Environmental Stewardship: Protecting Our Planet’s Future

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ENVIRONMENTAL STEWARDSHIP:
PROTECTING OUR PLANET’S FUTURE

by

Barbara C. Pierce

A capstone submitted in partial fulfillment of the requirements for the degree of Masters of Arts in Education: Natural Science and Environmental Education.

Hamline University
Saint Paul, Minnesota
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“Those who dwell, as scientists or layman, among the beauties and mysteries of the earth are never alone or weary of life.”

-Rachel Carson, The Sense of Wonder
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CHAPTER ONE

Introduction

Overview

As will be explained later in this introduction, this capstone is an accumulation of almost three years of graduate work on top of the year spent with a related topic in my undergraduate work. The research question, *How can Understanding by Design be used to create a curriculum that can be used to teach upper elementary students the basis of environmental stewardship?* resonates my personal goals for passing environmental awareness on to today’s youth. The initial project was analyzing sea turtle nesting data to determine if conservation efforts put in place had any long-term effect on nests laid each year. This sparked the idea as to how to translate the conservation aspect into an educational project. Teaching was not a career goal growing up, but through recent experience I am becoming more comfortable teaching. Late in my undergraduate days, it became apparent that there is more to being an educator than standing in front of a class day in and day out. Imparting important information to the public, either children or adults as students, is what being an educator entails at the core. If my knowledge and passion are imparted onto the world, then I have done my part to “save the world”. Since I grew up caring for the planet and wanting to do my part to help, I want to pass that passion on to the next generation.
This capstone is organized first with a description of how the research question was developed and then the pertinent literature is reviewed in Chapter 2. Chapters 3 and 4 describe and reflect upon the curriculum designing process, while Chapter 5 focuses on the future of the curriculum project and what was learned in the curriculum development.

This chapter will describe how the interest in this topic came about, including how personal background and experiences have contributed to this passion for environmental education. Undergraduate work and internships had a profound effect on the interest in environmental education, and more recent education experience has broadened the view on how to best reach students. The chapter concludes with how the research question has evolved since this process began.

**Origin of Interest**

Growing up in rural north central Florida, I did not frequent the beach often. My parents are not beach people. Awareness for the environment began before even starting kindergarten, since my family’s 100 acres of forest were my playground. A love of turtles began in that forest with the group of gopher tortoises that burrowed next to the driveway, whom were named Henry, Phillip, and Olivia. I protected them, watched their burrows on my walks home, and even stopped many times to rescue one of their brethren from the roads between my house and high school. The elementary school I attended also helped spark a love of nature. Until the fourth grade, my class was taken outside a few times a month to an area the school called “The Ecosystem” behind the playground. It was a wooded area, fenced around the perimeter that included a marshy pond and an abundance of places to spot wildlife. Many days the class collected water from the pond to find tadpoles and attempted to identify different woodland sounds, and each time the
class connected more to the world around us. The Ecosystem was not only enjoyable but I learned so much more from the hands-on exploration than in the classroom alone. This experience helped spark the idea to create a curriculum focused on helping students explore nature, as I was able to as a child. The college I attended is in a beach town, and sea turtles are a local fascination. I spent weekends helping with beach cleanups and then interned at a state park where a profound appreciation for turtles began.

The first occurrence watching a female loggerhead lay her eggs was remarkable. Watching all of the park’s guest’s faces after this shared experience and hearing their reactions was what helped develop an appreciation for environmental education. That fall semester internship (and the full-time summer internship that followed) was the reason behind considering education as a potential career track. Teaching in a typical classroom setting was not personally enjoyable, but talking about sea turtles, snakes or fish with groups who just absorbed everything said makes it feel like I am making a difference.

The most fascinating feature in the park for children and adults alike was the two loggerhead sea turtles that the park took care of at that time, named Caretta and Shelldon. Newly hatched loggerhead sea turtles are permitted as educational specimens in many state parks near their nesting beaches and they are released into the ocean once they are fit to survive in the wild. (Florida Fish and Wildlife Commission, 2016).

Growing up, I always wanted to be a superhero; I wanted to save the world. I alone do not have the skills or power to change the world, but I can pass my passion on to enough people so that together we can change the world. The definition of “change the world” is for enough people to make small changes that together make a difference. For example, if everyone drives less, then the amount of fossil fuels being used decreases.
This is a positive step towards slowing the warming of the earth. Thus as a population we have “changed the world.” Being an environmental educator is about more than teaching; it is about passing a passion on to the next generation so they can continue what we have started. And thus began my undergraduate thesis work. Since my campus was a beach town, it was easy studying sea turtles for a thesis project; I had access to all the data needed and a passion to show people that what I thought mattered.

**Undergraduate Work**

My undergraduate thesis project focused on the sea turtle nesting data in southern Florida on the Atlantic coast for the past 30 years, starting in 1982. Stemming from an internship, this seemed like an appropriate topic to focus on for the last year of undergraduate work. The research involved immersing myself in the history of the environmental conservation movement and then focusing on the history of sea turtle conservation. That information was compared to the nesting data collected at several beaches throughout the Atlantic coast of Florida to see if any trends emerged. The conclusion was that sea turtle nesting has been steadily increasing since 1982, which points to a positive relationship with increased conservation efforts and better technology for identifying the nests. Each year the number of nests laid are different, but the general trend observed was that a year where the nest counts are low is followed by a year where the nest counts are high, creating an oscillating pattern. Focusing on the high nest volume years, the number of nests had been increasing steadily. The data showed the potential that the increased nests may be due to the increased conservation and technology, but future research can show if there is a correlation.
The research into the environmental conservation movement was very helpful when it came time to begin this capstone work, since I was already somewhat familiar with the basics of environmental conservation; only more deep research was needed. This research allowed me to best determine how to pass the ideals of conservation on to today’s youth.

**Environmental Education Passion**

After interning with the park and seeing how much the education team influenced the students, an interest in becoming an environmental educator was developed. I have always had a passion for the environment, but that internship made me realize a need to share this passion with the next generation. I recently began substitute teaching as a way to observe techniques to connect with different students. Many days, the teachers do not leave much science work to teach, but the days where even a small amount of science assignments are taught, I feel like I make more of a difference. The goal is to be able to instill a passion for the environment into students while also allowing them to complete their science benchmarks set by the state and school district. I hope to accomplish that by allowing them to explore their world a little closer. My experience in environmental education helped to instill that passion discussed above.

**Education Experience**

I graduated in May of 2013 with a degree in Liberal Arts, concentrating in Environmental Studies, and a 15-month experience working/interning at John D. MacArthur Beach State Park in North Palm Beach, FL, with a goal to be a permanent Park Ranger either at the state or national level. I worked at every level in the park, but the first internship was in the education department. This park has a relationship with the
local public schools to have classes of students come each day and receive a grade-appropriate lesson on some aspect of the local ecosystem and park system. This experience showed that children absorbed everything the rangers and interns told them and for the most part they could not wait to learn more. The younger students, kindergarten through third grade, were more attentive and captivated by what we were doing than any of the older students or their adult chaperones. New to the situation, I was fascinated with how quickly they could understand the activities and recognize what we were trying to portray. What I observed during my time at the park was that every ranger is an educator and every ranger needs to know how to connect with guests and have the guests leave knowing more and wanting to learn more. This inspired my idea to study environmental education, knowing that it could only help to connect better to park guests. Teaching is not a strong skill of mine, and only more education could remedy this.

My undergraduate thesis project involved studying sea turtles and their life cycle. During the summer internship at MacArthur Beach State Park, I was tasked with presenting the pre-walk informational lecture for their nightly Sea Turtle Walks. This was one of the first experiences in educating the public. Even as I stumbled and repeated myself, the group was enthralled in what was said and the guests had so many more questions after the presentation was concluded. Knowing that I passed some of my passion on to those visitors made educating more appealing.

Once I began substitute teaching in 2016, I really determined how this curriculum would be approached. Many people may think substitute teaching is babysitting or giving out worksheets, but it is far from that. Many of the working days are spent in elementary schools, and the teachers will leave their lesson plans to teach the days’ subjects to the
students. As the substitute teacher, I alone am responsible for making sure the students have accomplished all of their daily goals. Even though I am not their permanent teacher, I ensure they have learned something, and find any way to help them connect to the lessons. This teaching is the bulk of my education experience, but the experiences in the state park as an environmental educator were much more rewarding, and contributed to the topic chosen for the curriculum.

**Topic Spark**

The original idea was to create a curriculum based around sea turtle conservation. Throughout the research process on this topic, it became evident that this topic would be too narrow. After college, while working at a hotel on the Gulf Coast one of the duties included talking to visitors and local patrons about the area. The beach and the environment were frequent topics. It became evident that visitors did not understand why the property was left wilder than other beach hotels. This also generated questions as to why the hotel allowed wildlife near the rooms. These conversations made me believe that the visitors lacked basic environmental education. One of the most common questions visitors would ask was about the line of trees that separated the hotel from the beach. It blocked the view from many rooms to the water, but the trees provided a necessary windbreak from hurricanes while also providing shade for the building. Though this knowledge is common for many who live near the beach, visitors coming from other parts of the country were unaware of these environmental needs.

This raised the question, how can this knowledge be incorporated into a nation-wide curriculum? We all learn about the plight of deforestation in the Amazon and old-growth California forests, about so many seemingly local issues, so why not learn about
general environmental stewardship? How do other states and countries handle environmental conservation and how do their residents learn about it? Could a curriculum be created to connect with those who do not understand environmental conservation? These questions evolved into evaluating the amount of environmental education students receive in their science curriculum. Many students get no science education at all in lower grades. This solidified the decision to design a curriculum that teaches the basics of environmental awareness and how to become an environmental steward. The goal of this curriculum, will be to broaden the environmental awareness of students with a topic that is easily relatable.

**Summary**

Raised in the woods, an appreciation for the environment is natural. A passion for protecting the earth stemming from exploration and wonder is one that all children should experience. With this unit, the goal is for students to have a better awareness of how human actions can affect the environment, and how even the youngest students can make a difference.

In the next chapter, a review of literature will provide crucial background information about the history of environmental education, thematic education programs, and the importance of environmental concern. There is much research into the history of environmental education, but not as much into how it creates environmental stewards. Chapter three outlines the curriculum design, while chapter four discusses the findings of creating the curriculum, and chapter five discusses and reflects on the curriculum designing process.
CHAPTER TWO

Literature Review

Introduction

The purpose of this study is to introduce conservation education to students. This is the basis of the research question: How can Understanding by Design be used to create a curriculum that can be used to teach upper elementary students the basis of environmental stewardship? This is a way to introduce environmental conservation and endangered species in a way that young students can connect to. Sea turtles, rabbits, and foxes are popular species that children recognize and enjoy. *Finding Nemo* (Walters, 2003) has increased children’s awareness of sea turtles since it was released many years ago, and now *Zootopia* (Lassiter, 2016) has introduced children to predators, prey, and the different interactions species can have with one another. Including species students can recognize in lessons allows for an easy transition to environmental awareness.

The first section of the literature review focuses on the history of environmental education and the different types of thematic curriculums that have been developed over the years. Understanding the history of environmental education and conservation education can help clarify why this curriculum is necessary. The importance of environmental concern becomes evident when students don’t want to learn about a subject they don’t care about. Environmental concern is not an innate idea in this modern
world, so motivating the students to care about the earth makes teaching more successful. Understanding conservation entails first determining why something needs to be conserved. With younger students, it can also be helpful to connect education to outdoor playtime, which is why schoolyard and thematic curriculum styles are featured. Science education principles can be based on child development milestones, and the national and state science standards reflect those milestones. The chapter concludes with a comparison of two curriculum development styles that can be used to create effective environmental education curriculums.

**History of Environmental Education**

The exact beginning of environmental education is unknown, since humans and the environment have always been connected. One of the first writings that discussed environmental education is *Emile* by Jean-Jacques Rousseau in 1762, a novel in which he discusses that “education should include a focus on the environment,” and teachers need to create opportunities for the students to learn (as cited in McCrea, 2006, p.1). In 1891, Wilbur Jackson defines the nature study movement. This movement is just as it sounds, the addition of nature study into children’s school curriculum before formal science education was introduced. Liberty Hyde Bailey originally rejected the term “environmental education” in 1905, which thought the term “imprecise, theoretical, pompous,” and would need constant explaining (as cited in McCrea, 2006, p. 2). In 1920, the field of ecology began to develop as a scientific field, a spin-off of the nature study movement. Ecology is one of the foundations of environmental education. The Dust Bowl was a large driving force behind environmental education, since it was a direct consequence of environmental degradation (as cited in McCrea, 2006).
Environmental education is also driven by the experiential education movement, which advocates allowing students to learn by using their senses. John Dewey, a prominent philosopher and environmental educator advocate, wrote in *The School and Society* that “all studies arise from aspects of the one earth and the one life lived upon it,” (1915, p. 80). Environmental education should be a way to teach children about all subjects, since all subjects can be related to the earth. In his book *Last Child in the Woods*, Richard Louv (2005) promotes children being outside and exploring rather than playing video games and learning about the rainforests from television. This increases their awareness and connection to the environment.

Scholars such as Dewey, Rousseau, and Bailey have influenced what today is taught as environmental education. Even though environmental education as a formal learning initiative has not been around for a long time, it has been gaining traction and attention for the last 200 years.

**Modern Environmental Education**

Environmental education is an important aspect of a well-rounded education, and is the focus of many important lessons today (Tillbury, 1995). Environmental education is not a new idea; it has been around since the eighteenth century, with the writings of Dewey, Montessori, and Goethe (Palmer, 2002). The first real collaboration of environmentalists and educators came with the Council of Environmental Education (CEE), which met for the first time in 1968. The CEE was focused on developing, promoting, and evaluating the effectiveness of environmental education (Palmer, 2002). This council was the basis for the modern environmental education movement. In 1974, the Scottish Environmental Education department published a report on its
recommendations. This report includes an important aspect of how environmental education should be delivered: “the programme of environmental education begun in primary school and pursued into secondary school should continue into informal education and later life,” (Palmer, 2002, p. 9). Environmental education should ideally be introduced in elementary school and continue to be part of the curriculum well into high school so the students can enter the world with a sense of environmental responsibility. Beginning this education early and sustaining it throughout a student’s academic career might result in adults who live a life focused on the improvement of the planet.

One of the most important aspects of education is getting the students interested and motivated about what they are learning. In environmental education specifically, getting the students outside and interacting with the environment allows the instruction to solidify in their minds. This type of education also allows the students to learn to live sustainably in their environment (Woodhouse & Knapp, 2000). Environmental education is “a relatively young, dynamic and immensely complex field for study and interpretation,” and it does not hold the priority that it should (Palmer, 2002, p. ix). In the past several decades, environmental education has increased in priority, but it still has not reached the priority it needs to make a difference. Environmental education is sometimes under-utilized in schools. It should be branched out to include a more interdisciplinary approach that can be incorporated in many subjects, creating a well-rounded education.

Recently, a philanthropist funded a new initiative to provide environmental education to all students in Virginia, free of charge (Mayfield, 2017). This initiative is a positive step towards increasing student’s environmental awareness. This curriculum is offered free of charge to not only public schools but also to homeschool students who
would otherwise need to pay for this sort of environmental education curriculum (Mayfield, 2017). Environmental education has come a long way in recent years, yet it still has a long way to go if today’s students are to become environmental stewards in the future.

**Science Education.** Environmental education is considered in many districts to be science education, and for categorical purposes, it is. Yet environmental education is so much more. While science education is generally rooted in facts and figures, environmental education should begin with a “sensitivity to the beauty of nature,” and a “caring for what happens to our natural environment,” (Wilson, 1993, p. 3). A suitable environmental education program should “foster a sense of appreciation and caring,” (Wilson, 1993, p.4). Science education is under-valued in many elementary schools, yet one study showed that students did better when science was highly valued school-wide (Levy, Jiam, Marco-Bujosa, Gess-Newsome, & Pasquale, 2016). It did not matter if the schools relied on the classroom teacher or a science specialist to teach the students science, the schools which prioritized science tended to have students who scored higher on their standardized assessments.

**Schoolyard Education.** An approach that was alluded to earlier is one that promotes exploration as a means to environmental appreciation. In the past, especially before television became a staple in American households, children went outside and explored. They built tree houses and learned about local plants and animals and how they are all connected. Those children grew up appreciating nature and what it taught them. Louv’s *Last Child in the Woods* (2005) discusses this phenomenon, but he focuses on how today’s children are more fearful of nature, and that brews *ecophobia*. This phobia is
fueled by children spending more time watching television, playing video games, and recess being cut from the school day. They are not spending time outside exploring, and thus are fearful of what lies outside and in the forest. By exploring what lies outside of the classroom and using the schoolyard as a classroom, this fear of the outdoors can be remedied (Winther, Sadler, and Saunders, 2010). This doesn’t have to be limited to just looking at plants, even sidewalks can be studied since “sidewalks will create heat sinks, creating microclimates,” and can be used as a lesson about how currents work while also allowing students to become more sensitive to the environment and its processes (Winther et al, 2010, p. 32). Studies have shown that students who spend time learning outdoors have increased comfort levels and environmental knowledge and compared to those students who do not spend time learning outdoors (Martin, 2003). The schoolyard as classroom movement is intended as a remedy for the many students who have a fear of the environment due to a lack of access to explore the outdoors.

**Place-Based Education.** Place-based education can be considered an extension of schoolyard education, with the difference being the community is the classroom. It has been called many things, including “community-oriented schooling, ecological education, and bio-regional education” (Woodhouse & Knapp, 2000, p. 2). The goal is to create “environmentally literate citizens, with the sensitivity, awareness, skills, and willingness to become knowledgeable and responsible citizens,” (Winther et al, 2010, p. 34). This utilizes not only the schoolyard, but also the community around the school as a source of education. Students can utilize local resources to solve real-world problems and get experience in real environmental issues. By focusing on local issues, students can build the necessary skills and knowledge to eventually tackle larger, worldwide problems.
Place-based education is “inherently multidisciplinary,” and can transcend generations and cultures (Woodhouse & Knapp, 2000, p. 4). Place-based education helps to foster a sense of connectedness between the student and the community in which they reside (Woodhouse & Knapp, 2000).

**Project WILD and other thematic education perspectives.** While not precisely curriculums, Project Wildlife in Learning Design (WILD) and other similar programs provide guided activities to help educators incorporate environmental initiatives into their curriculums. The first of these programs was Population Connection, published in 1975, which provided activities about population growth and human’s impact on the environment (Winther et al, 2010). The next year, 1976, Project Learning Tree (PLT) was started as a way to create to an unbiased program that both teachers and students could connect to (American Forest Foundation, 2016). PLT was originally created as a collaboration between the American Forest Institute and the Western Regional Environmental Education Council (now the Council for Environmental Education). The Council for Environmental Education (CEE) also created Project WILD in 1979, and made it widely available in 1983. The North Dakota Water Commission (Winther et al, 2010) created Project Water Education for Teachers (WET) in 1984. Project WET is still providing water education materials and they continue to advocate for sustainable water usage (Project WET Foundation, 2016).

Each of these projects achieves the goal of environmental education through different means. Population Connections promotes environmental sustainability through controlling population growth, and allowing the Earth’s resources to stabilize as well. Project Learning Tree uses forestry as a way to promote critical thinking and develop
decision-making skills about the environment and guides students to respond in an appropriate way. Project WILD uses wildlife-based activities to show how to take constructive action for wildlife and creating a sustainable future. Project WET promotes water conservation practices through awareness and stewardship. Each of these thematic curriculum programs provides the means to connect students to their environment in a focused way. Focusing on the forest, wildlife, or water allows the students to connect to the environment without having to introduce the negative potential of what may come in the future. This also allows the students to develop essential science skills in a more stimulating and purposeful environment rather than learning in the classroom.

All of these programs require the teachers to attend comprehensive training workshops to achieve optimal utilization of the provided activities. These workshops are the only way for teachers to obtain the materials and workbooks needed to conduct the programs. Each activity in the different programs has clearly identified learning objectives that support environmental education concepts. As Winther et al. states, the main theme of these guides is “not to tell students what to think, but to teach them how to think about the environment” (2010, p. 37). They are a useful bridge between science and environmental education, along with including links to art, civics, and mathematics. All of these programs have given environmental educators useful resources they can use to supplement or focus in environmental education units.

**Zoos and Aquariums approach to Environmental Education.** Nature centers, zoos, and museums are a useful resource for environmental learning. They have trained staff that manage natural areas and contain exhibits that promote an understanding of nature and its processes. Nature centers also tend to conduct programs for the public that
include learning activities. Zoos and museums may seem like destinations rather than a place to connect with the environment, but they also serve as “outdoor learning labs” that allow students to learn and connect with their environment (Winther et al, 2010, p. 37). By using exploration rather than assessment, students are able to learn without pressure of a specific outcome, while still gaining environmental knowledge. These non-formal learning centers are especially useful in urban areas where access to nature is limited.

One of the most powerful aspects of zoos, museums, and nature centers is the fact that “people can choose to visit these spaces and take ownership of their learning” (Winther et al, 2010, pg 38). One study showed that reflective engagement had the largest impact on visitor’s environmental learning when visiting zoos and aquariums (Packer & Ballantyne, 2010), that the visitors felt more emotional connection to the animals and experiences, and then reflected and discussed outside of the zoo or aquarium.

**Conservation Education**

Focusing on a single species in conservation education is a common practice. In many parts of the world, sea turtles are used as part of a larger conservation education curriculum, since sea turtles are familiar to students. The task at hand is to catch the interest of the locals and in turn, spark cooperation and action in the conservation of the species (Brewer, 2002). Having one specific species to focus on, rather than attempting to convince people to care about everything, can be a more effective approach to enlist the support of the general population in each geographic area. This strategy has been used in the past to gain support for a variety of endangered and threatened species. In Ecuador, the Andean bear’s endangered status was used to increase awareness about conserving their habitat. This included integrating the conservation ideas into the school curriculum,
the creation of a “Bear Day” with educational activities, and the development of an educational radio program. These strategies were proven to be successful when evaluated five years after implementation (Espinosa & Jacobson, 2012). In Greece, sea turtles were used to create environmental awareness in their young students. To reach this goal, a coloring book featuring sea turtles was translated and distributed to the students, in addition to having the students attend a presentation on sea turtles. This experiment also proved to be a success, and a similar program still continues today (Kremezi-Margaritouli, 1992). These examples show that choosing a species that is awe-inspiring allows the students to relate to the subject and thus retain the information better than if an unknown species is used. Including hands-on activities and full sensory experiences helps the students retain the information longer, as well as encouraging students to enjoy what they learn. This could also contribute to the student’s concern for the environment.

Increasing the student’s overall environmental awareness is the goal behind these different activity/models. Focusing on a single species can help to increase the student’s environmental concern.

**Environmental Concern**

Concern for the environment is hard to measure, though many studies have succeeded in quantifying it. Concern stems from a belief that harm will come to something found valuable in some way. In this case, a general belief that the environment is important and there is a concern that something bad is happening to it. Environmental concern can be separated into three categories using the Environmental Motives Scale (EMS): egotistic (concern for oneself), altruistic (concern for other humans), and biospheric (concern for all living things) (Yocco, Bruskotter, Wilson, & Heimlich, 2015).
The goal of many environmental educators is to create a biospheric world where concern transcends species and all living things are equalized. One study showed that the EMS is an effective tool to determine children’s environmental concern (Bruni, Chance, & Shultz, 2012). One issue that is arising is an increasing feeling of ecophobia, which translates to less concern and more fear of what cannot be controlled (Strife, 2012). This ecophobia, as discussed earlier, includes a fear of what lies outside in the environment. Introducing schoolyard education and place-based education can help to curb this ecophobia while also increasing environmental concern.

Children suffering from ecophobia tend to shy away from environmental issues. Beginning environmental education earlier in a student’s educational career can possibly prevent this ecophobia from ever occurring. An important factor to consider when creating an environmental curriculum is to change that phobia into motivation. By motivating students and letting them create solutions, the pessimistic feelings can subside. Another issue that occurs is that environmental concern can be place-based; for example, environmental concern is higher when at a zoo rather than at home. Any environmental concern is positive, and a goal may be to sustain that concern through more educational initiatives. It is positive to have zoo guests leave with motivation to help the environment, but the issue is sustaining that motivation. It is increasingly difficult to change the habits of the masses, but increasing environmental concern is a step in the right direction.

The goal of environmental education curriculums is to increase awareness of environmental issues while also increasing the value placed on the environment. Students today will become the leaders of tomorrow; so the more biospheric they are the
better the chances of preserving a high degree of biodiversity. Introducing this concern earlier in their education can help the students to become more environmentally aware adults, and create a more environmentally aware world. Understanding and nurturing environmental concern can contribute to well-rounded students and help curb ecophobia.

**Science Education and Child Development**

Science education is a great opportunity to allow children’s brains to develop (Yoon & Onchwari, 2006). Science allows students to learn “to question, observe, classify, communicate, measure, predict, infer, experiment, and construct models,” (Yoon & Onchwari, 2006, p. 419), rather than just having students memorize facts. It is also helpful to allow students to become involved in their own immediate environment to make the learning more significant. An educator needs to have a basic understanding of child development and what children can cognitively understand. If an educator chooses content too advanced for the child, the teacher will “resort to telling the information because the child cannot conceptualize the content,” (Lind, 1998, p.13). By including “regular, positive interactions with nature,” students can begin to “feel comfortable in it, develop empathy with it and grow to love it,” (White & Stoecklin, 2008, p.3). A crucial factor of science learning for children is to allow them to explore nature, while also avoiding introducing advanced topics before the students are cognitively ready.

**Science Standards**

Each state in the United States has their own set of standards for science instruction, though many states use the Next Generation Science Standards (Heiten, 2015). Minnesota and Florida each have their own set of standards for science instruction and do not use the Next Generation Science Standards. These two states’ standards were
chosen to explore because Hamline University is located in Minnesota. Florida was chosen because of a familiarity with how its curriculum is presented.

Minnesota’s science standard goals that involve environmental science include one for grade 4, “humans interact with and influence Earth systems,” and seven for grade 5. The standards covered for grade 5 are:

- “Identify renewable and non-renewable energy and material resources that are found in Minnesota and describe how they are used.”
- “Give examples of how mineral and energy resources are obtained and processed and how that processing modifies their properties to make them more useful.”
- “Compare the impact of individual decisions on natural systems.”
- “Describe how plant and animal structures and their functions provide an advantage for survival in a given natural system.”
- “Describe a natural system . . . in terms of the relationships among its living and nonliving parts, as well as inputs and outputs.”
- Explain what would happen to a system . . . if one of its parts were changed.”
- Give examples of beneficial and harmful human interaction with natural systems.” (Minnesota Department of Education, 2009).

Florida uses the Florida State Standards for all subjects. Their standards related to environmental science include three standards for grade 4 and two for grade 5. The standards involved for grade 4 contain:

- “Recognize ways plants and animals, including humans, can impact the environment.”
• “Trace the flow of energy from the Sun as it is transferred along the food chain through the producers to the consumers.”

• “Describe how, when the environment changes, differences between individuals allow some plants and animals to survive and reproduce while others die or move to new locations.”

The standards for grade 5 include:

• “Compare and contrast adaptations displayed by animals and plants that enable them to survive in different environments such as life cycles variations, animal behaviors and physical characteristics.”

• “Compare and contrast adaptations displayed by animals and plants that enable them to survive in different environments such as life cycles variations, animal behaviors and physical characteristics.” (Florida Department of Education, 2008).

The Next Generation Science Standards also includes specific standards for grades 4 and 5 for those states that have implemented the Standards. Those standards for grade 4 include:

• “Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.”

• “Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.”

The standards for grade 5 include:

• “Use models to describe that energy in animals’ food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun”
• “Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.”

• “Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.” (NGSS Lead States, 2013).

The two states’ and the Next Generation Science Standards are very similar for grades 4 and 5 in respect to environmental and life science.

State Science Assessment Scores. Two states that the curriculum designed is based on, Minnesota and Florida, have science assessment scores for fifth grade that are below 70%. Florida and Minnesota perform standardized testing for science in 5th grade for elementary age students. For this comparison, proficiency on the assessments is defined as the percentage of students who received passing scores on the science assessment their state provides. Comparing scores from 2013 through 2016 for fifth grade students only, Minnesota has an average proficiency on science assessments of 60.55% (Minnesota Department of Education, 2016). For those same years and grade, Florida has an average proficiency of 56.25% (Florida Department of Education, 2017). The percentage of passing scores is listed in Table 1. Florida used an assessment entitled FCAT 2.0, which stands for Florida Comprehensive Assessment Test 2.0 for 2013 and 2014. Beginning in 2016, Florida converted their assessment to a new test, the Florida Standards Assessments (FSA). Due to this change, Florida converted the student’s scores from the FCAT 2.0 in 2015 to align with the FSA, and thus the scores for 2015 and 2016 are more difficult to compare to 2013 and 2014.
Table 1: Florida and Minnesota Standards Assessment Results 2013-2016

<table>
<thead>
<tr>
<th>Year</th>
<th>Minnesota % Proficient</th>
<th>Florida % Proficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>59.9%</td>
<td>60%</td>
</tr>
<tr>
<td>2014</td>
<td>61.4%</td>
<td>61%</td>
</tr>
<tr>
<td>2015</td>
<td>59.3%</td>
<td>52%</td>
</tr>
<tr>
<td>2016</td>
<td>61.6%</td>
<td>52%</td>
</tr>
</tbody>
</table>

(Florida Department of Education, 2017)

Based on these proficiency rates, both Florida and Minnesota have not successfully taught science to allow students to become proficient. This suggests a need for a new type of curriculum for teaching science.

Minnesota, Florida, and the Next Generation Science Standards all align well in regards to their standards on environmental science, but proficiency scores in Minnesota and Florida suggest that more instruction is needed to obtain a higher proficiency in science (Florida Department of Education 2008; Minnesota Department of Education, 2009; National Science Teachers Association, 2014).

Curriculum Styles

There are many different curriculum styles in use throughout the world, and all have their merits. There are a few that appeal to today’s classrooms, with their integration of technology and text. Challenge-based learning (CBL) is a style developed by Apple, Inc. (2010), along with teachers and leaders to integrate real-world problems with what is taught in the text. This is a better strategy since students are tasked to solve a problem with what they have learned rather than just reading about a topic and being expected to recall the information. This curriculum allows the students to take charge of their
learning, and come up with solutions to problems they see in their world. CBL begins with the development of a “big idea,” a multi-disciplinary problem that becomes the basis for the lesson. That problem trickles down into a research question that can easily be researched and investigated. The students then develop a plan to solve the problem in their own communities, and attempt to integrate those solutions. This type of learning makes sense as an effective curriculum style. It allows the instructor to learn alongside the students as well, since “the role of the teacher in Challenge Based Learning is to find the solutions with the students, not for them,” (Apple, Inc., 2010, p. 8). This curriculum is beneficial when used to create activities, and increases the students’ connection with the subject matter rather than simply reading the textbook.

Understanding by Design (UbD) is a reverse way of creating curriculum; it begins with defining the desired outcome and then determines how to achieve it (Wiggins & McTighe, 2005). It is based on four “filters,” the first being how this idea has “enduring value beyond the classroom” (Wiggins & McTighe, 2005, p. 128). This filter also encompasses the concept that understanding the basic ideas leads to understanding the larger, more complicated theories. The second filter asks to “what extent the idea...reside [sic] at the heart of the discipline?” (Wiggins & McTighe, 2005, p. 28). This allows the student to become more active in the concepts instead of just learning about it. The third filter deals with the underlying abstract ideas that must be understood before getting to the big idea. Wiggins used an effective example of physics students not grasping gravity and force when trying to determine velocities of falling objects. The final filter involves how engaging a topic is for students. Students are more likely to grasp a concept if it is something that interests them rather than a “boring” topic. This curriculum style is also
good for 21st century students since it allows more student-led learning that can be technology based. Students may respond better to a curriculum style that allows them to use familiar technology and be more independent in their learning.

These two styles can be used together to create a curriculum that is challenging for the students and allows the students to have a larger part in their education. A curriculum based on Understanding by Design would have the potential to engage students in the subject they are learning about, which is why the designed curriculum is modeled using Understanding by Design. Projects are included that allude to Challenge-Based Learning, but the curriculum is focused around UbD.

Summary

In this literature review, three main aspects of environmental education were explored: the history of environmental education, types of thematic perspectives to teach about the environment, and creating environmental concern. These all work together to answer the research question *How can Understanding by Design be used to create a curriculum that can be used to teach upper elementary students the basis of environmental stewardship?* Older elementary students are at the proper stage to receive the largest amount of environmental education since their state and national science standards require more from them in the fourth and fifth grades. Both curriculum styles that were discussed would create a wonderful environmental education curriculum, though Understanding by Design was chosen due to its ability to identify the goals of the unit before creating the lessons. There are planned projects that will allow discussion as to how humans are connected to the world, that allude to CBL. This allows the students to retain more information about what they learn since they see immediately how it
connects to their lives. This type of curriculum can not only teach students about sea turtles and other species, but also help to create a concern for the environment and potentially begin the process of creating environmentally aware adults, who can make a difference in the future of the planet.

In Chapter Three, the methods involved in investigating the research question will be explored. The science standards that need to be met, along with the steps involved to create the curriculum are outlined in the next chapter. The reasons for the age group chosen are also explained, along with how the class grouping should look to have a successful learning environment.
CHAPTER THREE
Curriculum Design

Introduction

For those living in the wilderness, awareness of its importance is innate. Based on discussions with colleagues from Minnesota and around the country, it became apparent that the freedom of exploration experienced from living in the woods is not a common experience. This sparked interest to develop a curriculum focused on environmental awareness for an audience not familiar with conservation efforts, and the research question of *How can Understanding by Design be used to create a curriculum that can be used to teach upper elementary students the basis of environmental stewardship?* was formed. This study acknowledges that all students have little to no exposure to the conservation efforts surrounding the environment, and by extension, endangered species. A curriculum is designed that can be utilized nation-wide to introduce the environmental awareness that is needed as students become adults in a changing world.

Curricular Site Design

The curriculum was designed for use at any school in the country that enrolls grades four or five. These grades were chosen since the state standards aligned with the goals of the curriculum for these grades. It is intended for schools in any location, from
public to private to homeschool settings. The curriculum is designed to be flexible and adaptable for any school situation.

**Instructional Setting**

This curriculum is designed for use in classrooms with at least 20 students, though it is adjustable to include as little as 5 students. The average class size for primary schools in the United States is 21.6 students, so the curriculum is designed for an average class size (Blank, 2012). It can be used in any classroom setting. The unit can take over a month, and would consist of 30 minutes to an hour of each school day five times per week, totaling fifteen to thirty hours of instruction. The average time spent on science instruction in 2008 was 2.3 hours per week, which averages to 27.6 minutes of science instruction per day (Blank, 2012). Even if the smallest amount of time is used to implement the curriculum, the curriculum can be easily applied in any school situation. If the classroom setting allows, the lessons can extend to an hour, which allows for more thorough study. There will also be outside learning time in the form of a class project. The final project is designed to be able to be completed during instructional time, but it will be more thorough if the students can work outside of class as well.

**Target Audience**

The curriculum is geared towards students in any fourth or fifth grade class in any school in the United States. There are not any specifications as to the class setting; it should work with any ratio of students. It is intended for use in a science class or during the science portion of the instructional day. It is best used in the spring or in the fall, since those seasons are typically associated with the most comfortable temperatures for students to spend time outdoors, although any time the weather is comfortable is a fine
time to utilize the curriculum. This also allows students to observe organisms during season changes, which can lead to interesting class discussions.

**Science Standards**

This curriculum can be used to fulfill national science standards for “interdependent relationships in ecosystems” and cause and effect (National Science Teachers Association, 2014). The standards require that the students understand the changes that can happen when ecosystems change, and what the solutions to those changes may be. The cause and effect relationship is a standard that is ongoing, but this curriculum will be able to help explain that relationship as well. The curriculum can also be used to fulfill many other state science standards. Two states’ standards that were used as a guide for creating the curriculum, Florida and Minnesota, have many standards that can be fulfilled with the curriculum, as mentioned earlier in the literature review (Florida Department of Education, 2008; Minnesota Department of Education, 2009).

**Curriculum Focus**

This curriculum is focused on students reaching an understanding of the environment, how habitats work, and conservation efforts as a whole. Environmental education is a vital topic in today’s changing world, and this curriculum is meant to introduce the basic topics needed to understand the environment and its changes. Sea turtles are used in the example presentation since sea turtles are recognizable and children are more likely to relate with them. In recent years, sea turtles have been the focus of children’s movies, creating a character that is already endeared to today’s children. This curriculum is meant as an introduction to conservation education and basic environmental awareness. Below is a list of focus topics that are used in the curriculum development:
Understand what the term environment means, and explain many of the facets of the environment.

Understand habitats and the biotic and abiotic factors that make up a habitat.

Explain and understand how food chains work.

Understand what producers, consumers, and decomposers are and how they contribute to food chains and habitats.

Understand where natural resources come from.

Recognize why species need to be protected for the betterment of the planet.

These are the topics focused on as the curriculum was designed. All of these topics drive the instruction and assessment of the curriculum.

**Curriculum Design**

To establish the goal of introducing conservation education to students, the curriculum constructed is based on the Understanding by Design curriculum created by Wiggins and McTighe (2005). This curriculum is characterized by a backwards approach to creating curriculum, by outlining the desired results before creating the lesson plan. Having this clear goal allows the instructor to focus on the intended results. This curriculum will be geared towards fourth and fifth grade students as the standards required for those grades align with the goals of the curriculum.

The key questions of step one, or identifying the desired results of the curriculum of Understanding by Design are:

- What should students know, understand, and be able to do?
• What is the ultimate transfer we seek as a result of this unit?
• What enduring understandings are desired?
• What essential questions will be explored in-depth and provide focus to all learning? (Wiggins & McTigue, 2005).

In this curriculum, the goal is for students to understand the environment and how humans have affected it. They should be able to explain how they can contribute to conservation and what they as students can do from their own areas. The main ideas to be grasped are why the environment must be protected, and how each person can help.

The key questions in step two, which involves assessing the evidence to reach the goals in step one, are:

• “How will we know if students have achieved the desired results?
• What will we accept as evidence of student understanding and their ability to use (transfer) their learning in new situations?
• How will we evaluate student performance in fair and consistent ways?” (Wiggins & McTighe, 2005, p.28).

The students will know when they have fulfilled the goals of step one when they successfully explain the issues surrounding environmental conservation. To make this goal more tangible, the students will create a presentation about a species, its habitat, food chain, and major threats, to create an overall picture of what could affect the species.

Step three includes creating the actual lessons and plans to achieve the goals discussed in the first two steps. The key questions that must be addressed are:

• How will we support learners as they come to understand important ideas and processes?
• How will we prepare them to autonomously transfer their learning?

• What enabling knowledge and skills will students need to perform effectively and achieve desired results?

• What activities, sequence, and resources are best suited to accomplish our goals?

(Wiggins & McTighe, 2005)

Understanding by Design is a great way to implement the goals established. The template for the UbD Unit is provided in Table 2 (Wiggins & McTighe, 2005).

Table 2: Understanding by Design Framework

<table>
<thead>
<tr>
<th>Established Goals:</th>
<th>Understanding(s):</th>
<th>Essential Question(s):</th>
</tr>
</thead>
<tbody>
<tr>
<td>What relevant goals (e.g. content standard, course or program objectives, and learning outcomes) that the design targets.</td>
<td>Students will understand that:</td>
<td>What questions promote understanding, foster inquiry, and transfer of learning?</td>
</tr>
<tr>
<td>Understanding(s):</td>
<td>Essential Question(s):</td>
<td>Students will be able to...</td>
</tr>
<tr>
<td>Students will know...</td>
<td>• What are the “big ideas”?</td>
<td>• What should students eventually be able to do as a result of such knowledge and skills?</td>
</tr>
<tr>
<td>• Identify the key knowledge and skills that students should know and be able to do.</td>
<td>• What specific understandings are desired?</td>
<td></td>
</tr>
<tr>
<td>• What misunderstandings are predictable?</td>
<td>• What specific understandings are desired?</td>
<td></td>
</tr>
<tr>
<td>Stage 2- Assessment Evidence</td>
<td>Performance task(s):</td>
<td>Other Evidence:</td>
</tr>
<tr>
<td>• Through what tasks will the students demonstrate the desired understanding?</td>
<td>• What other evidence will be used (e.g. quizzes, tests, prompts, observations, homework, etc.) will students use to demonstrate achievement of the desired results?</td>
<td></td>
</tr>
<tr>
<td>• By what criteria will the understanding be judged?</td>
<td>• How will students reflect upon and self-assess their learning?</td>
<td></td>
</tr>
<tr>
<td>Stage 3- Learning Plan</td>
<td>Learning Activities:</td>
<td>W- Ensure that students understand WHERE the unit is headed and WHY</td>
</tr>
<tr>
<td>W- Ensure that students understand WHERE the unit is headed and WHY</td>
<td>H- HOOK students in the beginning and HOLD their attention throughout</td>
<td></td>
</tr>
<tr>
<td>H- HOOK students in the beginning and HOLD their attention throughout</td>
<td>E- EQUIP students with necessary experiences, tools, knowledge, and know-how to meet performance goals</td>
<td></td>
</tr>
<tr>
<td>E- EQUIP students with necessary experiences, tools, knowledge, and know-how to meet performance goals</td>
<td>R- Provide students with numerous opportunities to RETHINK big ideas, REFLECT on</td>
<td></td>
</tr>
<tr>
<td>R- Provide students with numerous opportunities to RETHINK big ideas, REFLECT on</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
progress, and REVISE their work.

E- Build in opportunities for students to EVALUATE progress and self-assess
T- Be TAILORED to reflect individual talents, interests, styles, and needs
O- Be ORGANIZED to optimize deep understandings as opposed to superficial coverage

Step three will be addressed more in depth in Chapter 4 as the curriculum is created. The learning plan also includes the implementation of smaller projects to allow students to have more hands-on learning.

**Instructional Tools**

The instructional tools used to develop the curriculum are some of the activities in the Project Wild program (CEE, 2015), teacher created assessments, and videos. The Project Wild program consists of activities to be used in the classroom and outdoors to help instruct the students about different environmental problems and solutions. These varied activities can help solidify the information being taught while letting students use their creativity (VARK Learn Limited, 2017). Bill Nye the Science Guy videos (Hunt & Nye, 1993), The Magic School Bus episode entitled *The Magic School Bus Hope Home* (Stevenson & Jacobs, 1994), and *Crash Course Kids* (Crash Course, 2015) from YouTube are all utilized in the unit.

**Learning Environment**

The goal of an environmental educator can be to encourage students to care about the world and become informed citizens who advocate for the planet. This curriculum is designed to allow its users to reflect on the effectiveness of the methods as the unit progresses, and allows for some leeway in its instruction to best fit the students. To an outside observer, this should appear as a fun lesson in conservation and allowing the students to enjoy learning about a new topic.
Incorporating both classroom and outdoor learning experiences in the planned curriculum contributes to a varied and interesting learning atmosphere.

**Assessment**

The assessment goal is to have small skill checks to gauge how well the students are coping with the information, allowing the instructor to review any areas needed before moving on. The data collection ends with a final, comprehensive assessment based on all the information presented in the curriculum.

**Data Collection**

There is a pre-assessment test to collect a baseline, using the post-test or creating a mix of the weekly quizzes and class discussions. The pre-test is not required, but is encouraged unless the classroom does not respond well to tracking their learning. The students’ learning can be tracked based on the weekly quizzes and final assessment. The short quizzes should only take the students 2-5 minutes to complete, and consists of fill in the blank or short answer style.

**Final Assessment**

The final assessment is a presentation that the students must research and complete based on a species of the instructor’s choosing. The presentations can be completed individually or in groups of up to 3 students. The presentation will assess how well the students understand how a species’ habitat contributes to their well being, as well as how that species contributes to the environment as a whole.
Human Subjects Review

The curriculum designed does not include any specific instructor names since it is not designed for any specific school. Human Subjects Committee approval has been met, under the understanding that for this capstone, it will not be tested on humans.

Summary

To answer the research question *How can Understanding by Design be used to create a curriculum that can be used to teach upper elementary students the basis of environmental stewardship?*, a diverse and thorough curriculum with an Understanding by Design framework is developed. The unit begins with a pre-assessment and the unit concludes with the same questionnaire. This allows the instructor to measure the student’s growth throughout the unit.

The goal is to create a unit that covers the basic aspects of environmental studies. In the following chapter, the process and findings of the curriculum unit will be explained. The insights and learning gained while creating this unit will also be included in Chapter Four.
CHAPTER FOUR

Findings

Introduction

Having never formally taught, it was a struggle to determine how to approach the research question of *How can Understanding by Design be used to create a curriculum that can be used to teach upper elementary students the basis of environmental stewardship?* Since having chosen this topic, exponentially more experience has been acquired in education as a substitute teacher, mostly in elementary school. This, along with the knowledge attained during the literature review, allowed a comprehensive unit plan to be created.

In this chapter, the curriculum unit is outlined first by identifying the results, and then determining the assessment evidence. After, the learning plan is explained in detail, followed by a brief commentary on the curriculum development process. This chapter concludes with connections to the literature review and how to determine the effectiveness of the curriculum.

**Understanding by Design**

Designing the curriculum using Understanding by Design allowed a determination of what the students needed to understand first, and then design the lessons around reaching that goal. This design was crucial as it allowed the destination to be
found before mapping the lessons to meet it. The next step in creating a curriculum using Understanding by Design is to identify the desired results.

**Identify Desired Results**

In the first stage of designing the unit plan, the goals were identified to align with State Standards in Minnesota and Florida, and the National Science Next Generation Standards for grades four and five (Florida Department of Education 2008; Minnesota Department of Education, 2009; National Science Teachers Association, 2014). These two states were chosen because Hamline University is located in Minnesota. Florida was chosen because of a familiarity with how its curriculum is presented. The unit is meant to focus on building environmental stewardship within students. There are no standards for environmental stewardship, so the unit focused on interdependence, environmental awareness, and resource scarcity. All of these standards are the building blocks of understanding environmental issues, which makes them an ideal starting point to teach environmental stewardship.

The first step in Understanding by Design is to began identifying essential questions, and ensure they aligned with UbD’s requirements for essential questions: they need to aim “to stimulate thought, to provoke inquiry, and to spark more questions,” (Wiggins & McTighe, 2005, p.106). The questions need to enable “us to cover the real riches of a topic otherwise obscured” by “routine teacher-talk” (Wiggins & McTighe, 2005, p. 106). The essential questions identified are:

- How are we (humans) connected to the Earth?
- What can you do to help the environment?
- What do we use every day that comes from the environment?
• How can we conserve resources?

• How are food webs necessary for the survival of species?

• Why is it so difficult to protect the environment?

After comparing all of the science standards, they were combined into the three cohesive understandings that the curriculum focused on. To fulfill the interdependence standard, students will need to understand that humans, plants, and animals must work together to survive and thrive. Then students can build on this knowledge to understand that we need to protect the environment so all species can thrive in the future. The last understanding is to conserve the resources we have, which aligns well with the previous two understandings, so that all the species on the planet can grow and thrive. Protecting the resources the planet currently has will ensure their availability for future generations to use.

The lessons are based on the premise that students have little interaction with the environment other than any time they have walking into school and riding the bus home, so the instructor must instill in them the basics of environmental stewardship. It is understood that some students will come with more environmental knowledge than others, but it is more effective to start with the basics rather than adding more material because the students did not have the basic knowledge required.

By the end of the unit, students should be able understand that humans share this Earth with many species, but humans should take responsibility to conserve and protect it. The end goal is that students will want to help the environment, and become environmental stewards in their own homes. The second step in designing a curriculum using UbD is to determine assessment evidence.
Assessment Evidence

Stage two of Understanding by Design is to determine assessment evidence. The curriculum unit’s assessment evidence revolves around a final performance task. A few smaller assessments are included throughout the lessons, to serve as understanding checks to evaluate whether the students are prepared to move to the next section.

The main assessment is a presentation at the end of the unit on an assigned animal, including information about their habitat, food web, and their connection to humans. The intention with this assessment is to gauge how well the students can connect an animal and their habitat to their lives as students. The hope is that the students will gain understanding that what they do and how they live does have an effect on species, but mostly that humans do effect the environment. Humans can either help or hinder the environment, and the objective is that students will see how they can help more than hurt.

With the other assessments throughout the unit, easy questions were avoided, and the assessment aims to include mostly full sentence answers. Multiple-choice questions do not reflect understanding as well as being able to write a full sentence answer (Simkin & Kuechler, 2005). Most of the assessments are based on participation in class discussion, which alone reflects how well the students are grasping the concepts.

For the majority of the unit, the assessment is simply the class discussion. Discussions allow students to ask new questions and the whole class benefits from finding out new information, and can deepen their understanding.

The following section outlines the unit’s learning plan week by week, which is step 3 in designing a UbD unit.
**Learning Plan**

The learning plan is located in Appendix A, and it was consulted as the detailed lesson plans were created. It is included as a table in the unit plan, as it includes the assessment evidence, objectives, and lesson overview. Lessons were created based on how the information would best flow, and adapted lessons from Project Wild and other sources. All of the lessons, excluding the two adapted from Project WILD (2015), were created and developed specifically for this curriculum. The two Project WILD lessons were modified to fit the unit goals. Each week of the planned unit is outlined below.

**Week One.** In week one, the goal is to introduce the environment and resources. The unit begins with a discussion that has the students defining basic environmental terms. Their responses should help guide the lesson and determine which lessons may need more time and which ones the group can grasp quickly. The pre-assessment, included in Appendix C, is intended for the students to complete at the beginning and conclusion of the unit. This assessment allows the instructor to have concrete evidence about how much the students have learned throughout the unit.

The rest of the first week is focused on resources, how humans use resources, and the consequences of depleting natural resources. This portion of the unit begins with an introduction into resources; focusing on what natural resources are, and where they come from. This is again assuming that the students come with little to no knowledge of resources. A CrashCourse Kids video (2015) was chosen for the way it covers the topic concisely in a format that the students can relate to. The video introduces resources as necessary for human survival, and investigates how humans use resources to make food, specifically cake. Utilizing multiple formats by having students watch videos and
complete activities allows them to connect to the material in a way that just listening to a teacher talk could never do (Neo & Neo, 2001).

A day to read *The Lorax* by Dr. Seuss (1971) is also included in the first week. It is a very simple book, but it is an effective tool to show students what can happen if natural resources are depleted. It is silly and interesting and many students will be familiar with it. It connects human’s impact on nature in a lighthearted way, which helps to avoid any sense of ecophobia. This day also includes time for the students to explore outside. The intent is for the students to look for plants and animals rather than play on the playground. This first exploration time does not require anything more than to look for plants and animals. Subsequent outside time will have more focused direction.

Week one concludes with an introduction of the focus for week 2, ecosystems. The intention is to familiarize the students with the terminology and general ideas behind what an ecosystem is. The intention of week two is to introduce students on how to analyze ecosystems and how one factor changing in an ecosystem can alter the whole system.

**Week Two.** This week begins with an entertaining video. Bill Nye the Science Guy makes interesting and informative videos that have been around for many years. This specific video is a good introduction to biodiversity and how biodiversity connects to ecosystems (Hunt & Nye, 1993). An understanding check is included as tangible evidence of how much the students have learned from the video. The objective of the video is to give the students a more interesting take on ecosystems and what ecosystems require to thrive. The second outside exploration time also happens on this day. The focus
for this day is to identify parts of the ecosystem they see. The main intent is to allow the students time to explore and connect to their immediate environment.

The next day, the two types of ecosystems are explored and the differences are explained. There are many differences between terrestrial and aquatic ecosystems and both are equally important when it comes to understanding ecosystems as a whole. During the following two days, the two types of ecosystems are investigated in more depth, and more examples are included of the types of organisms that live in each biome of terrestrial and aquatic ecosystems. In later years, the standards require the students to memorize the different biomes, but the intention with this section of the unit is to simply familiarize the students with the different types of ecosystems. The students should also discover that habitats are based on the location on the planet (i.e. elevation and latitude) as well as geological features, and species become adapted to certain biomes. The expectation is not for the students to memorize and regurgitate the names, rather that they realize that biomes are based on location on the earth, and certain species are better suited for each biome. Students should be able to recognize that tundras and taigas are colder than tropical rainforests and that freshwater ecosystems are not salty while marine ecosystems are very salty.

The final day of this second week includes a brief introduction into food webs and how they are dependent on the ecosystem in which the species involved live. Bill Nye the Science Guy’s video is featured again since he is thorough and entertaining (Hunt & Nye, 1997). The video covers the basis of food webs while also keeping the student’s attention. The quiz after is envisioned as a test to see how well the students have been paying attention to the video and the preceding lesson. The main facts the students should
comprehend are that a food web has three parts: producers, consumers, and decomposers. The students should also identify the role each part has in the food web.

**Week Three.** Week three begins with a lesson on biotic and abiotic factors in an ecosystem. Those terms are advanced, but the general idea behind them is recognizing the difference between parts of an ecosystem that are living and non-living. The objective on this day is to see if the students can recognize things that are living (plants, animals, and bacteria) and things that are not living (air, water, and temperature). This day can also be used to help solidify how abiotic and biotic factors influence food webs.

The second day of week three is the most challenging, but will show how much the students have learned thus far in the unit. This day is meant to see how well the students can identify parts of a food web, and to see how well they can cooperate within a small group. There are two ecosystem-focused stations and two food web-focused stations, though they all are connected. The most telling station is if the students can create a food web with no prompting or adult help. The underlying purpose of the stations is to have students show how much they have absorbed and can show that they understand what has been studied thus far. The goal of the ecosystem stations is to have students think deeper about how parts of an ecosystem work together, and how food webs are an integral part of the ecosystem.

The next two days the students will work on designing a habitat. This activity comes from Project WILD, which is a common program in state parks in Florida (CEE, 2015). The entire program is comprised of activity-based learning, while also allowing for larger discussions. Project WILD fits well into Understanding by Design, since it helps foster understanding through hands-on learning. The reason to have students design
a habitat is to foster their imagination while still having a tangible product showing how much they have learned and understood over the past three weeks. They have to think of everything the habitat may need, and it is made slightly more difficult since it is an aquatic ecosystem they have to model. Many schools have students create a poster habitat for a terrestrial ecosystem, so this is a different option for the students. Since humans do not live in the water, it is not as obvious what aquatic organisms need to survive. This results in students having to use critical thinking to create a complete habitat.

The final day of week 3 is the introduction of the final piece of the environmental stewardship puzzle: interdependence. Interdependence is a topic that is usually well covered, but the term interdependence is not used as much as connectedness. The pyramid example at the beginning of the lesson is used to help illustrate how working together can be beneficial for everyone involved. This illustrates how removal of one piece, no matter where it is located, is removed, falls or is missing, can create devastation for the rest of the pyramid. This final day of week three also includes time for outdoor exploration, this time focusing on food webs. The students should identify any parts of a food web they notice. Again, the main intention is for the students to strengthen their connection to the environment.

**Week 4.** This week is the final week of instruction, so the unit needed to finish up strong and tie all the lessons together. The first day, the class investigates the different types of relationships between organisms. This is meant to illustrate the positive and negative relationships between organisms that are necessary for the biodiversity and health of an ecosystem.
The second day of this week, a video is shown, “The Magic School Bus Hops Home” (Stevenson & Jacobs, 1994). Similarly to the videos from Bill Nye, the Magic School Bus is entertaining while also being educational. This particular video is about a pet frog that finds her way back into her natural habitat. The goal for students to take away from this video is that all the parts of the ecosystem help to create the best habitat for the organism.

The third day is a review and skill check of food webs. The students only need to show that they can draw a food web and identify the different parts of the food web. This day is meant to see how well the students have been paying attention and can show that they understand how food webs work. If the students perform poorly on this skill check that would trigger a need for more instruction to ensure the students are grasping the basic concepts.

The fourth day of this week is an exploration and observation day. On this day, students are free to explore the ecosystem around their school and create those connections that have been studied the last month in the classroom. The students will write their observations in a journal to assist the students in collecting their thoughts, using an example of a nature journal (Horton, Hagevik, Adkinson, & Parmly, 2013). The students are given focus points so they will not be wandering around aimlessly. The intention is to let the students have a bit of freedom to explore nature on this day, and have time to use their schoolyard as a classroom as Winther described (2010). This exploration can go for as long as the instructor desires, depending now how well the students are working. This day can be moved to any other day during week four in case
of inclement weather. If needed, this day can be postponed and used as a break while students work on their presentations.

Since the final project is a PowerPoint presentation, a brief tutorial on how to use the PowerPoint program for any students that are not skilled is included in the lesson plans. Many students of this age group will be skilled on the computer, but some may not and all students should be given the opportunity to succeed no matter their situation. This tutorial also acts as a template for what is required in the student’s presentations.

**Week 5.** This week the students will largely be working on their projects, but an example is given to show the kind of information that needs to be included in their PowerPoint presentation. This example also shows that they will need to do a little more research to be able to explain the human threats to the animal they are assigned to. The instructor can also use this lesson to demonstrate how the students should behave when giving a presentation: not fidgeting, not simply reading the slides, but speaking to the audience. The question portion is included because their audience (the rest of the class) may have questions about the species and the presenters should be prepared to answer those to the best of their abilities. The species chosen for the groups were purposely more difficult to identify; toucans and komodo dragons may not be familiar to the students. Dogs, deer, and bears would be too easy for the students to identify and the students may not attempt any research.

The rest of this final week will be devoted to allowing the students to work on their presentations with their groups. This time is added to the lesson plans so those students without home computers would have the same opportunity as the rest of the
class to work on the presentation. All of the work should be done in class to ensure the students, rather than their parents, design the presentations.

Once all presentations have concluded, the students will then be given the post-assessment to show their growth from when the unit began. This will give quantitative data as to how the students have grown and how their understanding about the environment has changed since the first day.

This learning plan, the final step in development of an UbD curriculum, is outlined above. The following section discusses the development process and what was learned.

**Development Process**

In theory, the curriculum development process was not difficult. When actually developing the curriculum, the difficulty set in. Attempting to create or adapt lessons that were not only age-appropriate, but engaging and fulfilled the science standards set out by the states and nation was much more challenging than anticipated. Designing a cohesive unit where each lesson lead into the next was also not easy. The lessons were redesigned and reorganized many times before satisfaction was achieved. The final unit fulfills the standards and is intended to be enjoyable and educational for the students.

The next section discusses the unit’s connection to the literature review.

**Literature Review**

In Chapter Two, the review of the literature led to focus on a single-species approach to help the students solidify the concepts that were being taught. While the unit is not focused on one species, the final project the students are assigned allows them to concentrate on a single species and how that species interacts with their environment.
Schoolyard education also influenced the lessons more than expected, as the students are free to explore their local environment and connect what they learn in the classroom to the real world. The literature review also compared UdB to Challenge-Based Learning, and concluded that UdB was a more appropriate choice for this curriculum. The following section assesses how the effectiveness of the curriculum could be determined.

**Curriculum Assessment**

The best way to assess the effectiveness of the lessons would be to use them in a classroom setting. Providing them to a teacher in a local school or receiving permission to present the unit in another teacher’s classroom would show how affective the lessons are in reality. The curriculum will be affective if the students complete the unit understanding more about the natural world and taking even small steps to help protect it.

**Summary**

In Chapter Four, the process of creating the curriculum unit plan was explained to answer the capstone question: *How can Understanding by Design be used to create a curriculum that can be used to teach upper elementary students the basis of environmental stewardship?* By using the Understanding by Design framework, the assessment evidence and desired outcomes were chosen first, and then the daily lesson plans were developed. The lessons were designed to avoid creating an activity-only curriculum and instead focused on creating lessons that would help to create environmental stewards of the students.

In Chapter Five, the results of Chapter Four will be reflected upon, along with reflecting on what was learned in the curriculum-designing process.
CHAPTER FIVE

Conclusion

Introduction

This chapter will reflect on the entirety of the capstone project, and how the research question: *How can Understanding by Design be used to create a curriculum to teach upper elementary students the basis of environmental stewardship?* was answered.

In the first section, the process of choosing the topic has been reflected on, and what has been learned throughout this process. A discussion of how the literature review influenced the final product is next; including which portions of the literature review had the greatest effect on the lessons.

The implications and limitations of the study are included in the next section, which includes what the plans are for the results and the important limitations to creating a successful curriculum. The final section includes future goals for the research, and how to communicate the results.

Reflections

The capstone began with Research Methods in Fall 2015. The capstone idea evolved and changed much over that one semester, and even more with beginning writing in Spring 2016. The original idea revolved around sea turtle conservation, but it quickly became evident that the students would need more technical knowledge than they would
have to be able to follow the lessons. So, the committee helped to guide the focus on environmentalism and the steps needed to create students who care about the world. So the research question evolved to: How can Understanding by Design be used to create a curriculum to teach upper elementary students the basis of environmental stewardship? Initially, the focus was on sea turtle conservation since that is where my comfort level lied. In reality, a unit was created that focuses well on overall environmentalism and connects with young students.

When beginning the capstone, I had yet to have any substantial teaching experience due to my job as a hotel clerk. A career change to substitute teaching in February 2016, and the experiences gained has influenced the capstone immensely. After reading through the resources and through the Understanding by Design workbook, it became evident that the curriculum that would be created needed to make the students think. The unit needed to avoid lessons that only required students to memorize and regurgitate. The goal of the curriculum was also for the students to be free to use their unique set of talents to learn about the subject. This is why the unit includes many group and partner activities, since some students are talented at art while some can help create the ideas for the habitat models they are making.

One of the most challenging yet rewarding portions was creating the ecosystem stations. All of the content was created except for the pictures; the pictures were found on the Internet, as art is not personally a strong skill.

In the elementary schools where I frequently work, less time is given to science lessons than language arts and math. It is understood why lessons are structured that way,
but the curriculum is intended to give the students a well-rounded science unit even with the limited time available.

**Review of Literature**

The literature review included a brief history of environmental education, which I concluded has always been around since we live within the environment. The unit was based on the schoolyard education that Winther (2010) discussed, and included lessons from Project WILD (CEE, 2015). It is believed that students will learn through exploring, and the final active lesson included the freedom for the students to explore and observe in real time the lessons they learned in the classroom.

It was planned to avoid supporting ecophobia as Strife (2012) discussed, and instead nurture the student’s curiosity and allow them to see all the wonders nature has to offer. It was discussed at length the importance of children’s education in the environment, since they are the ones that will be taking care of the planet in years to come. If they are not educated in environmental issues, then they cannot see the consequences of their actions. Having the students focus on one species in their final project allows them to put what they have learned into action, as shown with the “Bear Day” study (Espinosa & Jacobson, 2012).

Understanding by Design was successfully used to create the unit plan, and that met the goals outlined in the first step of UbD. This portion proved to be a vital aspect of the curriculum. Without the guidance of Understanding by Design, the curriculum would not be cohesive (Wiggins & McTigue, 2005).

I have a new appreciation for how difficult it is to keep students motivated about the environment. The individual lessons were created with the constant consideration to
create fulfilling lessons rather than just entertaining ones. If the unit could be tested in a classroom setting, the results of how successfully this goal was achieved would be realized.

**Implications**

This curriculum could be offered to school districts for use in their classrooms. It is designed to be adaptable to any classroom situation, in any area. The unit could be requested to be taught in the local schools, or provided to the current teachers to implement.

Further implications could arise if this curriculum is tested within a classroom. This could also include changing district policies to emphasize environmental education in the student’s learning. Since each state has different standards for science, this lesson can be adapted to fit in any grade level where the standards include interdependence, environmental awareness, and resource scarcity.

One implication of the study is that students will become more involved in the environment, and learn to incorporate conservation of resources in their everyday life. After spending a month learning about the environment, one would hope that the students would become environmental stewards and care about the world in which they live. The main goal for this unit is for students to leave caring about the environment more than when they started, hopefully due to a greater understanding of their connection to the environment.

**Limitations**

No matter how thoroughly the literature was studied, lessons were planned and thought, there are always improvements to be made. There may be schools where the unit
is impossible to replicate due to lack of outdoor space or computers. More examples could have been included to connect with the students, or adjustments made for Special Education students. This unit was created on the assumption that students come in with the most basic of knowledge about the environment; some districts and non-public schools would include more in-depth environmental science lessons beginning with younger students. This only slightly alters when a school could introduce the lessons: some may be able to be altered to for students as young as first grade.

The main limitation for this curriculum is the fact that it has not been able to be tested. Student reaction is not always predictable. Even though the curriculum was created to adapt to all types of student learning, this curriculum may not receive the results intended. The only way to know if this is a successful curriculum would be to test it in a classroom. The intention of the curriculum is for all students to grasp the concepts and have a greater awareness for the environment than before the unit.

**In the Future**

Designing the curriculum from the intended outcomes forward was a very rewarding experience. It allowed for each lesson to be focused on the content the students needed and connect each lesson to the next.

If the principal could be convinced, there is potential to include some of the lessons at the schools where I currently work. The Virginia Standards of Learning are quite different than Florida’s or Minnesota’s, but many of the lessons would fit in nicely to their required curriculum. It may be possible to implement the entire unit plan into one or two of the fourth or fifth grade classes in the school if proposed properly.
Every unit should be able to grow and change with the changing environments and students within each school. If the opportunity arose to test this unit in many different schools around the country, the unit would be able to be adjusted for each community.

**Communication of Results**

To best communicate the results of this curriculum, the unit can be provided to local schools in both Florida and Minnesota, emphasizing the sub-par science assessment scores as evidence that a new type of curriculum may be needed. I plan to contact principals and superintendents of at least a few school districts to inquire if they would be interested in implementing even some of the unit created. The curriculum will also be available for future graduate and undergraduate students to implement and evaluate in their research.

One of the most surprising aspects of this project involved an increase confidence in my teaching abilities. Having created a curriculum, a new appreciation occurred for the lessons the instructors leave. One of the ways to communicate the results is to include environmental discussions, when appropriate, in the classrooms where I am assigned. Many students are curious as to how the world works, and incorporating a short discussion on human’s connection to the environment can be beneficial. This would mainly include answering questions the students have, not imposing on the lesson plans by initiating out of the blue environmental lessons.

**Summary**

In this final chapter, the outcomes of the curriculum are examined, along with a reflection of the process of creating it. The future implications, future goals for the curriculum, and how the results will be shared are also discussed. The literature review
helped to conclude that the curriculum ought to be tested to see how successful the lessons are for increasing student’s environmental awareness.
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Appendix A: Unit Plan:

### STAGE 1 – DESIRED RESULTS

**Established Goals:**
Standards MN 5.4.2.1, 4.3.4.1, FL SC.4.L.17.3, NGS 5-LS2-1: Humans, plants, and animals interact with and influence Earth’s Systems.

Standards MN 5.3.4.1, 5.4.4.1, FL SC.4.L.17.4, NGS 3-LS4-4: Plants and animals, including humans, interact with and depend upon each other to satisfy basic needs.

Standards MN 5.4.4.1, NGS 4-ESS3-1, 5-ESS-1: Humans change environments in ways that can either be harmful or beneficial to themselves and other organisms.

**Understandings:** Students will understand that...
- Humans, plants and animals are all connected and we work together to survive. (Interdependence)
- We as humans rely on the environment for everything, including food, water, energy, and thus we must protect it for the survival of all species. (Environmental Awareness)
- There are only so many resources available on the planet, so we must conserve them to be able to sustain life. (Resource Scarcity)

**Essential Questions:**
- How are we connected to the Earth?
- What can you do to help the environment?
- What do we use everyday that comes from the Earth?
- How can we conserve resources?
- Why is it so difficult to protect the environment?
- How are food webs necessary for the survival of species?

**Students will know:**
- Key terms: environment, resource, interdependence, and natural resource.

**Students will be able to:**
- Explain how a specific animal is connected to the Earth and humans through a chain of influence.
• Types of organisms (plants, animals) and how they are connected.
• Where energy comes from
• How a food chain works
• Show how an animal’s actions can influence the environment in positive and negative ways.
• Analyze how their actions can positively and negatively effect resources in their own life.

STAGE 2 – ASSESSMENT EVIDENCE

Performance Tasks:
Students will create a presentation on how a species (instructor-selected) is connected to the Earth and humans. This includes a description of the species and its habitat, a food web, and what humans use in that habitat or of the species. This also includes what students can do to help protect the species and its habitat. Students will receive an example as a class using sea turtles.

Other Evidence:
Quiz- food web and key terms
Prompt- Describe how two organisms (ex. An oak tree and a squirrel) are connected and explain how they rely on each other. Then explain how that affects humans.
Class discussions

STAGE 3 – LEARNING PLAN

Summary of Learning Activities:
W- Ensure that students understand WHERE the unit is headed and WHY
H- HOOK students in the beginning and HOLD their attention throughout
E- EQUIP students with necessary experiences, tools, knowledge, and know-how to meet performance goals
R- Provide students with numerous opportunities to RETHINK big ideas, REFLECT on progress, and REVISE their work.
E- Build in opportunities for students to EVALUATE progress and self-assess
T- Be TAILORED to reflect individual talents, interests, styles, and needs
O- Be ORGANIZED to optimize deep understandings as opposed to superficial coverage

<table>
<thead>
<tr>
<th>Day</th>
<th>Objective(s)</th>
<th>Lesson Overview</th>
<th>Assessment</th>
<th>WHERE TO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Evaluate the student’s knowledge about</td>
<td>Discuss essential questions. Give students the Pre-Assessment</td>
<td>Unit Pre-Assessment</td>
<td>W</td>
</tr>
<tr>
<td>Day</td>
<td>Activity</td>
<td>Assessment</td>
<td>Resource</td>
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<td>2</td>
<td>Introduce what resources are and where we get many items we use each day (water, paper, gasoline, etc.)</td>
<td>Define what resources are and where they come from. Watch “Crash Course Kids-Resources” List resources</td>
<td>List of renewable and non-renewable resources.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Raise student’s awareness about where their clothes come from and how that connects to resources.</td>
<td>Skill check resources “What you wear is what they were” activity Discuss their drawings</td>
<td>Graphic organizer of renewable and non-renewable resources</td>
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<td>4</td>
<td>Use a funny book to raise awareness about the consequences of using up resources.</td>
<td>Read “The Lorax” Discuss how the book is a warning for us. Create a chart as a class on how the world changed. Go outside.</td>
<td>Class chart</td>
<td></td>
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<tr>
<td>5</td>
<td>Introduce ecosystems and how species cohabitate.</td>
<td>Define the term ecosystem. What is an ecosystem? How do changes affect the ecosystem?</td>
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<tr>
<td>6</td>
<td>Introduce biodiversity as a connection between ecosystems and the next lesson on food chains.</td>
<td>Watch “Bill Bye the Science Guy- Biodiversity” Check for Understanding quiz Class discussion to see if they can make connections Go outside.</td>
<td>Biodiversity Check for Understanding Quiz</td>
<td></td>
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<tr>
<td>7/8/9</td>
<td>Introduce students to the different types of ecosystems and how life differs in each one. Discuss terrestrial and aquatic ecosystems in depth.</td>
<td>Define terrestrial and aquatic ecosystems. Discuss to determine the different types of terrestrial ecosystem. Explain the biomes of the world: tundra, taiga, rainforest, etc. Explain there are two types of aquatic</td>
<td>Class Participation E</td>
<td></td>
</tr>
</tbody>
</table>
| 10 | Introduce food webs as a larger part of an ecosystem. | Watch “Bill Nye the Science Guy- Food Webs.”  
Give the Food Webs Quiz  
Discuss producers, consumers, and decomposers | Food Webs Quiz | E |
| 11 | Introduce students to living (biotic) and non-living (abiotic) parts of an ecosystem.  
Have students understand the importance of each part of an ecosystem. | Define biotic and abiotic.  
Explain that they mean living and non-living.  
Examples of those factors in an ecosystem.  
Living/Non-living whiteboard exercise | Living/Non-Living Whiteboard exercise | O |
| 12 | Allow students to practice identifying and organizing different aspects of ecosystems and food webs. | Rotate students through four different ecosystem stations:  
1. Analyze Food Web  
2. Analyze Ecosystem  
3. Create a Food Web  
4. Label and Ecosystem | Food Web Questions Ecosystem Questions | E |
| 13/14 | Give students practice in identifying habitat components by creating a habitat for an aquatic organism. | Discuss what organisms need to survive: food, water, shelter, and space.  
Explain the requirements of the habitat the students must create.  
Assign groups and species.  
Allow students to | Participation Group Report | E |
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<tr>
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<th>research and prepare their projects. Students give a short report on their habitat and where it fits in the zoo or aquarium.</th>
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<tbody>
<tr>
<td>15</td>
<td>Introduce students to the concept of interdependence.</td>
<td>Define the term interdependence Pyramid example Go outside.</td>
</tr>
<tr>
<td>16</td>
<td>To introduce students to the different types of relationships between organisms.</td>
<td>How do organisms interact? Define the four types of relationships: commensalism, mutualism, predation, and parasitism.</td>
</tr>
<tr>
<td>17</td>
<td>Review food webs and how they contribute to interdependence.</td>
<td>Prepare class to watch video Show “The Magic School Bus Hops Home” Give students the quiz</td>
</tr>
<tr>
<td>18</td>
<td>Review food webs and their parts</td>
<td>Review the three components of a food web Students will draw a food web based on organisms given.</td>
</tr>
<tr>
<td>19</td>
<td>Allow students to observe relationships in nature and make connections to what they have previously studied.</td>
<td>Inform students that they will be observing nature. They should look for food webs, relationships, and species. Allow them time to explore around the school grounds Come together and discuss observations</td>
</tr>
<tr>
<td>20</td>
<td>Show students how to use Microsoft PowerPoint.</td>
<td>Show students the tutorial and allow them to ask questions</td>
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<tr>
<td>21</td>
<td>Show students the</td>
<td>Show students how</td>
</tr>
<tr>
<td></td>
<td>sea turtle PowerPoint.</td>
<td>their presentation could look. Assign students their groups and species to begin research.</td>
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<tr>
<td>22-25</td>
<td>Allow students to work on and present their PowerPoint presentations.</td>
<td>Students will work in groups on their presentations. Groups will present when ready.</td>
</tr>
<tr>
<td>26</td>
<td>Wrap up the unit and give the students the post-assessment.</td>
<td>Inform students that the unit has concluded. Give students Post-Assessment. Ask the same simple question as in Day One.</td>
</tr>
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</table>
### Appendix B: Individual Lesson Plans

<table>
<thead>
<tr>
<th>Day 1: Unit Introduction</th>
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<tbody>
<tr>
<td><strong>Objective:</strong> Evaluate the student’s knowledge about the environment and ecosystems.</td>
</tr>
<tr>
<td><strong>Materials:</strong> Unit Pre-Assessment</td>
</tr>
</tbody>
</table>

**Procedure:**

**Whole Group - Discuss Essential Questions**

- Inform students that we will be beginning a new unit of ecosystems and the environment.
- Begin asking simple questions and ask for answers. Questions should include “What is an environment?” and “What is an ecosystem?” This is used as a basis to determine what the students already know and get them thinking before they take the pre-assessment. Ask questions for no more than 10 minutes, allowing all students to answer with appropriate responses.
- Pass out the pre-assessment. Inform students that they should answer every question with their best educated guess. This is to help show how their answers changed when they take another assessment at the conclusion of the unit.

**Assessment**

- Unit Pre-Assessment
Day 2: Resources

<table>
<thead>
<tr>
<th>Objective: Introduce what resources are and where we get many items we use each day (water, paper, gasoline, etc.)</th>
<th>Essential Questions: What is a resource? What are examples of natural resources? What do we use everyday that comes from the environment?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sources: <a href="http://kids.britannica.com/elementary/article-399553/natural-resource">http://kids.britannica.com/elementary/article-399553/natural-resource</a> <a href="https://www.youtube.com/watch?v=8LfD_EKze2M">https://www.youtube.com/watch?v=8LfD_EKze2M</a></td>
<td>Time: 45 minutes</td>
</tr>
</tbody>
</table>

**Procedure:**

**Whole Group- Define the terms**

- Begin the discussion by asking, “What is a resource?” Allow time for 2-3 students to give their best answer, and then define the term with “something found in nature that can be used by humans.”
- Inform students that on Earth, we have resources that are used to make all sorts of things, including clothes and plastic. Some of these items are renewable and some are nonrenewable.
  - Ask the students if they know the difference between renewable and nonrenewable.
- Renewable resources are those that can be remade naturally as fast or almost as fast as they are used.
  - Examples include water, wind, wood, oxygen, and cotton.
- Nonrenewable resources are those that take a long time to be made, and we use those faster than we could get more.
  - Examples of nonrenewable resources include coal, oil, and natural gas.
- The main problem with nonrenewable resources is that they are finite, which means they will eventually run out, since it takes millions of years to create coal and oil.
- We use coal and natural gas mostly for energy, to power our homes, and oil is used to make gasoline to power cars and to make plastic.
- There are other ways to make energy to power our homes. Solar (from the sun), wind, and hydroelectric (using the energy of moving water) are used in many places to help create energy that doesn’t waste nonrenewable resources.

**Whole Group- Watch Crash Course**

- Show the class Crash Course Kids Resources
  - [https://www.youtube.com/watch?v=8LfD_EKze2M](https://www.youtube.com/watch?v=8LfD_EKze2M)
- Have the students create a list of all the resources the video mentions as they watch it.
  - After the video, ask the students to label all the resources as renewable or nonrenewable. They can add more resources to the list based on class discussions if they desire.

**Assessment**

- List of renewable and non-renewable resources
### Day 3: Skill Check Resources

<table>
<thead>
<tr>
<th>Objective: Raise student’s awareness about where their clothes come from and how that connects to resources.</th>
<th>Essential Questions: What is the difference between renewable and nonrenewable resources? How is what we wear connected to the environment?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Materials:</strong> Paper and pencils</td>
<td><strong>Time:</strong> 30-45 minutes</td>
</tr>
</tbody>
</table>

#### Procedure:

**Whole Group- Skill Check**
- Begin lesson by asking students to create a chart to sort resources into renewable and nonrenewable.
  - Call out in any order, without giving away which side of the chart they belong to.
  - **Renewable** - wind, water, solar, cotton, leather
  - **Nonrenewable** - oil, natural gas, fossils, minerals

**Whole Group- “What you wear is what they were”** (from Project WILD pg. 210)
- Begin this activity by discussing what clothing is made of.
- Linen and cotton are two materials that come from renewable resources (they are both plants). In scientific terms, animals are considered a renewable resource, and materials like leather and wool come from animals.
- Have students look at what they are wearing today.
  - Students will then draw a picture of themselves in the clothing they are currently wearing.
  - The students will label each item of clothing based on what it’s mainly made of (cotton pants, polyester shirt, silk tie, etc.)
  - Then have the students identify each piece based on the natural resource they previously labeled, and determine if each source is renewable or nonrenewable.
  - They should then further classify those renewable resources as plants or animals.
- Propose the following questions once the students finish their drawings.
  - How do our clothing choices affect our natural resources?
  - What effect do our clothing choices have on our environment?
  - Which sources of clothing seem the most appropriate for conserving resources?

#### Assessment
- Chart of renewable and nonrenewable resources
<table>
<thead>
<tr>
<th>Day 4: The Lorax</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective:</strong> Use a funny book to raise awareness about the consequences of using up resources.</td>
</tr>
<tr>
<td><strong>Essential Questions:</strong> How are humans using resources? How is our world like the world in the book?</td>
</tr>
<tr>
<td><strong>Materials:</strong> “The Lorax” by Dr. Seuss</td>
</tr>
<tr>
<td><strong>Procedure:</strong></td>
</tr>
<tr>
<td><strong>Whole Group- Read “The Lorax”</strong></td>
</tr>
<tr>
<td>• Begin a class discussion.</td>
</tr>
<tr>
<td>o What is the main idea?</td>
</tr>
<tr>
<td>o How did the environment change in the book?</td>
</tr>
<tr>
<td>o How did the world look before the Thneed factory was built?</td>
</tr>
<tr>
<td>o How did the world look after all the Thneeds were sold?</td>
</tr>
<tr>
<td>• Create a chart on the board using all of the answers the students give to how the world looked before and after the Thneed factory.</td>
</tr>
<tr>
<td>• Finish the discussion by asking “What is being used in our world like they used Truffala trees in ‘The Lorax’?”</td>
</tr>
<tr>
<td><strong>Whole Group- Go Outside to Explore (15 minutes)</strong></td>
</tr>
<tr>
<td>• Take the whole class outside to explore the environment in their schoolyard.</td>
</tr>
<tr>
<td>• Have the students make observations about what they see.</td>
</tr>
<tr>
<td>• The intent is to just allow the students time to connect to the outside.</td>
</tr>
<tr>
<td><strong>Assessment</strong></td>
</tr>
<tr>
<td>• Class chart</td>
</tr>
</tbody>
</table>
**Day 5: Ecosystem Introduction**

**Objective:** Introduce ecosystems and how species cohabitate.  
**Essential Questions:** What is an ecosystem? How do species live together? How can changing the ecosystem effect the balance?

**Sources:**  
http://forest.mtu.edu/kidscorner/ecosystems/definition.html  
**Time:** 30-45 minutes

**Procedure:**

**Whole Group- Define Ecosystems**

- Define ecosystem.  
  - A biological community of organisms and their physical environment that interact.
- Ask students to write down a list of what makes up their ecosystem.  
  - Anticipated answers include: their house, try to encourage their yard, neighborhood, and street. Encourage adding living and nonliving aspects of their space.
  - Describe their ecosystem as their space, which includes all the plants, animals, and nonliving aspects of what they encounter outside.
- Ask students to verbally answer a few questions.  
  - How is our ecosystem different from a desert?  
  - How is it different from a tundra ecosystem?
- Ask students what animals they see in their ecosystem?  
  - How do these animals help their ecosystem? What is their role in helping biodiversity?

**Whole Group- Analyze an Ecosystem**

- Inform students you will be describing an ecosystem and their job is to decide what happens when you change it.
  - Begin by saying you are in a cow pasture.
    - What is in the pasture?  
      - We need grass, cows, a fence, bugs, dirt, etc.
    - What would happen if there were no cows?  
      - The grass would overgrow or the bugs would overpopulate.
    - What would happen if the grass were all gone?  
      - The cows would have to eat the bugs or die.
    - So is one species important in an ecosystem?

**Assessment**

- Class discussion
### Day 6: Biodiversity

<table>
<thead>
<tr>
<th><strong>Objective:</strong> Introduce biodiversity as a connection between ecosystems and the next lesson on food chains.</th>
<th><strong>Essential Questions:</strong> What is biodiversity? How is biodiversity connected to natural resources? How are humans connected to biodiversity?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Materials:</strong> Biodiversity Check for Understanding</td>
<td><strong>Time:</strong> 30-45 minutes</td>
</tr>
</tbody>
</table>

**Procedure:**

**Whole Group - Watch Bill Nye- Biodiversity**
- Show the video “Bill Nye the Science Guy- Biodiversity.”
- Give students the Check for Understanding to complete
- Ask a few questions to gauge if they can understand the connection between biodiversity and ecosystems.
  - How are humans connected to biodiversity?
  - How are natural resources and biodiversity connected?

**Whole Group - Go Outside to Explore (15 minutes)**
- Take the whole class outside to explore the environment in their schoolyard.
- Have the students make observations about what they see.
  - Inform students to focus on what parts of an ecosystem they see.
  - The intent is to just allow the students time to connect to the outside.

**Assessment**
- Biodiversity Check for Understanding
Biodiversity Check for Understanding

Name: _______________________________  Date: ______________

1. What is biodiversity?
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

2. Why do we want lots of different species in an ecosystem?
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

3. How did the video say you could help biodiversity in your own backyard?
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

4. What is the largest ecosystem in the world?
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
Key:
1. Biodiversity is an ecosystem having lots of different plants and animals.
2. Different species have different jobs that keep an ecosystem running.
3. Build a birdhouse.
4. The ocean
**Day 7: Terrestrial and Aquatic Ecosystems**

**Objective:** Introduce students to the different types of ecosystems and how life differs in each one.

**Essential Questions:** What is a terrestrial ecosystem? What is an aquatic ecosystem? How does the type of ecosystem dictate what organisms can live there?

**Materials:** NA  
**Time:** 30-45 minutes

**Procedure:**

**Whole Group- Define Terms**
- Begin by asking the class if they have ever heard the terms aquatic and terrestrial.
- Ask for definitions and/or examples
- Define terrestrial as an ecosystem found on land.
  - Examples include tundra, temperate forest, tropical rainforest, grassland, desert, and taiga.
  - We live in a terrestrial ecosystem.
- Define aquatic as a ecosystem in a body of water
  - Examples are freshwater and marine ecosystems
  - Marine ecosystems are those in the oceans and seas
  - Freshwater ecosystems are in rivers, streams, and lakes.
- End the discussion by asking students if they know why they are both important?
  - Biodiversity

**Assessment**
- Class discussion
### Day 8: Terrestrial Ecosystems

<table>
<thead>
<tr>
<th>Objective: Discuss terrestrial ecosystems in depth.</th>
<th>Essential Questions: What are the main characteristics of a terrestrial ecosystem?</th>
</tr>
</thead>
</table>
| Additional Sources:  
http://www.blueplanetbiomes.org/world_biomes.htm | Time: 30-45 minutes |

#### Procedure:

**Whole Group- Class Discussion**

- Ask students to review what the definition of a terrestrial ecosystem is.
  - An ecosystem on land.
- What are the main characteristics of a terrestrial ecosystem?
  - They are found on land.
  - Plants include trees, shrubs, vines, moss, etc.
  - Animals include all land mammals, insects, and reptiles
  - The different types of terrestrial ecosystems are also called biomes.
- The different types of terrestrial ecosystems and their characteristics:
  - Tundra- located in very cold conditions, treeless, harsh, low precipitation, and the ground is frozen almost year-round.
  - Taiga- located south of the tundra, mainly conifer (cone-bearing) trees, still very cold but does thaw to allow more plant growth than the tundra.
  - Temperate Deciduous Forest- has distinct seasons, moderate precipitation, and diverse plant life. Many types of trees grow in this ecosystem.
  - Tropical Rainforest- very warm year-round, located near the equator, high yearly rainfall totals, and plants grow very tall with the high humidity.
  - Desert- hot, dry, not many plants can grow, any that can grow have spiny leaves that hold moisture, and lots of nocturnal animals.
  - Grassland- lots of grass, very few trees, enough rain to keep the grass growing, found in the interior of continents, and can sustain many types of animals.

#### Assessment

- Class discussion and participation
<table>
<thead>
<tr>
<th>Day 9: Aquatic Ecosystems</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective:</strong> Discuss aquatic ecosystems in depth.</td>
<td><strong>Essential Questions:</strong> What are the main characteristics of an aquatic ecosystem?</td>
</tr>
<tr>
<td><strong>Additional Sources:</strong> <a href="http://www.ucmp.berkeley.edu/glossary/gloss5/biome/aquatic.html">http://www.ucmp.berkeley.edu/glossary/gloss5/biome/aquatic.html</a></td>
<td><strong>Time:</strong> 30-45 minutes</td>
</tr>
</tbody>
</table>

**Procedure:**

**Whole Group- Class Discussion**

- Ask students to review what the definition of an aquatic ecosystem is.
  - An ecosystem under a body of water.
- What are the main characteristics of an aquatic ecosystem?
  - They are found under water.
  - Plants include seaweed, lily pads, and algae.
  - Animals include fish, crustaceans, jellyfish, and marine mammals.
  - There is only one aquatic biome, but it is split into two types of habitats.
- The different types of aquatic ecosystems and their characteristics:
  - Marine- includes the oceans, involves salty water, and the organisms that live here are adapted to survive under the saltwater. There are three sub-categories of marine ecosystems.
    - Oceans- the largest ecosystem, which covers much of the earth. Involves salty water, and can be miles deep in places. This ecosystem is one that has yet to be completely discovered.
    - Estuaries- middle grounds between oceans and freshwater sources, so they aren’t quite as salty as oceans. Estuaries also are shallower than oceans, and can be used as breeding grounds and nurseries for baby fish and other animals to grow before heading to the ocean.
    - Coral reefs- very diverse habitats for many fish and other organisms to live. The corals create hiding places and homes for many of the fish to protect them from predators.
  - Freshwater- includes rivers, lakes, ponds, and wetlands. The water is not salty which allows for more types of plants to grow. Organisms adapted for the freshwater ecosystem would most likely not survive in the salty marine ecosystems.
    - Lakes and ponds- have isolated populations of organisms since they are usually not connected to one another. Lakes and ponds are home to many species of fish, insects, frogs, and freshwater plants. Lakes and ponds can be fairly deep depending on where they are located, which can allow for organisms to thrive that don’t like the surface of the water.
    - Rivers- flowing sources of fresh water. They are usually clearer and more diverse near the place where they begin, the source. As the river flows towards the ocean or other endpoint, the types of organisms will change, as will the clarity of the water. Fewer organisms can survive close to the mouth, or end, of the river.
    - Wetlands- very shallow pieces of standing water. Marshes and
swamps are considered wetlands. They can support many tall trees, such as cypress since they are so shallow. Wetlands are very moist and very humid, which allows for a diversity of organisms to survive.

<table>
<thead>
<tr>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Class discussion and participation</td>
</tr>
</tbody>
</table>
### Day 10: Food Web Introduction

<table>
<thead>
<tr>
<th>Objective:</th>
<th>Introduce food webs as a larger part of an ecosystem.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essential Questions:</td>
<td>What is a food web? How are species connected based on what they eat?</td>
</tr>
<tr>
<td>Materials:</td>
<td>Food Web Quiz, Bill Nye-Food Webs</td>
</tr>
<tr>
<td>Time:</td>
<td>30-45 minutes</td>
</tr>
</tbody>
</table>

#### Procedure:

**Whole Group- Bill Nye the Science Guy “Food Webs”**
- Show class the video “Bill Nye the Science Guy- Food Webs.”
- Give the students the Food Web Quiz to test how well they were paying attention.

**Whole Group- Food Chain Parts**
- Begin by asking students if they have heard the terms producer, consumer, and decomposer.
  - A producer is an organism that creates its own energy to survive, like plants.
  - A consumer is an organism that eats other organisms to get energy to survive, like animals.
  - A decomposer breaks down dead organisms to be used as energy and to incorporate them back into the ecosystem as nutrients. Examples are bacteria, fungi, and some crustaceans.
- Begin to call out, in any order, organisms and have students quickly decide if they are producers, consumers, or producers.
  - Producers: grass, wheat, corn, vegetables, trees
  - Consumers: humans, giraffes, angelfish, snakes, bald eagle
  - Decomposers: bacteria, cockroaches, shrimp, mushrooms, snails

#### Assessment
- Food Web Quiz
Bill Nye the Science Guy- Food Webs Quiz

Answer the questions using the word bank if needed.

1. All living things depend on _________________________________.
2. The connection between what we eat and where it comes from is called a _________________________________.
3. All _____________ is tied to plants.
4. ________________________________ is the process of growing plants without soil.
5. The food web is based on the _________________________________.
6. The process through which plants make food is called _________________________________.
7. All food webs get their energy from the _________________________________.

Word Bank:
Food
Food pyramid
Food web
Hydroponics
Photosynthesis
Plants
Sun
Day 11: Biotic and Abiotic Features

**Objective:** Introduce students to living (biotic) and non-living (abiotic) parts of an ecosystem. Have students understand the importance of each part of an ecosystem.

**Essential Questions:** What are abiotic factors in an ecosystem? What are biotic factors in an ecosystem? Why do we need both for ecosystems to survive?

**Materials:** List of living and non-living factors, dry-erase boards, dry-erase markers

**Time:** 30-45 minutes

**Procedure:**

**Whole Group** - Discuss Essential Questions

- Begin by defining biotic and abiotic factors in an ecosystem.
  - Biotic factors are living aspects of the ecosystem, like plants and animals.
  - Abiotic factors are those that are not living, like air and water.
  - Make sure to explain that living and biotic are synonyms and abiotic and non-living are also synonyms.
- Pass out or have students pull out their dry erase boards and markers.
  - Begin calling out features and have students write living or non-living on their whiteboards.
  - Abiotic: air, oxygen, temperature, humidity, water, and light.
  - Biotic: dolphin, oak tree, crab, beetle, shark, wolf, grass, roses, turtle, dandelion, bacteria, virus, mushroom, and owl.
  - If any students get the answer incorrect, stop and have them explain why they chose that answer to help clear up any misconceptions.

**Assessment**

- Biotic vs. abiotic whiteboard exercise
### Day 12: Ecosystem Stations

<table>
<thead>
<tr>
<th>Objective:</th>
<th>Allow students to practice identifying and organizing different aspects of ecosystems and food webs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essential Questions:</td>
<td>Can you identify a food web? Can you organize a food web? Can you identify a producer, consumer, and decomposer?</td>
</tr>
<tr>
<td>Materials:</td>
<td>Station materials, string, cards, labels</td>
</tr>
<tr>
<td>Time:</td>
<td>30-45 minutes</td>
</tr>
</tbody>
</table>

#### Procedure:

**Whole Group - Explain Ecosystem Stations**
- Inform students they will be doing ecosystem stations.
- Go over each station’s instructions and clear up any questions before they start.
- Split class into 4 even groups.
- Inform students that they will get 10 minutes at each station to complete the task and 1 minute to clean up and go to their next station.

**In Groups - Ecosystem Stations**
- Station 1: Review the food web that is given and have each student answer the questions. They can collaborate or work independently to determine the answers, as long as each student has their own paper to turn in.
- Station 2: Students will look at the ecosystem that is given and answer the questions that follow. Students should be analyzing what changes to an ecosystem mean for the health of the system.
- Station 3: Students will create a food web using the cards provided. Their web should have lines that cross, and they will show their web to the teacher when they are finished.
- Station 4: Students will label parts of an ecosystem as producers, consumers, and decomposers. The labels are provided and the students work as a team to put the labels in the correct place. The teacher will check their answers when they are finished.

#### Assessment
- Food web questions
- Ecosystem questions
After reviewing the food web above, answer the following questions.

1. List one food chain that is part of this food web.

________________________________________________________________________
________________________________________________________________________

2. List all of the producers in this food web.

________________________________________________________________________
________________________________________________________________________

3. List all the decomposers in this food web.

________________________________________________________________________
________________________________________________________________________
4. List all the consumers in this food web.

________________________________________________________________________
________________________________________________________________________

5. Explain what would happen if all the grass died in the area where this food web is located.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Station 2
Discuss as a group and come up with one-sentence answers to each of the questions. Each student needs his or her own copy of the answers.

1. What would happen to the ecosystem if half of the seaweed plants were removed?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

2. What would happen to the ecosystem if you added polar bears as predators for the seal?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

3. What would happen to the ecosystem if the dolphins were removed altogether?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Station 3 Instructions

Use all of the cards and the yarn to construct a food web.

Raise your hands when you are done to have your web checked.
Station 4: Label all of the producers, consumers, and decomposers with the provided labels.
### Station 4 Labels

<table>
<thead>
<tr>
<th>Producer</th>
<th>Consumer</th>
<th>Decomposer</th>
<th>Producer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer</td>
<td>Decomposer</td>
<td>Producer</td>
<td>Consumer</td>
</tr>
<tr>
<td>Decomposer</td>
<td>Producer</td>
<td>Consumer</td>
<td>Consumer</td>
</tr>
</tbody>
</table>
### Day 13: Design a Habitat Day 1

<table>
<thead>
<tr>
<th><strong>Objective:</strong> Give students practice in identifying habitat components by creating a habitat for an aquatic organism.</th>
<th><strong>Essential Questions:</strong> What are the main components of an ecosystem? How do all of these components work together?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Additional Sources:</strong> Activity adapted from Project WILD Aquatic pg. 19.</td>
<td><strong>Time:</strong> 45 minutes</td>
</tr>
</tbody>
</table>

#### Procedure:

**Whole Group - Class Discussion**

- Animals need food, water, and space, which all organisms need. In aquatic habitats, the water is an especially complicated piece of the puzzle. Organisms in aquatic habitats have specific tolerances for the specific gravity, pH, and even the types of nutrients in the water. The smallest amount of pollutants can mean the end of some organisms.
  - Organisms that reside in zoos and aquariums create a real challenge for the people that run them. They have to constantly monitor the conditions each species lives in.
    - Each species can have differing living conditions. For example, penguins like cold conditions, some fish need moving water, and some fish like completely still water to live. The coordination required to create suitable habitats for aquatic organisms is astounding.

**In Groups - Organisms Research**

- Split the class into groups of 2 or 4.
- Each group will get an index card with the name of an organism written on it.
  - The options are: trout, shark, goldfish, sturgeon, sea otter, large-mouth bass, water strider, beaver, diving beetle, killer whale, penguin, sea turtle, alligator, Siamese fighting fish, frog, and oyster. (Some options can be omitted if needed.)
- Explain to the students that they will be designing a habitat for their organism, and will need to build a model. They should be thinking as if they are creating an exhibit for a zoo or aquarium. Today, they will be conducting research to make a plan for how to create their habitat. They will need to know a few key facts to be able to create a successful habitat.
  - The students need to know if the organism lives in a marine or freshwater ecosystem, what kinds of food they eat, and any habitat requirements they may need to survive. These may be foliage for hiding or resting, or any outside features they will need to be comfortable.
- Allow the students to spend the rest of the time researching and creating a plan. Inform the students that the teacher will provide some materials for creating their model.
  - These materials are: art supplies (markers, paint, colored pencils, paper), modeling clay, jars, string, cardboard and boxes.
  - Any other materials they want to use they will need to bring from home.
- Inform students they do not need complicated models, as long as they can explain what the organisms need. They will have a limited time to work in class on the models.
<table>
<thead>
<tr>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Class discussion and participation in their groups</td>
</tr>
<tr>
<td><strong>Day 14: Design a Habitat Day 2</strong></td>
</tr>
<tr>
<td>-----------------------------------</td>
</tr>
<tr>
<td><strong>Objective:</strong> Give students practice in identifying habitat components by creating a habitat for an aquatic organism.</td>
</tr>
<tr>
<td><strong>Additional Sources:</strong> Activity adapted from Project WILD Aquatic pg. 19.</td>
</tr>
</tbody>
</table>

**Procedure:**

**Whole Group- Class Discussion**
- Remind students of what was discussed the previous day.
  - Organisms have specific needs to survive, and aquatic organisms are particularly complicated in their habitat requirements.
  - Today they get to build their habitat models. Make sure they remember that the habitats should be able to fit into a zoo or aquarium, and to keep proportion in mind.

**In Groups- Building their Model**
- Allow the students time to put their model together, ensuring that they have created a suitable habitat for their assigned animal.
- Walk around and monitor the students, ensuring they are staying on task.
- Each student should be able to explain the basic biological needs and habitat of their species.

**Whole Group- Reports**
- Each group should give the class a short report on their model, making sure to describe their organism’s basic needs and description of its natural habitat.
- After all groups report, ask the class a few questions about the general idea of habitat construction.
  - What are the components of a habitat that your organism needed to survive?
    - Food, water, air, shelter, and space.
  - Why is suitable habitat so important for the survival of a species?

**Assessment**
- Class discussion and participation in their groups
- Group Report
| Day 15: Introduce Interdependence |
|-----------------------------------|------------------|-------------------|
| **Objective:** Introduce students to the concept of interdependence. | **Essential Questions:** What is interdependence? How does interdependence help create habitats? |  |
| **Additional Sources:** NA | **Time:** 30-45 minutes |  |

**Procedure:**

**Whole Group- Class Discussion**

- Ask students if they know the word interdependence.
- Have them discuss with a neighbor as to what they think it means.
- Define it as “organisms working together for the mutual good.”
  - Have students think of some examples of interdependence in their lives
    - Any examples of working together positively are good.

**Whole Group- Pyramid Example**

- Ask for 3 volunteers to help with a demonstration.
  - Have two students get on their hands and knees, and help the third get on their backs. We’re making a pyramid.
  - Ask students what they think would happen if we took one of the bottom students away?
    - They should be able to visualize that the whole pyramid would fall down.
    - This is interdependence. The whole pyramid relies on each part. If either bottom person is gone, it topples. If the top person is gone, it is incomplete.

**Whole Group- Go Outside to Explore (15 minutes)**

- Take the whole class outside to explore the environment in their schoolyard.
- Have the students make observations about what they see.
  - Focus on food webs they can see.
- The intent is to just allow the students time to connect to the outside.

**Assessment**

- Class discussion and participation
## Day 16: Relationships between Organisms

**Objective:** To introduce students to the different types of relationships between organisms.

**Essential Questions:** What is commensalism? What is mutualism? What is parasitism? What is predation? How do these terms explain relationships between organisms?

**Additional Sources:**

**Time:** 45 minutes

### Procedure:

#### Whole Group - Class Discussion

- Begin by asking students how they think organisms interact.
  - Are all relationships beneficial for both sides?
  - Can you think of any relationships that hurt one or both sides?
  - Do you know of any relationships between species in the wild?
- Explain there are 4 main types of relationships between organisms: commensalism, mutualism, predation, and parasitism.
  - Commensalism is a relationship where one organism benefits while the other is not affected. An example is barnacles on whales. The barnacle can feed on plankton while the whale swims.
  - Mutualism is a relationship in which both parties benefit from the relationship. An example of mutualism is flowers and bees. The flowers are pollinated and able to reproduce while the bees use the pollen to make honey. Both are better off for the relationship.
  - Predation is a relationship where one party eats the other. Think of Zootopia (Lassiter 2016): Judy Hops is a rabbit, while Nick Wilde is a fox. In our world, foxes eat rabbits. So a fox is a predator and a rabbit is prey.
  - Parasitism is a relationship in which one side benefits while the other side suffers. An example of parasitism is ticks. Ticks feed on their host, and the host suffers by losing blood.
- Ask the students if they can think of any other examples of environmental relationships.
- How is understanding how organisms interact important?
- What do you think will happen if the relationships change, if one part disappears?
- Are these an example of interdependence?

### Assessment

- Class discussion and participation
<table>
<thead>
<tr>
<th>Day 17: Interdependence and Food Webs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective:</strong> Review food webs and how they contribute to interdependence.</td>
</tr>
<tr>
<td><strong>Additional Sources:</strong> Video “The Magic School Bus Hops Home”</td>
</tr>
<tr>
<td><strong>Procedure:</strong></td>
</tr>
<tr>
<td><strong>Whole Group- Class Discussion</strong></td>
</tr>
<tr>
<td>• Inform students that they will be watching a video and should be looking for a few key things that will be on a quiz after the video.</td>
</tr>
<tr>
<td>o Listen for habitat features, what an organism needs in their habitat, and the different parts of a food chain.</td>
</tr>
<tr>
<td>• Watch “The Magic School Bus Hops Home”.</td>
</tr>
<tr>
<td>• Give the students the quiz on the video.</td>
</tr>
<tr>
<td><strong>Assessment</strong></td>
</tr>
<tr>
<td>• Class discussion and quiz</td>
</tr>
</tbody>
</table>
Answer the questions based on the video.

1. What did Bella the bullfrog need more of when she was brought into the classroom?

2. What do the rabbits have in their habitat that makes it complete?

3. What do bullfrogs eat?

4. Why is a tree such a good place for birds to live?

5. What kind of habitat do the beavers live in?

6. Why is Bella in danger at the pond?
Magic School Bus Hops Home Key

1. Space
2. Water, food, and shelter
3. bugs
4. It gives them a safe place away from predators and cats
5. Freshwater/aquatic
6. She is in the middle of the food chain/ she will get eaten by a heron
<table>
<thead>
<tr>
<th><strong>Objective:</strong> Review food webs and their parts</th>
<th><strong>Essential Questions:</strong> What are the 3 parts of a food web? How can you draw a food web?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Materials:</strong> Paper and pencils</td>
<td><strong>Time:</strong> 30-45 minutes</td>
</tr>
</tbody>
</table>

**Procedure:**

**Whole Group - Class Discussion**
- Ask students to review the 3 components of a food web.
  - Producers, consumers, and decomposers
- Where does the energy for a food web come from?

**Independently - Make a Food web**
- Have students draw a food web using the components given. They only need to write the names, but drawing them is also acceptable.
  - Fox, owl, rabbit, grass, acorns, mouse, worm
  - Make sure to draw the lines/arrows between the components.
- In a different color, label each part as a producer, consumer, and decomposer.

**Assessment**
- Class discussion and food web
### Day 19: Go Outside

<table>
<thead>
<tr>
<th><strong>Objective:</strong> Allow students to observe relationships in nature and make connections to what they have previously studied.</th>
<th><strong>Essential Questions:</strong> What did you observe? What relationships did you find in nature? What food webs did you see?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Materials:</strong> Notebook, pencil</td>
<td><strong>Time:</strong> 30-45 minutes</td>
</tr>
</tbody>
</table>

#### Procedure:

**Whole Group- Instructions**
- Inform students that they will be going outside to observe nature. They should be looking for examples of relationships between organisms.
  - Look for parasitism, mutualism, commensalism, and predation.
- Look for food webs in nature.
- Look at and be able to describe the habitat.
- What are the resources you can identify within the habitat?
- Do you see a lot of biodiversity?
- Is this an aquatic or terrestrial ecosystem?
- Write everything down, any observations in a journal-type format.

**Independently- Observations**
- Allow the students 20 minutes outside in an area of the school with some biodiversity.
- Observe them to make sure they are making appropriate connections.

**Whole Group- Discussion**
- Have students share their observations and connections.
  - What food webs did you observe?
  - What resources could you find?
  - What organisms did you see?
  - Was there a lot of biodiversity?
- Collect the observation journals.

#### Assessment
- Class discussion, participation, and journals.
## Day 20: PowerPoint Tutorial

<table>
<thead>
<tr>
<th>Objective: Show students how to use Microsoft PowerPoint.</th>
<th>Essential Questions: How do you change slides? How do you add pictures?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials: Class Laptops or iPads</td>
<td>Time: 30-45 minutes</td>
</tr>
</tbody>
</table>

### Procedure:

**Whole Group- How to use PowerPoint**

- Show the students how to open the template for their presentation.
  - Show them how to add text, pictures, and change fonts if needed.
- Demonstrate how to create a presentation if they choose not to use the template.
  - Inform them if they don’t use the template, they are still responsible for including all the required information.
- Show the class the template, stopping to answer questions if needed.

### Assessment

- None
Animal Presentation Template
By: Mrs. Pierce

Description

- Include a description of the animal.
- Include any subspecies.
- Describe any special adaptations they have
Habitat

- Here is where you write about the habitat of your organism.
- Where does it live?
- Can you find a picture?
- To change the bullets, choose “Home” and look for the list icon.
  - Click the downward arrow, and choose a new bullet theme.

Predator/Prey

- Is it a predator?
- What does it eat?
- To change the theme of the presentation, click the “Themes” tab at the top, and scroll through to a new theme.

- Is it prey?
- What eats it?
- To add a picture, click “Insert” in the top menu, and go down to “photo”. Find the photo you want to use, and add it to the slide.
Food Web

What does the food web look like for this animal? Add a picture.

In this slide, you just click on the picture icon and find the file in the computer you want to use.
- You need to have the picture saved already.


Threats

- What are the biggest threats to their survival?

To change text, choose the “Home” tab and the text selections are under “Font.”
Life Cycle

- What does their life cycle look like?
  - Were they born or hatched?
  - How long do they live?
  - How many offspring do they have at a time?

Resources

- What resources do they use?
  - How do they use water?
  - Do they use any other resources?
Biotic and Abiotic Factors

- List all of the biotic factors in their ecosystem.
- List all of the abiotic factors in their ecosystem.
- What is the climate like in their ecosystem?
  - Hot, cold, rainy, dry, etc

Conclusion

- Wrap up and summarize what you’ve already said
- Hit the most important parts
- How can humans help?
Works Cited

- Cite any sources you used to create your presentation
- Include any pictures, or articles where you found information.
- Do not use Wikipedia as your source of information.

Questions?
<table>
<thead>
<tr>
<th>Day 21: Sea Turtles</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective:</strong> Show students the sea turtle power point.</td>
</tr>
<tr>
<td><strong>Materials:</strong> None</td>
</tr>
<tr>
<td><strong>Procedure:</strong></td>
</tr>
<tr>
<td><strong>Whole Group- Sea Turtle PowerPoint</strong></td>
</tr>
<tr>
<td>• Show the students the Sea Turtle PowerPoint.</td>
</tr>
<tr>
<td>o Stop at the end for questions.</td>
</tr>
<tr>
<td>o Ask if the students have any suggestions to improve the PowerPoint.</td>
</tr>
<tr>
<td><strong>Whole Group- Assign Animals</strong></td>
</tr>
<tr>
<td>• Assign groups of 2 or 3, so there are not more than 10 groups total.</td>
</tr>
<tr>
<td>• Animals can include: wolves, mustangs, bald eagle, polar bears, penguins, great apes, komodo dragons, alligator, toucans, honey badgers</td>
</tr>
<tr>
<td><strong>Assessment</strong></td>
</tr>
<tr>
<td>o None</td>
</tr>
</tbody>
</table>
Sea Turtles

By: Mrs. Pierce

Description

- Sea turtles are marine reptiles.
- There are seven main species of sea turtles: loggerhead, green, leatherback, hawksbill, Kemp’s Ridley, olive ridley, and flatbacks.
- Most species eat invertebrates and plants.
- As adults, leatherbacks can be the size of a small car, while Kemp’s Ridleys are much smaller.
- The shape of the turtle’s beak determines the kinds of food it eats.
Habitat

- Sea turtles live most of their lives in the ocean.
- They are hatched on beaches.
- They are found throughout the world's oceans.
- They stay near the surface to breathe, but can dive throughout the epipelagic zone.


What determines where they live?

- Any organism needs 3 things to survive: food, habitat, and a way to avoid predators.
- Finding these determines where the organism lives.
- A sea turtle needs water to live in and a place where they can find plenty of food to eat.
- They also need to be able to hide or avoid predators.
- Climate: The climate varies based on which ocean they live in and the latitude.
Food

- Loggerheads eat many different things.
  - Invertebrates, jellyfish, and plants
- Leatherbacks eat mainly jellyfish.
- Green sea turtles feed mostly on sea grass.
- Their main predators as adults are sharks.
- The eggs are a source of food for raccoons, crabs, and seabirds.
- Juveniles and hatchlings are preyed upon by larger fish.

Food Web

- As the web shows, loggerhead sea turtles have varied diets.
- The red line between the blue crab and eelgrass denotes that the crabs use the grass as habitat.
Threats

- Human influence is a large threat to sea turtles.
- Throughout the history of man, their eggs have been a commodity. Their shells have been used for jewelry and other items.
- Turtles can become entangled in fishing gear and drown.
- Artificial lighting on beaches can disorient hatchlings and discourage females from nesting.

Life Cycle

- After the female lays over 100 eggs during the summer months, the nest hatches and the hatchlings make their way to the ocean.
- The hatchlings go into the open ocean to feed for many years.
- As juveniles, they come back to the coastal foraging areas.
- As adults, they migrate to mate. The females then deposit the eggs on the beach.
- Some species tend to stay in one ocean basin and out into the ocean for the rest of their lives.
- It is difficult to determine exactly how long a sea turtle lives, though studies show they can live over 80 years.
Conclusion

- Sea turtles are complex species. They can eat many different varieties of organisms depending on their body design.

- By keeping the beaches clean and clear, and disposing of trash properly, you can help give them clean places to nest.

Works Cited

Works Cited (con’t)

- Raskoff, K. (2002). Chrysespler asthenes, one of the largest jellyfish commonly found in the Arctic, swims underneath the Arctic ice [Online image]. Retrieved from http://ocean.st.edu/jellyfish-and-coral-biologies
- WorldWildlifeWonders (n.d.). Green turtle swimming in the ocean, great barrier reef. [Image: green sea turtle swimming in the ocean] (Online) [Shutterstock]
### Days 22-26: PowerPoints

**Objective:** Allow students to work on and present their PowerPoints.

**Essential Questions:** How can we help the animals to survive? What can we do to better our world?

| **Materials:** Computers | **Time:** 30-45 minutes |

**Procedure:**

**Independently - Work on PowerPoint**
- In case students do not have access to computers, allow time during class to work on their presentation. By Day 26, all groups should be prepared to present.

**In Groups - Presentations**
- During presentations, all other students should be paying attention and preparing to ask any questions that may pop up.
- Presenters should get 5-10 minutes to present, and allow 5 minutes for questions.

**Rubric:**
- 20 points total.
  - 5 points for creativity
  - 5 points for filling all requirements
  - 5 points for all members participating
  - 5 points for knowledge on subject
- Full points only if all requirements are met
- 1 point will be taken for each missing slide.
- 3 creativity points will be given for leaving the same theme.

**Assessment**
- Presentations and Questions
<table>
<thead>
<tr>
<th>Day 27: Unit Wrap-Up</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective:</strong> Wrap up the unit and give the students the post-assessment.</td>
</tr>
<tr>
<td><strong>Essential Questions:</strong> What is an ecosystem? What is an environment? How do they relate to us?</td>
</tr>
<tr>
<td><strong>Materials:</strong> Unit Post-Assessment</td>
</tr>
<tr>
<td><strong>Time:</strong> 30-45 minutes</td>
</tr>
</tbody>
</table>

**Procedure:**

**Whole Group - Discuss Essential Questions**
- Inform students that we are done with this unit.
- Pass out the post-assessment. Do not mention that they already did this assessment at the beginning of the unit.
- Ask the same simple questions and ask for answers. Questions should include “What is an environment?” and “What is an ecosystem?” This is used as a basis to determine what they students already know and get them thinking before they take the pre-assessment. Ask questions for no more than 10 minutes, allowing all students to answer with appropriate responses.

**Assessment**
- Unit Post-Assessment
Appendix C: Pre and Post Assessment

Environment Assessment

Name ____________________________ Date _____________

Answer each question with complete sentences.

1. What is an ecosystem? ___________________________________________________
   ________________________________________________________________________
   ________________________________________________________________________
   ________________________________________________________________________
   ____________________________________________
   ____________________________________________

2. What is the environment? ________________________________________________
   ________________________________________________________________________
   ________________________________________________________________________
   ________________________________________________________________________
   ________________________________________________________________________
   ____________________________________________

3. How are humans connected to the Earth? ____________________________________
   ________________________________________________________________________
   ________________________________________________________________________
   ________________________________________________________________________
   ________________________________________________________________________
   ____________________________________________

4. What can you do to help the environment? _________________________________
   ________________________________________________________________________
   ________________________________________________________________________
   ________________________________________________________________________
   ________________________________________________________________________
   ____________________________________________

5. What do you use everyday that comes from the environment? ________________
Define the terms (complete sentences not required):

1. ecosystem-______________________________________________________________

2. environment-____________________________________________________________

3. conservation-____________________________________________________________

4. interdependence-__________________________________________________________

5. resource-______________________________________________________________
6. organism- ____________________________________________________________

______________________________________________________________

7. food chain- ________________________________________________________

______________________________________________________________
Appendix D: HSC Approval

HSC Approval

Speranza-Reeder, Mary <msperanza-reeder01@hamline.edu>

To: Barbara L. Pierce <bbody01@hamline.edu>, "Laura J. Heflin" <lheflin01@hamline.edu>

Thu, Jun 16, 2016 at 1:09 PM

To: Barbara Pierce
From: Vivian Johnson
Date: 6-16-16
Re: HSC Approval

On behalf of the Human Subjects Committee, we are pleased to inform you that your application has been fully approved and that you are now able to collect data related to your capstone. Please accept our best wishes for the successful completion of your project.

Vivian Johnson, PhD
Chair, HSC Committee
School of Education
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