An Investigation of Seventh Grade Students' Attitudes Towards Animals in a Middle School Science Classroom in Rural Alabama

by

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Abstract

This dissertation examines the different types of attitudes toward animals held by 7th grade students in one middle school in the rural southeastern part United States. This study was conducted using seven-point Likert scale surveys over the course of 5 weeks. Each survey contained twenty items consisting of a wide range of animals across four phyla. These surveys showed that students preferred smaller, local, colorful, vertebrates to other animals. The objective of the study was to determine what types of attitudes students exhibited towards animals presented in the surveys and what influenced these attitudes. The results show that students' attitudes mostly result from knowledge and exposure to a certain species, with aesthetics and perceived threat of the animals used to inform their attitudes in the absence of content knowledge or exposure to the animals. This project also examined students' attitudes and knowledge toward bats and questioned if the bat curriculum would influence these attitudes and science content knowledge. The survey toward bats used pre and post testing items and found that educational intervention did improve attitudes ($t(48) = -6.9$, $p < .001$) and knowledge X^2 (1, $N = 49$) $= 19.2$, $p < .001$ toward bats by a statistically significant amount. Themes discovered that strongly impacted student attitudes toward animals were knowledge, aesthetics, exposure, and taxonomic relation of the animal to other animals.

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Table of Contents

List of Tables

List of Figures

CHAPTER I: THE PROBLEM

Introduction

Problems with Attitudes Toward Animals

The problem addressed here is the lack of research to determine the animal values possessed by adolescents in the rural southeastern United States. These attitudes could be the deciding factor for the conservation of a species in the future. Scientists now believe we are entering the sixth mass extinction event. Species extinction rates are one thousand times higher than background extinction rates suggest they should be, and the main cause of this is linked to anthropogenic factors including deforestation, climate change, invasive imports, and overharvesting, which all impact this mass extinction (Ceballos et al., 2015). The attitudes of young people are particularly important, as they will be the adults making future decisions about conservation efforts based on their values and attitudes. By educating people, these values and attitudes can be changed (Kellert, 1980). In order to properly educate students about animals that may be seen as "bad", educators need to know why it is seen that way in the area in which they teach, as geographic location has been shown to be a major indicator of attitudes toward animals (Kellert, 1980). In the following section, geographic location is described as a factor that has historically impacted people's attitudes and values.

Geographic Location Problems

Geographic location is a major indicator of attitudes toward animals, and looking at the rural southeastern US, a high impact on utilitarian value for animals as seen in conservation efforts that focus on game animals (Diefenbach, 1997) and symbolic value is based in the predominant religion in the area (Nicolaus, 2011). For example, some popular game animals in the rural southeastern US are deer, boar, and fish. For this reason, conservation of these animals is so important that lakes are actually stocked with fish that would not otherwise be able to reproduce and survive in large enough numbers for the fishing sport. Also, deer are to be hunted during certain times of the year in order to keep the species' populations stable. An example of how Judeo-Christian values impact animals, serpents are sometimes seen as servants of the devil and are often killed when spotted outdoors, and black cats are depicted as symbols of misfortune as well as the familiars of devil-worshipping witches, and are often mistreated (Frazier, 1985; Cohn, 2004). The southeastern portion of the United States is also known as the "Bible Belt" due to the large number of evangelical Protestants, and Christianity is extremely dominant in the region compared to the rest of the United States (Heyrman, 2013). With the values of utility and symbolism in mind, attitudes toward animals in the rural southeast can be skewed toward animals that can be hunted and away from animals that are seen in a negative religious light.

Focus on game animal populations has already been seen to harm other organisms in an ecosystem multiple times and yet deer and largemouth bass over population continues to exist due in part to the utilitarian value of the species (Kohler & Kelly, 1991; Rooney & Waller, 2003). When animals are observed for only their utility, this can have disastrous impact on this species as well as others. Deer and largemouth bass overpopulation puts stress on an ecosystem which causes harm to other species in the ecosystem. These species are added to ecosystems and

stocked in areas for hunters and anglers to harvest and they pay a fee to do this. Plant species that are eaten by deer diminish and other species that are not eaten gain an advantage. Bass consume other species of fish and can reduce or even eliminate entire populations of fish in an area (Kohler & Kelly, 1991; Rooney & Waller, 2003). Though not directly observed through historical documentation, but only through fossil and archeological evidence, humans seem to have been the cause of large bird extinctions throughout the Pacific islands. The Moa (*Dinornis novaezelandiae*), Elephant Bird (*Aepyornis maximus*) and Hawaiian Flightless Swan (*Thambetochenini*) went extinct during early human expansion to the Pacific islands. Evidence supports that these birds were hunted for food by the Maori people (Diamond, 1989). There is a debate in the archeological community regarding the human impact of the extinction event that eliminated most mammalian megafauna from the Americas. However, there is some support that these charismatic megafaunas including the wooly mammoth (*Mammuthus jeffersoni*), mastodon (*Mammut americanum*), and giant ground sloth (*Megatherium americanum*) were hunted to extinction by immigrating human populations (Guthrie, 2006; Haynes, 2002). The perceived value of these animals to the human population immigrating to the Americas was one of utility. They were seen as an item to be harvested with no other values associated with them (Diamond et al., 1989).

Symbolic Value Problems

The symbolic value of animals possessed by some in the rural southeast can also impact conservation efforts. Animals can be seen by some as evil, either through religious symbolism or the media. These animals will be less likely to receive aid if conservation efforts are needed to save the species. Examples of species that faced this challenge over time around the world include snakes, rodents, and bats (Millsap, Gore, Runde, & Cerulean, 1990). In parts of the

western world, snakes, rodents, and bats are often symbols of evil or emissaries of the enemies of good, as described by religious texts of the Western World. (Frazier, 1985). Rodents were seen as part of evil rituals of the indigenous people of the New World by Old World Christian missionaries even though these rodents were just part of their diet (Sandweiss & Wing, 1997). Bats are sometimes still seen as a form that vampires take to invade households while people inside sleep (Prokop, Fančovičová & Kubiatko, 2009). Cats also suffered from a change in their symbolic value. Pope Gregory in the early 13th century declared that Lucifer was half cat and that he was worshipped in the form of a black cat. Black cats were then hunted and killed. This extirpation of cats most likely played a role in how quickly the black plague spread across Europe (Cohn, 2004).

A mix of symbolism and utilitarian values came together to bring about the extirpation of the grey wolf (*Canis lupus)* from across the continental United States. This species was seen as a threat to people and a threat to our utility animals, such as pigs, sheep, and chickens, which wolves would predate. This fear is shown in stories of the times such as *The Three Little Pigs* and *Little Red Riding Hood*. The grey wolf was extirpated from the United States and this lack of a top predator resulted in large herbivore populations, mainly Elk (*Cervus elaphus)* and White Tailed Deer (*Odocoileus virginianus*), increasing beyond the carrying capacity of the ecosystem (Vucetich, Peterson & Waite, 1997).

Attitudes

Attitude is defined as a set way of thinking or feeling about someone or something, typically a way of thinking or feeling that is reflected in a person's behavior. In psychology, it is a construct of the mind and of emotions that results in behaviors and actions toward a person, place, thing, or event. This is called the attitude object. Attitudes are a complex construct of the

mind that often come from experiences (Fishbein, 1963; Gross, 2015). Attitudes are thought to be derived by a mix of explicit and implicit measures. Explicit measures are at the conscious level and are easily reported. Implicit measures are formed at an unconscious level and are typically unknown to a person (Fazio, 1990). Attitudes serve a function in helping preserve or maintain the psyche of a person, and therefore, the only way to change a person's attitudes is if the function it would serve is greater that the function served by maintaining those attitudes (Katz, 1960; Knight & Boster, 2001).

Katz (1960) described the four functions of attitudes as adjustment, ego defense, value expression, and knowledge. Adjustment attitudes are those that are rewarding to people and/or help them avoid punishment. For example, bee stings hurt, so people typically avoid flying insects that can bite or sting (Batt, 2009). Ego defense is described as an attitude that protects a person from psychological harm. Examples of this might include denial, repression, projection, or rationalizing a situation (Pellitteri, 2002).

Knowledge attitudes are those that help a person maintain a stable world view. They are not necessarily factual knowledge, but things a person considers true and are part of logic statements, an example could include "Good things happen to good people. I believe I am a good person. I believe black cats are bad luck. I didn't get the job I wanted because I crossed paths with a black cat the day of the interview." These knowledge attitudes help a person rationalize their world and the events in it (Katz, 1960; Olsen & Zanna, 1993). Value expressive attitudes serve to express one's central values and self-concept. These are involved with the development of our self-identity and grant us social approval within a particular group (Maio & Olsen, 2000). An example of this would be a person's attitudes toward a politician or celebrity in light of a terrible scandal.

These four constructs: adjustment, ego defense, value expression, and knowledge, must be addressed when trying to change a person's attitudes. Attitudes come from an emotional and/or intellectual place and must be addressed accordingly (Barmby, Kind & Jones, 2008). There are numerous concepts involved with this idea of changing attitudes and many are appropriate in different settings and for different age groups (Zimbardo & Leippe, 1991).

Attitudes are developed as part of experiences within a person's life. These attitudes can change how a person feels and acts toward a particular subject (Olsen & Zanna, 1993). Attitudes toward animals have always played a major role in deciding the fate of a species. A declining, or at risk of becoming extinct species that is popular or generally loved by people is more likely to be saved from extinction than a less popular species (Lee & Priston, 2005). This means that conservation is a public issue that involves everyone.

Attitudes Toward Animals

Attitudes toward animals are created through various factors within a society. Kellert (1985) stated that these specific perceptions of values can be quantifiably assessed. In this section, a variety of "animal values" will be described, and examples of each will be given. The values and the attitudes they modify will be described in more detail in chapter two, but a brief overview is important for helping the reader understand the context for the rest of this dissertation. These animal values include: Naturalistic/outdoor recreational value, ecological value, morality value, scientific value, aesthetic value, utility value, and symbolic value.

Definitions of Animal Values

The naturalistic value describes how valuable an experience with a particular animal species is in a wild setting. For example, someone who sees a sloth in a rain forest is probably

going to have a more positive attitude toward sloths because they will have an experience that increases naturalistic value of sloths (Ballantyne, Packer, Hugher & Dierking, 2007).

Ecological values describe how important a species is to the stability and structure of an ecosystem in the mind of a person. For example, sea otters (*Enhydra lutris)* are a keystone species in the coastal Pacific environment, but people did not consider them to be important to the environment, and over hunting of this species nearly led to the collapse of that ecological environment (Mills, Soulé, & Doak , 1993).

Morality values are associated with the principles concerning the distinction between right and wrong humans feel and associate with a specific animal and its right to live. For example, this value is part of the decision of some people to give up various foods and is also part of the conversation related to the complete eradication of species like mosquitoes (Bouyer & Lefrançois, 2014).

A scientific value is the value of that animal to the scientific community. For example, a species that has been found to be resistant to human diseases or has been newly discovered has higher scientific value associated with it when compared to other species (Race, Raines, Raymond, Caughey & Chesebro, 2001).

An aesthetic value is the physical attractiveness of the animal to people; this could be the value a hummingbird or deer brings to a person's backyard or just how some people think butterflies are pretty (Mizejewski, 2004).

A utility value involves looking at the usefulness of the animal to humanity in the present and future (Pica-Ciamarra, Tasciotti, Otte & Zezza, 2011). Livestock animals would be those with high utility value to most people (Damron & Damron, 2013).

Symbolic value, also called cultural value, is a value associated with the religious beliefs, societal experiences, and/or unique attachments to the species within a culture. For example, the bald eagle as a symbol of freedom in the US, the dove a symbol of the holy spirit in Christian religions, and a black vulture as a symbol of death in Mayan cultures (Tresidder, 2005).

In summary, values are what affect and create our attitudes toward animals. The relationship between attitudes and values is not linear and is a summary of all of these values and the strength of each value combined.

Attitudes in Teaching About Animals

In the past decade, there has been increased interest among researchers regarding the attitudes of students in the classroom (Jenkins & Nelson, 2005). Attitudes in teaching have been found to be more important than once believed (Koballa & Crawley, 1985). This is especially true in science, where many teachers focus simply on concepts and facts and not on promoting interest. This lack of promoting interest is suspected to be a factor in the lack of students enrolling in degree programs that will lead to science-based jobs (Osborne, Simon & Collins, 2003). Educators have also begun to promote more interest in the subjects as attitudes toward a subject and academic achievement have been found to have a positive correlation (Shrigley, 1990). In recent years, educators have been attempting to improve attitudes and educating with styles of teaching that have been found to promote longer retention and interests in the subject (Lineberger & Zajicek, 2000).

Problems in Education About Animals

Perceptions of animals also play a critical role in developing attitudes (Kellert, 1984). Kellert (1984) found that attitudes toward vertebrates and arthropods came from the perceptions people living in urban settings had toward these animals. These perceptions were derived from a

mix of personal experience and education of the person. Kellert mailed surveys to people across the United States and asked them questions about their demographics including sex, race, age, income, and education level and them asked for their opinion of various animals using a Likert scale survey. The more educated the person, the higher their likelihood of having positive attitudes toward animals. In the following section, the impact of education on attitudes will be described.

Educating people about animals has been shown to promote less harmful behaviors toward animals, even those seen in a negative connotation (Dawna & O'Neal, 2015). Education can also be used to promote conservation of natural resources and biodiversity by improving peoples' attitudes toward an area or groups of animals. Promotion of appropriate attitudes toward exercise and outdoor recreation has been found to increase these things in school-aged children. This has been accomplished via physical educators promoting activity in extracurricular sports and clubs (Trudeau & Shepard, 2005). The problem is that it is unknown how to address students when educating about animals in order to promote better attitudes in the rural southeastern US. Assessment of adolescent youth's attitudes toward animals is necessary in order to find out how to improve their attitudes. However, most research of this type only involves young children. Another problem is that education of adolescents may not yield the expected results, especially with animals seen in a negative connotation. Kellert (1980) found that age was a significant factor in attitudes toward animals and the ability to change them. The older the person, the more solidified their attitudes toward animals are. Stevens, Allen, Lawrence, and Sullivan (2015) found that even when presenting people with facts it can be hard to change their held beliefs, and no research exists that suggests changing attitudes toward animals is any different. It is only after a person's presuppositions related to the concept and

their initial thought model are reinterpreted or dissolved can we change a person's perceptions (Vosniadou & Brewer, 1992)

Significance of the Study

This study aims to contribute to the knowledge base about attitudes toward animals as previous research has done, however this study will look at adolescent students in a rural school district in the southeastern United States to see if their attitudes match with what has been found throughout the rest of the United States, which is that domestic mammals are liked more than non-domestic animals and as animals move away from us evolutionarily, US citizens typically like them less (Almeida, Vasconcelos & Strecht-Ribeiro, 2014). A person's cultural background gives insight into expected attitudes toward animals (Kellert & Berry, 1981). Additionally, this study will look at morphological traits of animals and their closest relatives to see exactly which animal traits impact or influence children's attitudes toward them. Finally, this study will investigate attitudes toward bats and see if these attitudes can be improved through an educational intervention.

CHAPTER II: LITERATURE REVIEW

The Southeastern United States

The Ecology of the Southeastern United States

The southeastern United States is an ecological wonderland that has been described numerous times as being akin to the tropical rainforests of South America and Africa (Lydeard & Mayden, 1995; Martin, Boyce & Echternacht, 1993; Phillips, Falls & Johnson, 2006). The species diversity in the southeast is most likely due to the protection provided by the Appalachian Mountains during the last ice age two million to ten thousand years ago. Glaciation, or migration and covering of the land in glaciers, did not occur due to the barrier that is the Appalachian Mountains. Species emigrating during the ice age from glaciers found refuge in the southeastern United States. This event is thought to be the reason for the incredible species diversity, particularly in freshwater-dwelling species (Long, Kulp, & Eckelman, 1959; Lydeard & Mayden, 1995).

The rivers and streams of the southeast, when compared to the rest of the United States, contain much higher levels of biodiversity and endemic, or native, species. There are over 400 species of fish in the southeast, 300 species of mussels and clams, 150 species of amphibians, and over 4,000 species of arthropods (Folkerts, Deyrup & Sisson, 1993; Lydeard & Mayden, 1995; Moriarty, n.d.; Williams, Warren, Cummings, Harris, & Neves, 1993).

Fresh water is a critical resource and few high quality and free flowing rivers remain in the United States primarily due to the creation of dams. This has led to fifty percent of species of

fishes, turtles, and freshwater mollusks being imperiled, endangered, or becoming extinct (Lydeard & Mayden, 1995). One of the major threats to these species is the construction of dams by people. Dams create different temperature gradients within a stream ecosystem, with water behind the dam becoming colder and water after the dam becoming warmer (Collins, Rogers, Smith & Moser, 2000). Numerous dams have fragmented many of the large rivers crossing the southeast including the Chattahoochee-Flint system, the Tennessee River, and most of the rivers that lead into the eastern Gulf of Mexico (Ward, Harris & Ward, 2005). These temperature changes can result in trophic and environmental effects that reduce the number of surviving progeny for fish and mollusk species. Another factor threatening endemic species in the southeast is the desire for fishing for species such as the largemouth bass. Largemouth bass consume many endemic species while they are juveniles and are partly responsible for declining levels of these species. Lake are often stocked with largemouth bass to bring in economic revenue through sports fishing (Noble, 1981).

The terrestrial ecology of the southeast rivals the ecotourism hot spots of the world (Martin et al., 1993). There are 90 species of mammals and 376 species of birds in the southeastern United States (Brown, 1997; Rappole, 2003). This biodiversity comes from the wide range of habitats represented in the southeast. In the southeast, a wide variety of habitats exist from hardwood forest to coastal beach dunes, and numerous habitats in between (White & Jentsch, 2001). Terrestrial habitats across the southeast are threatened by anthropogenic factors such as pollution, housing development, and farming (Goldstein, Koven, Heald & Fung, 2009). Another factor impacting terrestrial habitats in the southeast is promotion, or growth, of habitats appropriate for game species. This mainly means the promotion of hardwood forest growth in game and state parks (Diemer, 1986).

Economy and Education in Rural Schools

Kellert (1980) found that economic status and education level were positively correlated with attitudes toward animals. The economy of the southeast for the past century has been one of agriculture, focused around the cotton crop (Hall, Leloudis, Korstad, & Murphy, 2012). From this crop came jobs in farming and jobs at mills working the cotton into all types of materials from clothes, linens, and yarn. These mills kept the economy strong until many of these jobs were replaced with machinery or were moved overseas to reduce cost (Pfannenstein & Tsai, 2004). This hurt the economy of the mostly rural southeast, and due to these changes the rural southeast has gone from a production economy with the mills to a more service-based economy that has been disproportionately associated with nonstandard work, including part-time, temporary, and contract work, and more often, no benefits such as health care and retirement plans

(McLaughlin & Coleman-Jensen, 2008). A rural area is defined as a place where most of the land is undeveloped or agricultural in nature, or an area that is not located in a town or city (Hart, Larson, & Lishner, 2005). Now, the southeast is the poorest of the four major regions that make up the United States, with it having the most people living below the poverty line. The average household income is $36, 901 and the unemployment rate in the southeast is 5.0% (DeNavas, Proctor & Smith, 2011; United States Department of Labor, 2018). These events have led to more concern for rural youth and the schools that educate them (Petrin, Schafft & Meece, 2014).

Rural schools are defined by The National Center for Education Statistics (NCES) as "schools that do not lie inside an urbanized area or urban cluster" (Strange, Johnson, Showalter, & Klein, 2012). Thirty three percent of American public schools are rural, and sixty percent of these schools are in the southeastern United States. Twenty percent of students attend a rural school (Williams, 2010). Rural communities are perceived as "ill equipped to run their own schools and prepare students to be economically competitive and productive in a modernizing world" (Schafft & Jackson, 2011). Barriers to STEM education in rural areas include acquiring material and learning concepts, and not being able to apply concepts to students' real lives (Avery & Kassam, 2011). Science education in rural schools has several differences with urban schools.

1) Rural schools are more isolated, this leads to fewer learning opportunities outside of the school from universities, businesses, and science advocates. This isolation is not only social, but can also be technological. Rural populations often have worse Internet and cell phone reception than their urban counterparts. This lack of Internet leads

to a lack of online educational opportunities for some students, and teachers cannot use online educational opportunities for homework (Avery, 2013).

2) Rural schools are often less funded than their urban counterparts (Williams, 2010). On top of this, twenty percent of rural students also live in poverty (Strange et al., 2012). This combination can make education, particularly science, technology, engineering, and mathematics (STEM) education for both teachers and students difficult, due to cost restrains. This lack of funding results in the inability of the school to hire qualified teachers, afford materials for education, or pay for groups, such as universities or science advocates, to come in and provide additional learning opportunities (Avery, 2013).

3) Rural schools, due to previously mentioned problems, end up creating a "learning to leave mentality," where those with exceptional or even average skills will leave these rural areas to seek better employment opportunities elsewhere. This emigration coupled with declining immigration leads to declining cultural and intellectual capital vital to rural communities (Deitz, 2007).

4) This combination of low funding and isolation makes it difficult for rural schools to attract and keep highly qualified teachers, especially in STEM fields. State and federal incentives often promote qualified teachers to urban schools where they receive bonuses or tuition waivers for additional education (Sipple & Brent, 2008). Teachers with backgrounds in chemistry, physics, or calculus may not be able to teach these courses in a rural school because the student body is too small to support advanced courses, or one teacher may not have time during the day to teach and prepare for multiple, small classes (Avery, 2013).

Attitudes and Values Toward Animals

This section will discuss the complexities of attitudes and values toward animals and seven of these articles will be reviewed in detail due to their direct work researching attitudes toward animals.

Attitudes and Definitions

Attitudes toward a subject are integral to increasing interest in the subject (Osborne et al., 2003). Attitudes, once formed, are enduring and difficult to change (Ajzen & Fishbein 1980; Vosniadou, 1994). Concern with the people's attitudes toward animals is not a new subject (Driscoll, 1992; Kellert, 1980). Throughout history, and even in prehistoric times, the attitudes toward a species has influenced or even decided the fate of a species. There are nine categories of attitudes people might hold toward animals (Kellert, 1980).

Naturalistic Attitudes. Those with a naturalistic attitude have a primary interest and affection for wildlife and the outdoors. For example, an Eco tourist, such as a bird watcher, who takes trips into the wild without intentionally harming the ecosystem or organisms in it probably has an attitude based on the naturalistic value (Brightsmith, Stronza, & Holle, 2008).

Ecologistic Attitudes. Those with an ecologistic attitude are concerned with the environment as a whole and relationships between species. This might include a conservationist for a nature preserve or an environmental lawyer (Garibaldi & Turner, 2004). Ecologistic attitude has been critical for preservation of the Grey Wolf in Yellowstone national park as wolves as a keystone species that help increase biodiversity by keeping elk numbers from getting out of control (Wilmers, et al., 2003).

Humanist Attitudes. A humanist is someone who has a strong affection for individual animals, which mainly includes household pets, but may include wildlife. For example, zookeepers often form strong bonds with the animals that are under their individual care (Hosey & Melfi, 2012).

Moralist Attitudes. Moralists are concerned with the treatment of animals in any situation. For example, a person who decides what company to buy from based on if animals were used to test products at that company has strong moralistic values. Vegans also commonly cite moralist values asa reason not to consume animal products.

Scientist Attitudes. Those with a scientistic view are concerned with the physical attributes and function of animals, an engineer who is interested in making robots that move in the most energy efficient way, such as robots that move like arthropods or vehicles that has a fusiform shape like many burrowing, flying, or swimming animals have to reduce resistance, might have a scientistic view when observing animals (Ritzmann, Gorb & Quinn, 2004).

Aesthetic Attitudes. Those with an aesthetic attitude are interested in animals for their appearance or what they symbolize (e.g., bald eagle is a symbol of freedom) (Knight, 2008). Sports teams commonly have animal mascots so those animals could be liked or disliked based on the opinion of the team a person has.

Utilitarian Attitudes. Those with a utilitarian view are concerned with the value of an animal, or the habitat used by an animal. Though the utility of animals today is usually associated with economic gains, it is not limited to that. For example, a hunter that hunts animals for resources has a utilitarian view. Mass production of animals for food consumption is often associated with a utilitarian value for that animal.

Dominist Attitudes. Dominists are primarily interested in the mastery of animals, particularly in a sporting scenario or animal fighting (e.g, horse or dog racing, cock fighting) (Agnew, 1998).

Negativist Attitudes. Negativists avoid animals due to indifference, hatred, or fear (Kellert, 1980). Kellert (1980) generated these values from mail survey responses of Americans. These values were based on responses to genera and polyphyletic, or animals that do not all share the same immediate ancestor, groupings of animals and this could bias scores for certain species. Common animals to have negativistic attitudes toward in the United States are snakes and spiders (Ozel et al., 2009; Prokop et al., 2010).

Perceived and Actual Values

The values that influence attitudes toward animals should be split into perceived values and actual values. Perceived values can be defined as values a person derives from personal experiences. This can be attachment or resentment to particular animals based on media influence, misconceptions, educational experiences, encounters with the species, or any other experience a person has with an animal that impacts attitudes toward that animal. Actual value looks at the value the animal has as part of a population, community, habitat, ecosystem, and biome, and any impact it may have on any species or individual. These values are not necessarily values we can truly know but do exist (Folkerts, personal communication, December 13, 2017). Looking at Kellert's (1980) list of measurable values naturalistic, humanistic, moralistic, aesthetic, doministic, and negativistic values can be categorized as perceived values, and ecologistic, scientistic, utilitarian can be categorized as actual values.

Interactions of Values and Attitudes

The purpose of this research is to expand on Kellert's (1980) definitions or point out concepts that may relate to his values. For example, though many of these values seem inherently good, they can also decrease attitudes toward animals. Community interactions, which are defined as actions taken by populations of species toward one another, can include "good" things such as species cooperation, but can also be things such as predation, resource competition, and parasitism (Vaughan, Ryan, & Czaplewski, 2015).

Interaction of Ecologistic Values and Attitudes. For example, "ecologistic values" can also decrease attitudes toward non-native or invasive animals. Non-native species are species that have come to a place through anthropomorphic means (Schlaepfer, Sax & Olden, 2011). Invasive species are non-natives that suppress or threaten native species. For example, feral pigs (*Sus scrofa*) destroy habitat of native animals across the United States including our native pig, the collared peccary (*Pecari tajacu*), which has led to reduced populations of the native pig (Desbiez, Santos, Keuroghlian & Bodmer, 2009). The same person may have different attitudes toward the same animal due to the location. If an animal is considered native, non-native, or invasive can affect our attitudes, either confirming or dissolving those attitudes (Kueffer & Kull, 2017). Ecosystem stability, or how well an ecosystem can return to its original state after a disturbance, is also most likely a factor involved with ecologistic values. A main reason for this connection is that ecosystem diversity, or the name of species living in an area, increase the ecosystem stability or that ecosystem (Loreau & Mazancourt, 2013).

Interaction of Naturalisitic Values and Attitudes. Naturalistic value has several layers to the concept that should be explored to see what drives this value for any person. Concern for the environmental integrity should be considered as part of the naturalistic value. Environmental integrity is defined as the health of an ecosystem based on exposure to pollutants or damage from manmade or natural disasters (Khan, Lyla & Khadharsha, 2017). An ecotourist may not care about those things as long as an animal of interest is thriving. This shows how ecologistic value and naturalistic value can overlap and/or influence each other. For example, due to global warming interest in polar bears has increased at zoos and aquariums (Derocher et al., 2013). The lack of environmental integrity in this example led to increase in the species through both naturalistic values, wanting to see a polar bear in a wildlife setting, and ecologistic value, where more people want to help preserve the habitat or the polar bear. (Gusset & Dick, 2011)

Interaction of Humanistic Values and Attitudes. The term "humanistic value" has a few concepts within it that could be better defined. One of these concepts is the anthropomorphizing of animals. Anthropomorphism is defined as imbuing the real or imagined behavior of nonhuman agents with humanlike characteristics, motivations, intentions, or emotions (Epley, Waytz & Cacioppo, 2007). People are likely to anthropomorphize when observing an animal and give it more "humanistic" traits, based on research this means a person's attitudes toward that animal will improve (Kellert, 1980). An example of this would be the popularity of octopi in aquariums compared to other mollusks. Octopuses often perform intelligent behaviors that are seem as extremely human-like and therefore people discuss anthropomorphized concepts related to them (Anderson, Wood & Byrne, 2002). Another concept that should be divided the researcher

would like to call the “evolutionary family”. This is where people consider a pet to be like a child. This is quite common and is another way that the humanistic value is expressed by people. Not only does this show up as just a term calling the pet a family member but also in behavior. A study found that most people who refer to their pet as a family member would give a scarce drug to save their pet over a person who was outside of the family (Cohen, 2002).

Interaction of Scientist Values and Attitudes. The “scientitistic value” could split into three categories. The first the researcher will call the “engineering value”. This is where scientists and engineers look to an animal and its anatomy and physiology as a blueprint for designing a tool or machine to help humans in an exploration or other endeavor (Ritzmann et al, 2004). The other category could be called the “medical value” this is for the animals that are used to research human medicine in order to find cures for our diseases, for example this could include lab mice and rats that are used to test most drugs on mammalian subjects (Magaki et al., 2017). The third category is the “psychological value” where animals are used to learn more about the development of the mind in our evolutionary history. This is done through performing experiment that test the critical thinking or problem solving skills of an animal and compare them to other animals and to humans at various ages. Examples of this include testing the ability of an animal to recognize itself in a mirror, solve puzzles for rewards, and cost-benefit analysis (Huttunen, Adams & Platt, 2017; Wang, Hu, Shi & Li, 2017).

Interaction of Aesthetic Values and Attitudes. Aesthetics play a critical role in everything people do. Attitudes toward animals in no exception. Aesthetics can be presented in several ways that will impact attitudes toward an animal. First we should

consider the evolutionary relation and anatomical similarity to us as a factor of aesthetic values. Relation to us has been found to be positively correlated with attitudes (Almeida, Vasconcelos & Strecht-Ribeiro, 2014). This should be called the "similarity aesthetic". A second type of aesthetic value relates to the attractiveness of the species. People have been found to have better attitudes toward animals that are colorful and appealing to look at (Knight, 2008). For example, based on Knight's (2008) research, all else equal people would prefer a parrot to a crow due to the colorful plumage of the parrot.

Previous works have rarely looked at attitude differences between closely related animals. Almeida et al. (2014) found that animals people thought were aesthetically pleasing scored higher than other similar animals, for example, they found that butterflies and caterpillars had very different associations. Another study looked at larger taxonomic subclasses (e.g., herptiles, invertebrates) to group animals to see generalized attitudes (Borgi & Cirulli, 2015). These studies, though excellent and insightful, did not look deep enough into one or more groups to see specifics that make that group appealing or disliked. For example, even though it is well known that domesticated mammals are the most preferred group we have no idea exactly why. It could be many of the ideas suggested in previous work or something more subtle such as the facial muscles known as platysma, which allow mammals to make facial expressions that other taxa of animals cannot do, trigger cues from us as fellow mammals (de Castro, 1980).

Interaction of Dominstic Values and Attitudes. The term "dominstic value" should be split into two categories. The first category the researcher would like to call "dominstic partnership" where the animals and people work together to best the competition. The person does not think they are superior to their animal, but instead they

are working together to best others in the competition and injury or death is not a planned part of the competition. Examples would include horse racing where jockeys often describe their relationship with the horse as a partnership where each must have trust, respect, and confidence in the other and communication is key (Wipper, 2000). Another example would dogs and handlers at dog shows where a strong bond formed around trust and communication between the handler and the dog is crucial to winning any of these dog shows. Though the human is technically in charge in these relationships the animal is stilled allowed volition to an extent as a "partner" in this relationship (Payne, DeAraugo, Bennett & McGreevy, 2016). The second category the researcher would like to define as "doministic leadership." This is where the human is in charge and they are working to best others in competition and injury or death are likely to occur. For example, animal fighting would be an example of doministic leadership. Animal fighting, particularly dog fighting, has been a history embedded with status-driven display of masculinity, power and violence (Kalof & Taylor, 2007). In this type of relationship, one uses the other for gains. If a dog is not able or willing to fight will be abandoned instead of worked with as in a doministic partnership.

Interaction of Utilitarian Values and Attitudes. The term "utilitarian value" should be divided into several smaller values to gain more detail. The researcher is dividing it into three categories: economic value, resource value, and entertainment value. Economic value for any utility term that has to do with making money, for example, a game warden would consider the economic value of game animals such as white tailed deer, as hunting and fishing permits provide a huge income source in some states (Burger, Miller & Southwick, 1999). Resource value could be defined as how you value

the resources the animal can provide you. For example, Mammoths were hunted for their skin to make clothes, bones to build structures and tools, and their meat for sustenance (Guthrie, 2006; Haynes, 2002). Resource value can also be an intangible value the animal may have. For example, dogs that act as service dogs may provide emotion resources for a person that allows them to endure crippling mental and physical issues such as depression or obesity (Burrows, Adams & Spiers, 2008; Topál, Miklósi & Csányi, 1997). Entertainment value would be an animal that entertains humans in some way. This could be by creating activities such as hunting or fishing, being an exciting zoo attraction, or a good pet at home. These values should be considered subcategories of utilitarian value, as one animal can have any of these values at the same time to a single or multiple persons.

Interaction of Negativistic Values and Attitudes. Negativistic attitudes, though the least favorable attitude in the eyes of the researcher, is probably the most complex and should be discussed with this in mind. Several types of negativistic values influence attitudes toward animals, these are experience, culture, and anatomy/physiology. Experience is probably the most simple of the negativistic values. This is when a person's attitude comes from a bad experience with the animal. For example, people who are attacked by even an animal as loved as dogs can come to dislike dogs after this traumatic experience (Peters, Sottiaux, Appelboom & Kahn, 2004). Culture negativistic values are negativistic values that come from the culture of a society where the animal is innately seen as a threat to people, this can be through threat to life or livelihood. For example, hippos (*Hippopotamus amphibious)* are seen as cute animals by many people who do not encounter them in the wild, however they are the most dangerous mammal in Africa with more human fatalities than any other mammal in Africa (Treves & Naughton-Treves,

1999). Killing people is not the only way an animal can be seen in a culturally negativistic light. Impacting livelihoods can also cause change attitudes toward an animal. The best example of this would be the Asian Elephant (*Elephas maximus)*. These animals are all but renowned across the world, however in some parts of Asia they are seen as farm pests. This places the farmers in an interesting situation where their historical interactions with the elephants have changed their attitudes. Asian elephants raid farmlands and even break into houses where they smell alcohol being made (Koirala, Raubenheimer, Aryal & Pathak, 2016). The last group of negativistic values is the anatomical/physiological values. This would best be defined as an animal having an anatomical design or physiological trait that is seen as off-putting or repulsive to people, therefore reducing attitudes toward this animal. Arthropods are often referred to as "creepy crawlies" due to their distinct body pattern that at times almost seems alien (Acorn, 2013). Many animals have physiological abilities people deem to be "weird" and these animals are often not favorite animals. For example, some sea slugs are hermaphrodites, meaning they have both male and female reproductive organs, and when they mate they fight and the loser gets stabbed in the head by the victor and the victor transfer sperm and hormones that will cause the loser to get pregnant with their progeny (Lange, Werminghausen & Anthes, 2014).Overall, researchers have found that people prefer animals that are domesticated and those that are more like us, in other words are social animals that have similar anatomical traits and evolutionary and/or domestication history (i.e., pets and mammals) and dislike animals that can bite or sting, and are the least like us (e.g., caterpillars, wasps, snakes, and spiders; Almeida, et al., 2014; Kellert, 1980). However, in some studies, people positively associate with butterflies, which

brings up the question of aesthetics in the formation of attitudes toward animals (Knight, 2008). Knight (2008) looked specifically at animals seen in a negativistic sense to see what role aesthetics played within this group of animals compared to mammal species seen as charismatic. A critique of this research would be that they could have used species that are more closely related to compare aesthetics across species. Aesthetics is a large category in the research, where people label animals as beautiful or ugly (Almeida et al., 2014). Particular traits or behaviors of an animal that make it aesthetically appealing have not been directly looked at in previous studies.

Empathy Toward Animals

Children need to be taught appropriate attitudes toward animals for several reasons. One, by promoting better attitudes toward animals, we can reduce animal cruelty and promote empathy (Komorosky & O'Neil, 2015). Promoting empathy with others is an excellent way to help people get along with other people, and by teaching people to care for animals first, they will be more likely to care for other people when they are adults (Daly & Morton, 2006). Children who exhibit cruelty toward animals may exhibit cruelty toward fellow humans later in life, including physical and verbal abuse of others (Lockwood & Ascione, 1998). Nearly eighty percent of women who reported domestic abuse also reported that their partner as abused one or more animals, most commonly pets (Ascione, 2007). Poor treatment of animals is a childhood behavior and common attribute of serial killers (Ascione, 2005). Second, the children of today will be the adults of tomorrow, and if they have appropriate attitudes toward animals, they are more likely to have the empathy necessary to try and save and protect endangered species from extinction (Kellert & Berry, 1981).

Animals Promote Interest in Science Learning

Research suggests that animals are an excellent way to get children interested in science (Moss & Esson, 2010; Rennie & McClafferty, 1995). Though these studies suggest that improving attitudes leads to better treatment of animals, there a few suggestions as to how we should improve or change the attitudes of children if they already show negativistic responses or even cruelty toward animals.

Education is becoming more important, especially for species that are commonly held in negative light or animals that help control pest and vermin, including animals like snakes, spiders, and bats (Knight, 2008). Rule and Zhbanova (2012) found that education interventions centered around eight animals that people dislike or fear improved the attitudes of first and second graders. They compiled results first and then began a multimodal educational intervention including story telling related to these species, designing puppets of these species, and finally puppet shows about the species while using the puppets. After this, Rule and Zhbanova (2012) detected an improvement in attitudes toward five of the eight animals in the lessons. The major limitation is the small group of animals they worked on, and one of the animals was listed in such a way that it doesn't differentiate between a number of species. Borgi and Cirulli (2015) also suggested early childhood interventions to improve attitudes of students toward animals. They suggested that early pet ownership can lead to better relationships with other people as well as better understanding of animals.

The age of students has been correlated with how students feel and derive their feelings about animals (Kellert, 1985). Kellert (1985) found that younger (ages 7-9) children's attitudes came from emotional and humanistic values of the animal, meaning

that the children's perceptions are based on how the animal was presented, and would be the greatest factor in how they felt about that animal, despite any educational information that may come with that. Once children got older, their attitudes were derived from more facts and knowledge that the child knew related to the animal and less on the presentation or situation the animal was shown in. For example, showing a snake that has a frog in its mouth could cause younger children to dislike snakes but would not be as significant a factor for older children who could consider the fact that a snake is a carnivore as part of their attitudes. This means that if children are receiving misinformation about animals, they could be influenced to treat the animal poorly (Kellert, 1985).

Educators are working to inform people about snakes and spiders, and this work seems to help improve the attitudes of people toward these animals (Lolley, personal communication, June 10, 2016; Prokop et al., 2010; Rule & Zhbanova, 2012). Most people have an innate tendency to seek out nature and other life; Kellert and Wilson (1995) coined the term "biophilia" to describe this love for nature. Since most people are innately interested in nature, zoos and botanical gardens provide an opportunity to educate people about animals and plants. Zoos provide a non-traditional education opportunity for people to experience, as well as provide conservationists a place to share the history of an endangered species (Moss & Esson, 2010). A concern is that new ways to improve students' attitudes toward animals, particularly older students, are not being explored. Previous research by Kellert (1985) suggests that how older students' attitudes are formed is significantly different from younger students, but current research that looks to improve attitudes toward animals is done primarily with younger (K-5) students or students of college age (Almeida, 2014; Kalof, Zammit-Lucia, Bell & Granter, 2016;

Rule & Zhbanova, 2012). This research involved students in secondary education and allowed researchers to see differences in how attitudes are formed in the student group.

Summary of Attitudes and Values Regarding Animals

In summary, attitudes toward animals are complex and multifaceted and categorizing all the attitudes can be a difficult and tedious process. We are drawn to animals that are like us and are part of our lives, and show less favorable attitudes toward animals that we do not have as much in common with. Education has been found to be effective at modifying attitudes but most of the research involves very young students and the methods to educate younger students have been found to be different than the methods to educate older students. Though it fills a knowledge gap to know that early interventions are effective, not every student is going to be exposed to these opportunities early in life. The issue of interventions with older people, originally noted in Kellert's (1980) research, are that older students are often set in what they think and how they feel about a particular subject. Though this is well documented very little has been done to improve attitudes in older students, instead most researchers focus on early invention as the best path researchers can take.

Attitudes Toward Bats

This section provides an overview of the situation regarding attitudes toward bats. There is a paucity of work concerning the effects of educating people about bats despite bats being common across the entire United States (Hester et al., 2007). Bats, like snakes and spiders, are viewed in a negative way by most people in the population (Knight, 2008). The main reason for this dislike of bats has to do with rabies. Bats are the third largest vector of the rabies virus (Hester, Best, & Hudson, 2007). Also, bats do not

display the stereotypically furious form of rabies that is typically depicted in films such as *Old Yeller* (1957), *Kujo* (1983), and *Quarantine* (2008), and when infected, typically fall to the ground and do not move quickly. This causes people to be more likely to pick up or encounter the slow moving sick bat than a healthy bat and causes encounters with infected bats to be more common than encounters with healthy bats, as rabies in bats is rare (<2% of bats) for the bat population (Hester et al., 2007). Rabies is very rare in bats, however the bats people see on the ground not moving are the few that do have rabies, this skews perception of bats and causes people to believe all bats have rabies (Hester et al., 2007).

Positive Attributes of Bats

Bats do more to help people than most people know (Boyles, 2011; Prokop et al., 2009). Most bats are insectivores, meaning they eat insects (Vaughan et al., 2015). Each bat must eat its body weight in insects each night, and a large portion of this is usually pest insects such as mosquitoes and grasshoppers. Mosquitoes are a vector of many diseases, and without predators such as bats to predate them, their numbers could increase and cause risk for humans (Nauen, 2007). Bats are voracious predators of many crop and forest pests and consume enough insects to protect 3.7 billion dollars in crops a year (Cleveland et al., 2011). Bats are also excellent fertilizers of soil (Harvey, Altenbach & Best, 2011). Guano from bats has long been mined from caves for use as fertilizer on agricultural crops due to the high concentrations of nitrogen and phosphorous, the primary limiting nutrients of most plant life (Kunz, Torrez, Bauer, Lobova & Flemming, 2011). These types of traits that are beneficial to humans are often valued by people, resulting in a more positive attitude toward these animals, but this does not seem to be the

case with bats (Driscoll, 1990; Knight, 2008; Kunz et al., 2011). Based on the values associated with attitudes toward animals described by Kellert (1980) bats have several values strongly attached to them.

Negative Values Toward Bats

Bats have many negativistic attitudes and values attached to them due to their association with rabies and the possible misconceptions around their diet. Many people believe that all bats drink blood, however most eat insects (Vaughn et al., 2015). Second, bats have utilitarian value attached to them based on estimates of the number of insects eaten and guano produced that fertilizes agricultural crops per year. The same traits also give them ecological value as they do these same things everywhere and not just where people are (Cleveland et al., 2011; Harvey et al., 2011). The issue appears to be that the misconceptions associated with bats cause strong negativistic feelings that cannot be overcome without informing people that these are misconceptions and presenting the facts in a way that will help create cognitive dissonance. (Kunz, 2009).

Bat Education

Educating young children about bats has been found to improve their attitudes toward the order. Rule and Zhbanova (2012) found that education interventions centered around eight animals that people dislike or fear improved the attitudes of first and second graders. Students read stories about bats and made bat puppets which they then used to perform puppet shows about the normal lives of bats. These stories often demonstrated the good things bats do for us and gave a realistic view of rabies related to bats. The methodology of the study used a pretest and posttest regarding 8 groups of animals that are typically disliked. The test was a Likert scale survey regarding attitudes toward these

8 groups of animals. The groups were mice, skunks, centipedes, bats, snakes, spiders, cockroaches, and mosquitoes. Following the pretest, educational interventions in the form of poetry, crafts, and puppet plays were done in the classroom with the students. Rule and Zhbanova followed up the pretest and posttest with interview questions regarding the answers the students gave. The limitation of this study is that it was done with young children and based on Kellert's findings (1985) that presenting animals by humanizing or anthropomorphizing them has a significant impact on attitudes toward animals in young children that would not be expected in older children. However, little research has been done to determine how to improve the attitudes of middle and high school students toward bats, which is of concern because older students are less likely to change how they feel or think about a subject (Posner, Strike, Hewson & Gertzog, 1982**)**.

In summary, bats are in a situation unlike many other animals regarding our attitudes toward them. They provide humanity with billions of dollars in advantages per year, yet they are seen and treated as pests. Education has been shown to improve these attitudes in young students and should be expanded to new student populations.

Educational Interventions for Animal Attitudes

In some studies about animal attitudes, socioeconomic status and ethnicity have been shown to be indicators of attitudes toward animals, as well as level of education (Kellert, 1980). Educating people about animals has been shown to promote less harmful behaviors toward animals, even those seen in a negative connotation (Dawna & O'Neal, 2015). Education can also be used to promote conservation of natural resources and biodiversity by improving peoples' attitudes toward an area or group of animals. This is done through visiting educational programs and zoo services (Patrick, Matthews, Ayers

& Tunnicliffe, 2007). This promotion of conservation through education seems to work by improving or changing a person's view of the animal at hand (Kellert & Berry, 1981).

Educational interventions are better at changing students' perceptions. The simple attempt to transmit knowledge from teacher to student is not enough to impact and change someone's behavior and/or lifestyle (Glifford & Nilsson, 2014; Limón, 2001). Having accurate information has been found to not always change someone's behavior (Stevens et al., 2015). So instead of pushing in facts against possibly held misconceptions, educational interventions work when new information is shared with the student, and the student incorporates this knowledge into their existing framework in one of several ways (Vosniadou, 1994). They will either disregard or distort the information to fit with current beliefs. They could also accept the new information and make the connection with other beliefs, or the new information will be connected to previous thoughts and previous thoughts will adapt around the new information (Limón, 2001). This additional information will cause the student to "rebuild" their existing ideas or concepts in some way (Limón, 2001; Posner et al., 1982). There are five steps to this process that are described by Thagard (1992): 1) ignoring new information, 2) incorporating new information into an old theory, 3) sublation of the old theory with new concepts, 4) supplantation of old information for new information within the theory or concept, and 5) disregarding the old concept or theory for the new one.

Surveys

In order to promote conceptual change, current ideas must be determined. One way to determine people's views or ideas is through surveys. Surveys are a list of questions that are designed to inform a researcher about the thoughts and feelings of a

particular group of people. Surveys may be conducted in numerous ways including mail, phone, Internet, and in person (Shaughnessy, Zechmeister, & Jeanne, 2011). The questions in a survey are typically predetermined by the researcher. Surveys are used by social scientists to help explain and analyze behavior (Sunstein, 2006).

Surveys have been found to be an effective tool for collecting data from middle school students (Childress, Brewerton, Hodges & Jarrell, 1993). Surveys are also used as part of educational interventions with middle school students to see test if the intervention is having the expected impact (Gibson & Chase, 2002). The major factor that can impact student responses to surveys is motivation. Classroom motivation has been found to be impacted by the social environment of the classroom (Ryan & Patrick, 2001).

CHAPTER III: METHODOLOGY

Purpose

The purpose of this study is to understand students' attitudes toward animals in one school in the rural, southeastern United States, to understand these students' attitudes toward animals based on taxonomic classification, and see if educational interventions can help improve these students' attitudes toward bats.

The research questions guiding the investigation are:

1) What are attitudes toward animals among 7th grade students in a rural school in the southeastern United States?
2) What values influence attitudes of 7th grade students attending a rural school in the southeastern part of the United States?
3) To what extent does education about bats improve these 7th grade students' attitudes and knowledge toward bats?

Data Collection

Data collection occurred starting in August, 2018 and continued through November 2018. Data were collected in several forms: a Likert survey scale, short descriptions, and interviews. Data collection occurred in the following order: Likert survey scales and short descriptions of animals, pretest of attitudes toward bats, educational interventions about bats, interviews, and posttest of attitudes toward bats. These varied sources of data helped with triangulation. A mixed method design was used

for data collection and analysis (Creswell, Tashakkori, Jensen, & Shapley, 2003). Mixed methods use both quantitative and qualitative methods in one study, and is defined as research where the researcher mixes quantitative and qualitative research techniques, methods, approaches, concepts and/or language into a single study. Mixed research gives the researcher the strengths available in both quantitative and qualitative studies and minimizes their weaknesses (Johnson & Onwuegbuzie, 2004). In this study, mixed methods research allowed the researcher to add descriptions and categorical terms to help explain the students' attitudes. There are many reasons why a person may like or dislike a particular animal and though quantitative research would give clear levels for attitudes it does not give specific meaning to those numbers.

Mixed Method Approach

This study implemented a mixed method approach in order to best answer the research questions. This section describes the mixed method process, and a quick summary of the sequence is described to help the reader and to explain and justify why this order helps to synergize with itself. First, students were given a pretest about knowledge and attitudes toward bats. Second, students were given a Likert scale survey of animals with a section for the student to explain their response. After the Likert scale surveys, the education curriculum was taught, and afterwards, a posttest related to knowledge and attitudes toward bats was given. This was done in order to help the researcher find out what was factoring into attitudes toward animals and also to help the researcher write questions for the student interviews which took place after the post test in order to answer any remaining questions about survey responses or the bat curriculum.

Quantitative portions of the study used a Likert scale. The Likert scale was developed in 1932 by the American psychologist Rensis Likert, and is a common survey format that allows respondents to score how they feel about individual items on a five to ten-point scale regarding the person's opinion (Likert, 1932). The Likert scale started as a five-point scale and eventually was turned into a seven-point scale with the addition of "very" to the top and bottom of the original five-point scales; this change was to improve the internal consistency of the statistical system (Allen & Seaman, 2007).

While some interview questions were pre-planned, others were designed based on themes generated from short descriptions that students added with the Likert scale responses to follow up and better understand what students were thinking as well as to help triangulate data (Barbour, 2001). Additionally, students were interviewed to obtain

a verbal explanation of the answers. Scripted interview questions are found in Appendix D. Interviews were semi structured to allow for ability to pursue new or unique statements that the students make during the interview process. Purposeful sampling was used to determine which students to interview. Students with low, high, and average attitudes toward animals were selected to generate an understanding for each group while also collecting interviews from students with wide ranging attitudes. Purposeful sampling helped in constructing the held attitudes toward animals for students with a wide range of attitudes. Seven students were interviewed. Interviews help to triangulate the data (Creswell et al., 2003).

Interviews were transcribed and analyzed. Themes came from previous research or were emergent in the interviews and short descriptions (Kellert, 1980; Driscoll, 1990). Since analysis was ongoing throughout data collection, the researcher paid attention to, and recorded emerging themes from the audio recordings from previous classes to examine emergent themes. Themes were condensed when possible and detailed definitions for each theme are provided in the results chapter.

Animal Attitudes Surveys

The researcher used a survey scale assessing if students liked or disliked a particular animal via images projected onto a screen through PowerPoint. Students were provided an answer sheet for each survey with a linkage system that keeps students' identities confidential (see Appendix A). For the linkage system, students used an ID which consisted of the initials of their first and last name and their numerical birth day and month. Each class was given a section number based on when the researcher was there during the week. For example, the first class of the week was section one, and this

continued in consecutive order. The animals were presented on the PowerPoint in a natural setting in as neutral a way as possible. For example, a picture had the animal either resting or traveling in its natural habitat. The animal was not performing behaviors such as predation nor any behavior that could be anthropomorphized into a behavior we do such as smiling to show happiness. Research has shown that people typically relate what the animal is doing to an anthropomorphic behavior or action when shown images of animals, so the animals were not shown bearing teeth (Henderson, 1998). The visual presentation included a variety of animals (see Table 1) with enough species present for the researcher to detect differences in opinions toward different taxonomic groupings. This list is extensive (100 items) and to prevent survey fatigue, surveys were given in twenty item surveys on five separate occasions (Galesic & Bosnjak, 2009; Porter, Whitcomb & Weitzer, 2004). Despite this list containing 100 species, this is by no means a comprehensive list of the biodiversity within the animal kingdom, and while many species had relatives within the same family and order, not every animal did. Some animals only had relatives at the phylum level.

Study Site and Participants

This study was conducted at Sweet Valley Middle School (a pseudonym). Sweet Valley Middle School is a public school. The student population of this school is 646 and 67% of the students qualify for free or reduced lunch (Sweet Valley Middle School, 2017). Demographics of the school population at the time of this study were 58% white, 38% black, 3% Asian, and 1% other. The average household income in the area at the time of the study was $36, 901. Unemployment in the area was 5.9%, and the most common jobs in the area involve sales and transportation (Springfield, Alabama

Economy, 2017). These economic statistics are similar to other rural areas in the southeastern United States. The school name will be kept confidential in this dissertation as one could easily identify teachers and the principal of the school involved with the research. This area was selected due to convenience and accessibility to the school as well as my having a rapport with the teachers and principal of the school. Participants included students from six 7th grade life science classes with approximately 20 students per class. Students in the class were between 12-14 years of age. Life science is the most appropriate middle school science for this research, as they are learning introductory biology concepts in the class and the curriculum and surveys are relevant to the state standards.

Permission was granted to conduct this research by the Office of Research Integrity at Auburn University. Parental consent and student assent forms were sent home before the research began. Students were incentivized to return these forms for a chance to enter a raffle for a $25 gift card regardless of whether they participate in the study or not. The return rate was between 50-70%, depending on the class, with an average return rate of 62%. There were107 students taught and fifty one students agreed to participate in the study. The curriculum about bats was taught and the animal surveys were administered during the same semester, with the post-test about bats being administered after the last animal survey. The curriculum was taught, and the surveys were administered by a single researcher across all five classes to ensure consistency.

The Curriculum

The curriculum, Save the Bats (see Appendix C), involved learning analogies related to bats and their traits and behaviors, viewing bats in the wild, and identifying a

species of bat and learning about it in field guides. All students participated in these lessons, but data were only analyzed from those who had given assent and parental consent to be part of the study. At the end of the curriculum, the students were presented with the same bat survey and questions again. Bats have been chosen for this research in order to determine if educational interventions can improve attitudes toward an animal because of the negative misconceptions surrounding them.

The curriculum was designed to be aligned with the 5E Learning Cycle (Bybee, 2002) to promote stimulating lessons about bats. The lessons were designed in order to reconstruct and rework thoughts and misconceptions the students had about bats, and in educating the students, answers to the research questions would be possible (Trowbridge & Bybee 1990). The curriculum was aligned to focus of adjustment and knowledge constructs in order to impact students' attitudes toward bats. Bats were chosen as the animal because they are often seen as a pest or vermin that carry disease and attack people, however they provide several resources to humans such as pest control and soil fertilization (Hester et al., 2007). Values that were taught in the curriculum included ecological, scientific, aesthetic, and utility values. The idea was by teaching the students relevant, real life information about bats the students might encounter would shift their view of bats. The curriculum was presented to two experts in designing educational curricula and subjected to revision, in order to make sure that it promoted interest. The curriculum had already been presented to a zoo education center manager and an expert in bat education, and these individuals provided feedback that supported the premise that the curriculum had the potential to be effective.

Theoretical Framework

Constructivism

Even before babies are born, they begin to generate views about their environment (Hepper, 1991). This generating of views continues as children develop after birth, and leads to ideas of how to make sense of the world (Kyle & Shymansky, 1989). Constructivism is a theory that explains how people learn, and follows this idea, stating that no one is a "blank slate" when learning. The founders of this theoretical framework are Vygotsky (1962) and Piaget (1972). People have their own previous experiences into which the new knowledge can be incorporated (Perkins, 1999). Learners have their own intentions, goals, ideas, memories, and emotions that are actively involved in the learning process (Wittrock, 1989). Knowledge is actively constructed by the learner, not passively taken in from the world as empty vessels (Driscoll, 2000). This means that each person can come to a different "truth" based on their past and context when learning about a subject. This also means that as knowledge and experience are added a person's "truth" changes or can be changed. Constructivist theory can be divided into two categories, cognitive development theory which focuses on the individual's personal construction of meanings within the knowledge, and social constructivist theory which focuses on social interactions as the key to learning (Lave & Wegner, 1991; Vygotsky, 1962). Constructivist theory will be the paradigm for designing the intervention and for analysis of data, because the research involves the formation of *attitudes* toward animals in students. This formation of attitudes will be derived from past experiences and come from preexisting thoughts and ideas developed through students' life experiences. Constructivist theory will be the theoretical lens when analyzing the

short descriptions written by students and the interview transcriptions. After examining the short descriptions, the researcher designed additional interview questions related to how students perceive animals as a whole and how they feel about various animals and why. Some interview questions examined a student's thought process regarding certain comments they made. Constructivism is key to this research, and the researcher considered the views of others not as wrong or less in some way, but examined how and why these views came into being. This lens allowed the researcher to see how certain attitudes can be promoted and/or modified so that they do not result in violence toward animals.

Reliability. Reliability is an indicator of how consistent scores will be, or the "precision" of the score. Any score that a researcher collects is comprised of this "true" score and measurement error. The process of developing a reliable instrument is in large part focused on reducing error in the measurement process (Kimberlin & Winterstein, 2008). Reliability was established by computing an internal consistency value, Cronbach's alpha coefficient, by using the results of a pilot study that was done in spring 2017. Cronbach's alpha is a measure of internal consistency, and it shows how closely related a set of items are as a group and is often used as predictor components of a scale (Santos, 1999). Reliability of the instrument was also be determined by computing Cronbach's coefficient alpha (α = .98) again after data from the test subjects in the current study was collected.

Validity. Validity informs the researcher about the extent to which an instrument measures what it is supposed to measure (Popham, 1997). Validity requires that an instrument is reliable, but an instrument can be reliable without being valid (Kimberlin &

Winterstein, 2008). Validity is not a property of a test, but a description of the interpretations of the results of a test and depend on the use of the research instrument (Popham, 1997).

Face validity is looking at the "face value" of the instrument and determining if this is a good translation of the external validity, which the support is shown for the instrument through previous research using the same or similar instrument (Cronbach & Meehl, 1955).

Content validity is a measure of how well the instrument covers the content domain. In order to determine the validity of the instrument, its ability to actually determine students' attitude toward animals, the instrument (the pictures, in groups of 20) was shared with a panel of experts who provided feedback to determine the face and content validity. Face validity was determined to be adequate when the panel of experts, a group of biologists, middle school teachers, and science education experts, agrees that the instrument appears to be well constructed, and professional in appearance. The interview questions and the knowledge about bat questions were assessed using face validity. Content validity was determined when the same panel of experts agree that the animals appear neutral, are easy to identify, and that each grouping of 20 has equivalent representation of different types of animals.

Context validity is the consistency of implementation of the research instrument. Surveys were presented in a consistent method by the researcher and followed methods described by others in this field of research to show construct and context validity (Wagler & Wagler, 2015).

Table 1

Taxonomic Groupings of Survey Animals

Phylum	Class	Order	Common Name
Arthropoda	Insecta	Hymenoptera	An ant
Arthropoda	Insecta	Hymenoptera	A wasp
Arthropoda	Insecta	Hymenoptera	A bee
Arthropoda	Insecta	Lepidoptera	Monarch butterfly
Arthropoda	Insecta	Lepidoptera	A moth
Arthropoda	Insecta	Lepidoptera	Monarch caterpillar
Arthropoda	Insecta	Hemiptera	A leaf hopper
Arthropoda	Insecta	Hemiptera	An assassin bug
Arthropoda	Insecta	Coleoptera	A dung beetle
Arthropoda	Arachnida	Araneae	An orb weaver
Mollusca	Gastropoda	Stylommatophora	A slug
Mollusca	Gastropoda	Achatinoidea	A snail
Mollusca	Cephalapoda	Octopoda	An octopus
Echinodermata	Holothuroidea	Apodida	A sea cucumber
Echinodermata	Asteroidea	Forcipulatida	A starfish
Chordata	Chondrichthyes	Orectolobiformes	Whale shark
Chordata	Chondrichthyes	Lamniformes	Great white shark
Chordata	Osteichthyes	Tetraodontiformes	A pufferfish

Phylum	Class	Order	Common Name
Chordata	Osteichthyes	Lepisosteiformes	Alligator gar
Chordata	Osteichthyes	Percomorpha	Clownfish
Chordata	Osteichthyes	Perciformes	Largemouth bass
Chordata	Osteichthyes	Acanthuriformes	Blue tang
Chordata	Osteichthyes	Scorpaeniformes	Lionfish
Chordata	Amphibia	Anura	Green treefrog
Chordata	Amphibia	Anura	Bullfrog
Chordata	Amphibia	Anura	American toad
Chordata	Amphibia	Caudata	Marbled salamander
Chordata	Amphibia	Caudata	Red hills salamander
Chordata	Reptilia	Testudines	Snapping turtle
Chordata	Reptilia	Testudines	Eastern box turtle
Chordata	Reptilia	Testudines	Gopher tortoise
Chordata	Reptilia	Testudines	Painted slider
Chordata	Reptilia	Crocodilia	American alligator
Chordata	Reptilia	Crocodilia	Nile crocodile
Chordata	Reptilia	Squamata	King cobra
Chordata	Reptilia	Squamata	Rattlesnake
Chordata	Reptilia	Squamata	Corn snake
Chordata	Reptilia	Squamata	Anaconda
Chordata	Reptilia	Squamata	Eastern indigo snake
Chordata	Reptilia	Squamata	Burmese python
Chordata	Reptilia	Squamata	Gila Monster
Chordata	Reptilia	Squamata	Horned lizard
Chordata	Reptilia	Squamata	Green anole
Chordata	Reptilia	Squamata	Komodo dragon

Phylum	Class	Order	Common Name
Chordata	Reptilia	Squamata	Six lined racerunner
Chordata	Aves	Passeriformes	Blue jay
Chordata	Aves	Passeriformes	Blue bird
Chordata	Aves	Passeriformes	American crow
Chordata	Aves	Passeriformes	A chickadee
Chordata	Aves	Accipitriformes	A kestrel
Chordata	Aves	Accipitriformes	Red tailed hawk
Chordata	Aves	Accipitriformes	Bald eagle
Chordata	Aves	Accipitriformes	Turkey vulture
Chordata	Aves	Strigiformes	Barn owl
Chordata	Aves	Strigiformes	Great horned owl
Chordata	Aves	Galloanseraformes	A duck
Chordata	Aves	Galloanseraformes	A chicken
Chordata	Mammalia	Rodentia	Brown rat
Chordata	Mammalia	Rodentia	House mouse
Chordata	Mammalia	Rodentia	Deer mouse
Chordata	Mammalia	Rodentia	Hispid cotton rat
Chordata	Mammalia	Soricomorpha	Southeastern shrew
Chordata	Mammalia	Soricomorpha	Eastern mole
Chordata	Mammalia	Chiroptera	Pallas' mastiff bat
Chordata	Mammalia	Chiroptera	Little brown bat
Chordata	Mammalia	Chiroptera	Easterrn red bat
Chordata	Mammalia	Chiroptera	Hoary bat
Chordata	Mammalia	Primates	Coquerel's sifika
Chordata	Mammalia	Primates	Capuchin monkey
Chordata	Mammalia	Primates	A gibbon

Phylum	Class	Order	Common Name
Chordata	Mammalia	Primates	Orangutan
Chordata	Mammalia	Proboscidea	African elephant
Chordata	Mammalia	Cetacea	Humpback whale
Chordata	Mammalia	Cetacea	Bottlenose dolphin
Chordata	Mammalia	Cetacea	Orca
Chordata	Mammalia	Cetacea	Sperm whale
Chordata	Mammalia	Artiodactyla	A hippo
Chordata	Mammalia	Artiodactyla	White tailed deer
Chordata	Mammalia	Artiodactyla	An elk
Chordata	Mammalia	Artiodactyla	Moose
Chordata	Mammalia	Artiodactyla	Pronghorn
Chordata	Mammalia	Artiodactyla	Gazelle
Chordata	Mammalia	Artiodactyla	A cow
Chordata	Mammalia	Artiodactyla	Yak
Chordata	Mammalia	Artiodactyla	Bison
Chordata	Mammalia	Artiodactyla	Water buffalo
Chordata	Mammalia	Artiodactyla	Wildebeest
Chordata	Mammalia	Artiodactyla	A pig
Chordata	Mammalia	Perissodactyla	A rhino
Chordata	Mammalia	Perissodactyla	A horse
Chordata	Mammalia	Perissodactyla	A tapir
Chordata	Mammalia	Carnivora	Housecat
Chordata	Mammalia	Carnivora	Bobcat
Chordata	Mammalia	Carnivora	Lion
Chordata	Mammalia	Carnivora	Tiger
Chordata	Mammalia	Carnivora	A dog

Phylum	Class	Order	Common Name
Chordata	Mammalia	Carnivora	Grey wolf
Chordata	Mammalia	Carnivora	Grey fox
Chordata	Mammalia	Carnivora	Coyote

Timeline for Research

The following figure (see Figure 1) lists the order in which the researcher collected data.

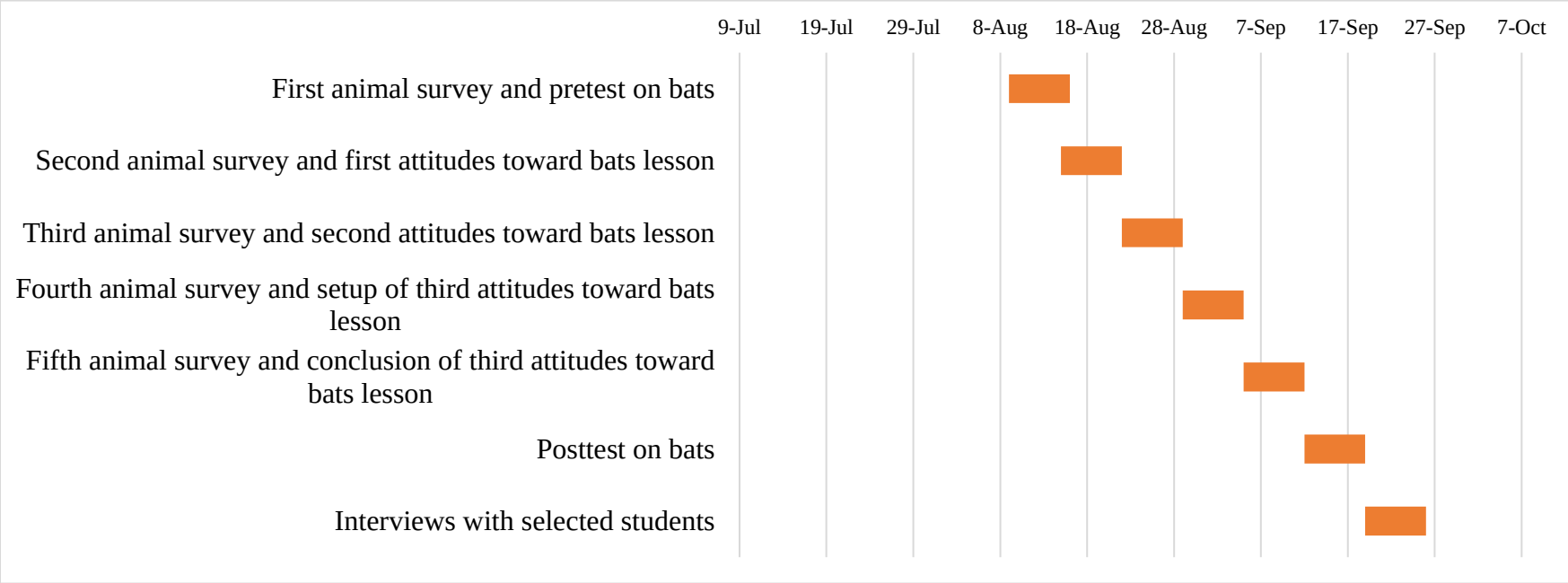


Figure 1. Timeline for research activities.

Administering the Animal Attitudes Survey to Youth

Surveys were given to 7th grade students participating in the research, and each student wrote answers on the answer sheets provided by the researcher along with a short description of why they chose the response that they did. Short descriptive terms or sentences that go along with the Likert scale help to detect careless survey taking (Meade & Craig, 2012). Using short descriptions also provides more nuanced depth to the survey and produces a more valid and more reliable measures of respondent opinion than the "simpler" abstract questions more typical of opinion surveys (Alexander & Becker, 1978). These descriptions were used to generate themes from the data. Some themes may be emergent while others may have been described in earlier work (Ascione, 2005; Kellert, 1985). Example responses (and themes) could be "it looks scary/ugly (aesthetics), I like eating them for my birthday (food), they make great pets (good/personal experience), I loved the movie they were in (media), I got bit by one once and it hurt (bad/personal experience).

Field notes were taken by the researcher after each lesson, and self-observations were conducted. Short notes were recorded during each lesson. A video recording of the teacher/researcher was made during each class in order to facilitate field notes and self-observations (Lomax & Casey, 1998).

Data Analysis.

In order to answer the first research question, "What are attitudes toward animals among 7th graders at a school in the rural southeastern United States?" numerical information was taken from the answer sheets from the first survey about animals, and recorded into Microsoft Excel and SPSS, and analyzed using Friedman's test of repeated measures ANOVA (George & Mallery, 2003). Friedman's one-way ANOVA functions as a traditional analysis of variance

with two key exceptions: 1) Comparisons are based on mean rank of variables instead of means and standard deviations of raw scores, 2) The Friedman test compares ranked values with expected values in a chi squared analysis instead of an *F* value (George & Mallery, 2003).

Assessing Attitudes Toward Bats

Students were also given a survey to assess attitudes and knowledge related to bats. They answered a survey question related to microchiropteran bats as with the other animal surveys, which assessed attitudes toward bats, and students also answered knowledge-based questions about bats. Themes were generated only from the short descriptions that were part of the Likert scale for what influences attitudes about bats.

Survey questions about bats (see Appendix B) were derived from current literature and presented to teachers, science education specialists, and bat specialists to ensure face and content validity of the questions. The panel of experts examined the bat survey and provided feedback on whether the questions are worded correctly, appropriate for the age group, and correct in science content. Responses were scored in terms of knowledge about bats, in other words, the number of correct answers regarding bats, and attitudes toward bats. The lower the knowledge score, the more likely a student was to have misconceptions about bats. Misconceptions about bats were predicted to lead to lower attitudes based on how media and society frame bats (Prokop et al., 2009). Knowledge about an organism can improve naturalistic, ecologistic, and utilitarian values (Kellert, 1980). After the two initial surveys had been administered in full, students were taught a curriculum where they learn about bats. Though themes regarding attitudes toward bats were noted, data analysis regarding bats was done using the pre and post test scores and comparing them using a one way analysis of variance (ANOVA). An ANOVA compares mean scores

between two groups, pre and posttest in this case, and detects differences in these means (George & Mallery, 2003).

Researcher Stance and Bias

I am biology instructor at a community college with two biology and ecology related degrees. I attended a rural K-12 school where I encountered people who primarily showed interest in animals for hunting purposes. Though I do not consider myself a Democrat or Republican, I am aware of the many stances that are held by Republicans, such as wishing to leave the Paris Agreement, can be detrimental to ecosystems and the species present, and there is need to educate so these types of events, that can devastate the environment, will not happen, or be reduced in the future. This is part of my motive for delving into the research. My ultimate goal is to promote conservation of all species that may need conservation efforts in the future. I believe that teachers can better promote non favorable or disliked animals to students, because teachers can strongly influence students (Amidon & Flanders, 1961).

The ultimate value to me is a mix of moralistic and ecologistic values. I have concerns for ecological communities across the world for a number of reasons (Agnew, 1998; Blehert et al., 2009; Burger at al., 1999; Cleveland et al., 2006; Diamond et al., 1989). This is also paired with an interest in preserving life whenever possible and taking great consideration and respect before choosing to a path that will result in the loss of animal life. As such, I consider these two values as the most important values and interpretations will be seen through a lens that considers moralistic and ecologistic values first and above the other values.

My ultimate goal is to find more ways to promote conservation. Though zoos and aquariums are doing excellent work in the eyes of the researcher to improve attitudes toward animals and promote conservation, this only works if a person goes to a zoo or aquarium which

may be difficult for rural and/or economically disenfranchised populations. I believe that teachers are a group of people who can impact many more youth and finding ways to help them do this is crucial.

CHAPTER IV: RESULTS

Introduction

The purpose of this study was to better understand the attitudes 7th graders in a school in the rural southeast have toward animals, and determine where those attitudes come from. What influences these attitudes? What is the extent to which education about bats improves 7th grade students' attitudes toward bats? This study was done in five 7th grade life science class. By analyzing the qualitative and quantitative data from the study in our five treatment groups (classes), inferences about how and where students form attitudes toward animals were made using Kellert's (1980) nine core values as a guide as well as inferring what other values influenced student attitudes toward animals. The research questions targeted in this study were:

1) What are attitudes toward animals among 7th grade students in a rural school in the southeastern United States?
2) What values influence attitudes of 7th grade students attending a rural school in the southeastern part of the US?
3) To what extent does education about bats improve 7th grade students' attitudes and knowledge toward bats?

This chapter is divided into three sections. The first section provides the results of the comprehensive assessment of students' attitudes toward animals and makes an inference as to why students had specific animal preferences and describes the various background affordances that may have influenced these attitudes. The second section will

described the major themes that arose from the interviews and short descriptions provided by student responses. The final section looks at the results from the pre and posttest about knowledge and attitudes toward bats and how the responses changed after an educational intervention.

Research Question 1

The first research question involved a comprehensive assessment of 7th grade students' attitudes toward a variety of animals. Based on the results of a Friedman's repeated measure ANOVA there was a statistically significant difference between the preferences students had toward all of the animals, X^2 (99, N = 40) = 1111.647, p <.001 (See Table 2). Student preferred animals they had been exposed to such as dogs, cat, songbirds, and farm animals, and animals from media such as books, TV, and movies. Students had negative attitudes toward animals they did not know about even if they were similar to animals they did know about. For example, students liked horses but other hooved mammals did not rank as high.

Table 2 depicts at the ordinal ranking each species received. Mammals and birds were typically ranked higher than other vertebrates. Reptiles, amphibians, and fish were equally ranked except for painted slider and eastern box turtles, gopher tortoise, blue tang, and clownfish. Invertebrates scored the lowest overall, however some of the invertebrates such as the butterfly, caterpillar, moth, and starfish were ranked as high as most mammals and birds.

Table 2

Descending Ranking of Animals Based on 7th Grader Attitudes using Friedman's ANOVA

Name	Mean Rank
Beagle	79.39
Clownfish	78.48
Bluebird	76.23
Blue Jay	75.86
A horse	73.56
Blue Tang	72.96
Red Eared Slider	71.63
Grey Wolf	69.81
Eastern Box Turtle	69.51
Monarch Butterfly	69.35
Bottlenose Dolphin	68.83
A Tiger	68.10
African Elephant	66.79
Red Tailed Hawk	66.65
A Kestrel	66.65
A Chickadee	66.61
White Tailed Deer	66.06
Grey Fox	65.15
Coquerel's Sifaka	64.78
Great Horned Owl	64.68
A Chicken	63.66
Bobcat	63.41
Pronghorn	61.86
Starfish	61.84
House Cat	61.43
Bald Eagle	61.03
Gopher Tortoise	60.65
Domestic Cow	60.44
Capuchin	60.39
Elk	60.01
Mallard Duck	59.83
Cotton Rat	58.36
Coyote	57.98

Name	Mean Rank
Barn Owl	57.90
Lion	57.61
Gibbon	56.33
Pufferfish	55.75
Tapir	55.59
Orangutan	53.78
Domestic Pig	53.48
Gazelle	52.96
Green Anole	52.43
A Moth	51.66
Monarch Caterpillar	51.49
Sperm Whale	51.44
Killer Whale	51.36
Deer Mouse	50.58
Rhinoceros	49.68
Komodo Dragon	48.89
Green Tree Frog	48.84
Moose	48.70
Humpback Whale	48.61
Water Buffalo	48.38
Yak	48.18
Spiny Horned Lizard	47.30
A Bullfrog	47.14
House Mouse	47.11
Six Line Racerunner	46.98
Whale Shark	46.90
Little Brown Bat	46.36
An Octopus	45.89
Eastern Red Bat	45.28
American Bison	45.26
American Toad	44.76
Alligator Snapping Turtle	44.75
Gila Monster	44.33
Southeastern Mole	44.10
Lionfish	43.23
Great White Shark	43.13
Marbled Salamander	42.83
Mastiff Bat	42.11

Name	Mean Rank
Alligator Gar	41.56
Largemouth Bass	41.21
Hippopotamus	41.04
Leafhopper	39.76
King Cobra	38.43
Hoary Bat	38.28
American Alligator	38.23
A Snail	37.69
Honeybee	37.48
Woodrat	37.48
Red Hills Salamander	37.43
A Crow	37.03
Eastern Indigo Snake	36.34
Corn Snake	35.05
Nile Crocodile	34.60
Python	33.31
Eastern Diamondback	32.84
Wildebeest	32.11
A Shrew	31.78
Turkey Vulture	30.78
A Slug	29.28
Sea Cucumber	27.18
Fire ant	25.06
Dung Beetle	24.49
Assassin Bug	24.06
Garden Orbweaver	22.99
Stag Beetle	22.10
A Wasp	21.44

The following table, Table 3, depicts the descriptive statistics, including mean Likert score for each animal in the survey from highest to lowest.

Table 3

Mean Scores of Students' Likert Scale Assessment of Attitudes

Name	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
Clownfish	40	6.28	0.85	4.00	7.00	6.00	6.14	7.00
Beagle	40	6.21	1.64	1.00	7.00	6.00	7.00	7.00
Blue jay	40	6.10	1.22	2.00	7.00	6.00	6.00	7.00
Bluebird	40	6.05	1.34	1.00	7.00	6.00	6.00	7.00
Blue Tang	40	5.90	1.37	2.00	7.00	5.25	6.00	7.00
A Horse	40	5.80	1.57	1.00	7.00	5.22	6.00	7.00
Red Eared Slider	40	5.77	1.51	1.00	7.00	5.20	6.00	7.00
Monarch Butterfly	40	5.70	1.59	1.00	7.00	5.00	6.00	7.00
Grey Wolf	40	5.62	2.11	1.00	7.00	5.19	7.00	7.00
Eastern Box Turtle	40	5.56	1.84	1.00	7.00	5.00	6.00	7.00
Eastern Box Turtle	40	5.54	1.77	1.00	7.00	5.00	6.00	7.00
Bottlenose Dolphin	40	5.52	1.87	1.00	7.00	5.00	6.00	7.00
A Kestrel	40	5.51	1.63	1.00	7.00	5.00	6.00	6.75
A Tiger	40	5.44	2.01	1.00	7.00	5.58	6.00	7.00
African Elephant	40	5.38	1.89	1.00	7.00	5.00	6.00	7.00
A Chickadee	40	5.36	1.95	1.00	7.00	4.25	6.00	7.00
A Chicken	40	5.30	1.88	1.00	7.00	4.25	6.00	7.00
Coquerel's Sifaka	40	5.30	1.94	1.00	7.00	5.00	6.00	7.00
White Tailed Deer	40	5.29	1.96	1.00	7.00	4.00	6.00	7.00
Red Tailed Hawk	40	5.25	2.00	1.00	7.00	4.00	6.00	7.00
Grey Fox	40	5.23	1.99	1.00	7.00	4.25	6.00	7.00
Gopher Tortoise	40	5.15	1.86	1.00	7.00	4.00	5.50	7.00
Great Horned Owl	40	5.13	2.04	1.00	7.00	4.00	6.00	7.00

Name	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
A Starfish	40	5.10	1.79	1.00	7.00	4.00	6.00	6.00
Domestic Cow	40	5.05	1.97	1.00	7.00	4.00	6.00	7.00
A Capuchin	40	5.05	1.97	1.00	7.00	4.25	6.00	6.00
Bobcat	40	5.05	2.06	1.00	7.00	3.25	6.00	7.00
Pronghorn	40	4.98	2.09	1.00	7.00	2.50	6.00	7.00
House Cat	40	4.93	2.32	1.00	7.00	2.25	5.55	7.00
Bald Eagle	40	4.93	2.28	1.00	7.00	2.25	6.00	7.00
Elk	40	4.77	2.22	1.00	7.00	3.00	6.00	6.75
A Gibbon	40	4.74	2.36	1.00	7.00	2.00	6.00	7.00
Cotton Rat	40	4.72	2.26	1.00	7.00	2.00	6.00	7.00
A Tapir	40	4.72	2.25	1.00	7.00	2.25	6.00	7.00
Coyote	40	4.70	2.26	1.00	7.00	2.00	5.50	7.00
Lion	40	4.67	2.22	1.00	7.00	2.00	5.00	7.00
Mallard Duck	40	4.67	2.15	1.00	7.00	2.25	5.00	7.00
Barn Owl	40	4.64	2.36	1.00	7.00	2.00	6.00	7.00
Green Anole	40	4.56	2.06	1.00	7.00	2.50	5.00	6.00
Pufferfish	40	4.51	2.41	1.00	7.00	2.00	5.50	7.00
Domestic Pig	40	4.49	2.17	1.00	7.00	2.00	5.00	6.00
A Gazelle	40	4.46	2.10	1.00	7.00	2.00	4.76	6.00
A Moth	40	4.36	2.01	1.00	7.00	2.25	5.00	6.00
Orangutan	40	4.36	2.28	1.00	7.00	2.00	4.65	6.75
Monarch Caterpillar	40	4.35	2.21	1.00	7.00	2.00	5.00	6.00
Killer Whale	40	4.29	2.21	1.00	7.00	2.00	5.00	6.00
Yak	40	4.28	2.21	1.00	7.00	2.00	4.67	6.00
Deermouse	40	4.23	2.30	1.00	7.00	2.00	4.63	6.00
Green Treefrog	40	4.22	2.17	1.00	7.00	2.00	5.00	6.00
Moose	40	4.20	1.95	1.00	7.00	2.25	4.00	6.00
A Rhinocerous	40	4.18	2.24	1.00	7.00	2.00	4.00	6.00

Name	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
Humpback Whale	40	4.18	2.18	1.00	7.00	2.00	5.00	6.00
American Bison	40	4.13	1.84	1.00	7.00	2.25	4.00	6.00
Sperm Whale	40	4.13	2.31	1.00	7.00	2.00	4.00	6.00
Water Buffalo	40	4.05	2.19	1.00	7.00	2.00	4.00	6.00
Spiny Horned Lizard	40	4.02	2.33	1.00	7.00	2.00	4.00	6.00
Komodo Dragon	40	4.00	2.65	1.00	7.00	1.00	4.00	7.00
Little Brown Bat	40	3.97	2.22	1.00	7.00	2.00	4.00	6.00
House Mouse	40	3.93	2.35	1.00	7.00	2.00	4.00	6.75
A Bullfrog	40	3.92	1.91	1.00	7.00	2.00	4.00	6.00
Whale Shark	40	3.92	2.08	1.00	7.00	2.00	4.00	6.00
American Toad	40	3.89	2.20	1.00	7.00	2.00	4.00	6.00
Eastern Red Bat	40	3.87	2.28	1.00	7.00	2.00	4.00	6.00
Six Line Racerunner	40	3.79	2.24	1.00	7.00	2.00	4.00	6.00
Alligator Snapping Turtle	40	3.79	2.34	1.00	7.00	1.25	3.87	6.00
An Octopus	40	3.79	2.05	1.00	7.00	2.00	4.00	6.00
Marbled Salamander	40	3.77	1.91	1.00	7.00	2.00	4.00	5.00
Lionfish	40	3.72	2.25	1.00	7.00	1.25	4.00	6.00
Southeastern Mole	40	3.69	2.24	1.00	7.00	2.00	3.38	6.00
Gila Monster	40	3.69	2.14	1.00	7.00	2.00	4.00	5.75
Great White Shark	40	3.67	2.46	1.00	7.00	1.00	3.00	6.00
Mastiff Bat	40	3.64	2.17	1.00	7.00	2.00	3.39	6.00
Hippopotamus	40	3.64	2.22	1.00	7.00	1.00	4.00	6.00
Alligator Gar	40	3.53	2.09	1.00	7.00	2.00	3.69	6.00
Red Hills Salamander	40	3.51	2.05	1.00	7.00	2.00	3.74	5.00
Leafhopper	40	3.51	1.78	1.00	7.00	2.00	4.00	4.75
Largemouth Bass	40	3.44	2.30	1.00	7.00	1.00	3.00	6.00
A Snail	40	3.35	2.07	1.00	7.00	2.00	2.50	5.00
King Cobra	40	3.34	2.46	1.00	7.00	1.00	2.00	6.00

Name	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
A Crow	40	3.31	2.22	1.00	7.00	1.00	2.50	6.00
Honeybee	40	3.31	2.15	1.00	7.00	1.00	2.00	5.00
American Alligator	40	3.28	2.31	1.00	7.00	1.00	2.00	6.00
Woodrat	40	3.23	2.22	1.00	7.00	1.00	2.00	6.00
Hoary Bat	40	3.23	2.17	1.00	7.00	1.00	2.00	5.75
Corn Snake	40	3.18	2.33	1.00	7.00	1.00	2.00	5.75
Eastern Indigo Snake	40	3.13	2.42	1.00	7.00	1.00	2.00	6.00
Wildebeest	40	3.10	1.74	1.00	6.00	1.25	3.00	4.00
Nile Crocodile	40	3.03	2.19	1.00	7.00	1.00	2.00	5.75
A Python	40	2.88	2.10	1.00	7.00	1.00	2.00	4.00
A Shrew	40	2.84	1.99	1.00	7.00	1.00	2.00	4.00
Eastern Diamondback	40	2.80	2.34	1.00	7.00	1.00	1.00	5.50
Turkey Vulture	40	2.78	2.20	1.00	7.00	1.00	2.00	4.75
A Slug	40	2.69	1.84	1.00	7.00	1.00	2.00	3.75
A Sea Cucumber	40	2.41	1.72	1.00	7.00	1.00	2.00	3.75
Fire ant	40	2.29	1.81	1.00	7.00	1.00	2.00	2.33
Garden Orbweaver	40	2.23	1.79	1.00	7.00	1.00	1.00	3.00
Dung Beetle	40	2.23	1.42	1.00	7.00	1.00	2.00	3.00
Assassin Beetle	40	2.18	1.55	1.00	6.00	1.00	2.00	2.27
Stag Beetle	40	2.13	1.59	1.00	6.00	1.00	1.50	2.13
A Wasp	40	2.01	1.36	1.00	6.00	1.00	2.00	2.00

The following table, Table 4, depicts the mode for the Likert scale score for each of the attitudes toward animals.

Table 4
Mode Scores for Students Attitudes Toward Animals

Name	Mode
Dolphin	7.0
Killer Whale	7.0
Red Eared Slider	7.0
House Cat	7.0
Beagle	7.0
Coyote	7.0
Eastern Box Turtle	7.0
Red Tailed Hawk	7.0
Butterfly	7.0
Blue Tang	7.0
Gibbon	7.0
White Tailed Deer	7.0
Green Treefrog	[a]7.0
Bald Eagle	7.0
Gopher Tortoise	7.0
Lion	7.0
African Elephant	7.0
Pronghorn	7.0
Pufferfish	7.0
Bobcat	[a]7.0
Yak	[a]7.0
Cotton Rat	7.0
Tapir	7.0
Bluebird	7.0
Eastern Box Turtle	7.0
Horse	7.0
Clownfish	7.0
Tiger	7.0
Orangutan	7.0
Great Horned Owl	7.0
Rhinoceros	7.0
Grey Wolf	7.0
Water Buffalo	7.0
Gazelle	7.0

Name	Mode
Domestic Cow	7.0
Blue jay	[a]7.0
Chickadee	7.0
Deer mouse	7.0
Chicken	7.0
House Mouse	7.0
Barn Owl	7.0
Mallard Duck	7.0
Starfish	6.0
Capuchin	6.0
Pig	6.0
Grey Fox	6.0
Humpback Whale	6.0
Green Anole	6.0
Kestrel	6.0
Elk	6.0
Moth	6.0
Coquerel's Sifaka	6.0
American Bison	5.0
Leafhopper	4.0
Moose	4.0
Marbled Salamander	2.0
Octopus	2.0
Mastiff Bat	[a]2.0
Bullfrog	2.0
Snail	2.0
Alligator Gar	2.0
Southeastern Mole	2.0
Dung Beetle	1.0
Corn Snake	1.0
Great White Shark	1.0
Wildebeest	1.0
Python	1.0
Hippopotamus	1.0
American Alligator	1.0
Nile Crocodile	1.0
Whale Shark	1.0
Eastern Diamondback	1.0
Little Brown Bat	1.0

Name	Mode
Slug	1.0
Largemouth Bass	1.0
Garden Orb weaver	1.0
Gila Monster	1.0
Sea Cucumber	1.0
Red Hills Salamander	1.0
Eastern Indigo Snake	1.0
Stag Beetle	1.0
Fire ant	1.0
Spiny Horned Lizard	1.0
Turkey Vulture	1.0
King Cobra	1.0
Alligator Snapping Turtle	1.0
American Toad	1.0
Hoary Bat	1.0
Lionfish	1.0
Assassin Beetle	1.0
Sperm Whale	1.0
Wasp	1.0
Honeybee	1.0
Caterpillar	1.0
Six Line Racerunner	1.0
Crow	1.0
Woodrat	1.0
Short Tailed Shrew	1.0
Eastern Red Bat	1.0
Komodo Dragon	1.0

a. Multiple modes exist. The smallest value is shown

Several taxonomic groupings (such as snakes, birds, insects, etc.) were examined to see if there were differences in attitudes within closely related groups. These groups included: carnivores, ungulates (hoofed mammals), cetaceans (whales and dolphins), birds, reptiles, and amphibians. These groups were chosen for several reasons. First, they are groups that people often have positive attitudes toward but only for a few of the species in the groups. For example, people can have negative attitudes toward insects, but positive attitudes toward one species, the butterfly (Knight, 2008). This was tested with the 7th grade southeastern students. Second, several taxonomic groups were examined to see if a particular species was seen with different attitudes than species closely related to that species.

Attitudes Toward Felids and Canids (Cats and Dogs)

Within the carnivore group the assessment listed four species from the family felidae and four species from the family canidae. The four species from canidae were domestic dog (beagle), grey wolf, grey fox, and coyote. The four species from felidae were domestic cat, tiger, bobcat, and lion. Between the felids and canids there were statistically significant differences, X^2 (7, N = 51) = 52.175, p <.001 in attitudes toward felids and canids (Figure 2) with 7th grade student preferring most canids to most felids. The domestic dog was the highest ranking animal on the entire survey list. Within the canids there were statistically significant differences in attitudes with students preferring dogs and grey wolves to grey foxes and coyotes X^2 (3, N = 53) = 41.768 p <.001. Within the felid group there were also statistically significant differences in attitudes with students preferring the house cat to the bobcat and the tiger to the lion X^2 (3, N = 54)= 4.8, p = .05 and p = .028 respectively.

Reasons for Attitudes Toward Felids and Canids

In writing and during interviews students stated several reasons for liking or disliking felids and canids. The most common reason for liking most felids and canids was the aesthetic appeal of the animal. Students stated that the beagle, housecat, bobcat, coyote, and grey fox were cute. Beagles were cited as being loyal and helpful and it was the animal with the highest rank. Many of the felids were seen as scary or dangerous as they could scratch or harm the student. These reasons were cited for all felid species on the survey. Wolves were seen as a symbol of freedom and some students even cited the grey wolf as their "spirit animal." Negative attitudes about wolves came from fear they could attack humans or our livestock. In Figure 2, note that the differences between felids and canids are large with the tiger, which was ranked the highest of the felids, is almost the same rank as the grey fox and coyote, which were the lowest ranked of the canids. This shows that 7th grade students in this study prefer canids to felids.

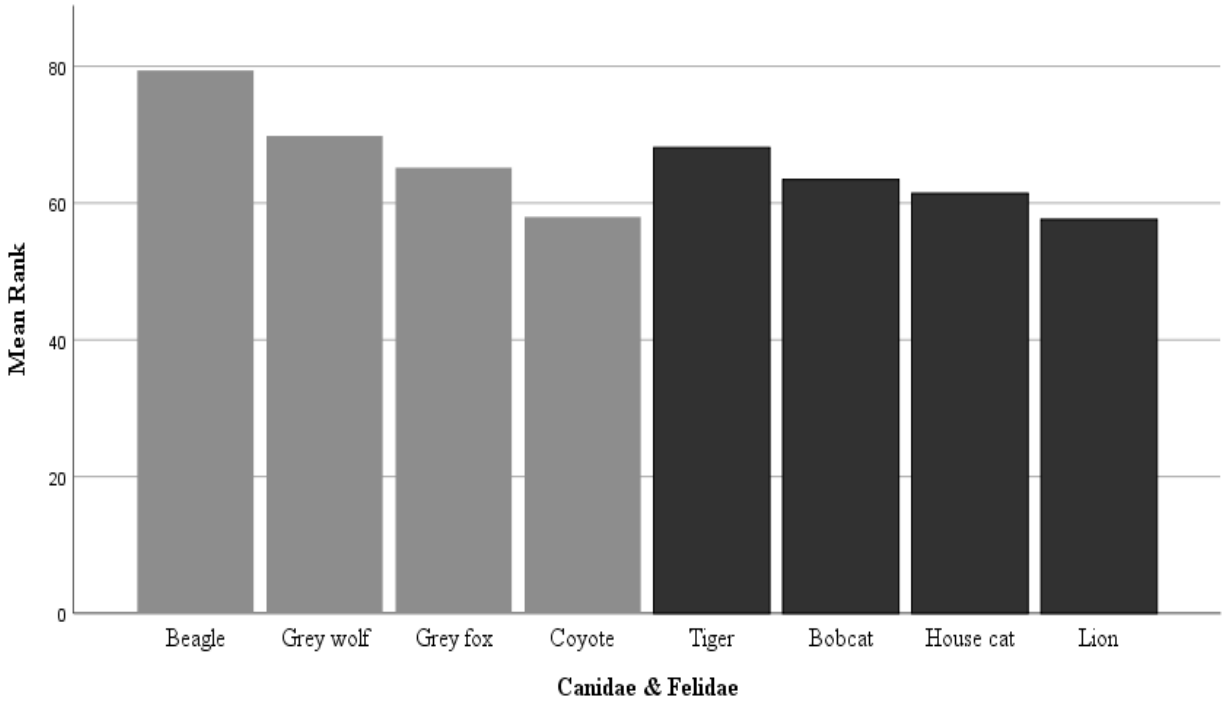


Figure 2. Ranked scores of canids (grey) and felids (black).

Ungulates

Students possessed a wide variety of attitudes toward ungulates (hooved mammals) (see Figure 3). Dividing the ungulates down to family level still resulted in statistically significant differences between even closely related species X^2 (14, N = 46) = 119.452, p <.001). The main reason for this seems to be that students are concerned with the animal harming them and large land animals were perceived to be what caused the greatest threat of harm to students except the horse and cow. This will be discussed in more detail in the next section.

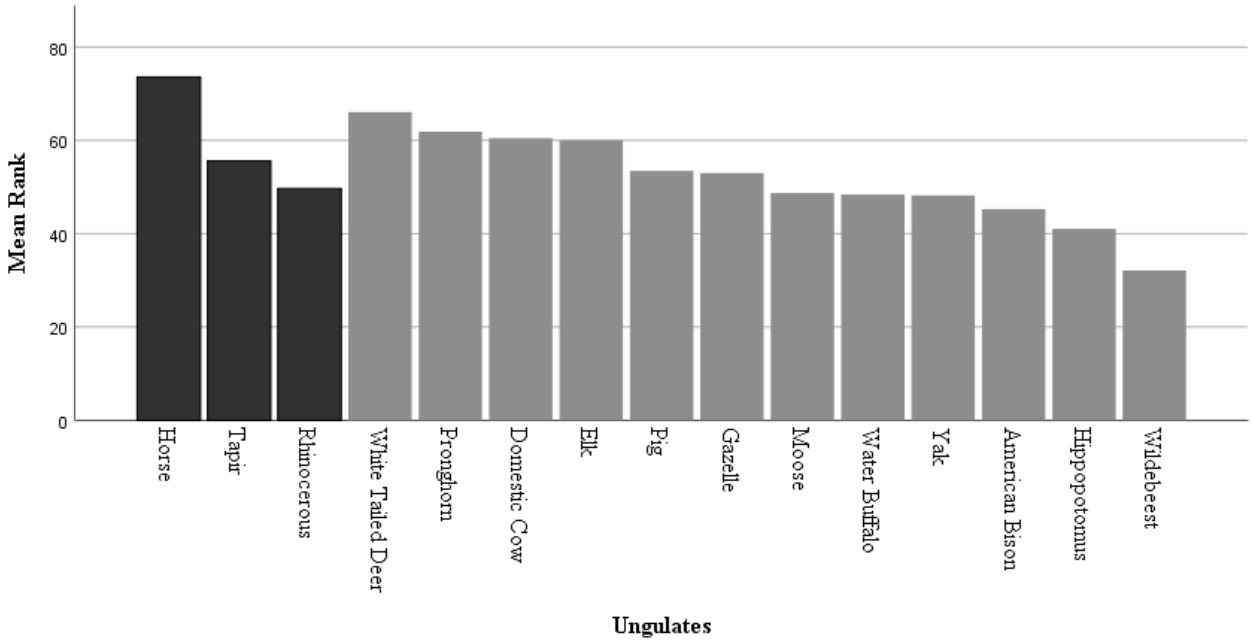


Figure 3. Ranked scores of ungulates. Odd toed ungulates in black and even toed ungulates in grey

Causes of Attitudes Toward Ungulates

Attitudes toward ungulates were strongly impacted by exposure to the species. Students indicated encounters with horses and the domestic cow and had positive attitudes toward these species. Within the Kellert framework these attitudes would come from utilitarian and aesthetic mindsets. Other ungulates scared the students as they were concerned with this large animal harming them by accident or on purpose. For example, a typical quote was like this one:

Researcher: What were some animals you didn't like from the PowerPoints?

KG: The spiders and most of the big animals.

Researcher: Why?

KG: The spiders they could hurt you and like most of the big animals could run you over if you weren't paying attention.

Researcher: I noticed that was a common response for you that if an animal was big you were worried it might hurt you, why is that such a concern for you? Have you had a big animal attack you or something?

KG: No sir, it is just I am afraid of the big animals and them hurting me.

This fear was stated in several of the interviews and explains why ungulates had negative attitudes associated with them.

Cetaceans and Elephants

Much like the ungulates, attitudes toward cetaceans (whales and dolphins) were influenced by how much the students had been exposed to the species, and the size of the animal negatively impacted attitudes.

Attitudes Toward Elephants

Though the elephant is the largest land animal if ranked very high overall, this is most likely due to a mix of exposure to the species and the symbolism associated with the species in the southeastern United States. In Figure 4 the elephant and cetaceans (whales and dolphins) ranking are presented with the elephant and dolphin, which are species children are often exposed to, having more positive attitudes toward them.

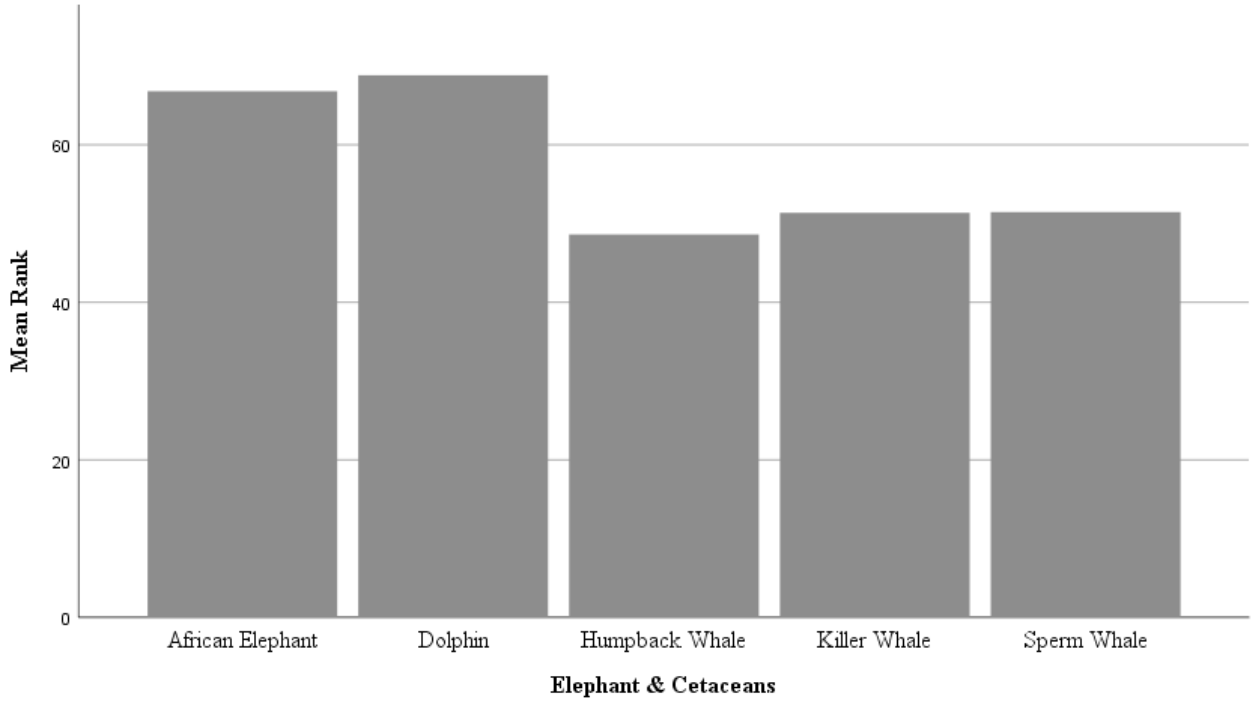


Figure 4. Ranked scores of elephant, dolphin, and whales.

Birds

Birds were divided into three groups: raptors, songbirds, and farm birds (see Figure 5). There was a statistically significant difference between the three groups. Students preferred songbirds to raptors and farm birds

Attitudes Toward Raptors

Raptors included the red tailed hawk, American kestrel, bald eagle, great horned owl, barn owl, and turkey vulture. Within the raptor group there were no statistically significant differences between raptors except for the turkey vulture, which had a statistically significant difference in ranking X^2 (5, N = 49) = 59.173, p <.001. All raptors had the same overall positive attitudes toward them except the vulture which had overall negative attitudes toward it. The reasons for this difference were cited as the color of the feathers and that the turkey vulture eats dead animals and its symbolic association with death.

Researcher: One of my last questions for you, that I wanted to follow up on because your reasoning was, they are vultures. It is a turkey vulture, so why is that a bad thing?

CC: It's really not but I guess I consider them nasty.

Researcher: What is nasty about them?

CC: They eat dead stuff and but they do help us though… by cleaning up the stuff on the sides of roads.

Attitudes Toward Songbirds

Student preferred songbirds to other types of birds. Overall birds had positive attitudes, the reasons cited included aesthetics, the song of the animal, and the ability to fly.

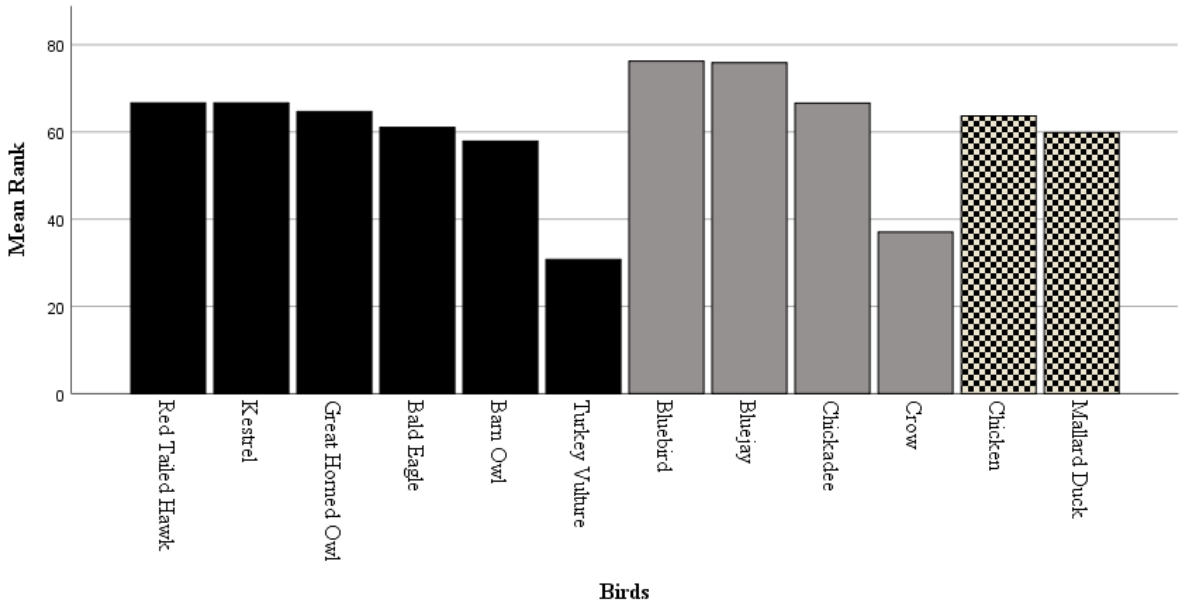


Figure 5. Ranked scores of birds. From left to right raptors (black), songbirds (grey), and farm birds (checkerboard).

Songbirds on the survey included the bluebird, blue jay, chickadee, and American crow. Seventh grade students had strongly positive attitudes toward the blue bird and blue jay, mildly positive attitudes toward the chickadee and negative attitudes toward the crow. These differences were statistically significant X^2 (3, N = 52) = 65.937, p <.001. The reasons stated for positive attitudes toward the bluebird, blue jay, and chickadee included the aesthetic appeal of the animals, the harmlessness of the species, and the song of each species. The negative attitudes toward the crow involved the black color of it feathers, its symbolic relationship with death, and the "caw" noise that crows make.

Attitudes Toward Farm Birds

There was not a statistically significant difference in attitudes between chickens and ducks, with both having positive and slightly positive attitudes toward them

respectively. The aesthetic appearance and the food that they provide were the reasons why students preferred the chickens. Ducks were liked for the way they look and disliked for how they behave.

Researcher: Have you had bad encounter with a duck?

RH: No.

Researcher: You said ducks can be mean.

RH: Yes they can.

Researcher: I was wondering if you had a bad encounter.

Reptiles

There were statistically significant differences in how students felt about different species of reptiles $X^2(14, N = 46) = 115.684$, $p < .001$. Students preferred turtles to lizards to crocodilians to snakes (Figure 6). Students had strong positive attitudes toward turtles citing that turtles were cute, slow, and harmless. The exception to this was the alligator snapping turtle, which students saw as mean and feared could bite them. Student attitudes toward lizard were neutral to negative with a huge variety in the reasoning that will be discussed in the next section. Students had weakly negative attitudes toward crocodilians, citing that they were mean or dangerous, while some students had positive attitudes, stating that they were cool, strong, or dinosaurs. Differences in attitudes between alligators and crocodiles were not statistically evident ($p = .589$). Overall, students had similar attitudes toward both alligators and crocodiles when presented with each one.

Students' attitudes toward snakes were low on average and showed that overall, the students had negative attitudes toward snakes, and these attitudes were the same for both venomous and non-venomous species of snakes. Species of snake on the survey included local species of snakes such as eastern indigo snake, corn snake, eastern diamondback rattlesnake and exotic species such as the Burmese python and king cobra. All species have similar rankings and mean Likert scale scores, meaning that all species of snakes were disliked equally regardless of traits (p = .924).

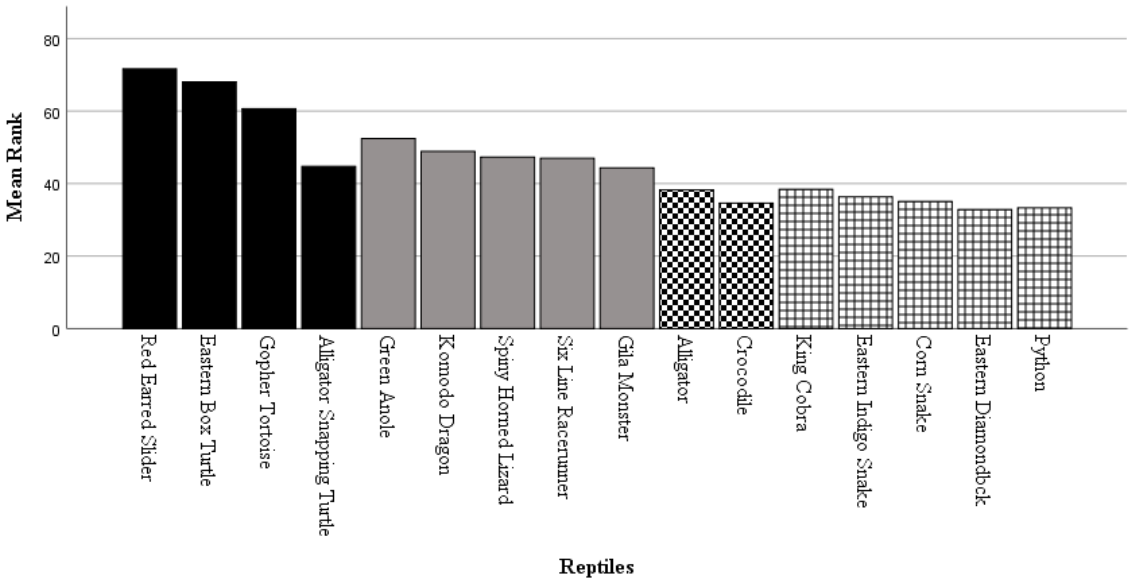


Figure 6. Reptile attitude scores. From left to right turtles (black), lizards (grey), crocodilians (checkerboard), and snakes (gridlines).

Reasons for Attitudes Toward Reptiles

Attitudes toward reptiles were negatively associated with the students' beliefs that the animals could harm them. The higher the perceived harm, the lower the attitude. The

students believed turtles were the most harmless, then lizards, then crocodilians, and snakes were seen as approximately the same as crocodilians.

Attitudes Toward Amphibians

There were slightly negative to neutral attitudes toward amphibians, and amphibians were ranked fairly low on the Freidman's ranking ANOVA. Species presented included local species such as green tree frogs, marbled salamanders, red hills salamanders, bullfrogs, and the American toad. All species had similar ranking and there was not a statistically significant difference between attitudes toward frogs, toads, or salamanders (p = .098) (see Figure 7). Salamanders were then compared to lizards because in the qualitative data it appeared that many students did not know the difference between salamanders and lizards. The Likert scores and Friedman's ANOVA ranking also reflect this as differences in ranking seem to be minimal across the two groups with the scores being mixed up overall with no consist pattern (Table 3) or statistical significance (p = .09).

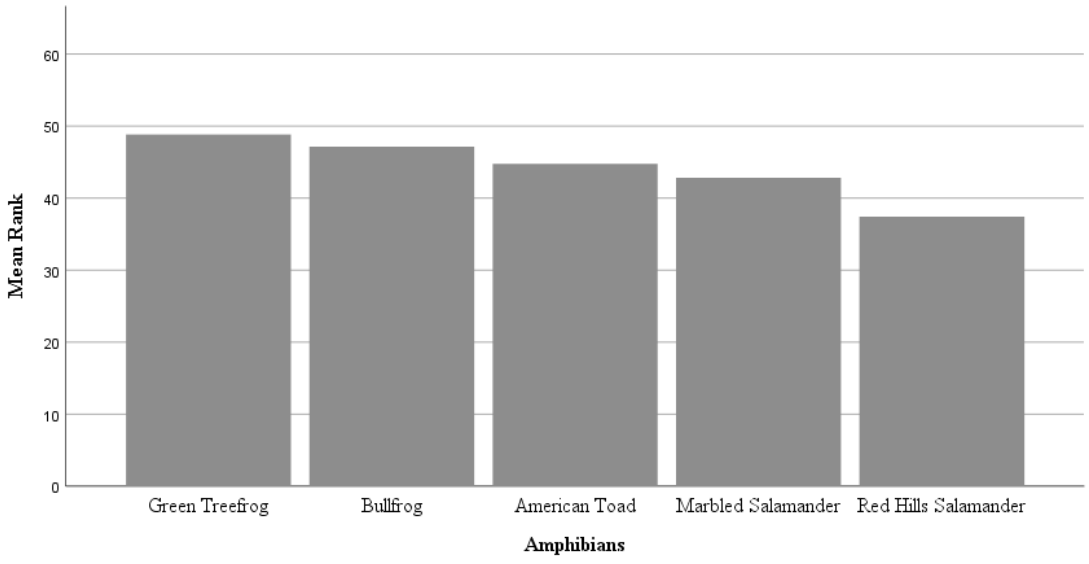


Figure 7. Ranked scores of amphibians

Reasons for Attitudes Toward Amphibians

In their remarks and comments students did not have a specific reasoning for disliking amphibians. Some students liked the colors of some of the amphibians including the marbled salamander and green tree frog. Overall, negative attitudes were more commonly cited due to the slimy nature of amphibians and fear that the skin either contained poisons or could give the student a disease.

Table 5

Lizard and Salamander Ranks

Name	Mean Rank
Red Hills Salamander	3.37
Marbled Salamander	3.90
Gila Monster	3.77
Spiny Horned Lizard	4.20
Green Anole	4.47
Six Line Racerunner	4.20
Komodo Dragon	4.09

Fish

There were surprising attitudes toward fish when compared to previous research and this will be explained in the next section (Figure 8). Overall fish attitudes were mostly neutral to negative, however the blue tang and clownfish had strongly positive attitudes, and the main reason was cited by the movies *Finding Nemo* and *Finding Dory*. The clownfish as noted in Table 2 had the highest average Likert survey score out of all animals. The blue tang was also ranked very high, with both species being ranked in the top five of the Friedman's ANOVA. Other species of fish did not score this well and there were statistically significant differences

between the different species and also between freshwater and saltwater species X^2 (7, N = 52) = 101.562, p <.001. Students demonstrated differences in attitudes between sharks and bony fish with students preferring bony fish to sharks. Negative attitudes toward fish were mostly because of the look of the fish with the drab colors of the freshwater fish and ugly appearance being cited. Negative attitudes toward sharks was due to the supposed danger the shark might pose to the student. Besides the blue tang and clownfish, attitudes toward marine bony fish were mixed but the reasoning was almost always related to the appearance. Positive attitudes involved the bright and vibrant colors of the fish, while negative attitudes were based on the facial characteristics common in fish or if the student thought the fish could harm them.

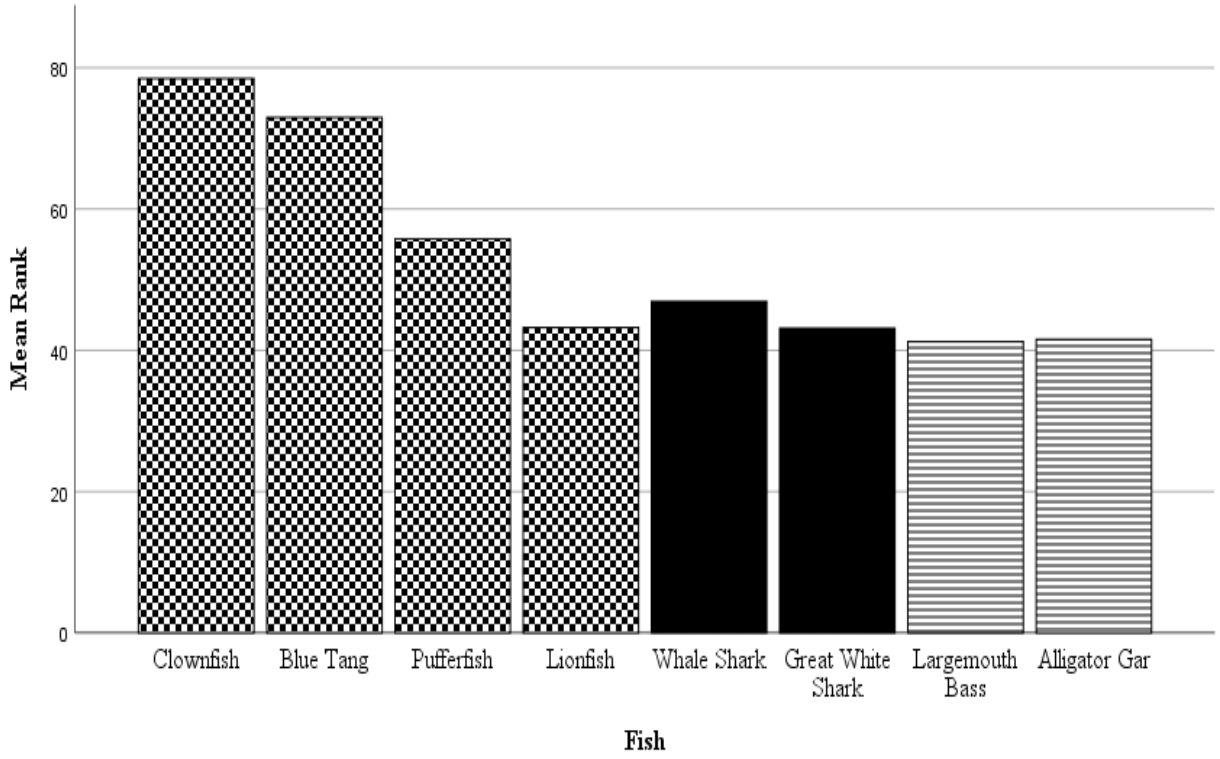


Figure 8. Ranked scores of fish. Saltwater fish are presented in checkerboard, sharks in black, and freshwater fish have vertical lines.

Invertebrates

One the survey, there were three phyla of invertebrates. Attitudes toward invertebrates can be broken down into three groups: attitudes toward echinoderms, attitudes toward mollusks, and attitudes toward arthropods (Figure 9).

Attitudes Toward Echinoderms

Echinoderms included the starfish and sea cucumber and the students' attitudes toward each were very different. Students had strong positive attitudes toward the starfish and strong negative attitudes toward the sea cucumber. The strong positive attitudes toward the starfish

came from several places, student indicated that starfish were harmless, they had bright colors, and from Patrick the starfish from the TV show *Spongebob Squarepants*. The negative attitudes toward the sea cucumber came from it being not colorful, boring, and weird looking to the students X^2 (1, N = 54) = 31.837, p <.001.

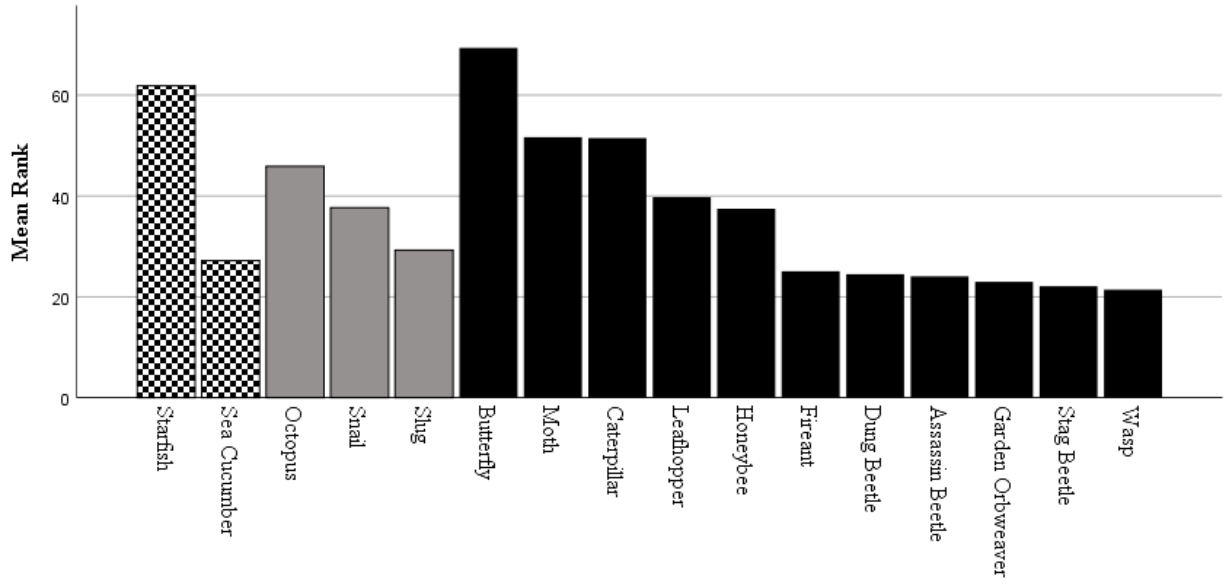


Figure 9. Ranked scores of invertebrates. From left to right echinoderms (checkerboard), mollusks (grey), and arthropods (black).

Attitudes Toward Mollusks

The mollusks presented to students were all mollusks that students might have seen and included a slug, snail, and octopus. Attitudes toward snails and slugs were negative and common responses as to why included that the animal was slimy or weird looking. There was a statistically significant differences in snail and slug scores overall X^2 (2, N = 54) = 11.681, p =.003. Students had less negative attitudes toward the snail when compared to the slug. Octopus

had neutral attitudes toward with some student not likely octopuses for fear of harm to people and some student liking octopuses due to their unique characteristics such as camouflage, intelligence, and flexibility. Differences between the octopus and the gastropod species was statistically significant (p = .003).

Attitudes Toward Arthropods

Attitudes toward arthropods had wide variety between species and orders X^2 (10, N = 49) = 190.191, p <.001. The reason for this variety in attitudes came from the students' knowledge as to if the animal could hurt them or not. Butterflies scored the highest out of all of the invertebrates and higher than most other animals. The reason for positive attitudes toward butterflies included the harmlessness of butterflies along with the bright color and "playful" behaviors. Students had slightly positive attitudes toward moths and caterpillars with both scoring and ranking the same. Reasons for these attitudes were like that of the butterfly except moths and caterpillars were not seen as colorful but instead dull or ugly. Students had neutral attitudes toward bees as many knew that bees help pollinate plants and flowers however they also knew that bees can sting you. The wasp, assassin beetle, fire ant, leafhopper, dung beetle, and orb weaver spider all negative attitudes toward them. Students were concerned about the ability of the animal to bite them or they cited "I just don't like bugs" which was investigated in the interviews with students and will be detailed in the next section.

Reasons for Attitudes Toward Invertebrates

This complex group of animals had equally complex reasoning for liking or disliking species within the group. Slimy, ugly, weird, scary, and could hurt me were the most common reasons for disliking invertebrates. Positive attitudes were associated with colorful invertebrates or invertebrates that the students knew could not harm them.

Research Question 2

Research question 2 investigated what values influenced the attitudes toward animals of 7th grade students at this middle school. Attitudes toward mammals came from two major values, aesthetic values of the animal and the possibility that the animal may harm the student (negativistic values). Other major themes included the symbolic, utilitarian, and ecological values of the animal. The common themes that emerged from this research were: aesthetic values, uniqueness, fear of harm, media influence, symbolism of a species, and dislike (e.g. because it is a bug). Each theme is discussed in the following sections.

Aesthetic Values

Many animals were cited as cute, pretty, beautiful, cool, unique, or ugly and this was the reason why students liked these animals. These responses suggested that aesthetic values of the animal were influencing the students' attitudes. During the interviews, students were asked what makes an animal cute or ugly:

> Researcher: My next question what do you think makes a particular animal cute?
>
> JR: How their face, something with their face. Some faces are big and they are not cute but some have small faces with big cheeks and they are cute. Their eyes and eye colors make them cute.
>
> Researcher: What eye colors are the cutest?
>
> JR: Blue, hazel, and green

This student mentioned facial shape and eye color and eye colors that is most common in mammals.

SR: I like hippos, white tigers, hector dolphin, it is one of the smallest dolphins, and I like river otters.

Researcher: Why do you like those animals in particular?

SR: Because I think they are really cute.

Researcher: That is actually on of my other questions. A lot of students mentioned aesthetics or they thought it was pretty or cute. What do you think makes an animal pretty or cute?

SR: The color or the I think all the animals are really cute the ones with big eyes.

The aesthetics these students mention are most common in mammals other students mentioned traits that are exclusive to mammals that without these traits an animal is ugly

Researcher: Makes sense has to do with you term strong. So this goes into the cute and ugly stuff. What makes an animal ugly?

HO: Probably an animal with no fur.

Common responses from students mentioned that cuteness is based on the expressions an animal makes and this can be tied to mammals' platysma that allows us to make facial expression and is exclusive to mammals. Fur is also exclusive to mammals and this trait's being associated with cuteness helps show why mammals typically score higher than other groups. Students used their previous understandings about aesthetics to explain why they did or did not like an animal.

Researcher: makes sense has to do with you term strong. So this goes into the cute and ugly stuff. What makes an animal ugly?

HO: probably an animal with no fur.

Researcher: the capuchin had fur?

HO: what is a capuchin.

Researcher: the little monkey. So I am not suggesting you change your answer but what makes him ugly vs not.

HO: he doesnt have fur on his face and he has got like big eyes that look black.

Researcher: so hairless face and no whites of the eyes.

This student considered the close relative of humans ugly because it had traits that would be scary if a person had them. Constructivism suggests that no one comes into a situation as a blank slate. The student's previous mindset about eye coloration in primates made the capuchin appear as ugly.

Uniqueness

Animals with specialized or unique features had more positive attitudes associated with them than closely related species without those unique features. Uniqueness would be considered a form of naturalistic value. Birds had positive attitudes associated with them because of the color of their feathers and their ability to fly. Both being unique characters within the animal kingdom. This power of uniqueness was not exclusive to birds:

Researcher: Well what are a few of them then that you really like?

HO: The turtle, the lionfish, snakes, I like butterflies.

Researcher: I was about to ask if it was because they are all strong animals but the butterfly isn't really strong. What do you like turtles, lionfish, snakes, and butterflies?

HO: Lionfish they have colors and most of them have venom. The colors stand out to me but also the way they can keep predators away with their bright colors and venom. Turtles might be slow but they some of them have a strong bite.

Researcher: They do.

HO: What else did I say?

Researcher: Snake and butterfly.

HO: Snake because they can swallow their prey whole and butterflies because of the color.

Researcher: Those are all unique animals compared to others so maybe those special characteristics make them more interesting to you?

HO: Yes

The most common unique traits cited by students were physical traits that a student could see, however a student's knowledge also played into this and if a student knew that a species had a special trait that was not obvious from the picture they would mention that. For example, students noted that bees help the environment through pollination and one student noted the defensive trait of the horned lizard:

Researcher: If they have been trained to yeah. You put that you like the horned toad because it bleeds out of its eyes.

RH: Yes

Researcher: That is a trait that they have so that knowledge about them is why you like them

RH: And cause of the horns and how they camouflage into the ground.

Researcher: So some of its traits.

RH: Nods

My Definition of a Snake is That They Will Hurt Me.

Many students were concerned about the likelihood that an animal could hurt them. If an animal was big and students did not know about it. Most defaulted to fear of the animal because it could hurt them:

Researcher: For the capuchin that you didn't like it but you didn't know. Did you mean you don't know why you don't like it or you don't know about it?

SS: Yeah I.. both because …. I don't know because I don't like but I don't know why because I have never seen one of those before or heard anything about them and what they do and like to do.

Researcher: So maybe if you knew more about them you might give them a higher score

SS: Yes

This fear was also caused if they had heard of someone being killed by the species:

Researcher: So we talked about how you don't like animals when they are too big because they might attack you is that your reasoning for when you say it is too big

on different animals? when you said an animal kills, in this case the orca here why is that a bad thing to you?

JR: I mean I don't know anyone that has been killed but I know people have been killed by it but I when I see that happen I try and stay a distance away from them because like it could be me that gets killed by it.

Researcher: So you are talking specifically that it kills people

JR: Yes

Some mammals scored as low as most reptiles and amphibians. Large ungulates scored the lowest out of all of the mammals with the main reason being that the animal was big. When given an opportunity to ask some students why this was a bad thing they explained that larger animals had a higher perceived ability to harm the student than smaller mammals.

Attitudes toward snakes were also described through the animal's ability to harm or kill a student. Students were not able to determine if local snakes were venomous or not from the PowerPoint images:

Researcher: Why do you think a corn snake would attack you?

KG: It is a snake and my definition of snakes is that they will hurt me.

This student's statement was not the only one involving concerns that snakes could hurt them.

Researcher: Are you scared of any animals

RH: Some venomous snakes, not really scorpions, I cant really think of anything else?

Researcher: Can you tell the difference between a venomous and non-venomous snake?

RH: I heard that for venomous snake they have a rounded hood, a rounded head then non venomous have like a regular size. I am not sure.

Spongebob Squarepants may be the Best Show for Saving Animals

The media played a huge role in the attitudes toward several species. Previous studies have shown that fish and invertebrates do not have positive attitudes toward them, however the starfish, clownfish, and blue tang were some of the animals with the most positive attitudes toward them. The most common answer cited was in regards to TV show *Spongebob Squarepants* were one of the main characters is a starfish named Patrick Star, the starfish, and the movies *Finding Nemo* and *Finding Dory* were mentioned as reasons to like these animals. TV plays a critical role in determining attitudes toward animals. The negative attitudes toward crows and vultures may also be because of media representation:

Researcher: Why are crows ugly because most people thought birds were pretty but the crow ugly. You said the crow was ugly and scary what is ugly and scary about it?

KG: Because of its black color

Researcher: Is that the ugly or scary part?

KG: Ugly and scary

Researcher: So its association with haunted house, Halloween, death, those things?

KG: Yes sir

Several other television shows were also mentioned in one of the interviews showing just how attitude toward animals come from media:

Researcher: So one of your responses confused me you put that you didn't like or dislike the house mouse but your reasoning was Mickey Mouse. Can you explain?

RH: Mickey is like a friendly mouse he has big ears, how his nose is round like that mouse. I like how the whiskers come out.

Researcher: It sounds like you like Mickey Mouse so why not like this mouse?

RH: It just relates to me in how Mickey looks.

Researcher: So maybe you don't like mice but you like Mickey so it got pulled up to the middle?

RH: Yeah

Researcher: You were one of the students that mentioned media with your ATA and it looked like with animals that showed up in media you mentioned Ninja Turtle, Lion King, and Rocksteady (from TMNT) and the one with the rhino (Spiderman) so would you say that these tv shows have made you like these animals more?

RH: Yeah it pretty much relates to how they look.

Researcher: Can you explain that a little better?

RH: Lion King has all the fur for protection and how the lion will protect its kids. And with ninja turtles, and their shell stayed as a dent on their back and then Rocksteady how rhino hide is intimidating looking.

Media came in the form of books as well and played a role in modifying attitudes toward animals. Several students wrote about Hedwig from *Harry Potter* in their positive responses to the barn owl and great horned owl. This shows that even though Hedwig was a snowy owl that

attitudes toward groups of similar animals are often the same. Negative attitudes toward animals were also created via the media. The Bible seemed to influence students' attitudes toward animals.

Researcher: What were some of your least favorite animals from the PowerPoint?

CC: Maybe the snakes.

Researcher: Snakes, yes, and actually I have, I went through your survey, and I noticed snakes are, while we are talking about it, your responses for any of the snakes was "they are the devil". Elaborate on that some more.

CC: Cause in the bible God represented him (Satan), in the garden of Eden, they bit or something with the apple and some.. Whenever they… yeah

Researcher: The snake informs Eve, tempts her to bite the apple?

CC: Yes.

This representation of snakes was common and this student's response was not the only one. Several students wrote similar descriptions of snakes.

I Just Don't Like Bugs

One of the most common responses regarding the arthropods on the survey was that the student just did not like bugs. When asked about this, students responded by saying the shape of the arthropod or the movement of the arthropod bothered them.

Researcher: What was ugly about the dung beetles?

KG: How their bodies are curved and shaped.

Students also would give responses that seemed contrary to common positive responses about vertebrates when it came to responses about arthropods:

Researcher: How is an animal too colorful? You said that this animal was too colorful

SS: I really don't know I don't remember what was going on. I don't know what that is

Researcher: It is an assassin beetle

SS: Ew

Researcher: They live around here, they assassinate other bugs

SS: Oh I don't know I really don't know.

Researcher: I just wanted to follow it up that is fine. So I think this is the same question but different because you said they crawl on you why that is a bad thing is it the same as earlier with the dung beetle.

SS: Yes because it gives you the feeling that people don't like of things crawling on you and I don't know if they can bite or not they might bite.

Colorful vertebrates were seen with positive attitudes, in this case the arthropod is too colorful and fear about it crawling on them is also an issues:

Researcher: Ok, my first question for you and I actually have a lot...some of them will be the same response. You said the dung beetles are creepy, what makes them creepy?

SR: I don't know, they look creepy. I just don't like their legs, their legs like they are gonna hurt me.

Researcher: The way, so the fact that their legs have sharp points on them?

SR: Yeah and I just don't like insects period.

Researcher: Why?

SR: They are disgusting and creepy! I have just never liked them at all.

This student typically had positive attitudes toward most animals, however she did not like insects either.

Research Question 3

The third research question looked to see to want extent did education improve 7th grade students' attitudes and knowledge toward bats. Students were given a pretest that assessed students' knowledge and attitudes toward bats. Students then participated in several learning activities spread over three weeks. These lessons are described in Appendix B. At the end of these students took the same test again and pre and post test scores were compared. A single *t*-test was done. Students typically scored higher on the posttest. Differences in the pre ($M = 2$, $SD = 1.2$) and posttest ($M = 2.9$, $SD = .97$) were found to be statistically significant ($t(48) = -6.9$, $p < .001$) and correlation was strong at .796 $p < .001$. A measure of internal consistency, Kuder-Richardson Formula 21 (KR-21), was high for knowledge about bats at 0.8, and this informs the researcher that the instrument is reliable and the concept has been captured adequately (Henson, 2001). Most of the students in the interviews said they learned something new about bats ranging from what they eat to the number of bat species that exist. Even students with very negative attitudes toward animals said they were less afraid of bats now. The following interview excerpt is an example of this change in attitudes.

Researcher: Over the course of the whole time did you learn anything new about bats?

JR: I did not know that there were 15 species around here.

Researcher: How do you feel about bats after learning more about them?

JR: Still scared of them, I have got a little bit more used to them because I feel like I am not that in danger and they are not that dangerous. They are alright.

Another thing that seemed to be a concern was students thought bats were large and were therefore more afraid of them. Exposure to bat specimens seemed to help deal with this misconception:

Researcher: Did learning more about bats, how did you feel about them before and after all of this, did that change?

HO: Well yeah because I didn't know they are small animals I thought they were bigger because of their wing size. And then when we finally got to hold bats I then felt like I liked them a lot.

Researcher: So the exposure to actually seeing what a bat looked like was the thing that kind of changed it the most for you would you say or was it something else?

HO: It was the size.

Researcher: So getting to see their size?

HO: Yes

Attitudes toward bats improved, with Likert scale results increasing between the pretest and postest X^2 (1, N = 49) = 19.2, $p < .001$. Cronbach's alpha for attitudes was acceptable at .651.

Assertions from Results

There are several assertions we can make based on the findings of this research.

1) Based on the results involving research questions 1 and 2, student knowledge about an animal plays a critical role in determining their attitudes toward that animal. Knowledge about an animal can modify one of the values described by Kellert to change the student's perspective. The most likely values to be modified and improve attitudes toward an animal by knowledge are naturalistic, ecologistic, utilitarian, and negativistic values.
2) Research question 2 examined the factors that influenced attitudes of 7th grade students and the results suggest that students use the aesthetics of an animal and the likelihood of the animal harming them to determine their attitudes when they do not have knowledge about the animal. This means that there is a size of the animal component to attitudes toward animals. This means larger animals need to be presented in a different way than smaller animals to improve attitudes.
3) Research question 3 examined how education would improve attitudes and knowledge about bats. Based on the results, teaching students about animals is a critical way to help improve attitudes toward animals. Education should be done in a hands-on way to give students experience with the animal at question. By showing students that the animal is harmless by presenting the animal, you are challenging misconceptions they have constructed regarding the animal.
4) Results from research question 1 indicated that students group similar animals together and the attitudes, beliefs, and thoughts about any are shared through the entire group. So,

one bad experience can lead to negativistic values toward an entire family or order of animals.

CHAPTER V: DISCUSSION AND IMPLICATIONS

Introduction

Attitudes toward animals have always played a role in the fate of a species. As we enter the sixth mass extinction event that has been facilitated by anthropogenic factors, understanding the attitudes toward animals held by younger generations and the values that influence them is more important than ever (Ceballos et al., 2015; Kellert, 1985; Komorosky & O'Neal, 2015). This study looked at the attitudes and values that rural students held toward animals and how an education curriculum could be designed to change values and improve attitudes toward species that are seen as pests or vermin. The results of this research are aligned with findings of previous research that show that exposure to an animal often improves attitudes toward that animal and that older children's attitudes will improve when facts about the animal are presented to them (Rule & Zhbanova, 2012; Kellert 1981). Using education to promote more appropriate attitudes toward animals should be done with children. Results from this study suggested that the most common student values that influenced their attitudes toward animals were Aesthetic, Negativistic, Humanistic, and Utilitarian Values.

This chapter will discuss its findings in seven sections. The first four sections will discuss the results related to the first two research questions, which are what are the attitudes toward animals among 7th grade students in a rural school in the southeastern United States and what values influence attitudes of 7th grade students attending a rural school in the southeastern United States. First, student beliefs and ideas about animals will be discussed and how this impacted

attitudes. Second, naturalistic, scientist, and doministic values will be discussed and how they influenced into student's attitudes. Third, naturalistic, ecologistic, and utilitarian values will be discussed. Next, aesthetic, moralistic, and humanistic values of the students will be evaluated and discussed. Following, the results regarding the bat surveys will be evaluated. Penultimate, the themes of chapter four will be discussed. Lastly, a section for discussing implications of these results, limitations of the research, and recommendations for future research will be listed.

Students Beliefs and Ideas About Animals

The most common reason for liking of disliking an animal was related to the aesthetic features of the animal with birds and mammals being cited as cute more than other groups. Many students found that invertebrates were ugly and this may be because of the extreme differences in their anatomy compared to our own. Previous studies have found that we prefer animals that look like us, so this is to be expected (Knight, 2008). The amount that aesthetics was cited was surprisingly large, however, and should be considered as either an advantage to promoting positive attitudes or a hindrance that must be considered in conservation work.

One issue that came up was how knowledge impacted attitudes. Students were more likely to dislike an animal if they cited a misconception or an incorrect statement about the animal as their reason. For example, many students that disliked reptiles stated that they did not like them because they were slimy. This is a common misconception in students, and is a good example of how knowledge plays a role in positively changing attitudes of students (Bucher, 2010). Constructivist theory states that a person's preconceptions influence their decision and we see this with the negative attitudes toward reptiles and these constructed misconceptions about reptiles have been detected in previous research (Trowbridge & Mintzes, 1988). We saw this same issue arise with the bat curriculum, and as described later, how the bat curriculum

improved attitudes by discussing confronting the misconceptions students held. Students' knowledge about local reptiles was low, and this lack of knowledge about local animals was most prevalent in the comments about snakes. As described previously in the results section, all the snakes' rank values were almost identical, meaning that students did not see a difference between local, exotic, and invasive species. Also, students did not differentiate between venomous and non-venomous species. Two of the species listed are local, non-venomous, and endangered species of snakes. These two species listed were the corn snake (*Pantherophis guttatus*) and the Eastern Indigo Snake (*Drymarchon couperi*). These species are likely to be encountered during these students' lifetimes so having positive attitudes is critical for these species' success.

Naturalistic, Scientist, and Ecologistic Values

The naturalistic value describes how valuable an experience with a particular animal species is, while an ecological value describes how important a species is to the stability and structure of an ecosystem in the mind of a person. Naturalistic values and ecologistic values were rarely mentioned. The crow, vulture, and bee were the only animals where naturalistic or ecologistic values were expressed. These values related to the crow and vulture were mentioned because of their nature as scavengers and this trait was associated with negative attitudes. Students had misconceptions about scavengers, considering them as bad or lesser somehow. Scavengers are important to ecological systems and instruction about this niche needs to reflect that (Geng & Cote, 2002). This idea that scavengers are bad is most likely constructed by students due to the symbolism of scavengers with death and the perception that they are lesser beings by having to scavenge the dead for food. This should be avoided by teachers, or teachers should explicitly described the benefits of scavengers and the animals that fill this ecological

niche. Detritivores, or organisms that eat dead, decaying organic matter, play a critical role in all ecosystems and should be taught in a way that creates positive feelings toward these organisms similar to how we teach about pollinators. By discussing the importance of these ecological roles in an ecosystem, educators can show students the value of these species, so through ecologistic values we could also promote utilitarian values. Bees were mentioned for their association with pollination and were expressed with positive attitudes.

Negativistic Attitudes, Doministic Attitudes, and Utilitarian Values

The negativistic attitudes that students come largely from fear that the animal can hurt them, but some animals were cited as pests that could harm other animals such as farm animals or pets, or harm plants such as crops. Negativistic attitudes of the students are similar to those found in previous studies, however in interviews many of the students in this study said that they would be more receptive to an animal if they knew more about it. Also based on the attitudes toward animals that have been in media, simple exposure may be a way to improve attitudes toward an animal. For example, the elephant, which is the largest living land animal, is a species that many students are exposed to through symbolism, media, and education. Elephants had strong positive attitudes associated with them. However, other large mammalian fauna such as the wildebeest and buffalo were had less positive and more negative attitudes associated with them. Students have constructed preconceptions about elephants that they do not have for other large mammalian fauna, and as a result these preconceived ideas influenced their values and attitudes toward elephants, but with large mammals that do not have the same amount of media exposure, students defaulted to beliefs that large animals will harm them. Attitudes can be improved and negativistic values can be reduced through exposure to the species. Education and conservation groups should use a wider variety of examples in flora and fauna in order to

promote more positive attitudes. Students typically had previously constructed ideas or thoughts that influenced their attitudes toward animals. Some students had more knowledge about certain species than other students did and knowledge about an animal almost always positively influenced attitudes. The following interview excerpt is an example of this.

Researcher: You put that you like the horned toad because it bleeds out of its eyes.

RH: Yes

Researcher: That is a trait that they have so that knowledge about them is why you like them

RH: And cause of the horns and how they camouflage into the ground.

Researcher: So some of its traits.

RH: Nods

This student's previous knowledge about the horned lizard influenced their attitudes toward the species, in other words they were not seeing the horned lizard for the first time with no experiences with the animal. Lizards typically did not have positive attitudes associated with them, but this student had prior knowledge that positively influenced their attitudes toward the horned lizard. Many students had not seen a horned lizard before so when they saw a spiny animal like this for the first time many responded with fearful responses.

People with doministic attitudes are primarily interested in the mastery of animals, and this attitude can be seen as an attitude formed from utilitarian values taken to an extreme. No comments or interviews suggested that students have doministic attitudes.

A utility value involves looking at the usefulness of the animal to humanity in the present and future (Pica-Ciamarra, Tasciotti, Otte & Zezza, 2011). Students cited the utility of certain animals as to why they liked the animal. Many students only liked certain animals because of the food they could provide us and held beliefs that this animal was only good because of its use to us. This means that students may like an animal and show positive attitudes toward it, but only liking an animal for what it can give you in return can devalue the life of that organism (Schroder & McEachern, 2004). Students also saw the utility that some animals do in the wild such as honeybees which help plants reproduce by pollinating them. Some students also saw the value that dogs provided as a reason to like them. The utility associated with dogs was wide, and included the service a dog provides as a guard, the amazing hearing they have, and the therapy that dogs can provide, and everything inbetween.

Aesthetic, Moralistic, and Humanistic Values

An aesthetic value is the physical attractiveness of the animal to a person. The appearance of an animal was the most common reason cited for liking or disliking the animal. Animals that were perceived as ugly by the students received a lower score than animals that were seen as pretty. Common traits of the animals that were seen as aesthetically pleasing included colorful hair, feathers, or scales, having feathers or hair, and being a warm-blooded vertebrate. Animals that were aesthetically unappealing included animals that did not look like us, invertebrates, and animals that had slime or the students perceived to have slime. As with previous research, students preferred the butterfly to the caterpillar or the moth, despite both the caterpillar and butterfly presented in this study being the same species (Knight, 2008).

Humanistic attitudes were seen in animals that students have in their backyard or as pets. Many students personified the animals in their descriptions to give them either good or bad traits.

For example, some animals were described as loyal while others were described as mean. When asked in more detail about this, students would say they thought the animal liked harming them or liked doing things for us to describe why they said the animal had this personified trait. Personification of animals was used as a way to improve attitudes toward an animal in younger students in previous research. However, personification is used in media about animals and making a particular group of animals always the villain, as is done with snakes, crows, and vultures this can have a long lasting effect on the mindset of the person and should be taken into consideration. Conservation workers creating media should consider using animals often seen as being mean or scary in a more positive light. Educators should be careful to not over-personify species and give them negative or bad traits, as the students incorporate these metaphors and analogies along with the information and create a new misconception related to the personality traits of a species.

Humanistic values regarding family were only mentioned for two animals, the cat and the dog. Both were cited as either a best friend or a part of the student's family when the animal was a pet. This is similar to what has been cited by other research that people consider pets as a part of their family (Cohen, 2002). Moralisitic values were rarely mentioned by the students. Snakes were seen as evil or as the Devil by some students which is one of the major issues that need to be addressed in the southeast as when one sees something as absolute evil, any action against that evil is morally justified (Rowe, 1979).

Research Question 3

The third research question investigated how the Save the Bats curriculum would impact students' knowledge and attitudes toward bats. This curriculum was successful in improving

attitudes toward bats through exposure and knowledge about bats. These results are what the researcher predicted based on the results from the survey about animals.

The Bat Curriculum

The curriculum improved students' attitudes toward bats. By teaching students about bats and then exposing them to voucher specimens (dead, cleaned, and stuffed) so they could see a real bat, previously held misconceptions were challenged. By teaching the students about the attributes of bats in lesson one, students learned ecologistic, moralistic, and utilitarian values of bats by comparing them to humans and teaching about the impact bats have on farmers through the elimination of pests and through fertilizing the soil. In the second portion, students were able to see bats in the area and handle voucher specimens, which was designed to change aesthetic, naturalistic, and moralistic values toward bats. Previously constructed beliefs, such as the size of bats, were challenged, based on interviews. Students had warped ideas about the size of bats in our area. The last part was made to show the students the bats where they live to make bats relevant to the student in their day-to-day lives. This resulted in the new perception of bats that improved the attitudes most students had toward bats. By showing the students bats that live in the same part of the world that they do, their knowledge about bats become relevant and by seeing a voucher specimen of a bat, the students were potentially able to identify bats they see outside. This knowledge will improve interest long term in bats.

Themes

The following sections will discuss the primary themes that emerged from this research and how this impacts teacher education, biology education, and conservation efforts. Based on these assertions, implications and recommendations for teachers and teacher educators follow.

Content Knowledge

Based on the results involving research questions 1 and 2, student knowledge about an animal plays a critical role in determining their attitudes toward that animal. The more a student knew about an animal, the more likely they were to hold positive attitudes toward that animal. Previous research supports this finding and the findings related to assertion 3, as educational programs in zoos have been successful in promoting interest in species (Derocher et al., 2013). When students do not know about an animal they are more likely to look at aesthetic traits and use their previous experiences and knowledge to assess if this animal is a threat to them. This means that animals that look like animals they know are dangerous are likely to be thought of as a threat as well, as we see in results related to assertion 4.

Aesthetics

Students use the aesthetics of an animal and the likelihood of the animal harming them to determine their attitudes when they do not have knowledge about the animal. Animals that had responses related to their aesthetics included animals with colorful hair, feathers, or scales. Students are more likely to like colorful animals than animals seen as ugly, which typically include animals with dull color patterns. The monarch butterfly had stronger positive attitudes associated with it when compared to the moth or monarch caterpillar. Colorful fish also scored higher than freshwater fish which typically are not as colorful. With the Blue Jay and Bluebird responses, students mentioned the color more than other birds. This ties into previous literature that aesthetics positively impact attitudes toward animals (Knight, 2008).

Education Through Exposure

Teaching students about animals is a critical way to help improve their attitudes toward animals. Education should be done in a hands-on way to give students experience with the

animal in question. Education about animals should include species that are not a threat to people because if students are grouping animals together that are similar, then this can be used to the advantage of conservationists. Exposure to animals helps promote positive attitudes; teachers could lead students in outdoor education lessons to help expose students to these animals, especially arthropods and mollusks which are common in all of our backyards (Richardson & Hari, 2008). This supports preexisting literature that suggests people who are exposed to an animal are more likely to like that animal (Derocher et al., 2013).

Taxonomic Relationships of Animals and Students' Attitudes

Students group similar animals together and the attitudes, beliefs, and thoughts about any are shared through the entire group. So, one bad experience can lead to negativistic values toward an entire family or order of animals. This is the most critical of the assertions for conservationists who are trying to preserve endangered species and the areas they inhabit. If a person has had a bad experience with a spider, how likely are they to care if a spider in at risk of becoming extinct? Education about animals should include species that are not a threat to people because if students are grouping animals together that are similar, then this can be used to the advantage of conservationists. By presenting people with the harmless relative they may be more likely to accept species that typically have negative values. An example based on the results of this study could be the turkey vulture; perhaps showing it as an example of a bird of prey along with the bald eagle could promote positive attitudes toward the turkey vulture. This finding has not been well documented in the literature and should be considered in future research.

Implications

The implications that the results and the discussion imply follow in this section. The implications of this study consist of five sections followed by an implications section that focuses on the uses of this study for teachers and teacher educators. Each section will be discussed in an appropriate order.

First, students derive their values and attitudes from their experiences, so educators need to promote a diverse range of experiences related to animals in order to promote greater positive attitudes toward animals. Getting students to handle a reptile, arthropod, or other animal phyla with negative attitudes in a safe environment will help by creating new experiences that the student will enjoy. These experiences will impact student attitudes for the rest of the student's life.

Second, student knowledge is another factor in their attitudes toward animals. Education about an animal improves attitudes by promoting interest in the species as well as removing or modifying misconceptions and creating cognitive dissonance about misconceptions. Diversity in organisms discussed would be a simple solution for this and will be discussed more in the recommendations that follow.

Third, animals that are seen as evil should receive a more positive focus, and this misconception of evil morality in an animal needs to be addressed, as it is very dangerous to the conservation efforts to save that species. These misconceptions that students bring to the classroom need to be addressed.

Fourth, aesthetically pleasing phyla should be selected for teaching about phyla, particularly invertebrates. Aesthetics was the most important value in regards to students'

attitudes toward an animal, especially animals the students had no previous knowledge about. Marine species of most phyla are often colorful and examples from aesthetically pleasing specimens would have a positive impact on attitudes toward the groups especially invertebrates.

Fifth, this study asserts that exposure to bats is a simple and effective way to promote positive attitudes toward animals. Rural school have the opportunity to take advantage of this by having students partake in informal education. This could be in the form of teaching lessons outside of fall or spring days where students can be closer to nature while learning. This plays into Kellert and Wilson (1995) coining the term, "biophilia" which is defined as humans have an innate need to be involved with nature. Teachers could be improving attitudes toward animals simply by the addition of this type of informal or outdoors education.

Implications for Teachers

Outdoors education, such as taking students outside during class time while discussing relevant lesson material could improve attitudes toward animals through passive exposure to outdoor settings. Outdoor lessons in natural settings have been found to have a positive impact on students' learning, social relations, and physical activity levels (Mygind, 2009). Several ALCOS learning objectives for life science classes involve ecology, ecological niches, and food webs, and these are all objectives that could be covered in a trip outside where the teacher uses the outdoor environment to discuss these concepts.

Students, if properly supervised, could even search while outside for animals that the class could observe and the teacher could lead a discussion about the species that these students essentially find in their backyard. Assignments for students could also include a photo journal where they take pictures of animals in their backyards. The students could then have to research and present at the end of the year on the animals they found at or around their house.

Teachers of biology and environmental sciences also need to have positive attitudes toward animals, as they are a role model that the students are influenced by (Lumpkin, 2008). Teachers' attitudes toward an animal can influence the student, so if a teacher considers an animal as bad or evil in class, students are more likely to also. Teachers need to find ways to teach about scavengers and detritivores in the same way we discuss pollinators, by showing how scavengers are needed to maintain ecological balance just like pollinators. Teachers should be able to improve attitudes toward scavengers like the vulture and the crow.

Implications for Teacher Educators

Educators of future teachers can use the implications of this study to inform their teaching practices also. Teacher educators can look to outdoor teaching as a way to facilitate outdoor education ideas. Teacher educators can also expose teacher candidates to informal education programs that students might participate in after school or during the summer. Curriculum associated with outdoor education, whether formally in classrooms or informally outside of classrooms, can passively expose future science teachers to ecology of the community they will be working in. Education promotes positive attitudes toward animals, and informal education has been found to be as effective as formal education in zoos and ecology parks (Prokop & Fančovičová, 2017). Teacher educators can also expose students to animals that typically have negative attitudes associated with them, as most universities have resources that educators can use to get access to animals, especially reptiles and amphibians for educational purposes.

One issue can be teaching the teachers how to identify a wide variety of animals. Correctly identifying species in the field can be possible with time and exposure, as teacher educators do not want to promote misconceptions in future teachers. Teaching future teachers to

find animal identification resources for their area would be important for biology and environmental educators.

Limitations

This study was limited in several ways. One, the study was only conducted in one school and not multiple rural schools throughout the southeastern United States. Second, this study did not look at schools in suburban or urban districts within the southeastern United States which may have different attitudes toward animals due to an emphasis on different values. Third, PowerPoint images were the only way to show the animals and some animals are not photogenic and can be hard to photograph in a neutral pose. For example, shrews can be hard to photograph alive in a neutral position. Purposeful sampling in the interview can also be considered a limitation in this study, as it is possible that the researcher's bias can play a factor in the selection process. Though the researcher defends this choice based on distribution of student attitudes sampled and based on available time to interview students, it is impossible to be sure there was no bias in this process. This study was done at one public school in the rural southeast, so there is a possibility that these finding do not translate to other rural school systems. A final limitation that was observed by the researcher was the limit of the number of items to prevent survey fatigue. During the research it became clear to the researcher that more questions about different taxonomic groups could be included, especially with the invertebrate phyla. This study was unable for survey items have a relative closer than the phylum level. Though this survey looked at a large number of species, it by no means scratched the surface in terms of diversity. There are about thirty phyla total, and this study, only looked at four phyla. This study also did not represent these four phyla in a way that represents their diversity, as the arthropods only had eleven species on the list despite being the largest phylum.

Another limitation was the lack of a control group which would have allowed students to read about bats or had students not participate in any bat related lessons instead of participating in the Save the Bats curriculum. Without a control group the researcher is unable to see if and how the curriculum was more effective in improving attitudes compared to traditional teaching methods.

Recommendations

After examining the results of this study and literature from previous studies, it is clear that more research can be done in this area. Though previous research was consistent in findings, and these findings were across many researchers, there were very few animals included on surveys. Most previous research studies only looked at attitudes toward animals for 8 to 20 animals and many of them were domestic mammals and some were polyphyletic groupings. This is the major limitation of previous research as it does not allow us to detect possible nuances in people's attitudes toward various species, particularly species that are closely related. New research should use larger list of animals that are all within the same phylum or order to detect changes. Research in this field shows that older people's values and attitudes toward animals come from a place of utility and knowledge about the animal as well as their experience they had with that animal when they were younger, however little has been done to examine at how to best improve older students' attitudes toward animals in an academic setting (Ballantyne, 2007; Kellert, 1985).

Future research should include a larger number of non-mammal and non-domesticated mammals in order to gain greater understandings about why people hold attitudes toward animals the way that they do. Future research also needs to test attitudes toward less common phyla, as this research suggests that students do not understand the amount of animal biodiversity

that exists. Students in this study could not tell the difference between salamanders and lizards, so it is likely that they will not know the amount of diversity present in the invertebrate phyla. Teachers and researcher both need to show the biodiversity present in life and use invertebrate examples that do not come from the phyla Mollusca or Arthropoda. Education about different phyla should include aesthetically appealing examples of each group that are harmless to people, as when students have limited knowledge about a group this research found that they will use the appearance of the animal for formation of attitudes and attitudes are shared across closely related species. Education curricula should include a portion where the students get to interact with the animal in some way. Examples might include live demonstrations or use of museum voucher specimens to educate in a hands-on approach about the animal. By asking about more animals, particularly animals closely related to those researched in this study, we can understand how physical as well as behavioral traits of animals might impact our attitudes, and work toward teaching students so they understand, and therefore appreciate, the animal. Also, by viewing animals that are not typically shown through media or known typically to laypersons, we can compare these animals to animals that are well known and typically have positive or negative attitudes associated with them. Future research should also focus on educating an older population about animals often seen in a negative context. Previous research using educational interventions to improve attitudes of younger students has been successful. We do not know what types of educational interventions will be effective at improving older students' attitudes toward animals often seen in a negative context.

Future research should visit multiple rural school systems to confirm the results of this research. Research methodology should include a control group, by having researchers investigate and include a control group in order to see if the curriculum is more effective than

traditional teaching methods. Future research could also be done in the southeastern United States looking at urban and suburban districts to see what values the students have and their attitudes to see if there is a difference. If there is a difference, the cause of this difference would also be critical to understand. Improving attitudes in all students is critical for helping organisms survive in a quickly changing world.

REFERENCES

Acorn, J. (2013). How many parts? *American Entomologist*, *59*(4), 256-256.

Agnew, R. (1998). The causes of animal abuse: A social-psychological analysis. *Theoretical Criminology*, *2*(2), 177-209.

Alexander, C. S., & Becker, H. J. (1978). The use of vignettes in survey research. *Public Opinion Quarterly*, *42*(1), 93-104.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behaviour.* Englewood Cliffs, NJ: Prentice Hall.

Allen, I. E., & Seaman, C. A. (2007). Likert scales and data analyses. *Quality Progress*, *40*(7), 64.

Almeida, A., Vasconcelos, C., & Strecht-Ribeiro, O. (2014). Attitudes toward animals: a study of Portuguese children. *Anthrozoos*, 27 (2), 173-190.

Amidon, E., & Flanders, N. A. (1961). The effects of direct and indirect teacher influence on dependent-prone students learning geometry. *Journal of Educational Psychology*, *52*(6), 286.

Anderson, R. C., Wood, J. B., & Byrne, R. A. (2002). Octopus senescence: The beginning of the end. *Journal of Applied Animal Welfare Science*, *5*(4), 275-283.

Ascione, F. R. (2005). *Children and animals: Exploring the roots of kindness and cruelty*. West Lafayette, IN: Purdue University Press.

Ascione, F. R. (2007). *Emerging research on animal abuse as a risk factor for intimate partner violence. Intimate partner violence*. Unpublished manuscript..

Avery, L. M. (2013). Rural science education: Valuing local knowledge. *Theory Into Practice*, *52*(1), 28-35.

Avery, L. M., & Kassam, K. A. (2011). Phronesis: Children's local rural knowledge of science and engineering. *Journal of Research in Rural Education, 26*, 1–18.

Ballantyne, R., Packer, J., Hughes, K., & Dierking, L. (2007). Conservation learning in wildlife tourism settings: Lessons from research in zoos and aquariums. *Environmental Education Research*, *13*(3), 367-383.

Barbour, R. S. (2001). Checklists for improving rigor in qualitative research: a case of the tail wagging the dog? *BMJ: British Medical Journal*, *322*(7294), 1115.

Barmby, P., Kind, P. M., & Jones, K. (2008). Examining changing attitudes in secondary school science. *International Journal of Science Education*, *30*(8), 1075-1093.

Batt, S. (2009). Human attitudes toward animals in relation to species similarity to humans: a multivariate approach. *Bioscience Horizons*, *2*(2), 180-190.

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report*, *13*(4), 544-559.

Birch, L. L., Fisher, J. O., Grimm-Thomas, K., Markey, C. N., Sawyer, R., & Johnson, S. L. (2001). Confirmatory factor analysis of the child feeding questionnaire: A measure of parental attitudes, beliefs and practices about child feeding and obesity proneness. *Appetite*, *36*(3), 201-210.

Bjerke, T. & Ostdahl, T. (2004). Animal-related attitudes and activities in an urban population. *Anthrozoös,* 17(2), 109–129.

Blehert, D. S., Hicks, A. C., Behr, M., Meteyer, C. U., Berlowski-Zier, B. M., Buckles, E. L., ... & Okoniewski, J. C. (2009). Bat white-nose syndrome: An emerging fungal pathogen. *Science*, *323*(5911), 227-227.

Borgi, M. & F. Cirulli. (2015). Attitudes toward animals among kindergarten children: Species preferences. *Anthrozoos*, 28(1), 45-59.

Bouyer, J., & Lefrançois, T. (2014). Boosting the sterile insect technique to control mosquitoes. *Trends in Parasitology*, *30*(6), 271-273.

Boyles, J. G., Cryan, P. M., McCracken, G. F., & Kunz, T. H. (2011). Economic importance of bats in agriculture. *Science*, *332*(6025), 41-42.

Brightsmith, D. J., Stronza, A., & Holle, K. (2008). Ecotourism, conservation biology, and volunteer tourism: A mutually beneficial triumvirate. *Biological Conservation*, *141*(11), 2832-2842.

Brown, L. N. (1997). *A guide to the mammals of the southeastern United States*. Knoxville, TN: Univ. of Tennessee Press.

Bucher, A. M., Burgoon, J., & Duran, E. (2010). Exploring elementary and middle school in-service teachers' knowledge of animal classification: A comparison of student and teacher misconceptions. *National social science journal, 35*(1), 31-37.

Burger, L. W., Miller, D. A., & Southwick, R. I. (1999). Economic impact of northern bobwhite hunting in the southeastern United States. *Wildlife Society Bulletin*, *27*, 1010-1018.

Burrows, K. E., Adams, C. L., & Spiers, J. (2008). Sentinels of safety: service dogs ensure safety and enhance freedom and well-being for families with autistic children. *Qualitative health research, 18*(12), 1642-1649.

Bybee, R. W. (2002). Scientific inquiry, student learning, and the science curriculum. *Learning science and the science of learning*. Danvers, MA: National Science Teachers Association Press.

Ceballos, G., Ehrlich, P. R., Barnosky, A. D., García, A., Pringle, R. M., & Palmer, T. M. (2015). Accelerated modern human–induced species losses: Entering the sixth mass extinction. *Science Advances, 1,* 1-5.

Changing Minds (2018, February 2). Types of Validity. Retrieved from http://changingminds.org/explanations/research/design/types_validity.htm

Childress, A. C., Brewerton, T. D., Hodges, E. L., & Jarrell, M. P. (1993). The Kids' Eating Disorders Survey (KEDS): A study of middle school students. *Journal of the American Academy of Child & Adolescent Psychiatry*, *32*(4), 843-850.

Cleveland, C. J., Betke, M., Federico, P., Frank, J. D., Hallam, T. G., Horn, J., & Sansone, C. G. (2006). Economic value of the pest control service provided by Brazilian free-tailed bats in south-central Texas. *Frontiers in Ecology and the Environment*, *4*(5), 238-243.

Cohen, S. P. (2002). Can pets function as family members? *Western Journal of Nursing Research, 24*(6), 621-638.

Cohn, N. (2004). T*he myth of Satan and his human servants. Witchcraft Confessions and Accusations. Oxfordshire, OX: Routledge.*

Collins, M. R., Rogers, S. G., Smith, T. I., & Moser, M. L. (2000). Primary factors affecting sturgeon populations in the southeastern United States: Fishing mortality and degradation of essential habitats. *Bulletin of Marine Science*, *66*(3), 917-928.

Creswell, J. W., Tashakkori, A., Jensen, K. D., & Shapley, K. L. (2003). *Teaching mixed methods research: Practices, dilemmas, and challenges. Handbook of mixed methods in social and behavioral research*. Thousand Oaks, CA: Sage Publications.

Cronbach, L. J., & Meehl, P. E. (1955). Construct validity in psychological tests. *Psychological Bulletin*, *52*(4), 281.

Daly, B., & Morton, L. L. (2006). An investigation of human-animal interactions and empathy as related to pet preference, ownership, attachment, and attitudes in children. *Anthrozoös*, *19*(2), 113-127.

Damron, W. S., & Damron, W. S. (2013). Introduction to animal science: global, biological, social, and industry perspectives. *North America Colleges and Teachers of Agriculture Journal*, 49(3), 60.

Dawna, K., & O'Neal, K. K. (2015). The development of empathy and prosocial behavior through humane education, restorative justice, and animal-assisted programs. *Contemporary Justice Review*, *18*(4), 395-406.

de Castro, C. C. (1980). The anatomy of the platysma muscle. *Plastic and Reconstructive Surgery*, *66*(5), 680-683.

DeNavas W, C., Proctor B. D., & Smith, J. C. (2011). *Current Population Reports. Income, poverty, and health insurance coverage in the United States.* Bureau USC. Washington, DC: United States Government Printing Office.

Deitz, R. (2007). *A brain drain or an insufficient brain gain?* New York, NY: At-A-Glance.

Derocher, A. E., Aars, J., Amstrup, S. C., Cutting, A., Lunn, N. J., Molnár, P. K., ... & Wiig, Ø. (2013). Rapid ecosystem change and polar bear conservation. *Conservation Letters, 6*(5), 368-375.

Desbiez, A. L. J., Santos, S. A., Keuroghlian, A., & Bodmer, R. E. (2009). Niche partitioning among white-lipped peccaries (Tayassu pecari), collared peccaries (Pecari tajacu), and feral pigs (Sus scrofa). *Journal of Mammalogy*, *90*(1), 119-128.

Diamond, J. M., Ashmole, N. P., & Purves, P. E. (1989). The present, past and future of human-caused extinctions [and discussion]. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *325*(1228), 469-477.

Diefenbach, D. R., Palmer, W. L., & Shope, W. K. (1997). Attitudes of Pennsylvania sportsmen toward managing white-tailed deer to protect the ecological integrity of forests. *Wildlife Society Bulletin, 25*, 244-251.

Diemer, J. E. (1986). The ecology and management of the gopher tortoise in the southeastern United States. *Herpetologica, 42*, 125-133.

Driscoll, J. W. (1992). Attitudes toward animal use. *Anthrozoös, 5*, 32-39.

Driscoll, M. P. (2000). Introduction to theories of learning and instruction. *Psychology of Learning for Instruction, 2*, 3-28.

Driver, R., & Easley, J. (1978). Pupils and paradigms: A review of literature related to concept development in adolescent science students. *Studies in Science Education, 5*(1), 61-84.

Epley, N., Waytz, A., & Cacioppo, J. T. (2007). On seeing human: a three-factor theory of anthropomorphism. *Psychological Review, 114*(4), 864.

Fazio, R. H. (1990). Multiple processes by which attitudes guide behavior: The MODE model as an integrative framework. *Advances in Experimental Social Psychology, 23,* 75-109.

Fishbein, M. (1963). An investigation of the relationships between beliefs about an object and the attitude toward that object. *Human Relations, 16*(3), 233-239.

Fogg, B. J. (2002). Persuasive technology: using computers to change what we think and do. *Ubiquity, 5*, 89-120.

Folkerts, G. W., Deyrup, M. A., & Sisson, D. C. (1993). Arthropods associated with xeric longleaf pine habitats in the southeastern United States: a brief overview. *Proceedings of the Tall Timbers Fire Ecology Conference 18*, 159-192.

Frazier, C. A. (1985). More Snakes. *Journal of the American Medical Association, 254*(17), 2410.

Galesic, M., & Bosnjak, M. (2009). Effects of questionnaire length on participation and indicators of response quality in a web survey. *Public Opinion Quarterly*, *73*(2), 349-360.

Garibaldi, A., & Turner, N. (2004). Cultural keystone species: implications for ecological conservation and restoration. *Ecology and Society*, *9*(3), 1-18.

Geng, Y., & Côté, R. P. (2002). Scavengers and decomposers in an eco-industrial park. *The International Journal of Sustainable Development & World Ecology*, *9*(4), 333-340.

George, D., & Mallery, M. (2003). *Using SPSS for Windows step by step: a simple guide and reference.* Boston, MA: Allyn & Bacon.

Gibson, H. L., & Chase, C. (2002). Longitudinal impact of an inquiry-based science program on middle school students' attitudes toward science. *Science Education*, *86*(5), 693-705.

Gifford, R., & Nilsson, A. (2014). Personal and social factors that influence proenvironmental concern and behavior: a review. *International Journal of Psychology*, *49*, 141-157.

Goldstein, A. H., Koven, C. D., Heald, C. L., & Fung, I. Y. (2009). Biogenic carbon and anthropogenic pollutants combine to form a cooling haze over the southeastern United States. *Proceedings of the National Academy of Sciences*, *106*(22), 8835-8840.

Gross, R. (2015). *Psychology: The science of mind and behavior. Seventh edition.* Hachette, UK: Hodder Education.

Gusset, M., & Dick, G. (2011). The global reach of zoos and aquariums in visitor numbers and conservation expenditures. *Zoo Biology*, *30*(5), 566-569.

Guthrie, R. D. (2006). New carbon dates link climatic change with human colonization and Pleistocene extinctions. *Nature*, *441*(7090), 207-209.

Hall, J. D., Leloudis, J. L., Korstad, R. R., & Murphy, M. (2012). *Like a family: The making of a southern cotton mill world.* Chapel Hill, NC: UNC Press Books.

Hallgren, K. A. (2012). Computing inter-rater reliability for observational data: an overview and tutorial. *Tutorials in Quantitative Methods for Psychology*, *8*(1), 23.

Harrington, D. (2009). *Confirmatory factor analysis*. London: Oxford University Press.

Hart, L. G., Larson, E. H., & Lishner, D. M. (2005). Rural definitions for health policy and research. *American Journal of Public Health, 95*(7), 1149-1155.

Harvey, M. J., Altenbach, J. S., & Best, T. L. (2011). *Bats of the United States and Canada*. Baltimore, MD: The Johns Hopkins University Press.

Haynes, G. (2002). The catastrophic extinction of North American mammoths and mastodonts. *World Archaeology, 33*(3), 391-416.

Henderson, S. J. (1999). The use of animal imagery in counseling. *American Journal of Art Therapy, 38*(1), 20.

Henson, R. K. (2001). Understanding internal consistency reliability estimates: A conceptual primer on coefficient alpha. *Measurement and Evaluation in Counseling and Development*, *34*(3), 177.

Hepper, P. G. (1991). An examination of fetal learning before and after birth. *The Irish Journal of Psychology*, *12*(2), 95-107.

Hester, L. C., Best, T. L., & Hudson, M. K. (2007). Rabies in bats from Alabama. *Journal of Wildlife Diseases*, *43*(2), 291-299.

Hewson, P. W. (1982). A case study of conceptual change in special relativity: the influence of prior knowledge in learning. *European Journal of Science Education*, *4*(1), 61-78.

Hewson, M. G., & Hewson, P. W. (1983). Effect of instruction using students' prior knowledge and conceptual change strategies on science learning. *Journal of Research in Science Teaching*, *20*(8), 731-743.

Heyrman, C. L. (2013). *Southern cross: the beginnings of the Bible Belt*. New York, NY: Knopf.

Hosey, G., & Melfi, V. (2012). Human–animal bonds between zoo professionals and the animals in their care. *Zoo Biology, 31*(1), 13-26.

Huttunen, A. W., Adams, G. K., & Platt, M. L. (2017). Can self-awareness be taught? Monkeys pass the mirror test—again. *Proceedings of the National Academy of Sciences, 114*(13), 3281-3283.

Jenkins, E. W., & Nelson, N. W. (2005). Important but not for me: students' attitudes toward secondary school science in England. *Research in Science & Technological Education, 23*(1), 41-57.

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: a research paradigm whose time has come. *Educational Researcher*, *33*(7), 14-26.

Kalof, L., & Taylor, C. (2007). The discourse of dog fighting. *Humanity & Society*, *31*(4), 319-333.

Kalof, L., Zammit-Lucia, J., Bell, J., & Granter, G. (2016). Fostering kinship with animals: animal portraiture in humane education. *Environmental Education Research*, *22*(2), 203-228.

Katz, D. (1960). The functional approach to the study of attitudes. *Public Opinion Quarterly, 24*(2), 163-204.

Kellert, S. R. (1980). *Affection and basic attitudes toward animals in American society. Phase III.* Springfield, VA: U.S. Government Printing Office.

Kellert, S. R. (1984). Urban American perceptions of animals and the natural environment. *Urban Ecology*, *8*(3), 209-228.

Kellert, S. R. (1985). Attitudes toward animals: age-related development among children. *Advances in Animal Welfare Science 1,* 43-60.

Kellert, S. R. & Berry, J. K. (1981). *Knowledge, affection and basic attitudes toward animals in American society.* Springfield, VA: U. S. Government Printing Office.

Kellert, S. R., & Wilson, E. O. (1995). *The biophilia hypothesis*. Washington D.C.: Island Press.

Khan, S. A., Lyla, P. S., & Khadharsha, K. (2016). Environmental impact assessment of estuaries in southeast coast of India using fish health index and index for biotic integrity (IBI) for fishes. *Proceedings of International Forestry and Environment Symposium, 21,* 7-17.

Kimberlin, C. L., & Winterstein, A. G. (2008). Validity and reliability of measurement instruments used in research. *American Journal of Health-System Pharmacy*, *65*(23), 2276-2284.

Knight, S. (2008). "Bats, snakes and spiders, oh my!" How aesthetic and negativistic attitudes, and other concepts predict support for species protection. *Journal of Environmental Psychology 28*(1), 94–103.

Knight, M. L., & Boster, F. J. (2001). Modeling the ego-defensive function of attitudes. *Communication Monographs*, *68*(3), 314-324.

Koballa, T. R., & Crawley, F. E. (1985). The influence of attitude on science teaching and learning. *School Science and Mathematics*, *85*(3), 222-232.

Kohler, C. C., & Kelly, A. M. (1991). Assessing predator-prey balance in impoundments. *Proceedings of the Warmwater Fisheries Symposium, 1,* 257-260.

Koirala, R. K., Raubenheimer, D., Aryal, A., Pathak, M. L., & Ji, W. (2016). Feeding preferences of the Asian elephant (Elephas maximus) in Nepal. *Biology and Medicine Ecology*, *16*(1), 54.

Komorosky, D. & O'Neal, K. K. (2015). The development of empathy and prosocial behavior through humane education, restorative justice, and animal-assisted programs, *Contemporary Justice Review*, *18*(4), 395-406.

Kueffer, C., & Kull, C. A. (2017). *Non-native species and the aesthetics of nature. Impact of biological invasions on ecosystem services*. Gewerbestrasse, Switzerland: Springer International Publishing.

Kunz, T. H. (2009). *Ecological and behavioral methods for the study of bats*. Baltimore, MD: John Hopkins University.

Kunz, T. H., Braun de Torrez, E., Bauer, D., Lobova, T., & Fleming, T. H. (2011). Ecosystem services provided by bats. *Annals of the New York Academy of Sciences*, *1223*(1), 1-38.

Kyle, W. C., & Shymansky, J. A. (1989). Enhancing learning through conceptual change teaching. *National Association for Research in Science Teaching News*, *31*(3), 7-8.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge, UK: Cambridge University Press.

Lange, R., Werminghausen, J., & Anthes, N. (2014). Cephalo-traumatic secretion transfer in a hermaphrodite sea slug. *Proceedings of the Royal Society. Biological Sciences*, *281*(*1774*), 2013-2424.

Lee, P. C., & Priston, N. E. (2005). Human attitudes to primates: perceptions of pests, conflict and consequences for primate conservation. *Commensalism and Conflict: The Human-Primate Interface, 4,* 1-23.

Likert, R. (1932). A technique for the measurement of attitudes. *Archives of Psychology,* 140, 55.

Limón, M. (2001). On the cognitive conflict as an instructional strategy for conceptual change: a critical appraisal. *Learning and Instruction, 11*(4), 357-380.

Lineberger, S. E., & Zajicek, J. M. (2000). School gardens: can a hands-on teaching tool affect students' attitudes and behaviors regarding fruit and vegetables? *HortTechnology, 10*(3), 593-597.

Lockwood, R., & Ascione, F. R. (1998). *Cruelty to animals and interpersonal violence: Readings in research and application*. West Lafayette, IN: Purdue University Press.

Lomax, H., & Casey, N. (1998). Recording social life: reflexivity and video methodology. *Sociological Research Online, 3*(2), 13-14.

Long, L. E., Kulp, J. L., & Eckelman, F. D. (1959). Chronology of major metamorphic events in the southeastern United States [Appalachians]. *American Journal of Science, 257*(8), 585-603.

Loreau, M., & Mazancourt, C. (2013). Biodiversity and ecosystem stability: A synthesis of underlying mechanisms. *Ecology Letters, 16*(1), 106-115.

Lumpkin, A. (2008). Teachers as role models teaching character and moral virtues. *Journal of Physical Education, Recreation & Dance, 79*(2), 45-50.

Lydeard, C., & Mayden, R. L. (1995). A diverse and endangered aquatic ecosystem of the southeast United States. *Conservation Biology*, *9*(4), 800-805.

Magaki, M., Ishii, H., Yamasaki, A., Kitai, Y., Kametani, S., Nakai, R., ... & Ohnishi, T. (2017). A high-fat diet increases the incidence of mammary cancer inc-ha-ras proto-oncogene transgenic rats. *Journal of Toxicologic Pathology*, *30*(2), 145-152.

Maio, G. R., & Olson, J. M. (2000). *What is a "value-expressive" attitude? Why we evaluate: functions of attitudes*. Mahwah, NJ: Lawrence Erlbaum Associates.

Martin, W. H., Boyce, S. G., & Echternacht, A. C. (1993). *Biodiversity of the southeastern United States: Upland terrestrial communities*. Hoboken, NJ: John Wiley & Sons.

McLaughlin, D. K., & Coleman-Jensen, A. (2008). Nonstandard employment in the nonmetropolitan United States. *Rural Sociology, 73*, 631–659.

Meade, A. W., & Craig, S. B. (2012). Identifying careless responses in survey data. *Psychological Methods*, *17*(3), 437.

Mills, L. S., Soulé, M. E., & Doak, D. F. (1993). The keystone-species concept in ecology and conservation. *BioScience*, *43*(4), 219-224.

Millsap, B. A., Gore, J. A., Runde, D. E., & Cerulean, S. I. (1990). Setting priorities for the conservation of fish and wildlife species in Florida. *Wildlife Monographs, 111*, 3-57.

Mizejewski, D. (2004). *Attracting birds, butterflies and other backyard wildlife*. Upper Saddle River, NJ: Creative Homeowner.

Moriarty, J. (2017, December 6). Amphibian and reptile diversity and distribution in the United States. *Frog Watch*. Retrieved from https://cgee.hamline.edu/frogs/science/StateA&R.pdf.

Moss, A., & Esson, M. (2010). Visitor interest in zoo animals and the implications for collection planning and zoo education programs. *Zoo Biology*, *29*(6), 715-731.

Mygind, E. (2009). A comparison of children's statements about social relations and teaching in the classroom and in the outdoor environment. Journal of Adventure Education & Outdoor Learning, 9(2), 151-169.

Nauen, R. (2007). Insecticide resistance in disease vectors of public health importance. *Pest Management Science*, *63*(7), 628-633.

Nicolaus, P. (2011). The serpent symbolism in the Yezidi religious tradition and the snake in Yerevan. *Iran and the Caucasus*, *15*(1), 49-72.

Noble, R. L. (1981). Management of forage fishes in impoundments of the Southern United States. *Transactions of the American Fisheries Society*, *110*(6), 738-750.

Olsen, J. M., & Zanna, M. P. (1993). Attitudes and attitude change. *Annual Review of Psychology*, *44*(1), 117-154.

Osborne, J., Simon, S., & Collins, S. (2003). Attitudes toward science: A review of the literature and its implications. *International Journal of Science Education*, *25*(9), 1049-1079.

Özel, M., Prokop, P., & Uşak, M. (2009). Cross-cultural comparison of student attitudes toward snakes. *Society & Animals*, *17*(3), 224-240.

Patrick, P. G., Matthews, C. E., Ayers, D. F., & Tunnicliffe, S. D. (2007). Conservation and education: prominent themes in zoo mission statements. *The Journal of Environmental Education*, *38*(3), 53-60.

Payne, E., DeAraugo, J., Bennett, P., & McGreevy, P. (2016). Exploring the existence and potential underpinnings of dog–human and horse–human attachment bonds. *Behavioural Processes*, *125*, 114-121.

Pellitteri, J. (2002). The relationship between emotional intelligence and ego defense mechanisms. *The Journal of Psychology*, *136*(2), 182-194.

Perkins, D. (1999). The many faces of constructivism. *Educational Leadership*, *57*(3), 6-11.

Peters, V., Sottiaux, M., Appelboom, J., & Kahn, A. (2004). Posttraumatic stress disorder after dog bites in children. *The Journal of Pediatrics*, *144*(1), 121-122.

Petrin, R. A., Schafft, K. A., & Meece, J. L. (2014). Educational sorting and residential aspirations among rural high school students: what are the contributions of schools and educators to rural brain drain? *American Educational Research Journal*, *51*(2), 294-326.

Pfannenstein, L. L., & Tsai, R. J. (2004). Offshore outsourcing: current and future effects on American IT industry. *Information Systems Management, 21*(4), 72.

Phillips, D., Falls, R. P., & Johnson, R. (2006). *Discovering Alabama forests.* Tuscaloosa, Alabama: University of Alabama Press.

Piaget J. (1972). *The principles of genetic epistemology*. London, England: Routledge & Kegan Paul.

Pica-Ciamarra, U., Tasciotti, L., Otte, J., & Zezza, A. (2011). *Livestock assets, livestock income and rural households: cross-country evidence from household surveys*. Washington, DC: World Bank

Popham, W. J. (1997). Consequential validity: right concern-wrong concept. *Educational Measurement: Issues and Practice*, *16*(2), 9-13.

Porter, S. R., Whitcomb, M. E., & Weitzer, W. H. (2004). Multiple surveys of students and survey fatigue. *New Directions for Institutional Research*, *121*, 63-73.

Posner, G. J., Strike, K. A., Hewson, P. W., & Gertzog, W. A. (1982). Accommodation of a scientific conception: toward a theory of conceptual change. *Science Education*, *66*(2), 211-227.

Prokop, P., & Fančovičová, J. (2017). The effect of hands-on activities on children's knowledge and disgust for animals. *Journal of Biological Education*, *51*(3), 305-314.

Prokop, P., Fančovičová, J., & Kubiatko, M. (2009). Vampires are still alive: Slovakian students' attitudes toward bats. *Anthrozoös*, *22*(1), 19-30.

Prokop, P., Tolarovicova, A., Camerik, A. M., & Peterkova, V. (2010). High school students' attitudes toward spiders: a cross-cultural comparison. *International Journal of Science Education*, *32*(12), 1665-1688.

Race, R., Raines, A., Raymond, G. J., Caughey, B., & Chesebro, B. (2001). Long-term subclinical carrier state precedes scrapie replication and adaptation in a resistant species: analogies to bovine spongiform encephalopathy and variant Creutzfeldt-Jakob disease in humans. *Journal of Virology*, *75*(21), 10106-10112.

Rappole, J. H. (2003). *A guide to the birds of the southeastern states.* Washington, DC: Library of Congress Cataloging-in-Publication Data.

Rennie, L., & McClafferty, T. (1995). Using visits to interactive science and technology centers, museums, aquaria, and zoos to promote learning in science. *Journal of Science Teacher Education, 6*(4), 175-185.

Richardson, M. L., & Hari, J. (2008). Teaching students about biodiversity by studying the correlation between plants & arthropods. *The American Biology Teacher, 70*(4), 217-221.

Ritzmann, R. E., Gorb, S., & Quinn, R. D. (2004). Arthropod locomotion systems: from biological materials and systems to robotics. *Arthropod Structure & Development, 33*(3), 183-185.

Rooney, T. P., & Waller, D. M. (2003). Direct and indirect effects of white-tailed deer in forest ecosystems. *Forest Ecology and Management, 181*(1), 165-176.

Rowe, W. L. (1979). The problem of evil and some varieties of atheism. *American Philosophical Quarterly, 16*(4), 335-341.

Rule, A., & Zhbanova, K. (2012). Changing perceptions of unpopular animals through facts, poetry, crafts, and puppet plays. *Early Childhood Education Journal, 40*(4), 223-230.

Ryan, A. M., & Patrick, H. (2001). The classroom social environment and changes in adolescents' motivation and engagement during middle school. *American Educational Research Journal, 38*(2), 437-460.

Sandweiss, D. H., & Wing, E. S. (1997). Ritual rodents: the guinea pigs of Chincha, Peru. *Journal of Field Archaeology, 24*(1), 47-58.

Santos, J. R. A. (1999). Cronbach's alpha: a tool for assessing the reliability of scales. *Journal of Extension, 37*(2), 1-5.

Schafft, K. A., & Jackson, A. (2011). *Rural education for the twenty-first century: identity, place, and community in a globalizing world*. University Park, PA: Penn State University Press.

Schlaepfer, M. A., Sax, D. F., & Olden, J. D. (2011). The potential conservation value of non-native species. *Conservation Biology, 25*(3), 428-437.

Schröder, M. J., & McEachern, M. G. (2004). Consumer value conflicts surrounding ethical food purchase decisions: a focus on animal welfare. *International Journal of Consumer Studies, 28*(2), 168-177.

Shaughnessy, J. Zechmeister, E., & Jeanne, Z. (2011). *Research methods in psychology* (9th edition.). New York, NY: McGraw Hill.

Shrigley, R. L. (1990). Attitude and behavior are correlates. *Journal of Research in Science Teaching, 27*(2), 97-113.

Sipple, J. W., & Brent, B. O. (2008). *Challenges and opportunities associated with rural school settings. Handbook of research in education finance and policy*. Oxford, England: Taylor & Francis.

Stevens, D. P., Allen, B., Lawrence, E. D., & Sullivan, J. L. (2015). *Partisanship and perceptions of fairness: ignoring the facts*. Cambridge, UK: Cambridge University Press

Strange, M., Johnson, J., Showalter, D., & Klein, R. (2012). Why rural matters. Retrieved from http://www.ruraledu.org/ articles.php?idD2820.

Sunstein, C. R. (2006). *Infotopia: How many minds produce knowledge*. London: Oxford University Press.

Thagard, P. (1992). *Conceptual revolutions*. Princeton, NJ: Princeton University Press.

Topál, J., Miklósi, Á., & Csányi, V. (1997). Dog-human relationship affects problem solving behavior in the dog. *Anthrozoös*, *10*(4), 214-224

Tresidder, J. (2005). *The complete dictionary of symbols*. San Francisco, CA: Chronicle Books.

Treves, A., & Naughton-Treves, L. (1999). Risk and opportunity for humans coexisting with large carnivores. *Journal of Human Evolution*, *36*(3), 275-282.

Trowbridge, L. W., & Bybee, R. W. (1990). *Becoming a secondary school science teacher.* Columbus, OH: Merrill Publishing Company.

Trowbridge, J. E., & Mintzes, J. J. (1988). Alternative conceptions in animal classification: A cross-age study. *Journal of Research in Science Teaching*, *25*(7), 547-571.

Trudeau, F., & Shephard, R. J. (2005). Contribution of school programmes to physical activity levels and attitudes in children and adults. *Sports Medicine*, *35*(2), 89-105.

United States Department of Labor. (2018). Bureau of Labor Statistics. Retrieved from https://www.bls.gov/regions/southeast/data/xg-tables/ro4xg02.htm.

Valley, Alabama Economy (2017, October 18). Retrieved from http://www.bestplaces.net/economy/city/alabama/valley.

Vaughan, T. A., Ryan, J. M., & Czaplewski, N. J. (2015). *Mammalogy. Sixth edition*. Sudbury, MA: Jones and Bartlett Publishers.

Vosniadou, S. (1994). Capturing and modeling the process of conceptual change. *Learning and Instruction, 4*(1), 45-69.

Vosniadou, S., & Brewer, W. F. (1992). Mental models of the earth: a study of conceptual change in childhood. *Cognitive Psychology*, *24*(4), 535-585.

Vosniadou, S., Vamvakoussi, X., & Skopeliti, I. (2008). *The framework theory approach to the problem of conceptual change. International handbook of research on conceptual change.* London, England: Routledge.

Vucetich, J. A., Peterson, R. O., & Waite, T. A. (1997). Effects of social structure and prey dynamics on extinction risk in gray wolves. *Conservation Biology*, *11*(4), 957-965.

Vygotskiĭ, L. S. (1962). *Thought and language*. Cambridge, MA: MIT Press.

Wagler, R., & Wagler, A. (2015). Assessing the attitudes and beliefs of preservice middle school science teachers toward biologically diverse animals. *International Journal of Environmental and Science Education*, *10*(2), 271-286.

Wang, S., Hu, S. H., Shi, Y., & Li, B. M. (2017). The roles of the anterior cingulate cortex and its dopamine receptors in self-paced cost–benefit decision making in rats. *Learning & Behavior*, *45*(1), 89-99.

Ward, G. M., Harris, P. M., & Ward, A. K. (2005). *Gulf Coast rivers of the southeastern United States. Rivers of North America.* Burlington, MA: Elsevier Academic Press.

W.F. Burns Middle School (2017, October 18). Retrieved from https://www.niche.com/k12/w-f-burns-middle-school-valley-al/.

White, P. S., & Jentsch, A. (2001*). The search for generality in studies of disturbance and ecosystem dynamics. Progress in Botany*. Berlin, Germany: Springer International.

Williams, D. T. (2010). The rural solution: How community schools can reinvigorate rural education. Retrieved November 20, 2017 from www.americanprogress.org/issues/2010/09/pdf/ruralschools.pdf.

Williams, J. D., Warren Jr, M. L., Cummings, K. S., Harris, J. L., & Neves, R. J. (1993). Conservation status of freshwater mussels of the United States and Canada. *Fisheries, 18*(9), 6-22.

Wilmers, C. C., Crabtree, R. L., Smith, D. W., Murphy, K. M., & Getz, W. M. (2003). Trophic facilitation by introduced top predators: grey wolf subsidies to scavengers in Yellowstone National Park. *Journal of Animal Ecology, 72*(6), 909-916.

Wipper, A. (2000). The partnership: the horse-rider relationship in eventing. *Symbolic Interaction, 23*(1), 47-70.

Wittrock, M. C. (1989). Generative processes of comprehension. *Educational Psychologist, 24*, 345–376.

Yin, R. K. (2003). *Case study research: Design and methods.* Thousand Oaks, CA: Sage Publications.

Yin, R. K. (2015). *Qualitative research from start to finish*. New York City, NY: Guilford Press

Zimbardo, P. G., & Leippe, M. R. (1991). *The psychology of attitude change and social influence*. New York City, NY: Mcgraw-Hill Book Company.

Appendix A

Survey answer sheet

Animal attitude answer sheet

ID:_____

Instructions: Please circle how much do you like or dislike each animal presented? Please respond to your first reaction and add a short description about why.

1. Strongly Like Like Slightly Like Neither Slightly Dislike Dislike Strongly Dislike

   Why?

2. Strongly Like Like Slightly Like Neither Slightly Dislike Dislike Strongly Dislike

   Why?

3. Strongly Like Like Slightly Like Neither Slightly Dislike Dislike Strongly Dislike

   Why?

4. Strongly Like Like Slightly Like Neither Slightly Dislike Dislike Strongly Dislike

Why?

5. Strongly Like Like Slightly Like Neither Slightly Dislike Dislike Strongly Dislike

   Why?

6. Strongly Like Like Slightly Like Neither Slightly Dislike Dislike Strongly Dislike

   Why?

7. Strongly Like Like Slightly Like Neither Slightly Dislike Dislike Strongly Dislike

   Why?

8. Strongly Like Like Slightly Like Neither Slightly Dislike Dislike Strongly Dislike

   Why?

9. Strongly Like Like Slightly Like Neither Slightly Dislike Dislike Strongly Dislike

   Why?

10. Strongly Like Like Slightly Like Neither Slightly Dislike Dislike Strongly Dislike

    Why?

11. Strongly Like Like Slightly Like Neither Slightly Dislike Dislike Strongly Dislike

    Why?

12. Strongly Like Like Slightly Like Neither Slightly Dislike Dislike Strongly Dislike

    Why?

13. Strongly Like Like Slightly Like Neither Slightly Dislike Dislike Strongly Dislike

    Why?

14. Strongly Like Like Slightly Like Neither Slightly Dislike Dislike Strongly Dislike

    Why?

15. Strongly Like Like Slightly Like Neither Slightly Dislike Dislike Strongly Dislike

    Why?

16. Strongly Like Like Slightly Like Neither Slightly Dislike Dislike Strongly Dislike

    Why?

17. Strongly Like Like Slightly Like Neither Slightly Dislike Dislike Strongly Dislike

    Why?

18. Strongly Like Like Slightly Like Neither Slightly Dislike Dislike Strongly Dislike

    Why?

19. Strongly Like Like Slightly Like Neither Slightly Dislike Dislike Strongly Dislike

Why?

20. Strongly Like Like Slightly Like Neither Slightly Dislike Dislike Strongly Dislike

Why?

20. Strongly Like Like Slightly Like Neither Slightly Dislike Dislike Strongly Dislike

Why?

Appendix B

Questions Regarding Bats

1. What do you think most bats in the southeastern United States eat?
2. What do you like about bats?
3. What do you dislike about bats?
4. Are bats birds or mammals? What makes you think so?
5. Can bats see well? What makes you think that?
6. If you see a bat are you afraid of it? Why or why not?
7. Using the scale from our other surveys how much do you like or dislike bats?

   Strongly Like Like Slightly Like Neither Slightly Dislike Dislike Strongly Dislike

Appendix C

Save the Bats Curriculum

An Introduction to Bats of the southeastern United States

Introduction

Bats assist humans by helping to control arthropod populations. Economists and ecological experts have calculated that bats save farmers billions of dollars each year in pesticides and fertilizers between the consumption of pests and the production of guana that the bats spread. Despite the beneficial nature of bats, most people see them and evil creatures of the night and flying vermin that spread disease. Both of the misconceptions cause people to want to harm bats that they find and have this has reduced bat populations in the United States. This educational curriculum is a way to help promote interest and reduce fear of bats.

ALCOS 7th grade science:

7.) Use empirical evidence from patterns and data to demonstrate how changes to physical or biological components of an ecosystem (e.g., deforestation, succession, drought, fire, disease, human activities, invasive species) can lead to shifts in populations.

8.) Construct an explanation to predict patterns of interactions in different ecosystems in terms of the relationships between and among organisms (e.g., competition, predation, mutualism, commensalism, parasitism).

6.) Obtain, evaluate, and communicate information to describe how human activity may affect biodiversity and genetic variation of organisms, including threatened and endangered species.

Goal: improve student knowledge and therefore attitudes toward bats

Context: I will have students describe what they know about animals prior to my interventions and how it is informed or related to their lives in the southeast. Students have taken 6.5 years of science education. Students will also have life experience to reflect on for their attitudes toward animals.

Day 1: A bat is like a…

Objectives: Given an image, students will be able to identify traits of microchiropteran bats that they share with the image and detail how these traits help the animal survive in its habitat in one or more sentences.

Materials-may use picture of one if you cannot get these items. Additional items can be used and these may be modified based on your comfort level teaching the lesson.

- Drawing bag
- Sweater
- Stethoscope
- Bug zapper
- Fertilizer
- Bird
- Person
- Whale

Engage: Get Students to think about bats and tell me something they know about bats and what bats are like. Ask students "can anyone tell me what they know about bats?" (EA:

they fly, they are birds, they are mammals, they live in caves, they are warm blooded, they eat blood, they live here) Present students with video of bat gleaning bugs in total darkness. Have them make observations and inferences. Listen to their ideas.10 minutes

Explore: Students will work in groups of four. Each group will draw an item or a picture of an item from the drawing bag. Each group then has to think about how a bat is like this item. Item listed above and following. List items drawing bag, sweater, stethoscope, bug zapper, fertilizer, bird, person, whale 15 minutes

Explain: all groups will come together and share their thoughts and other groups will have a chance to share how they think a bat is like this item or item in the picture as well. Using PowerPoint I will go through the items as well to show any additional analogies that the students may have missed or to clear up any misconceptions (e.g. bat is like a bird because they are both birds). Ask students to summarize traits that bats have in total (EA: Mammals, fly, produce milk, insectivores, hibernate, live in caves, piscivores, echolocation, fly, guano is good for soil, carry and take young with them.)Evaluate:

Using PowerPoint and students writing answers in science notebook. Present new items and ask a bat is like this item because… Example Items include but are not limited to

- Fisherman
- Bear
- Glider

Figure 1 Pictures that will be placed on index cards to hand to groups of students. Each picture will go on a separate card

Closure

At the end of class, ask students “What did they learn about bats today?” (EA: mammals, eat insects, etc.) ask students “What did you think about bats that you learned today is untrue?” (EA: they are birds, they all drink blood, etc). Ask students if they have any additional thoughts or questions on bats.

Day 2: Bat Bonanza

Objectives: Given a field guide and seeing a bat, Students will be able to identify a species of bat and state two or more facts about that species of bat.

Materials:

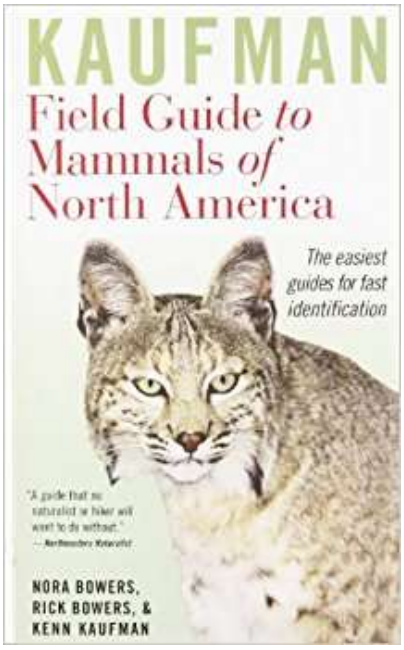
- Bat voucher specimens from Auburn Natural History Collection
- Field guides on mammals from library, Ex. Kaufman field guide to mammals, mammals of Alabama. Any guide with a dichotomous key is acceptable.
- A created dichotomous key based on the bat specimens you have available for the students.

Engage: ask the students how many species of bats they think fly above us every night? Show them footage of bats leaving a cave at night in mass. (EA: 3-5, actual answer 16 bat species). Discuss how they think we can tell certain species apart? Show them pictures of two similar bat species and ask how you would tell them apart. (EA: dichotomous keys (should be review) and field guides). Then ask why is it important for anyone to be able to identify species (EA: we can all help, scientists can't be everywhere at once) Define citizen science and Ask students what do they think about the idea of citizen science and show them Frog Watch and how it is used to report frog sightings across the USA and the Cornell lab birding apps that helps people identify birds in their area and then how it helps the scientists too by providing them information.

Explore: Each table of students will receive one or two voucher bat specimens of the same species and using a field guide or dichotomous key they will identify the species they have and when they have done this they will ask me for confirmation. If they have

identified their bat correctly, I will ask them to learn about it from the field guide. If they did not identify it correctly I will help address where I think they made a mistake in identifying the species.

Bat voucher specimen



Field Guide

Explain and evaluate: Each group of students will teach the class about their species of bat and tell them at least 2 interesting facts about that species of bat.

Example “We identified our bat as the Eastern Red Bat. The eastern red bat is a bat that eats insects. This bat also does not live in caves but actually lives in trees and makes tiny houses by cutting leaves so they fold around the bat at night.”

I will then turn to the rest of the class to see if they have any additional questions before continuing to the next group.

Closure

At the end of class I will ask the students “why do they think it is important that even nonscientists can do this kind of work?” (EA not everyone is a scientist, animals are everywhere and scientists are not, it helps scientist know where to look for something special, etc). I will also ask who thinks they are going to try and participate in citizen scientist activities and I will give information on these groups to any student interested (Cornell lab phone app, frog watch web address, etc) I will do this for any group of animals that the students are interested in.

Lesson 3: Bats and their houses

Objectives: Given a situation regarding a picture of a bat house, Students will be able to explain why bats chose certain bat house over others and choose the most appropriate location for the bat house

Materials:

Bat house per class

Engage: Discuss that many species of bats are endangered and ask the students why they think this is the case (main reason is loss of habitat)? Then class will discuss that bat habitats have been destroyed (misconception: all bats live in caves). Yes, while it is true many species of bats live in caves only a few in this area do. Many other species in this area live in trees (Show picture of bat sleeping in a leaf. ask them about these images and ask what they think. If students are having trouble give hints that lead them to bats build tiny house each night by cutting into the leaves so that they build tiny tents each night. Also show that some bats sleep under the bark of some trees like a tiny house. Also ask the students what bats eat based on our other lessons (EA: insects, which is right {some may still answer blood}) so ask the students where do they see a lot of insects outside at night? Have helping questions prepared to guide students if they do not know where insects are outside. (EX. Ask questions related to football game lights on Friday night or where mosquitoes put their babies).

Explore: At this point I will ask the class where do they think we should put a bats house then? Students in this class need to have a discussion (I will act as leader to keep the conversation on track and civil) and they need to decide on an area near the school that

we can walk to. It needs to be on school property. Once we have determined the place for the bat house I will set a camera trap on it that afternoon so we can monitor our bat house to later compare to a location on Auburn University.

Elaborate: at least 2 weeks later we will look at the pictures of bats taken at each bat house placed by the students and discuss why or why didn't bats took up living in each bat house placed by the students and why the bats are in the location at Auburn University. Using the board label each of the bat houses by location and ask if a bat lived there (yes or no). Next, ask the students to discuss traits of the location (trees, water present, lights outside present, etc.). After discussing the traits of the bat house locations, ask students what do they think bats like to have near their house (EA: bodies of water, trees, lights that draw in insects).

Closure

Students will continue discussion about where the best place to put a bat house is. I will encourage students to find the best place to put a bat house in Valley. I will ask if the students have any questions or comments related to bat habitat selection.

Figure 1: image of bat leaving a bat house on a camera trap

Appendix D

Interview questions

1. "Have you been stung or bitten by an animal?" What were you doing when this happened?
2. "Do you like this animal for any reason other than eating it?" what are the reasons?
3. Are you scared of any animals? Why?
4. Do you have a favorite animal? Why?
5. "Do you like zoos? And if so what is your favorite animal? If not, why?"
6. "What makes this particular animal cute?"