmental levels of children." This reasons for supporting the learning of young children with activities appropriate to their cognitive, physical, and social development. (Minnesota Early Childhood Environmental Education Consortium, 2002). These earliest experiences in nature ought to create empathy for the environment as the foundational soil from which a meaningful relationship with nature can grow (Sobel, 2013). Sobel reasons that children seek out sensory experiences, not ecological themes, and their experiences should be appropriate to the child's developmental maturity. Because of this reasoning there should be a push back against the trend to rush students into learning about the world's countless ecological problems. Adults and educators lay too much on students' young shoulders too soon, even before they have established a foundation of empathy. "What's important is that children have an opportunity to bond with the natural world, to learn to love it and feel comfortable in it, before being asked to heal its wounds" (Sobel, 2013, p.13).

As an example of too much worry too soon, Sobel describes the common use of rainforests as a theme for early elementary curriculum. Electronic media is able to connect students to far away places and endangered species in the tropical rainforests, but leaves them disconnected from local ecosystems found in their own backyard. Developmentally, young elementary students are able to grasp the here and now as these are tangible concepts. Abstract and far away places that they have never been to in person are difficult to understand as these are intangible concepts. Starting off by teaching young students about the animals and plants of their own backyard helps to form the foundation for eventually understanding wider concepts such as rainforest ecosystems and endangered species (Sobel, 2013).

This culminates in the conceptual idea of waiting for cognitive development and personal experiences to accumulate before teaching abstract concepts. By this reasoning Sobel describes his personal, if unpopular opinion, that abstract mathematical concepts should be taught during later elementary grades after students have the cognitive development to better support learning intangible and abstract concepts. Along the same lines the ecological concepts of endangered species and deforestation of rainforests are not developmentally appropriate concepts for early elementary students (Sobel, 2013).

Sobel believes in three key stages in child development regarding their relationship with nature. These are early childhood from ages four to seven, elementary from ages eight to eleven, and early adolescence from ages twelve to fifteen. His recommendations are for an emphasis on local nature close to home during “early childhood” to focus on fostering empathy development with nature. He recommends investigating ecosystems around the world during the “elementary years” to focus on students’ innate desire for exploration. Lastly, expand learning about the

social importance of ecology by participation in citizen science or social action projects during “early adolescence” (Sobel, 2013).

Importance of Herpetofauna in Environmental Education

Ecologically reptiles and amphibians help maintain biodiversity within habitats and function in the middle of food chains as both predator and prey animals. Reptiles and amphibians make up forty-six percent of global species of terrestrial vertebrates, but suffer dramatically low representation in scientific research. In a review of literature for six wildlife research journals from 1980 to 2009 it was found that less than six percent of the journal articles addressed research on herpetofauna. Of those articles, 66% of them were published recently between 2000-2012. With approximately 4,800 species of amphibians and 7,500 species of reptiles described globally it seems like there should be greater representation in scientific research journals (Christoffel & Lepczyk, 2012).

This underrepresentation in research is unjustified when compared to the multitude of conservation issues that face herpetofauna. According to the Minnesota Department of Natural Resources herpetofauna face many factors contributing to population decline including road mortality, habitat loss and degradation, effects of climate change, spread of disease (such as Ranavirus and Chytrid fungus), increased pollution, and overuse of agricultural and backyard pesticides (MNDNR, 2018). The greatest factor contributing to declining herpetofauna populations and diversity is habitat loss and destruction (Moriarty & Hall, 2014). Alterations to habitats such as roads pose a great obstacle for many species. By helping a turtle across a road in the direction it was traveling you may very well save its life. Often turtles on the move are seeking new wetlands with the change of seasons, traveling to a nest site to lay eggs, or are newly hatched young on the move to find a permanent body of water to call home. Habitat loss

and fragmentation in fast growing urban areas has contributed to recent declines in particularly frog and toad populations (Moriarty & Hall, 2014). Herpetofauna deserve increased research and funding for conservation efforts to make up for historic underrepresentation.

Possible reasons for less research may be difficulty of finding herpetofauna with many species exhibiting nocturnal behavior, cryptic coloration, and relatively short active seasons within temperate regions of the world. Another reason may be the relatively low economic importance that herpetofauna represent and the ways in which funds are allocated to nongame wildlife management programs at least in the United States. In-depth study into the causes of global herpetofauna population declines would serve to inform more effective management and habitat conservation (Christoffel & Lepczyk, 2012).

Herpetofauna are sensitive bioindicators representative of ecosystem health. Health, diversity, and abundance of herpetofauna show the quality of both terrestrial and aquatic habitats. Having semi-permeable skin and a water-dependent life cycle makes amphibians highly sensitive to water quality and pollution, therefore making them excellent biological indicator species and valuable research subjects (MNDNR, 2018). For instance, frogs have permeable skin to help them breathe and lay their egg masses in or very near to fresh water sources. Tadpoles eat lots of algae as they are growing which helps to trap excess nutrients in wetlands. Herpetofauna in general are very good at converting their prey to biomass (MNDNR, 2018). By occupying the middle of the food chain they are often eaten by other herpetofauna, birds, fish, and mammals. Reptile eggs and amphibian larva provide a significant food source for many other animals as well (Christoffel & Lepczyk, 2012). Pollution bioaccumulates higher up into the local food chain. These herpetofauna tend to thrive best in clean, healthy habitats with good water quality and will occur in lower population abundance and species diversity if there are environmental

contaminants. Urban chemical pollution, coupled with habitat loss, may have factored into the disappearance of Spring Peepers from the Twin Cities metropolitan area of Minnesota (Moriarty & Hall, 2014, p.42).

Existence of particularly rare species can also indicate a valuable habitat that may be vital to other animal or plant species sensitive to disturbance. Locating rare herpetofauna species helps researchers identify habitats in critical need of conservation efforts (MNDNR, 2018). Many reptile and amphibian species would benefit from the future conservation efforts of a generation of students that are more aware of the ecological importance of their slithering, hopping, swimming and crawling neighbors.

Humane Education & Student Empathy Development

How do we feel empathy for an animal when we understand their feelings so little? The perspective of reptiles and amphibians is one that sparks curiosity in students. One begins to wonder how the world looks from the perspective of a snake slithering on its belly or how it feels to interpret vibrations rather than hearing with the assistance of external ears. Creative play during early childhood helps to create an emotional foundation for a child's relationship with nature. Stories, songs, animal roleplay, exploring signs of the season, and developing a sense of wonder are all important to help foster a childhood connection to nature. David Sobel (2014) believes that "the environmentally correct notion of not anthropomorphizing animals can be thrown right out the window." Children like to act out and become animals because they are relatable and spur their curiosity.

Humane education programs use a variety of teaching methods with the aim of promoting kindness and compassion towards animals. Much of the research by Frank Ascione focuses on how the prosocial behavior of child kindness and caring towards animals can be generalized to

human-directed empathy (Ascione, 1997). This form of moral education attempts to develop altruistic behavior in children during a time in their lives when they view the world very egocentrically. Humane education activities investigate or illustrate the needs of animals, empathy towards both humans and animals, respect for all forms of life, and interdependence of humans and animals. “Instilling, reinforcing, and enhancing young people’s knowledge, attitudes, and behavior toward the kind, compassionate, and responsible treatment of human and animal life are examples of shared components of most humane education programs” (Ascione, 1997). The hope is that teaching interspecies relationships and dependence will generalize to kindness and compassion in the way children treat each other.

Many different curriculum-blended approaches can be used to convey generalized humane education objectives. Humane education program methods vary greatly from reading animal-themed literature, direct interactions with pets and farm animals, visits to zoos and nature centers, and lessons on animal behavior (Ascione, 1997). Research has shown mixed results regarding the measurable effects on attitude change as a result of supplemental humane education programs. Studies often suffered from a lack of pretest data with which to compare posttest data, making interpretation of results problematic. Ascione decided that more accurate methods were needed to reliably test for the impacts of humane education programs while taking into account the quantity and quality of the program intervention. “We must be willing to expend the energy and resources to determine whether children who experience humane education in fact behave more kindly toward animals, act more responsibly in caring for pets, engage in cruelty less frequently, take action on behalf of threatened species, support habitat preservation for wildlife, and so forth” (Ascione, 1997).

Scott & Matthews (2012) observed students demonstrating possible development of empathetic thoughts towards herpetofauna encountered during a hands-on field program. Students asked to give the animal subjects names, asked whether they could be kept as pets, and talked to the animals during data collection. In investigating classroom pets, Daly & Suggs reflected that anthropomorphizing pets can help provide social support for their human caretakers (Daly & Suggs, 2010, p. 108). Naming an animal like a classroom pet or an animal found during a field-based education program may help students form a temporary bond with an animal and promote empathetic behaviors.

A chemical in our brains may be responsible for many of the positive effects that we experience when interacting with animals. Authors Beetz, Uvnas-Moberg, Julius, and Kotrschal (2012) investigated the role of oxytocin in human-animal interactions. The presence of friendly animals stimulates positive human social behaviors. For example, a class of first grade students showed increased attention toward their teacher while a dog was in the classroom compared to absence of the dog (Beetz et. al., 2012). In another study, children with autism interacted more with a real dog than objects or other people, were more playful with the dog than with toys, and were more aware of their social environment when with the dog (Beetz et. al., 2012). They also found that animal assisted therapy had similar socio-behavioral benefits in patients with dementia and prison inmates. Presence of pets even stabilized the marriages of couples after their children left home. The extensive evidence showed that human-animal interactions benefit children and adults both with or without mental health problems. Results showed common human-animal interaction benefits of lowered heart rate and blood pressure, lowered stress response, reduced anxiety, reduction in depression and feelings of loneliness, improved social functioning, greater social motivation, less inattention and distractibility, higher self-efficacy,

more empathy, more social integration, and less aggression. Beetz et. al. deduced that human and animal interactions with a friendly companion animal positively affect levels of cortisol, epinephrine, and norepinephrine relating to lowered stress responses. Additionally, presence of either familiar or unfamiliar friendly animals generally reduces heart rate and blood pressure even when a stressor is introduced (Beetz et. al., 2012). Release of oxytocin in the brain stimulates social interaction with increased eye contact, empathy, face memory, trust, social skills, positive self-perception, and generosity. Oxytocin can counteract aggression, improve learning by conditioning, promote maternal care behavior and bonding to offspring, and facilitate pair bonding. Oxytocin has anti-stress effects of lowered stress hormone levels in humans and animals (Beetz. Et. al., 2012).

Experiential Learning & Observations with Live Animals

Educational animals may be used in direct, hands-on interactions or as observational models depending on what amount of human interaction is appropriate for each species. These wildlife ambassador animals are representational of their species, allowing people to have experiences with an animal that may be difficult to observe in the wild. They may exhibit natural behaviors and display physical adaptations that teach us about their wild counterparts (International Wolf Center, 2018). Other educational opportunities involving animals include animal-assisted activities, interactions with and daily care of a classroom pet, or temporarily capturing wild animals for education, research, or citizen science programs.

Classroom pets for hands-on & observational learning. Daly and Suggs investigated teacher attitudes and experiences using pets in the classroom, concluding that pets contributed to increased social competence and use of student empathy in the classroom (Daly & Suggs, 2010). They surveyed 75 Ontario elementary school teachers on their attitudes towards pets in the

classroom, how pets are used in the classroom, and why or why not the pets were used in the classroom. A majority (69%) of teachers responded as liking pets, but only 14 classrooms reported keeping classroom pets. About half of the teachers reported that they have had pets visit the classroom for various reasons. The most common activity using pets centered on care of the pet or its home. Occasionally, classroom pets were used to stimulate interest in animal research. 47 of the 71 respondents reported using some form of formal humane education program in their classroom. Only eight teachers reported taking field trips to nature centers, farms, or zoos. Teachers believed that having pets in the classroom contributed to the academic and socio-emotional development of students. The surveyed teachers believed that the positive impacts of having pets in the classroom outweighs any concerns about safety and liability (Daly & Suggs, 2010).

Animal-assisted activities. Animals are used in a variety of educational and therapeutic settings from animal-assisted programs or activities, animal-assisted therapy, ambassador animal visits, and classroom pet interactions as just a few applications. Most commonly dogs are the therapy animal of choice for children, but many other animals have potential in animal-assisted activities including potentially herpetofauna. One of the key aspects to animal interactions is that students perceive them as a non-judgemental listener without the pressure of human social norms (Daly & Suggs, 2010, p.107). Human-animal interactions have a variety of impacts on children that require further research to determine the specifics of these interactions. Specifically, research is needed to examine the qualities of child-pet bonding and also the relationship between children's humane attitudes and their treatment of animals. (Ascione, 1994).

Animals in a classroom can help students to focus on lessons and activities in animal-assisted therapy sessions as supported by Lori Freisen's (2010) research and analysis. There are

many diverse applications of animal-assisted therapy including stimulation of social interactions in home, therapeutic, classroom, hospital, or special needs environments. According to Friesen, the benefits of animal-assisted therapy include emotional, social, physiological, and physical support for children in stressful situations which can be observed in reduced blood pressure, reduced heart rate, stable emotional state, better attention, better communication, and more cooperation with adults.

Friesen (2010) proposed that educators teach their students how to interact with animals respectfully and understand animal perspectives to promote development of empathy. This illustrates empathy as a safety measure for interactions with any animals. During an animal-assisted therapy program the animal should be continually observed for signs of stress to determine if the animal needs a physical break from the activity. Friesen (2010) recommends researching best-practices for animal assisted therapy programs from both the emotional and developmental standpoint of both the child and animal participants. In contrast to animal assisted therapy, there are many benefits to animal-assisted activities which do not have the same set of therapy goals but rather focus on motivating students or engaging them in a recreational activity with the animal. Unfortunately, research has focused on atypical classrooms and not much research has been done on animal-assisted therapy within typical elementary classroom settings to compare with animal assisted activities.

Encounters, observation, & interactions with wild animals. Field-based programs and citizen science involving herpetofauna usually will involve encountering wild animals, observing them up close, and possibly even direct, hands-on interactions. In a project on surveying wild turtles with elementary students, Scott & Matthews (2012) cautioned potential participants that there are safety concerns with collecting live herpetofauna in the wild. He stressed the

importance of experienced leaders with regards to animal handling in both field and captive settings (Scott & Matthews, 2012). Properly implemented programs have the potential to provide valuable experiential learning opportunities for students.

Randler et. al. (2005) designed a program to improve third and fourth grade students' knowledge and attitudes about amphibians. As developmentally appropriate, the other portion of the program was comprised of a conservation action in which students helped protect migratory amphibians. Prior to the outside portion, the study species was covered in class via small groups to learn contextual information on identifying the species, its life cycle, habitat, and predators. After the outside portion, students learned about the species' ecology, migration behaviors, and winter survival strategy. Elementary students were guided through the outside component by college students to collect, identify, and count the amphibians during peak breeding migration times. To assess effectiveness of the program, students were tested prior to the program, one week after the program, and again four to five weeks after the program (to test knowledge retention) on their amphibian species, ecology, and behavior knowledge. After the program intervention student knowledge improved significantly. In a separate measurement of emotional variables, results showed that students showed very high levels of interested in the program and reported high emotional well-being. The emotional variables of boredom, anger, and anxiety were reported as low values. Applications for this study are to have outdoor ecological activities happen more regularly and occur during normal days as the reason for half participants in the field-based activity was due to its timing over a school holiday. The authors promoted more schools organizing local outdoor ecological programs. They also supported science education on biodiversity that is focused on a small number of species, aimed at starting programs in

elementary schools, take place outdoors, and reflect a discussion in the classroom (Randler et al., 2005).

Opportunities to Change & Improve Student Attitudes & Perceptions of Herpetofauna

Public attitudes towards reptiles and amphibians vary from adoration to revulsion. Ignorance and fear lead to deliberate killing of snakes every year (Moriarty & Hall, 2014, p. 47). Persecution of snakes is totally unjustified, but has been supported by multiple state governments. A bounty on Timber Rattlesnakes was still in effect for the state of Minnesota up until 1989 and impacted Timber Rattlesnake populations for over fifty years. Timber Rattlesnakes are now protected under threatened classification and listed as a Species of Greatest Conservation Need by the Minnesota Department of Natural Resources. “Conservation efforts focused on habitat improvements and public outreach have helped to change attitudes regarding this threatened species” (Moriarty & Hall, 2014, p.273). The goal of environmental education is to dispel myths and facilitate the spread of correct information, especially about frequently misunderstood animals such as reptiles and amphibians. Many studies have found that exposure to hands-on educational programs with live animals can improve student attitudes and perceptions of these animals.

Dispelling myths & spreading correct information. Environmental education program goals often include dispelling myths about misunderstood animals, plants, or natural events. In the place of those myths educators aim to provoke students curiosity and share the truth in a memorable way so that knowledge can translate to acceptance. A classic example of this is the “Wolves and Humans” exhibit at the International Wolf Center (2018). Wolves have been persecuted by humans for centuries due to the damaging effects of storybook tales made to frighten children. Add to that a few lost cattle or sheep from a farmer’s herd eaten by a hungry

family of wolves and an aggressive persecution of large carnivores becomes a part of human culture. The International Wolf Center does not teach in terms of “good” or “bad” wolves, but rather narrates the wolf’s story through interpretation of their complex ecology and social behaviors. The “Wolves and Humans” exhibit shows both sides of the coin with fables juxtaposed next to truth. The exhibit lays out a narrative of a vastly misunderstood species that was brought to the brink of extinction by human ignorance (International Wolf Center, 2018).

Similar to the persecution of wolves on the basis of misunderstanding, snakes and other reptiles have had a negative representation in many human cultures throughout recorded history. Dramatic defensive displays made by surprised snakes are misinterpreted as sheer aggression towards humans. Seeing as snakes are in the middle of the food chain they are reacting as a prey animal would when encountered by a predator. Snakes and lizards moving to cover may be interpreted as “chasing”, when in fact a human is in the way of their retreat to cover objects (MNDNR, 2010, p.12). Defensive displays of snakes are meant to scare off the potential predator without causing either animal harm. Some species, such as Western Foxsnakes, may mimic behaviors of venomous species to scare away potential predators. They will coil, strike repeatedly, vibrate their tails, and may even try to flatten their head to appear more like a venomous Timber Rattlesnake. It can be very hard to tell if a snake is venomous or not unless you can identify the exact species. The shape of a snake’s pupils is yet another myth as that trick only works in a few distinct areas (Minnesota being one of them where it works oddly enough). When encountered with a defensive snake people react based on their learned behaviors. We are not born with a fear of snakes, it has to be learned from others (MNDNR, 2010). More people are bitten by snakes while trying to kill them, than those people who simply got out of the way carefully and gave a scared animal the space to escape on it own.

Another animal that has developed a reputation is Common Snapping Turtles. When moving over land to other bodies of freshwater Snapping Turtles are slow moving. Snapping Turtles have such a small plastron (lower shell) that they are unable to pull their head into their shell for protection like many other turtle species. To compensate they have strong defensive responses to stress, snapping at dangers they encounter on land (Moriarty & Hall, 2014). However, these animals are often more docile underwater when disturbed likely because they can more easily move away from danger.

Measurement of student attitude change towards animals. Adults and children tend to hold particular attitudes towards various animals, often these are either fearful or negative attitudes towards species of herpetofauna. To measure these attitudes and interpret changes or improvements in these attitudes as a result of humane education, there needs to be a way to reliably measure attitudes. Children's attitudes towards the treatment of animals can be measured reliably in a developmentally sensitive manner through the use of attitude scales. The Primary and Intermediate Attitude Scales developed by Frank Ascione utilize pretesting and posttesting to interpret the effectiveness of humane education interventions.

Ascione (1992) analyzed the impact of a year-long humane elementary education program on student attitudes toward the treatment of animals using either Primary and Intermediate Attitude Scales appropriate to student grade level. Additionally, he measures generalization of these attitudes towards human-directed empathy. Mean post-test measurements of empathy were higher for the experimental group compared to the control group in all four grade levels tested. The humane education program covered a total of approximately 40 classroom hours to represent a more intensive approach than previously used in most comparative studies. 16 classrooms were assigned randomly to either the experimental or control

group. Other factors taken into account were gender and experience with companion animals represented by pet ownership. Goals of the humane education intervention focused on developing compassion, a sense of justice, and respect for all living things, providing knowledge and understanding to convey those principles, and fostering responsibility for students to act on their beliefs. The content implemented incorporated itself into regular instruction of language arts, social studies, math, health, and science. Teaching techniques varied from vocabulary lessons to dramatic storytelling to scientific classification skills. The Primary Attitude Scale was used to assess first and second graders as it used a simple yes or no format for questions. The Intermediate Attitude Scale assessed fourth and fifth grader responses to declarative statements on a four-point scale. Higher scores on the empathy index indicated greater empathy. In the results, humane attitudes were enhanced in the first grade experimental group compared to the first grade control group, but was not significantly different in second graders. In fourth and fifth grade experimental groups there was not a significant difference either. The empathy index scored higher in experimental groups for all grade levels (Ascione, 1992). In a follow-up study one year later, Ascione (1996) retested the fourth graders from the previous year which were now fifth graders. Results showed that the pre-test and post-test scores of the students from the experimental group were higher than the control group. This supports evidence that the humane education program was successful in improving student attitudes. "The enhancement of attitudes toward animals generalized to human-directed empathy, especially when the quality of the children's relationships with their pets was considered as a covariate" (Ascione, 1996). This study used the Companion Animal Bonding Scale to measure the quality of student-pet relationships through a set of questions answered by students' parents. Approximately three-quarters of the students reported owning pets. This study showed that intensive humane

education programs are effective and have lasting effects on student humane attitudes. These humane attitudes can also be generalized to human-directed empathy (Ascione, 1996).

In a study performed by Taylor & Signal (2005), 194 adult undergraduate students were surveyed using two methods of attitude measurement. The Animal Attitude Scale indicated a high score as representational of a student's pro-animal attitudes. The Interpersonal Reactivity Index indicated a measurement of empathy by scoring four scales of empathetic concern, perspective taking, fantasy, and personal distress. Students who reported current pet ownership scored significantly higher on the Animal Attitude Scale than students without a pet. Females scored higher than males on the Animal Attitude Scale, indicating more pro-animal attitudes, but both genders scored fairly high on the pro-animal attitudes end of the scale. Results of the study indicated a possible strong relationship between positive animal welfare attitudes and human welfare attitudes (Taylor & Signal, 2005).

Prokop and Tunnicliffe (2009) found that children ages 10-15 who kept a greater diversity of pet species at home were more likely to have positive attitudes towards particular species of animals. Their study compared both attitudes and ecological knowledge of 6 different animal species with opposing reputations: potato beetle (agricultural pest) versus ladybug (beneficial insect), wolf (predator) versus rabbit (prey), and mouse (unpopular, disease-spreading rodent) versus squirrel (popular rodent). Generally students were found to have higher knowledge and less favorable attitudes towards unpopular animals in the potato beetle, wolf, and mouse. They believed their results may be influenced by human evolutionary history and a possible compulsion to avoid dangerous or disease-causing animals. Prokop and Tunnicliffe reference other research that lists the benefits of pet ownership to include improved ecological and behavioral knowledge of animals, improved self-reported health over non-pet owners, and

greater aptitude for social interactions with peers. Additionally, pet owners had more favorable attitudes towards wild animals than non-pet owners and had less favorable attitudes of hunting. Other studies referenced by these authors found that animals with unpopular attitudes towards them may be disliked as much by pet owners as non-pet owners. Results of this study showed that having pets developed positive attitudes towards both the popular and unpopular animals. Having pets also seemed to indicate better knowledge of animals. Consistently the surveys showed students having better animal knowledge, but more negative attitudes towards unpopular animals. In regards to applications of these findings, the authors suggested that schools embrace keeping pets at home or in the classroom and also focus humane education programs on unpopular species of animals (Prokop & Tunnicliffe, 2009).

In a similar study, children with a higher diversity of pet species in their home may have less fear of snakes according to Prokop et. al. (2009). These authors were interested in the impacts of cultural bias on student attitudes towards a particular unpopular animal, in this case snakes. This cultural bias may influence whether snakes are deemed worthy of protection or conservation efforts. In both Slovakia and Turkey, the settings for this study, snakes were placed under government protection after snake populations fell into decline. Aspects under study were the quantitative attitudes of college students towards snakes, comparing these attitudes as a function of a student's area of study (biology versus non-biology majors), and comparing pet owners attitudes to those of students without pets. The results showed that students in both countries are fearful of snakes and concerned about encountering them in the wild. The study also found that interest and knowledge of the biology of snakes was not influenced by students' gender. Generally, having progressively more pets reflected more positive attitudes toward snakes and pet owners were less fearful of snakes than non-pet owners. In making comparisons

across cultures Turkish students were more interested in the biology of snakes, but also believed in more myths about snakes than Slovakian students. Female students tended to show greater fear of snakes than male students. Biology majors had more positive attitudes towards snakes than non-biology majors. It seemed to the authors that despite having more species of venomous snakes, Turkey does not have proportionally greater fear or negative attitudes towards them. The study concluded that the bad reputation of snakes comes from largely the belief in myths. By focusing education on dispelling myths and spreading correct information, fear of snakes may be reduced (Prokop et. al., 2009).

Opportunities for Inquiry, Experiential, & Hands-on Education Strategies

Inquiry learning involves asking open-ended, guided questions during activities or explorations, and letting students choose their area of focus to investigate. Students make discoveries individually or with a group through asking questions, experimenting, using trial and error, discussion, and evaluating (Minnesota Early Childhood Environmental Education Consortium, 2002, p.30). Experiential or hands-on learning fits into inquiry in that students interact with the objects or natural phenomenon that they are investigating through sensory exploration. An example of experiential or hands-on tactile learning may be picking up a wild frog, observing it up close, and having students investigate the requirements of that animal's habitat through a combination of recalling previously acquired knowledge and comparing that information to their current observations. Experiential learning emerges when students can get up close observations, handle tools and objects that are the focus of their investigations, and make connections with intangible concepts and tangible objects.

In a student's early elementary years, David Sobel suggests that exploration play, fort building, following streams and deer paths, taking care of animals, planting gardens, and

imaginary play follow developmentally appropriate practice. Big intangible concepts like the water cycle have potential to be investigated at a tangible level by following streams and finding out where they start and where they end. He believes from personal communications with other naturalists and writers that these years of childhood are generally when people remember having first formed a deeper connection with nature. The immersive experience of following a stream reflects elements of inquiry learning. Meandering adventures filled with student questions can be a change of pace for classroom teachers. “We infect our children with our impatience” (Sobel, 2013).

Sobel believes social action projects to be developmentally appropriate for children ages 12 to 15, but “no tragedies before fourth grade” (Sobel, 2013). This is in reference to approximately when children can begin to handle complex and emotional ecological issues such as deforestation for agricultural development or the impacts of oil spills on marine and coastal ecosystems. Sobel states that “asking young students to study ecological problems before they have developed the power of abstract thinking invites them to draw oversimplified conclusions” (Sobel, 2013).

Grueber and Whitin’s (2012) research takes a stand for incorporating more inquiry in classrooms, presenting it as a small shift in the way educators address core concepts and scientific investigation. This shift centers around educators changing the way that they communicate with students and guiding students to collaborate ideas and observations. A professional development program was delivered for these elementary educators who felt unprepared to incorporate inquiry-based scientific discussions in their curriculum. The program promoted five aspects of inquiry which included student engagement in scientific questioning, providing evidence, forming explanations from that evidence, linking explanations with prior

knowledge, and communicating explanations with scientific justification. In this new social learning environment students are encouraged to give reasons for a scientific argument by communicating and collaborating ideas so that multiple perspectives are incorporated and defended. When put into practice and used with repetition, these models of inquiry are reinforced and can become second-nature to educators (Grueber & Whitin, 2012).

The term “minds-on” may be used during inquiry learning referring to a student’s engagement in linking evidence to previous scientific knowledge. One way to demonstrate students prioritizing evidence is to predict, observe or collect data, and explain during a scientific investigation. This process of inquiry differs slightly from the traditional scientific method in that students discover relationships within their observations and have to justify their explanations with a synthesis of the evidence collected in their data set and previous scientific knowledge. Students also have opportunities to display effective communication skills, promoting a respectful environment where all perspectives and opinions can be safely heard, and valuing diverse ideas offered. Students collaborate to form a logical argument that supports or refutes a prediction or claim with an explanation of recorded observations (Grueber & Whitin, 2012).

Curiosity is another important facet of inquiry learning which Brusich and Steinmacher (2015) believe is supported by the evidence of three key aspects of “tinkering”, “modeling”, and acceptance of failure. Inquiry and open curiosity can lead to better retention of knowledge and deeper understanding of concepts according to Brusich and Steinmacher (2015). Educators can foster student curiosity by creating opportunities for tinkering, modeling, or acceptance of failure in their classrooms and outdoor explorations.

“Tinkering” involves making or fixing items to understand how they work or go back together. The student learns through their own hands-on experience which can build confidence

and motivation in the learning environment. This process appeals highly to students that learn best in engaging tactile settings. Students can learn how to appropriately use tools, new materials, and interact with unfamiliar objects while tinkering (Brusic & Steinmacher, 2015).

The second key aspect of curiosity described by Brusic and Steinmacher (2015) was “modeling” by which educators can show their own enthusiasm for a subject to engage students. Educators can positively model engagement in exploration to fulfill curiosity and promote that their students find subjects that fuel their passion and inspire curiosity. Allowing time for group discussions and investigating new questions can help improve interest in new subjects and form connections between student knowledge and new learning (Brusic & Steinmacher, 2015).

The final key aspect to foster curiosity was creating a culture of respect in the classroom community that allows for acceptance of failure and maintains feelings of security. Students fearful of failure can miss out on opportunities by simply passing them by without consideration. Due to the boundless curiosity of students, failure is inevitable and accepting it as an opportunity for learning and improvement sets students up for success in their future explorations in inquiry. Students should be encouraged to keep exploring and tackle problems head on so that they learn how to take responsibility for their failure. Student should take the time to reflect on these failures and learn from their mistakes to try and change future outcomes. Promoting curiosity inside and outside the classroom is essential to fueling the passion of lifelong learners. As Brusic and Steinmacher (2015) believed, we need to foster these students’ expansive curiosities to find solutions to problems we have yet to face in the future of our society.

Research by James & William (2016) questioned whether experiential outdoor education was a valuable use of time for seventh and eighth grade curriculum. Due to schools focusing on test-based accountability, educators have less opportunities to expose students to experiential,

nature-based environmental education. As a method for improving student engagement and motivation to learn with curriculum materials, the authors suggest integrating classroom curriculum with outdoor environmental education through education standards. These curriculum changes seem to most greatly benefit students struggling with attention, motivation, social skills, and academic achievement. The conclusion of the authors was that experiential outdoor education is absolutely an effective use of integrated curriculum time (James & Williams, 2016).

Benefits of educational games & activities. There are many reasons to play educational games. Games can teach a new skill or illustrate a concept. These new skills can be practiced through repetition in the game's setting. They help to build community in a classroom by supporting social interactions between students. These interactions fuel children's desire to be competitive and cooperative with their classmates. Games use the kinesthetic or body-centered approach to learning by incorporating multiple senses of sight, sound, and sometimes touch. These types of interactions can help improve body coordination and develop gross-motor skills, particularly in young students. The movement aspect of games allows students to expand excess energy that will allow them to refocus in the classroom (Minnesota Naturalists Association, 2016).

Types of games can generally fit into six categories according to the Minnesota Naturalists Association. Chasing games tend to be less structured and contain fewer rules, can be played in a short amount of time, and are adaptable to many themes. Historical or cultural games teach students about people or culture from a different time and place. Simulation games teach a specific concept, may include roleplay of animal characters, and have lots of rules. Simulation games also likely have a discussion session afterwards to cover the concepts illustrated during gameplay. Observation games foster development of students' observation skills to notice

patterns, changes, or hidden objects. Observation skills are often visual, but can also use the senses of hearing, smell, taste, or touch depending on the topic addressed. Skill-based games utilize team-building and cooperation to overcome or solve a challenge presented to the group. These skill-based games may require physical ability, mental skills for problem-solving, or a combination of the two. The last type of game is time fillers. These are simple, fun, and a good way to just pass the time during transitions in the camp or school day.

Citizen science as a new tool for educators. Citizen science is crowdsourcing data collection for research projects to increase the geographic range, number of species, and frequency of data collection. Prior to citizen science, monitoring projects were restricted to small localities constrained by budgets and availability of trained staff or volunteers. Participation in citizen science can be a great tool for involving older elementary students in social action. Students benefit from the hands-on learning environment, repetition and direct application of scientific practices to reinforce knowledge retention, and development of civic responsibility through community service (Green Teacher, 2014). Citizen science is also an opportunity for long-term school projects as more data for a particular location over many years can show valuable data trends. Educators can take on the role of facilitator to ensure student participation and accurate data collection. Typically in herpetofauna databases, the researchers ask for at least a photo of the animal and where it was found. Once the data is verified it may be used in local, national, or even global research projects. One of the detriments to citizen science projects is the quality of data that is collected. Educators should make a concerted effort to contribute as much information as possible to avoid misidentified species or incomplete data.

Reptiles and amphibians are the focus in many citizen science projects in Minnesota which has diverse ecosystems and incredible access to aquatic habitats. Educators can search the

internet for either local or global citizen science projects promoted by researchers.

Herpmapper.org is a global atlas of reptiles and amphibians entirely compiled by citizen scientists of all skill levels. The Minnesota Department of Natural Resources uses the Amphibian and Reptile Survey of Minnesota to assist in monitoring wild herpetofauna populations and species diversity. Up until recently Minnesota collected data as part of a national initiative with the Minnesota Frog and Toad Calling Survey, however this project has ended due to a lack of funding. This annual spring survey helped train students and the public to improve their observational listening skills by differentiating multiple species of amphibians calling at once. Researchers at the University of Minnesota use the website iNaturalist.org to collect local citizen science data for various graduate student research projects. Many more citizen science options can be found if educators reach out to research organizations for ideas of what their students could do to help collect useful data for current research within their state.

According to Scott (2016) many elementary educators lack experience implementing inquiry methods and thus have less confidence using these methods with students. Scott's study investigated preservice elementary teachers implementing an introductory citizen science project. Involvement in a citizen science project provided opportunities for the educators to facilitate and students to practice inquiry learning methods. Scott's study recorded observations and responses from the pre-service elementary educators. The citizen science project chosen sampled a local turtle population with visiting elementary students. Participation in the project resulted in improved content knowledge of turtles and research methods (measuring carapace, plastron, and weight; setting turtle traps; and visually marking turtles for ease of recapture) for the participating educators. Participants also showed an improved understanding of citizen science projects in general. Educators were initially worried about implementing a large-scale informal

research project, but after their own hands-on experience, participants were convinced that they would be capable of coordinating a similar project with a class of elementary students. The overall themes that emerged from the study showed participating teachers felt a stronger sense of responsibility, ownership for the project, and a desire to teach about environmental impacts discovered during the project. During the program teachers approached members of the public to educate them about the rationale of their project. They likely did this with the intent of educating the public to avoid people tampering with the equipment for catching turtles in the local pond. Teachers also educated participating students on the impacts of invasive species on local species and degraded habitat quality. The results of the project showed that pre-service elementary educators acquired better content knowledge and improved attitudes towards incorporation of citizen science projects in their classrooms (Scott 2016).

Scott & Matthews (2012) wrote an earlier article on introducing herpetology into classrooms through inquiry and experiential learning opportunities. This article focused on the informal side of environmental education promoting its flexible and adaptable nature for effective science programs and exploration opportunities with animals. The two programs that were created for this study aimed to be adaptable for a formalized classroom setting. Scott & Matthews (2012) included a disclaimer prior to description of the activities outlining safety with snakes and other animals that may be encountered during the programs. It was believed that students would benefit from both field-based ecology programs and typical summer camp experiences (crafts, hiking, and captive animal handling). The first activity was a field-based program investigating herpetology, the study of reptiles and amphibians. Students in second through fifth grades helped to collect wild herpetofauna for their research, make hypotheses and research questions, take measurements, and analyze their own data. Data was collected from

animals attracted to wooden cover boards (damp and cool to attract amphibians) or aluminum cover boards (warm and dry to attract reptiles) to simulate safe spaces for animals to thermoregulate (maintain comfortable temperatures). Scott & Matthews (2012) indicated that this practice could be useful for observation of herpetofauna throughout the school year, weather permitting. A few other tools were described that could be used in the program. Squeeze boxes, turtle traps, minnow traps and other methods for data collection were covered in enough detail to replicate the process. These methods should be closely monitored by facilitating educators to maintain safe procedures for animal specimens as completely submerged turtle traps can cause animals to drown and squeeze boxes can injure snakes if used improperly. A second program included themed camp days in which students went on morning walks to look for herpetofauna using observational skills, handled captive raised herpetofauna, and utilized crafts, coloring pages, and informative talks with an educator. The activities were a mix of visual, tactile, and occasional hands-on activities to provide opportunities for inquiry learning. In comparing the two programs, the first, field-based experience directly applied the scientific method, so despite it being a less formalized option, it more closely fit state science standards. Common themes present within both programs included opportunities for inquiry, experiential learning, hiking, and collaboration with peers. According to Scott & Matthews (2012), both programs were engaging for students and many of them enjoyed the experiences of holding snakes and other herpetofauna, particularly due to their previous lack of opportunities to do so (Scott & Matthews, 2012).

Inquiry can lead to unexpected investigations. A field trip to a river was cancelled due to parents' intense fear of their children encountering snakes. Rather than schedule a whole new field trip, educators decided to turn it into an opportunity for inquiry. The new project involved

modifying the scientific method to create inquiry-based research questions over the course of a 5-day unit on snakes. Scott, et. al. (2010) subsequently explored the fifth graders' fear of snakes and how it affected their ability to accurately guess the length of snakes. Students formed questions based on the observation that fearful students often overestimated the size of snakes. Student recorded the accuracy of each other's guesses in regards to perceived length of various snakes. They wanted to investigate if there was a relationship between reported fear of snakes and the accuracy of guesses. Students took a pretest survey to rate attitudes towards snakes and asked each student to report prior experience handling snakes. The students estimated lengths of four different snakes including a rope painted like a snake, a rubber snake, a live snake in a habitat, and a live snake handled by an educator. Students went into the experiment having recently done a unit in math class where they estimated and measured lengths of various objects around the classroom. Students made their guesses of snake length in all four scenarios, guessed the species of snake, and listed any questions that they may have about snakes after participating in the experiment (Scott, et al. 2010).

In this experiment students practiced inquiry through collaboration on a research question, determining a need for actual measurements of the snakes and objects to make comparisons, and formulated questions for future research. The students used measurement methods similar to those of field researchers including squeeze boxes, snake tubes, and gently aligning the snake next to a measurement device. After measurements were recorded, students compared whether their hypotheses were supported by the data (Scott, et. al., 2010).

After the experiment the authors listed precautions for educators and safety rules to use while handling live reptiles. These precautions included hand washing before and after handling animals to prevent transmission of possible diseases between species. Additionally, acting

responsibly and safe while handling live animals, supporting the entire snake and treating the animal with respect, and avoiding snakes that cannot be easily identified. They recommended only having consenting, confident students handle live animals and that students stay seated while holding live animals. The authors encourage contacting local herpetologists and naturalists to present to classrooms, share ecological information, answer student questions, and promote career options in wildlife and environmental education (Scott, et. al., 2010).

Conclusion

Herpetofauna need conservation help as animals that live in a world managed by humans who often dislike and mistreat them. Students have the potential to develop empathy and learn compassion for these misunderstood animals through direct interactions with live herpetofauna and influential humane educators. Inquiry, experiential, and hands-on learning strategies can integrate ecological concepts into classroom science curriculum. Games and activities illustrating animal interactions can make learning fun. Getting outside to explore and find wild herpetofauna to pick up and examine up close leaves a lasting impression on students. Facilitated field exploration can help students participate in real science through citizen science. The culmination of these experiences with herpetofauna is a shift in student attitudes and perceptions of these animals.

CHAPTER THREE

Project Description

Introduction & Overview of Project

How do I create an elementary educator resource guide to herpetology in Minnesota bridging the gap between the classroom and nature center experience? I chose a familiar framework on which to base the games and activities of this resource guide. Other components chosen for the resource guide were sections on importance of herpetology, vocabulary terms, ethical considerations, field etiquette, animal handling techniques specific to various herpetofauna that are likely to be encountered in Minnesota, and resource lists of relevant materials for building new curriculum or supplementing existing lessons.

Curriculum Framework & Supporting Rationale

The framework for the games and activities in this curriculum resource guide was adapted from Dodge Nature Center's curriculum template. This curriculum template was chosen due to my familiarity with its use and intent to create activities with a similar, primarily outdoor format. I have seen a very similar framework promoted in seasonal staff trainings with the Minnesota Department of Natural Resources which were then used to develop public natural history programs. Additionally, the National Association for Interpretation uses a framework with essentially the same components as both of these examples.

Typical, Dodge Nature Center classes consist of an indoor classroom component and an outdoor exploration component to illustrate ecological or scientific concepts. The components of a Dodge Nature Center curriculum guide template include a title, general class description,

suggested grade level, length of the program, suggested location, season that the class was usually taught for the local school district, last date of curriculum revision, materials list, objectives, and state science standards. The rest of the template laid out the general class procedure broken into three class components. An introduction of the natural history or science concepts, the possible outside activities, and supplemental information on the class topic were outlined and generally a short discussion was recommended at the end of the class.

For my purposes I chose to include similar components, but kept the framework relatively simple. Games followed a template that listed a title, objectives, vocabulary terms, suggested group size, duration, and materials list. Next, each game had a description of its setup, rules plus gameplay, and a facilitated class discussion. The only difference between games and activities was a longer duration and inclusion of state science standards that could be addressed by either the activity or during the facilitated discussion. I felt that it was important to add a vocabulary terms section to the games and activities due to the field of herpetology having a large amount of specific terminology. I added a discussion component with a description of how to engage students in a facilitated group discussion after the games or activities. This was intended as a way to hopefully improve student knowledge retention, evaluate if educational objectives were met, and promote inquiry learning.

In addition to games and activities, the resource guide also has sections on why it is important to study herpetology, a vocabulary terms list and their definitions, ethics of wild animal encounters and field herping etiquette, and recommended best practices for handling live herpetofauna. The section on importance of herpetology was used to establish rationale for the project. Ethical considerations and best practices of handling live animals were components that I personally felt compelled to include. Informed educators knowledgeable in ethical and

empathetic approaches to encountering and handling live animals will be better prepared to interpret to students in my opinion.

After the games and activities there are lists of citizen science project resources, live animal outreach opportunities for educators to contact, and recommended books or websites for more information to help build herpetology-themed curriculum. Citizen science has the opportunity to engage students in an outdoor, hands-on learning environment where all of the other principles conveyed in this resource guide are able to culminate. There is potential for very memorable student experiences to help establish a deep, personal connection with nature. The list of possible live animal outreach educators is included so that all schools, but particularly schools with limited access to green space, have opportunities to incorporate live animals into their classroom curriculum.

This herpetology resource guide uses a straightforward framework with clearly defined components and easy to follow game and activity instructions. My hope is that this framework is relatively easy for educators to incorporate into their new or existing science curriculum. Educators could select one game and one activity to blend into a single, longer lesson with complementary learning objectives or themes. Another option may be to choose games or activities that roleplay science concepts being explored in existing classroom curriculum. The short duration of the games and activities leave them adaptable to a variety of options.

Setting & Audience

This educator resource guide has been designed primarily for use at urban nature centers, elementary schools, and other environmental education learning centers. It is intended to serve a diverse student body and supplement either curriculum-guided field trips or classroom-based environmental education. The curriculum options are adaptable so as to be accessible in diverse

education settings regardless of available space for activities, school funding options, student family income, or proximity to natural or recreational green spaces. Any of the games and activities in this guide can be improved by access to a large natural area, but it is not necessary.

The goal for this resource guide is to provide a colorful array of curriculum options for incorporating experiential learning opportunities in the formal classroom, schoolyard, school forest, field trip, or summer camp setting. It is a starting point for educators to create their own lessons by adapting from this guide and combining games and activities that fit their learning objectives. Game descriptions list the amount of necessary space and materials that should be gathered. Typically, materials are relatively inexpensive or free to acquire. Local environmental education facilities such as nature centers or state parks may be able to either provide materials and equipment for outreach programs facilitated by one of their environmental educators or else offer kits of materials to borrow on a temporary basis.

Project Description, Explanation of Methods, & Implementation in Curriculum

Games and activities are used to illustrate ecological concepts and connect students to nature. These can provide inquiry and experiential learning opportunities, fostering empathy development through interactions with animals, and hopefully improve student attitudes and perceptions of herpetofauna. The games and activities that were adapted for this resource guide are borrowed from similar ones used either interchangeably by nature centers throughout the Twin Cities metropolitan area, directly from Dodge Nature Center curriculum, or blended together from my personal teaching experiences. Overall, the adapted source materials are largely communicated by verbal and hands-on trainings and rarely written down anywhere in detail. Much of the details pertaining to rules and gameplay have been synthesized from my experiences of past successes and failures with various student and summer camp groups.

The many engaging games and activities listed within this guide are a way to hopefully bridge the experiential, hands-on learning experiences of nature centers with the formalized classroom. These games get students moving and interacting with one another to better understand the ecological roles of reptiles and amphibians. Students may play games in which they take on the role of either a predator or prey species. They may practice using camouflage to represent how some herps hide from their potential predators. Some games can even be played inside of the classroom or a gymnasium if weather conditions don't allow for outside play or the school doesn't have access to outside spaces during the school day. The closer students can get to a somewhat natural space, the better. All games and activities can be played in outside spaces. A few of the games require some type of outdoor space whether it be a school forest, nature center, community garden area or even a backyard to allow students the opportunity to find wild herpetofauna.

The section on recommended best practices for handling live reptiles and amphibians is a culmination of personal experience providing daily care and educating with herps in hands-on environments, suggestions from the experienced animal care coordinators at numerous environmental education facilities where I have worked, and suggestions from Minnesota Herpetological Society field survey facilitators and their various volunteer educators. Techniques were occasionally species specific to provide the most thorough instructions possible as every species has its own general temperament and may have particular quirks regarding their handling for the optimum comfort of the animal. A comfortable animal allows the educator to be more effective and focused by providing less distraction and a safer environment. For example, Painted Turtles, Snapping Turtles, and Softshell Turtles all have shells, but should be handled in different ways for safety reasons and the comfort of the animal. Snapping Turtles have

exceptionally long and powerful necks that can reach around and bite over half of the way across their back shell (carapace). Softshell Turtles are notoriously aggressive, but can be considerably calmer when held with one hand supporting their lower shell (plastron) like a plate and the other held flat on top to provide stability. These are an example of how even two animals that resemble each other can exhibit distinctly different behaviors. Such species-dependent quirks are best learned from personal experience in the field or communication with an experienced educator or field herper.

Temporary captive animal care can be generalized by groups of reptiles or amphibians, but as explained above, every species has quirks to their behavior. Species also differ in their dietary preferences, basking preferences, substrate requirements, humidity requirements, and more. The “wildlife sleepover” activity in this resource guide is intended to provide an introduction to temporary housing of a reptile or amphibian pet in an elementary classroom for observation. It is not a substitute for researching animal husbandry of a selected species if it is to be used as a long-term addition to a classroom. If considering acquiring a classroom pet, I encourage educators to consider adopting a healthy, surrendered animal in need of a home that has been placed in foster care with the Minnesota Herpetological Society. Adopting an animal also makes purchasing fees for a new classroom pet significantly less than buying a new animal.

Safety tips are available throughout the curriculum guide to address areas of concern for both teachers and parents about interacting with herps or playing hands-on learning activities or games. Suggestions are there to keep both students and animals safe. The animal's welfare should always be a consideration before the students' learning experience. Animals do not have voices to express their discomfort. I have observed many students who mishandle animals because they do not understand this. A surprised or uncomfortable animal can quickly become

unpredictable and could even injure the student in an attempt to flee. Explaining this concept to the students is also an opportunity for empathy development. Help your students see the world from the animal's perspective through analogies, open-ended questions, and questions that allow for a think-time pause for processing before a response is shared. These inquiry teaching techniques will help formal classrooms interact more respectfully and immersively with nature on their next trip outdoors.

A list of resources for educators is included along with contact information for a variety of free or relatively inexpensive public education organizations with outreach volunteers and environmental educators. In particular, I recommend the Minnesota Herpetological Society and Minnesota Department of Natural Resources as they provide free programs. These organizations may be able to bring live native reptiles and amphibians to your classroom and facilitate a hands-on learning experience for students. There may even be flexibility in which animals are brought along on the outreach if you ask the educator about the selection of ambassador animal species that are in their care. Snakes, aquatic turtles, salamanders, toads, and other herpetofauna are fairly common education animals.

Summary

The project artifact is an elementary educator resource guide meant to support teaching students about herpetofauna in the wild and in the classroom. The guide includes indoor/outdoor games and activities, suggested animal handling techniques and ethical considerations, citizen science projects that involve herpetofauna, options for free or affordable live animal interpreters, and additional resources for educators to create their own curriculum on herpetology. The games and activities are not laid out in an explicit order. It is intended to be used as ongoing materials to assist in building curriculum. The guide is designed to make environmental education with

herpetofauna as approachable as possible even for the inexperienced educator who may still be uncomfortable handling herpetofauna.

Implications and limitations of the resource guide and its components are detailed in the next chapter. Chapter four will also reflect on the author's journey researching and writing throughout the capstone project process and literature review. The author shares their thoughts on suggestions for future research and future implementation of the project resource guide.

CHAPTER FOUR

Conclusion

Introduction

Within this final chapter the author discusses their reflections on the capstone writing process and literature review. Implications and limitations of the project are reviewed as well as ways in which this project contributes to the field of environmental education. Additional possibilities for future research are explained in detail. The author shares their future research agenda and expanded project goals. The research question addressed was *how can I create an elementary educator resource guide to herpetology in Minnesota bridging the gap between the classroom and nature center experience?*

Reflection on the Capstone Project Process & Literature Review

Throughout the capstone research and writing process I repeatedly realized just how much effort I was having to put into every aspect of the project and research. From collecting ideas for the games and activities to contacting researchers directly to access their literature that was no longer published in a publicly-accessible database. I also realized that I have a lot to learn about formalized classroom settings that could have provided insight into how to make these activities more successful for classroom teachers. I didn't want to make assumptions about how classrooms are run and what teachers find necessary in their lessons. To account for that I made relatively short curriculum components that I knew a lot about implementing from personal experience in the hopes that they can be integrated into existing curriculum.

It was very difficult to get any participation from outside educators when requesting content suggestions for an activity guide. I requested ideas face-to-face at a naturalists conference. I posted on social media requesting ideas for favorite educators I could contact or activities that could be shared. For being professional interpreters, it was very difficult to get anyone to communicate with me about herpetology education in Minnesota. This is about when I realized that my involvement with the Minnesota Herpetology Society and my own passion had probably surpassed that of most other naturalists. Very few other educators were just as herpetology crazy as I was, and those that were already attended monthly MHS meetings. I dug up published resources for ideas and reflected a lot on successful games and activities from past programs and summer camps for content inspiration. I resolved to look back through my favorite summer camp outlines for natural history games that could be adapted to herpetology themes. Many of the games and activities had to be written largely from scratch as most naturalist trainings are hands-on or orally translated and don't have written instructions for many games. Then the only hard part was finding literature that would support my rationale for making a resource guide primarily out of games and activities.

I am glad that I chose the themes that I did for the literature review as the content that I have read informs my teaching strategies as a naturalist. Themes of inquiry or experiential learning, empathy development, and student attitudes about animals are relevant on a near daily basis in environmental education. In the literature review, I found that Frank Ascione's research covered many aspects of child empathy development, implementation of humane education programs, and evaluations of student attitudes. The articles and research produced by Catherine Scott were very influential in my representation of inquiry and experiential learning through herpetology. Another helpful resource was the Minnesota Department of Natural Resources

website. I have grown familiar with using it as a resource for accurate information about Minnesota wildlife when building natural history programs. I have continued to use it as an invaluable resource for both myself and as a place to send other educators for more information on herpetology in Minnesota.

Implications, Limitations, & Contributions to the Field of Environmental Education

This resource guide was created by an environmental educator who has no full-day classroom experience. I am limited by simply not understanding how to fit these games and activities into formalized lesson plans. My hope was to provide a simple format for games and activities that could be adapted to fit into established or new lesson plans. A benefit of these games and activities is that they require very little setup and materials, thus mostly needing a time set aside to play or explore outside. By meeting state science standards they hold relevance for classroom educators who may be worried about the expectation of meeting standards with their curriculum if they take their students outside.

I tried to take into account that not all schools are within an accessible distance to a green space to perform all of the activities, and educators have a limited number of hours in a school day. There are a number of games and activities that can be done indoors in either a cleared classroom space or open gymnasium area. Most of the activities would benefit from being outside, but it is not necessarily a requirement in all cases. The activities are fairly short and the games are even shorter. Activities are tailored to fit within a 45-minute lesson, but could be expanded into a longer lesson with repeating rounds of a game, an extended discussion session, or by combining one game and one activity into the same block of lesson time. By keeping these easy and providing resources for educators there is flexibility to either keep lessons short or build something longer out of multiple components. To build longer lessons such as participation in a

citizen science project, educators can pick and choose elements of an activity or a facilitated discussion and blend them into new curriculum. By making the game and activity elements simple I hoped that more educators would feel that the themes and materials are approachable and easy to implement.

Games commonly used for nature center programs are generally shared or reused by all naturalists. Each nature center has their own names and slightly different rules for many of the same activities. Schools without access or funding to visit a local nature center for field trips now have access to the same activities that nature centers use to teach natural history concepts. I gave the games a herpetology theme, but the types of animals can be changed and often portray a similar ecological concept. Since the games played at nature centers are often learned through trainings or verbal communications, I simply wrote down the gameplay in the way that I had been using it for my own programs and summer camps. Through trial and error I played the games with many different audiences and changed various aspects to make the rules more fair, understandable, and balanced. Some of the activities I worked on had to be built from scratch.

The “Wildlife Sleepover” activity in the resource guide was tricky to build from the ground up due to legal protections surrounding herpetofauna. It was something that needed to be worked over very carefully, but that could have a huge positive impact on student learning and engagement. I loved encountering wild herps at nature centers and state parks to show students and even other naturalists. I wanted to be sure that if I made an activity that involved taking an animal back to a classroom for a day or two, it wouldn’t put teachers in any hot water regarding local wildlife regulations. I included numerous disclaimers of what would be expected of educators if they chose to remove an animal temporarily from its habitat. I indicated researching local herpetofauna species before going outside with students, knowing what species were

protected in that region, and returning animals to the exact same spot where they were found. Despite all of these careful restrictions, there are so many important things that can be learned from students observing a live animal up close. It is worth the extra effort. I detailed a few options for investigations that could be done with students including writing down a list of prior knowledge, questions that were formed, and first-hand observations of the animal. At first, glancing over my activity, my content reviewer almost shut it down. I was crestfallen but determined to write it as carefully as possible to see if it could still be included in the resource guide. I was so excited when my content reviewer approved it and agreed that it was a great learning opportunity for students.

Recommendations for Future Research

There should be more research into ways to make herpetology accessible to elementary education. There are multiple resource guides for secondary education, but most elementary education resources are overly simplified or non-existent. Certain concepts in biology can be taught at an early age to harness students' intense curiosity about animals. We stand a better chance at inspiring young scientists by involving them when they are young. In the meantime, I would recommend that parents take their students out to citizen science events, attend a meeting of their local herpetology society, or explore their local nature center or state park to fuel their elementary student's interest in herpetology.

Currently, there are not many options to search for active citizen science projects by the group of animals, plants, or natural events that they study. There should be a website hub for current citizen science projects across the country, or even globally, where students, parents, educators, and scientists can search for their local citizen science initiatives and get involved. A few of the websites that I came across were still in early development and lacking a lot of

information. There could even be an option for labeling projects by skill level so that new citizen scientists such as students or families feel capable and helpful in contributing information.

Additional research could look into child-animal interactions and the effectiveness of various other components of humane education interventions. What are the short-term and long-term impacts on children from direct interactions with live animals? What are the short-term and long-term impacts of humane education programs on children? Researchers are seeing a positive trend in the impacts that humane education has had on empathy development and student attitudes. There are bound to be more positive implications that have yet to be investigated. Along the lines of researching aspects of child empathy development and how they experience emotions, we have very little understanding of how herpetofauna experience emotions.

How do herpetofauna interpret discomfort, pain, or other emotions? What emotions are they capable of experiencing? We understand very little about herpetofauna cognitive capabilities including the scope of their emotions or perceptions. For being some of the oldest vertebrate species on our planet, we still know very little about herpetofauna and have relied on basic understandings to shape our perceptions of them. However, research funding more often goes to charismatic megafauna or the “cute and fuzzy” animals. Herpetofauna are not well represented in global research even despite the massive extinction events which face so many amphibian species. Chytrid fungus and Ranavirus are among two of the largest concerns for amphibian populations across the globe (Moriarty & Hall, 2014). A newly discovered snake fungal disease is spreading in the United States and also requires urgent study. There are great implications for better understanding the way that herpetofauna minds work and their bodies experience pain or emotion. By learning about the details of their physiology we may yet discover ways to help various herpetofauna recover from otherwise debilitating diseases spread

to them by human interactions. If we accidentally introduce a deadly fungus or disease to a population of herpetofauna, should we not also find the cure?

Author's Future Research Agenda & Expanded Project Goals

My hope is to expand this activity guide to incorporate more supporting materials such as native species lists, general characteristics to compare various species of reptiles and amphibians, an expanded vocabulary list, and additional resources to explore citizen science and herpetology education. It is entirely possible that this will take on a new form as either booklets or multiple smaller documents for publishing with the Minnesota Herpetological Society. I would like to grow the amount of free resources available to educators via the MHS website.

In the future I plan on incorporating even more games and activities. This resource guide is just what I have come across thus far in my career as an educator and I am sure that there will be more. These games and activities are what I have found to work well, but there are certainly many more games that can be adapted to fit a herpetology theme. In the meantime, I will keep trying to find ways to integrate herpetology into the programs that I teach as a naturalist and hands-on animal interpreter.

I would also like to practice illustration of herpetofauna to create semi-realistic coloring pages for educator use. So many coloring pages currently used by classrooms and summer camps are overly simplified and misrepresent herpetofauna appearance and behaviors. I would love to publish coloring pages with more accurate proportions and that can show herpetofauna in their habitats or displaying natural behaviors.

To gather source material to reference while illustrating, I would like to spend more time outside field herping during the months that herpetofauna are active in Minnesota. I could also travel to other nearby Midwestern states to see their native species. This way I could practice

field herping techniques to develop personal interpretation skills and to describe in future additions to the resource guide. This also includes attending the annual Minnesota Herpetological Society field survey and taking detailed notes on qualities of preferred herpetofauna habitat, likely hiding places for these animals, and proper handling techniques for capturing various species of wild herpetofauna.

I would like to spread knowledge of this activity guide to educators as a free public resource. I will be proposing to the Minnesota Herpetological Society that we publish these resources for free on their website. This includes possibly preparing presentations to exhibit the project in front of peers at the Minnesota Herpetological Society and Minnesota Naturalist Association. Depending on suggestions by the rest of the board of directors these resources may be split up into smaller components to make them easier to digest for educators that are new to herpetology. The society is attempting to form a new education committee. I will propose that we formulate ways to make more documents similar to this resource guide available to the public as a way to support our mission of spreading correct information about the ecological significance of herpetofauna. I want to see the organization grow and support educators in any way possible. If we truly wish to support the study and conservation of reptiles and amphibians then we have to inspire the students that hold their future in their hands.

Summary & Conclusion

As a naturalist I came to love a group of animals that many other people find disgusting. Yes, herpetofauna are weird and very different from us, but I think that is part of what makes them so interesting. Misunderstood and feared animals unfortunately do not get the same amount of conservation support as the charismatic megafauna that people commonly like to see or hunt. Every animal has an ecological role somewhere, but human interactions with the environment

are quickly spiralling our ecosystems out of balance. Herpetofauna deserve to be researched and understood. They deserve to be encountered by humans that have enough empathy and compassion to leave an animal alone rather than kill it out of fear.

Through educating the public, and particularly children who will influence our future with the environment, we as educators help shape the ideas, attitudes, and perceptions of others. Our lessons influence the children that will grow into future scientists, politicians, and conservationists. We have the power to help change social norms about how people interact with animals and the environment. We have so much potential. Students have so much potential. We can foster their love of the environment and show them the way to be compassionate of animals that most other people dislike.

Go into the woods with your students and pick up a toad and look at it closely. Show them how its toes can grab the tip of your finger like you are shaking hands. Watch it blink its golden eyes ever so slowly. Touch the bumps on its back, each one a little different from the other. Find a gartersnake slithering through the grass and pick it up. Feel the snake's scales glide over your hand. Watch its black and red tongue flick out and wiggle as it tries to learn about your smell. Set the animals down gently, watch them go on their way, then share your stories with everyone you meet.

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