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The Benefits Of Experiential Learning In An Outdoor Expedition Setting

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THE BENEFITS OF EXPERIENTIAL LEARNING IN A OUTDOOR EXPEDITION SETTING

by

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Abstract

Experiential learning has been around for hundreds of years. This is one of many pedological methods that teachers use today. Technological advancements in the classroom, and in modern day society, is creating withdraw from these experiential hands on learning tactics in an outdoor setting. To understand the extreme importance and benefits of college level students to have interest and incorporate an experiential learning experience in their lives, presented below in the literature review there is content backing this approach. Through the literature review findings, my personal experience on expeditions, and in the field teachings, the Rediscovering North America experiential learning curriculum has been created. The resulting curriculum consists of lessons for any college level student to pursue an expedition like the Rediscovering North America canoe trip. Experiential learning lessons pertaining to the structure and function of the brain, how students make decisions, interaction amongst each other through group dynamics and expedition behavior. Becoming stewards of the land through environmental topics like Leave No Trace, watershed, and human impact. Lastly, observing the natural world through the Phenology lense, understanding biomes, species development, and migration. All of which would be experienced during an expedition style trip. Together, the contents of my research and project included with my paper answer, *what are the benefits of college level students participating in an experiential learning expedition?*

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CHAPTER ONE

Introduction

"To give anything less than your best, is to sacrifice the gift" -Steve Prefontaine

Opening

Education is one of the cornerstones of the developments of all humans. For me, attaining new knowledge is addictive. In this world of ever-changing technology, there is no shortage of exciting developments. Being able to better myself through attaining more knowledge is what has motivated me to pursue my Masters. While the classroom has advantages in comprehending lessons and overall information, I have found that the best way to learn in my field is to live it. All you have to do is be willing to take the step outside the door, and open up to the world and be willing to challenge yourself through experience. This concept is foundation of my experiential education.

After the first semester of my Master of Arts: Natural Science and Environmental Education "MAED NSEE" in 2015, I decided to practice what I preach through an amazing 8 month, 5,300 mile journey through North America. This trip, aptly named Rediscovering North America, was life changing and challenged me in ways I had no idea were possible. After finishing the 5,300 mile canoe journey across the North American continent, I returned to the NSEE program at Hamline. While on the canoe expedition the six man crew documented as much as we possibly could of our adventure, through video and picture footage, journaling, and blog documentation.

Now two years after the completion of the expedition, I can see the finish line. Just like the expedition, the MAED NSEE program has been a long and winding river that I have tried to

navigate through to the best of my ability. This capstone project is the culmination of my experiences professionally and personally. The knowledge attained through these endeavors, I have focused on creating an experiential learning curriculum on the Rediscovering North America expedition. In addition to drawing knowledge attained in the field, I have concentrated my research on specific topics we encountered on the expedition. Designing an experiential curriculum for future students that could embark on such an expedition. The question I will focus on to help design such a curriculum is *what are the benefits of college level students participating in an experiential learning expedition?*

Chapter Overview

Chapter one of my capstone project is an introduction consisting of four different parts. First, I answer the question of who I am and what gives me the expertise to speak on this topic by providing information on my personal and professional background. The second portion of this chapter will include an in depth look at the expedition. The third portion is my motivations for this project. All sections will help the reader to understand the reasoning for my research. Lastly there is a summary of the chapter and a short introduction into Chapter Two.

Personal and Professional Background

Growing up

Looking back on my life it is easy to understand why it is that I am so passionate about the outdoors. Growing up as a toddler in the flatlands of Des Moines Iowa, I have fond memories of being a Boy Scout, learning “how to camp”. In addition to that formal education, I was also heavily influenced by my father, who instilled in my three brothers and I an affinity for all things pertaining to nature; hunting, camping, fishing, etc. Even if it was simply camping in our

backyard, my love for being outside was being inspired through this informal experiential learning, throughout my childhood.

As a child, I also had the benefit of having a friend who shared my affinity for the outdoors, Jarrad was Tom Sawyer to my Huckleberry Finn. When we were kids we spent most of our time in the woods building forts and fishing. Instead of spending our time in front of a TV screen, we read survival books like, *Hatchet* by Gary Paulsen, which sparked more advanced forms of outdoor activity. We read about these activities and then went out to experience them. Together we went on short camping trips, where we would set traps, build survival shelters, build fires, make tools, and pretended we were in survival situations. We challenged ourselves through these trips to one day go on a thirty day trip in the wilderness and survive solely off of our knowledge and experience.

The more time I spent outside the more passionate I became. By the time I graduated high school, I felt a yearning for a new adventure far away from the flat plains of Iowa. John Muir once said “The mountains are calling and I must go”. Learning through books and hands on experience. All of these childhood and teenage experiences influenced the decision behind me moving out to the Colorado Rockies to become a mountain guide, after a short stint in Wisconsin.

Education

My first year of college was spent in northern Wisconsin at the University of Wisconsin Barron County studying business management. After a year of this it was clear that I needed something more than just sitting at a desk in the future. Although I had no experience in the backcountry of the mountains, the only way for me to get that experience was by moving there.

In my second year of college I attended Colorado Mountain College (CMC) in Steamboat Springs Colorado. At the time it was a two-year community college, that offered an Associates of Arts in Outdoor Education (OE). Over the next two years I was immersed in backcountry experiences, learning about the geology, meteorology, geography, ecology, navigation, and hands on backpacking skills of mountain, desert, canyon, snow, and river environments.

Most students that attend the OE program are looking at becoming a guide in the outdoor environment, or using the education as a stepping stone to further education in the outdoor world. I was there to become a mountaineering guide. Little did I know that I was going to become a teacher instead of a guide.

After finishing my AA with an OE emphasis, I was fortunate to have an opportunity to help teach one of my favorite classes, Rock Climbing 1. Over the next few years I started to teach more and more classes every semester.

A few years after completing my AA, CMC expanded their curriculum to offer four-year degrees. Although I wanted to continue my education, I did not want to at the expense of my teaching job. CMC allowed me to do both, teaching eleven credits and taking sometimes eighteen credits as a student each semester. While completing my Bachelors in Sustainability Studies (BASS), I additionally completed certifications as a Wilderness First Responder and a certified American Mountain Guides Association Single Pitch Instructor.

After completing my BASS, I felt the yearn for more education. Again though I did not want to give up my profession as an OE instructor. Looking for graduate programs that would allow me to do both, led me to enroll at Hamline University in the MAED NSEE program.

Teaching

Since the fall of 2010 I have been teaching for the OE program at CMC. I teach a handful of different experiential learning based classes, Rock and Ice Climbing, Technical Canyoneering, Basic Mountaineering, and five day backpacking courses in the mountain, desert, winter, and canyon environments. My students vary in both age and experience. I have taught students who are as young as 17 to and as old as 60. The experience and knowledge that students have ranged greatly from being ex military to city folk who have never spent a night outside.

Most people first think that the OE program is just simply camping for college credit, it is much more than that. These students are immersed in whichever environment they are in, receiving the same experiential learning lessons and education I received. Also learning how to cope with interactions amongst each other, working together during hardships.

Achievements

Expeditions

Over the last decade I have spent a majority of my time in the field (outside), learning through experience. In 2015 I spent a total of 304 days outside in a sleeping bag. Also doing extensive research on particular topics of certain areas such as human history, flora and fauna, geology, and etc. Yes most of the time spent is for my job teaching, but also I have extended my wilderness experience personally through a handful of trips. These trips range from five day white water rafting trips, to long expeditions.

2012- When I was twenty-three years old, shortly after unexpectedly losing a lifelong friend, I headed once again for the mountains. I successfully backpacked from Denver CO to Durango CO on the Colorado trail. Hiking the 550 mile trail, solo, in roughly twenty-eight days.

At the time I only had week long backpacking trips on my resume. I battled through wildfires, countless lightning storms, navigational problems, hunger, blistered feet and hips, and psychological issues with tremendous fortitude.

2014- Once again I had a calling to go on another trip, this time I turned to a lifelong goal of mine, to bike across the country. At the age of 25, I attempted to bicycle across the country with my fifty five pound brittany spaniel, Buddy, in a trailer. We made it roughly 2,200 miles in just over a month. Buddy and I hitched a ride on a semi truck from Iowa for roughly three days. Starting just off the Atlantic Coast in New Hampshire, we biked through the Adirondack Park in New York, past Niagara Falls, along the shores of Lake Ontario and Lake Erie. We battled extraordinary headwinds, climbed over mountains at a snail's pace, endured thunderstorms, physical and mental fatigue. The people we met along the way was an extraordinary part of the trip. Right when I felt like quitting, call it fate, I met certain individuals that produced amazing effects on our journey; from playing yard games, to giving me an ice cream cone, a bed, a shower, or just a high five in passing, these interactions gave me the ability to keep going. Biking from campground to campground, public lands to public lands, I started to see that the midwest truly isn't just cornfields and hog farms. As much as we were enjoying our journey, once I found out about the Rediscovering North America expedition, I decided halfway through that I had to call the bike trip off.

2015- As I explained earlier, in May just before leaving on my bike trip, I was invited to be part of the Rediscovering North America canoe expedition. Six of us successfully paddled 5,300 miles over 245 days, from the Gulf of Mexico to the Arctic Ocean.

The Rediscovering North America Expedition

Below is a complete description that the six of us came up with to post on our website. On the Rediscovering North America website you can find all information pertaining to the trip.

> "The expedition began January 2nd 2015 in the Mississippi Delta near Buras, Louisiana. From there, it was a grueling 2,000 miles over eighty-five days paddling upriver, traveling north through Memphis, Tennessee and Saint Louis, Missouri (among many other US cities) before we reached the Minnesota River, which lies just south of Minneapolis/Saint Paul around the beginning of April. The Minnesota River flows southwest for 70 miles before altering its course back northwest. We followed the Little Minnesota River, one of the Minnesota's tributaries, and headed-up to Browns Valley, Minnesota. After a short portage, we arrived on Lake Traverse and followed the Bois des Sioux River to the Red River, which flows all the way to Lake Winnipeg across the border between the United States and Canada. By the time we were on the north end of Lake Winnipeg, we'd already traveled over 3,000 miles by the middle of May. The Saskatchewan River flows into the northwest end of Lake Winnipeg. We traveled upriver on the Saskatchewan and followed one of its tributaries, the Sturgeon-Weir River, until we reached Frog Portage by late June. From there, we paddled the classic Churchill River until it was time to put the boats on our backs again for the infamous Methye Portage, a fifteen-mile trail that connected us with the water system feeding Lake Athabasca and Great Slave Lake. With the Clearwater River and Fort McMurray in the rear-view mirror days later, we traveled the Slave River, which flows out the west end of Lake Athabasca 200 miles before reaching Great Slave Lake. It's a lot of shoreline along the northeast arm

of Great Slave Lake and back west through Yellowknife before we paddled upstream on the Marian River. We continued upstream on the Emile River, a tributary of the Marian before heading downstream on the Parent River. The Parent River joins the Coppermine River at Red Rock Lake, and then the final descent into the Hamlet of Kugluktuk" (Delano, 2016, Rediscoverna.com).

Expedition of the Year Award

After the conclusion of our expedition the six of us went our separate ways and back to the regular grind of reality. Eight days after the completion of the expedition I was back in Steamboat Springs, Colorado teaching OE classes for CMC. In the following summer of 2016, almost a year after our trip, we were reunited, being nominated and winning the Expedition of the Year award from Canoe and Kayak Magazine at the Outdoor Retailer Show in Salt Lake City. To even be nominated for this award was an honor, but to have won was extraordinary. The recognition, of the feat that we completed, brings great joy. Every year one expedition receives the Expedition of the Year award, in 2015 what the six of us endured, was acknowledged as the most committing, toughest, and historically significant expedition completed in the world.

Motivation

Why?

Now that we have covered my history in experiential learning, teaching, and love for the outdoors, you hopefully understand why it is that I enjoy teaching in the experiential education field. The capstone project will be an experiential learning curriculum, designed from the experiences and lessons had on the 2015 Rediscovering North America expedition. Looking at specific topics like, the brain function and the impact of the group dynamics and expedition behavior of each crew member, digging into sustainability aspects such as pollution, preservation, and conservation, writing lessons on phenology through species migration, seasonal changes, and species development, as well as understanding the watershed and geology of the Rediscover North America route. Each lesson of the experiential learning curriculum will ultimately help answer the following question: *what are the benefits of college level students participating in an experiential learning expedition?*

For Who?

The capstone project will be an informative piece for future college level students that are interested in experiential education and expedition style trips. The project will give examples of each class that could be taken throughout the NSEE program. Ultimately the project will give information and research about what we encountered on the Rediscovering North America trip.

Summary

In conclusion because of my life experiences, I have been able to better my educational processes. By constantly combining the knowledge gained either through education or field experiences, I have been able to sharpen my teaching skills and I have become a more effective

teacher by using my own experiences as teaching tools. After completing the 245 day, 5,300 mile canoe expedition I decided to create an experiential learning curriculum focused on the Rediscovering North America trip to help answer the question, *what are the benefits of college level students participating in an experiential learning expedition?*

Once returning to the MAED NSEE program, I found many similarities of topics in each class that we encountered while on our expedition. For my capstone project I will be breaking down my experiences on the Rediscovering North America expedition into specific topics and create an experiential learning curriculum for future students. Many of the topic lessons in the curriculum are similar to classes I have taken for the completion of the MAED NSEE program. Each class offered a plethora of topics that related directly to our trip. In researching specific issues that were discussed in each class and directing it towards experiences on the trip, I will be able to incorporate an abundance of educational information into real life experiences. The research conducted for this project will be beneficial for those who are interested in experiential learning, as well as provide a wealth of knowledge about the North American continent.

A Look at Chapter Two

Before diving into Chapter two, let's first look at it from a bird's eye view. Chapter two is a literature review. For this I will begin to look at what other scholars have written about specific topics within the overarching theme of *what are the benefits of college level students participating in an experiential learning expedition?* I will accomplish this by breaking down the idea of experiential learning, examining specific examples of experiential learning education, and then looking at each lesson topic of the experiential learning curriculum. The literature that I

will bring forward will provide a brief insight of what is to come for the remainder of my capstone project research.

CHAPTER TWO

Literature Review

Introduction

When in a wilderness, backcountry environment, every action you make has the potential to be a learning experience with the discipline of self-reflection. Experiential learning is defined as learning through experience, and or more specifically learning through reflection on doing. For instance setting up a shelter before a storm comes, only to find out once inside that the fly of the tent was not connected correctly. During the storm, the fly is torn away and you are left sitting in your tent with the elements soaking everything inside. Reflecting back on this experience, the next time you are faced with a storm in the backcountry you will be sure that your shelter is setup properly. Or in a more lesson based experiential learning experience, you are given facts to asses the differences between two species of trees, the Spruce which is has shaggy bark and sharp needles, compared to the Douglas Fir which has flat lines on its bark and soft friendly needles. Walking around the forest you are able to identify these trees by these characteristics versus just looking at them in a book in a classroom. By having hands on experience with the tree rather than sitting in a classroom most students will remember such identification principles. The benefits of experiential learning are vast and have been studied throughout human history.

Chapter Outline

Throughout Chapter Two we will be looking at what others have said about the main question, looking at the basis of what experiential education is, the history of experiential education, different models of experiential learning, and what are the benefits of students

participating in an experiential learning. By examining current literature about experiential learning, we will identify the different benefits of experiential education for college level Students which include senses, critical thinking/decision making skills, physicality, social interaction, sense of self, and sense of place/stewardship.

Once we have a clear understanding of the benefits of experiential learning, thru the lense of academia, we will take a look at the specific topics of the experiential learning curriculum, and how it is beneficial to the students while on an expedition style trip like the Rediscovering North America trip. This includes topics such as how our brain functions and reacts under certain circumstances, specifically looking at group dynamics and expedition behavior, decision making, and risk. Environmental topics like watershed, Leave No Trace, pollution and geology. Lastly diving into the idea of phenology specific topics like migration patterns, species development, and plant growth through seasonal changes.

What is Experiential Learning?

There are many different pedagogical approaches when examining education. The main focus for this project is the pedagogical practice of experiential learning. Quoting the philosopher Confucius “I hear, I know. I see, I remember, I do, I understand” (UC Davis). Experiential learning in the most clear sense is education and learning through hands on interaction and experience with the world that surrounds us; learning by doing (Kolb, 2015). Throughout history experiential learning has been at the forefront of the human advancements. Whether it was Columbus sailing the ocean blue in 1492 or Louis and Clark traversing North America for the first time, humans have learned much by the act of doing. Aristotle believed that without action

to apply knowledge there is not comprehension of knowledge gained. In other words without any experience to applicate knowledge, the knowledge will not be gained.

Experiential learning is engaging students with direct contact in the field of study to better understand its meaning. Once the student has engaged in this learning experience they will then reflect on the experience. Students gain the knowledge and then understand the knowledge gained.

History of Experiential Learning

Although the idea of experiential learning has been around since the time of Aristotle, 322 BC, there wasn't any greater understanding of the theory. The theory of experiential learning was brought to light from the great John Dewey in the early 1900's (Sternberg, 2014). Education through the act of experience is much greater than that of concrete education, such as lecture learning. The efforts of John Dewey's theory of experiential learning in education through experience and reflection is still used today in all manners of education. He emphasized especially that hands on learning in an active in context experience was an essential piece to comprehend the knowledge gained (James, 2017).

Since the inception of this theory, schools have been created to put into curriculum some of the concepts Dewey identified in the outdoor arena. Two of the most well-known are Outward Bound and then later, the National Outdoor Leadership School, or more commonly known as "NOLS". These two companies are the leading schools of outdoor education and main focus is experiential education. Although, Paul Petzoldt founder of NOLS, never stated directly towards the experiential learning cycle, his research was that of experiential learning believing students learn best by doing and reflecting (Wagstaff, 2002). One of my idols, Paul Petzoldt, studied

students in the field for many years through many different expeditions. He is most well-known for his studies of experiential learning through the expedition behavior and group dynamic lense. Watching students and or clients work together, or not work together, to accomplish a goal, like summiting K2 was the heart of his research, we will dive deeper into expedition behavior and group dynamics later in this chapter.

And finally, we will look at the grandfather of this topic and some of his works. When identifying influential people in the experiential learning realm we need look no further than David Kolb. Kolb who is founder of Experienced Based Learning Systems, INC. He has studied and written many publications about experiential learning. As well as developed many different models for teaching experiential learning (Kolb, 2017).

Experiential Learning Methods and Models

As mentioned earlier, experiential learning has been around for many years and has been studied extensively in certain areas. There are many different models and methods in which instructors use to discuss this topic. To be honest there are hundreds of different practices one can use, as an instructor, when educating students. That being said there are a few different models and methods that I found to be most instructive in the experiential learning outdoor field scope and I use in my own teaching methods.

First, let’s start with John Dewey's model which the essential tenet is that for learning to happen, the experience must exhibit: continuity and interaction. Dewey believed that “It is the failure and uncertainty of the primary experience that gives rise to reflective thought and learning” (Reijo Miettinen, 2000, 54-72). This idea can be further broken down by going out in any environment, having an initial experience, reflecting on this experience and learning what

may have worked or what did not. Then, students should return and having a secondary experience with the knowledge attained through the initial experience.

On the other side of things, we will examine Kolb's model for experiential learning. Kolb breaks down his model in four different steps. Kolb's theory, designed in 1976, is called the Lewinian Experiential Learning Model or mainly known as Kolb's Model (Reijo Miettinen, 2000, 54-72). Kolb's Model is a continuous cycle of four different pieces:

1. First students must have a *concrete experience.*
2. Following the concrete experience students then *Observe and Reflec*t on the experience had.
3. Once students have reflected on the initial experience and reflected upon it they *form abstract concepts and generalizations* of the experience.
4. Lastly the students then return to test implications of concepts in new situations.

(Kolb, 2015)

Most models of experiential learning are aimed towards having an initial experience and reflecting upon that experience. For instance, let's use Kolb's Model in the scope of an outdoor field class I teach for CMC, Technical Canyoneering. For this class we spend five days in Zion National Park. When teaching students about the geology of the course, the concept and scope is extremely hard to grasp for the time frame is so large. However, once students are walking on the 200 million year old solidified sand dunes they see first hand, the cross bedding of layers over millions of years (Eardley, 1971).

Breaking this down under Kolb's Model

1. Concrete Experience- lecture style lesson explaining the geological creation of Zion National park. Explaining that water has sculpted the park through erosion.
2. Observe and Reflect- while walking around the park, exploring deep slot canyons, students see how water has sculpted the park.
3. Form Abstract Concepts and Generalizations- touch and see each layer of sand that was laid down, which is now solidified.
4. Test Implications of Concepts- explore different areas of the park.

Another example of this model in my field of work in a more hands on experience rather than lecture style. In the same course as mentioned above, Technical Canyoneering, we teach students how to safely rappel, using a harness, rope, and other proper technical gear.

1. Concrete Experience- we show how to properly rappel down a rope on a flat, safe surface. Each student watches and listens carefully to each step to safely rappel. After they watch then each hooks up on the line and goes through the same motion that was shown.
2. Observe and Reflect- we then hike to the entrance of the slot canyon and approach the first rappel. Students are then informed once again how to properly and safely rappel.
3. Form Abstract Concepts and Generalizations- students have a rough idea what to expect for the first real rappel down in the canyon. This concept or generalization might be correct or may not be.
4. Test Implications of Concepts- now students hook up on rappel and go down the line, using the knowledge gained in the ground school.

After looking at a few examples using Kolb's Model, and having a better understanding of what experiential learning is, let us move forward and look at the benefits of experiential learning.

Benefits of Experiential Learning

The benefits of experiential learning are vast. Although other pedagogical methods have beneficial qualities, experiential learning is in its own realm, because of the hands on experience it employs. Most importantly, experiential learning is extremely important today because of technological advancements. Most students are being taught and learning on computers and other technology. This extreme reliance on technology has limited the interactive nature of learning, which I believe makes the preservation and study of experiential learning in an outdoor setting is

more important. The most beneficial qualities of experiential learning are the use of all five sense, critical thinking skills, physical exercise, social interaction, sense of self, sense of place, and building ethics to become good stewards of the land.

Senses

By using the different models of experiential learning, students will benefit tremendously. First looking at the effect it can have on the use of all sense. Students that engage in outdoor experiential learning will soon find that all sense are essential in whatever environment they are in; desert, mountain, canyon, and water. By exposing oneself to outdoor elements and nature, students will have a more meaningful connection and attachment. Being able to touch, see, smell, hear, and even taste the surrounding environment will cause students to connect more with nature, rather than just reading about the subject topic. This will not only bring connection but also help with brain function (Ronglien, 2016).

Examining this idea, let's take a look at a lesson on a five day backpacking course. After hiking a total of eleven miles over two days in the mountain wilderness, you stumble across a raspberry bush. The students understanding of a raspberry is more often than not that they are sold at the store in a plastic container. Sitting in front of the bush we give a lesson on the perennial plant and its adaptations. Afterwards, students are able to feel the thorns on its stock for protection, taste the fruit that it produces, see and be able to properly identify the plant after examining it fully. In contrast to sitting in a classroom where you are limited to just reading about the plant in a book or online. Environmental educator Louis Agassiz encouraged the thought to study nature, not books (McCrea, 2006, p. 1).

Critical Thinking/Decision Making Skills

The second benefit to experiential learning is the process of critical thinking and decision making skills. When in the field it is absolutely crucial that each individual is making proper decisions, thinking critically in certain situations. I find that Paul Petzoldt explains this idea best, "Judgment is the result of experiences that are the result of poor judgment" (Petzoldt, 1974). Paul explains that through critical thinking and decision making or judgment we learn best. Judgment is to relate one thing to all things you know. Judgment is being able to change plans when needed. While in the field students are faced with many different challenges, navigating or simply surviving. For instance, if a student makes proper judgment from past experience this was good judgment, whereas if the student fails to execute a purpose it is bad judgment (Wagstaff, 2002).

In these hands on experiences, students must be able to act in the moment while thinking critically to make the best decision. In the field this is extremely important. Sometimes storms come unexpectedly and the tent needs to be set up in a hurry. If the student fails to properly set up the tent in this stressful situation the storm may rip the fly off, ending with the student being wet. Or in a more serious case, the decision was made to go into the slot canyon when flash flood danger was high, and would likely end in death.

For example two weeks before heading to Zion National Park in fall 2015, there was the worst human disaster in almost one hundred years. Due to a flash flood, seven people with very little experience of canyoneering were caught in the smallest of technical slot canyons. All seven perished in the accident. In an Outside Magazine article by Grayson Schaffer he states

" At Zion, there are very few places where rangers will tell you not to do something for your own safety. If you want to climb the giant sandstone walls or descend the steep canyons, it's up to you to learn the skills and look out for yourself. People make their own decisions about risk and accept the consequences, which can be swift and severe" (Schaffer, 2016).

Physicality

The third benefit of experiential learning in the outdoor field, is that more often than not you are doing something physical. Exposing oneself to active physical experiences is beneficial in that you are helping your body and brain function. Whatever the activity may be canoeing, hiking, biking, skiing, etc there is physical action.

The first benefit of exercise in the outdoor field is the benefit of overall positive well-being. Physically fit people show fewer symptoms of depression, anger and stress.The second benefit is that through exercise research shows better cognition and human brain function. Those that exercise regularly show better execution of tasks involving attention, memory and learning. By exercising one will increase blood flow, which has direct connection with metabolism which is important to help neurotransmitters like serotonin and dopamine (Stroth, 2009).

Social Interaction

The fourth and one of the biggest benefits, I believe, is social interaction. Social interaction in the experiential learning outdoor field can come in a number of different ways. First students will interact with other students that are part of the group, or they may interact with external groups. As well as there are groups within groups, like tent mates or cook groups. Together students are working to achieve the same goal. For instance looking at the

Rediscovering North America trip, there were six members that worked together for 245 days straight to successfully paddle from the Gulf of Mexico to the Arctic Ocean.

To understand the social interactions we must look once again at the grandfather of group dynamics and expedition behavior, Paul Petzoldt.

> "An awareness of the relationship of individual to individual, individual to group, group to individual, group to other groups, group to administrative agencies and individual and group to the local populace. Good expedition behavior is the awareness, plus the motivatior and character to be as concerned for others in every respect as one is for oneself. Poor expedition behavior Is a breakdown in human relations caused by selfishness, rationalization, ignorance of personal faults, dodging blame or responsibility, physical weakness and in extreme cases, not being able to risk one's own survival to insure that of a companion" (Petzoldt, 1974, p.165-185).

Being able to communicate clearly and positively to one another is one of the most important aspects while on an outdoor field trip. As well as being able to agree even if you disagree (Phipps, 1985). John Maxwell put it very appropriately in the title of his book *Teamwork Makes the Dream Work*.

Sense of Self

The fifth benefit of experiential learning in an outdoor education context is how students build sense of oneself. On the opposite of interaction amongst the group, sense of self is the reflective piece to oneself. The exploration of how one fits, discovery of abilities and or limitations (Priest, 1986).

Through experiential learning in the outdoor field students individually, in an unfamiliar place will foster sense of self through new perspectives, spiritual growth, sense of mastery in particular instances. Through positive and negative experiences students will reflect upon one's decision, or interaction with the environment that surrounds them (Passarelli, 2010).

For instance while on a five day backpacking trip students have a tremendous amount of time to explore one's thoughts, rather than living through other people's lives on the internet. As well as there is no one else to blame if something is wrong, most of the time. Through experience of different topics, and reflection the student will have time to figure out their own perspective and beliefs.

Sense of Place/Stewardship

Lastly, experiential learning helps create a sense of place and the internal want to preserve the land through being a proper steward and advocating such a position to others. Having direct hands on contact with the surrounding environment students will feel more connection to the ecological world that surrounds them. Creating an ethic through experiential learning is extremely important, especially in the world we live in now. Climate change, pollution, water rights, land rights, are just a few issues facing the preservation of the land for future generations. The more direct contact people have to these places, the probability of them being advocates for the land grows exponentially. By creating ethics based values of the environment students will become stewards of the land. Developing awareness and ecological knowledge, ownership or personal connection, will help build a sense of place and ethic (Siemer, 2001). In the article *Redefining Outdoor Education*, the author Priest explains, “Through exposure to the outdoor setting or environment, individuals learn about their relationships with

the natural environment, relationships between various concepts of the natural ecosystems"(Priest, 1986, p. 13-15). Through these experiences students will develop personal responsibility to the land and ecological systems that surround them.

To illustrate this connection, I again turn to my experiences on the Mississippi River. While paddling along the shores of the Mississippi for roughly eighty-five days, it was a triumph to finish and continue on to a different river. However, the connection I now have with that river will last a lifetime. I experienced first hand the third largest watershed and the fifteenth largest river in the world. The power it has is tremendous. Depressingly though, as we continued north slowly approaching larger cities like Memphis or St. Louis, the amount of trash is astonishing, one could spend a lifetime picking up trash in just a small portion of land.

In another context I teach a course which takes place in Utah. Named, Canyon Orientation, the hot topic of this course is water. After many days talking about the water of the west, and the damming of the waterways, we go visit Lake Powell. Students get to see first hand the impacts of dams, they see that the water is evaporating at an incredible rate by visiting Lake Powell. The canyon walls express this evaporation rate with a visible "bathtub" line, where the water was once and where it is now..

Experiential Learning Curriculum Topics

Now that there is a greater understanding of what experiential learning is, its history, and all of the benefits, we will now look at specific topics of my capstone project. These include Brain Functions, Group Dynamics and Expedition Behavior, Environmental topics such as Leave No Trace, Watershed, Damming of our Waterways and Human Impact. Lastly diving into the

idea of Phenology specific topics like Species Migration, Species Development, and the different Biomes.

Experiential Learning Conclusion

Experiential learning has been around for a long time and has been used in many different contexts. Throughout history the main players of experiential learning, John Dewey and David Kolb, have had a great impact on such models and teaching theory. Experiential learning in an outdoor setting is extremely beneficial for students. Giving students a concrete experience, observing and reflecting, forming abstract concepts, and using these concepts, they will benefit in a number of different ways. First, students will use all human senses to better understand their environment. Second, they will benefit in critical thinking and decision making skills. Third, by participating in an experiential learning outdoor setting students will stay active promoting good health and increase brain function. Fourth interacting in a group setting students will have an increased social interaction, benefiting in proper communication and leadership skills. The fifth benefit of experiential learning in and outdoor setting is students will grow creating and exploring individuality. Lastly, students will form a sense of place creating an ethic to become stewards of the particular environment through hands on experience and connection.

Next, in Chapter 3, I will explain the students and or beneficiaries of the experiential learning curriculum. Diving deep into the reasoning of my research of experiential learning in an outdoor setting. As well as present the layout and methods behind the main question, *what are the benefits of college level students participating in an experiential learning expedition?* Lastly explain the rationale of my research of experiential learning for students.

Chapter Three

Project Description

Overview

Now that we have a greater understanding of my background and the main benefits of experiential learning, we will explore the Rediscovering North America curriculum I have designed for this project. First, I will navigate us through what I deem a curriculum of experiential learning, this will focus on where the curriculum would take place, who the curriculum will be for, and my reasoning for this type of project. Following these topics, I will then explain which method or curriculum style I will use, and give an outline of format and content. Each lesson provided will help answer the question of, *what are the benefits of college level students participating in an experiential learning expedition?*

Project Description

After spending the last decade exploring (consciously or subconsciously), many different aspects of experiential learning in an outdoor setting, I have decided for my Hamline University capstone project to create an experiential learning curriculum based off my Rediscovering North America expedition. The curriculum encompasses major topics including, Brain Function specifically looking at Group Dynamics and Expedition Behavior, Environmental topics like watershed, pollution and geology. Lastly, I will delve into the area of Phenology, covering specific topics like migration patterns, species development, and the biomes we will be traveling through.

The Rediscovering North America expedition was extremely influential in my life and will be for any student brave enough to embark on such an endeavor. Just as a refresher of what

the trip entailed. The expedition was roughly 5,300 miles, paddling in a canoe from the Gulf of Mexico to the Arctic Ocean. The trip took a total of 245 days to complete. Starting January 2nd 2015, myself and five others left the Gulf of Mexico. Paddling against the current up the Atchafalaya River in Louisiana for roughly nine days, then continuing up the Mississippi River for the next 85 days, reaching the Twin Cities on April 4. Leaving the Twin Cities we continued upstream on the Minnesota and Little Minnesota Rivers until we made it to the divide. After almost 2,200 miles we made it to downstream paddling. Passing over the border into Canada we followed the Red River north to Lake Winnipeg. Paddling roughly 250 miles in 17 days we finished the massive lake, following smaller streams and lakes we paddled another few thousand miles reaching the town of Yellowknife in the Northwest Territories. After leaving Yellowknife we finished paddling Great Slave Lake, the 10th largest lake in the world. Connecting smaller streams and lakes over the next month we made it to our destination, the Arctic Ocean, and the small town of Kugluktuk in the Nunavut Territory.

Future students that are interested in such an expedition will have countless experiential learning moments. For this curriculum project I will write up specific lessons involving the topics stated above; Brain Structure, Environmental Topics, and Phenology. The curriculum project will help students understand the benefits of experiential learning in an outdoor expedition setting helping answer the question *what are the benefits of College Level Students participating in an Experiential Learning Expedition?*

Setting and Participants

The main participants of this project are any future college level students that has interest in an expedition style trip. Students that enjoy experiential learning in an outdoor setting will

benefit from this curriculum design. Even if the students were not to participate in such an expedition of this scale, they will be able to have a greater understanding of certain things they would experience through my design..

The setting of the experiential learning curriculum will encompass parts of the Rediscovering North America expedition. Any future student that has decided to embark on this journey would receive these lessons of the curriculum as the expedition continued. Particularly, most lessons are focused on the Mississippi River, looking at species migration and their patterns, the different biomes of North America, the history of the geological processes in the US, Mississippi River watershed, etc. Participants of the trip would receive the lessons when either the time presents itself, or as we continue along the river. For example, presenting the Leave No Trace, (see Appendix B), lesson early on in the expedition, would be beneficial for then students would have a greater knowledge of human and personal impact. Or presenting the Group Dynamic and Expedition Behavior lesson, (see Appendix A.3), early on in the trip so that participants attain the knowledge needed, to understand their own or others actions to each other and how it could impact the expedition. Whereas it would be more beneficial to present the Damming Our Waterways and Human Impact, (see Appendix B.2), once we have made it further along in the expedition.

Rationale

As I have always enjoyed learning through hands on experience type of education, I find it extremely important for future generations and students to have similar experiences. The benefits stated in Chapter Two: using your senses, staying physically active, interacting socially, creating and exploring sense of self, and lastly creating an ethic through sense of place and

becoming a proper steward of the land is not only extremely important for students in today's age, but the entire human population if future generations want to see this land as beautiful as it is today. With all technological advancements our generation is experiencing, it is easy to become lazy, staying inside, eyes glued to a television or computer. It is so obvious to me that getting students outside and involved in nature will not only greatly benefit them individually, but will create more stewards of the environment. Through experiential learning students will hopefully build proper ethics and positive outlook on the many environmental issues we face today. It is not only environmental issues that worry me, but the future of human mental condition. Early environmental enthusiast like Aldo Leopold, John Muir, Henry David Thoreau, Walt Emerson, Teddy Roosevelt, and John Wesley Powell, fought hard to protect our lands. Also they educated and brought awareness of the need for return to wilderness for the better of our health (Nash, 2001).

"Man Always Kills the thing he loves, and so we the pioneers have killed our wilderness. Some say we had to. Be that as it may, I am glad I shall never be young without wild country to be young in. Of what avail are forty freedoms without a blank spot on the map?" -Aldo Leopold

(Brame, 1992, p 17)

Methods

For the Rediscovering North America experiential learning curriculum, I have a distinct advantage over regular classroom professors because I have lived what I am teaching. I don't just show slides of google images, I show the pictures of where I have been, and where students can go! The curriculum research and design will come from personal experiences that I had while out

on the 2015 expedition. Looking back at my personal journal, our video and written blogs on Rediscoverna.com, as well as specific research that others have conducted about certain topics. I have created and designed an experiential learning curriculum for college level students, that would go on an eight month canoe trip across the North American continent.

Outline of Format and Content of Curriculum

When designing lessons or curriculum there are many different ways to approach it, instructors over many years will find a process and design that works best for them. For the Rediscovering North America experiential learning curriculum project, (see Appendix A-C), I feel that I have effectively created and designed lessons beneficial for college level students that would embark on such a journey. Using the literature and methods presented in Chapter Two, I have selected and researched specific topics that would be experienced first hand on the expedition. These lessons will coincide with the geographic area or feature and seasonal changes, while on the trip.

Format

Below is the format in which I will use to create lessons while on the trip that students will experience hands on which include; Brain function specifically looking at group dynamics and expedition behavior, risk and decision making skills. Environmental topics like watershed, Leave No Trace, damming our waterways and human impact. Lastly delving into the idea of Phenology specific topics like migration patterns, species development, and biomes.

Rediscovering North America Curriculum

Topic Title

INTRODUCTION AND CENTRAL FOCUS

The Introduction will establish the main topic lesson, where it will be experienced or held on the expedition. The introduction will also promote the main focus of my lesson by introducing the essential concepts and questions.

NATIONAL SCIENCE EDUCATION STANDARDS

The lessons produced follow National Science Education Standards (N, 1996).

- Standards for science teaching
- Standards for assessment in science education
- Standards for science content
- Standards for science education programs
- Standards for science education systems

CURRICULAR FIT

The lessons produced for the experiential learning curriculum follow the Chapter Two stated benefits.

- Critical thinking/Decision making skills
- Physicality
- Social Interaction
- Sense of Self
- Sense of place/stewardship

CURRICULAR FIT

Will explain how and why this lesson fits in the Experiential Learning Curriculum, and describe how this lesson sequence will fit into the rest of the curriculum. Include topics that will

be taught before and after, and describe knowledge and skills that you expect your students to have acquired prior to these lessons.

LEARNING OBJECTIVES

This will explain what the students will receive from this lesson. What kind of skills, ethics, values, questions, etc the students will gain. The learning objectives will be goals that students will learn or be able to explain after the completion of the lesson. Looking at all of the different benefits listed for experiential learning.

LESSON SCOPE AND SEQUENCE

The Scope and Sequence portion will be the nuts and bolts, and meat of the lesson. Here I will layout an outline of the lesson, listing all lesson components in the order in which they will be discussed. This will be all content that I have researched and put together. All information gained will reflect back to the objectives portion.

CITE REFERENCES

All references I used to help create and write each lesson.

Content of Curriculum SEE APPENDIX A-C

Using the above format I have effectively created lesson plans for each topic for the experiential Learning curriculum. Over the last two years I have experienced first hand lessons created below, I have researched specific topics relating to certain areas of the expedition. For example the Mississippi River watershed.

Brain Function Topics Lesson Content (SEE APPENDIX A-A.3)

The brain function lessons consist first of introductory explanation systems thinking, what systems are and how systems function (Appendix A). Following systems thinking with an intro to neuroscience and how the brain has developed, is structured, and functions (Appendix A.1). Once students understand how the brain functions we will be able to dive into other lessons like exploring the group dynamic, and proper expedition behavior on an expedition (Appendix A.3). While on the trip students will be using the above content throughout. Also within the brain function topic I would like to look at such experiential learning encounters like perceived risk vs actual risk, and proper decision making skills through proper communication (Appendix A.2).

Environmental Topics Lesson Content (SEE APPENDIX B-B.2)

The environmental Topics lessons provide in depth perspectives of individual impact through Leave No Trace ethics and principles (Appendix B). Hands on experience on waterways like the Mississippi and learning about its watershed and overall impact connected with pollution and erosion (Appendix B.1). Lastly, exploring the history of the Mississippi river waterways, and the human impact, through dams and other controlling factors (Appendix B.2).

Phenology Topics Lesson Content (SEE APPENDIX C-C.3)

Lastly the Phenology part of the experiential learning curriculum, begins with the introduction of what phenology is, why it is important, and how we will document our findings (Appendix C). Once students have an understanding of experiential learning through observation we will explore lessons on such topics as to what biomes are, and which biomes we would be traveling through, what types of species exist in these areas and their adaptations (Appendix C.1). While on the expedition students may experience first hand, witnessing, species development; watching dragonflies life cycle over a month long span (Appendix C.2). Lastly from when we start at the Gulf of Mexico to the Arctic Ocean, we will experience daily seasonal changes, witnessing these effects and what impact they have on the environment that surrounds us, particularly species migration (Appendix C.3).

Conclusion

I believe students will benefit tremendously from such an experiential learning curriculum. Using the research conducted and the creation of each lesson of the curriculum, students will be educated on such topics like brain function, environmental topics, and phenology. Through these lessons and first hand experience I hope that students will see advancements in, using their senses, staying physically active, interacting socially, creating and exploring sense of oneself, and lastly creating an ethic through sense of place and becoming a proper steward of the land. Providing an overall positive experiential learning experience.

CHAPTER FOUR

Reflection

Chapter Overview

I have researched and provided examinations of the benefits of experiential learning. From these benefits, my personal ethic, experiences, and research, I have created an experiential learning curriculum. This process and creation of the project have been conducted for the last three years, through my personal teaching and experience, through all of the knowledge gained from classes throughout the MAED NSEE program at Hamline University, and research building the curriculum for the last eight months. Much like the Rediscovering North America canoe expedition, which was eight months, there have been amazing experiences, as well as a tremendous amount of obstacles and roadblocks that needed to be overcome. Through great perseverance and mental fortitude, I have developed and created a project that helps answer the main question: *what are the benefits of college level students participating in an experiential learning expedition?*

Beneficial Literature

Let us first examine and look back on the beneficial literature that helped my progress through this project. I found it inspiring once reading about the history of experiential learning and its impact on the human race. Of all the influential peoples, I found John Dewey, David Kolb, and Paul Petzoldt perspectives and studies to be most beneficial for my research, the development and completion of my capstone project. John Dewey's approach that, education through the act of experience is much greater than that of concrete education such as lecture learning, brings a smile to my face (Sternber, 2014). Throughout all of my experiential learnings,

I remember most that were experienced in the field rather than in a classroom. Hands on learning in an active context is essential for students, getting outside and being active creates happiness (James, 2017).

Most importantly though, looking at my literature review, I found that David Kolb's Lewinian Experiential Learning Model was of the utmost benefit in the creation of my curriculum. The Lewinian Experiential Learning Model or Kolb's Model is a continuous cycle of four parts; Concrete Experience, Observe and Reflect, Form Abstract Concepts and Generalizations, Test Implications (Kolb, 2015). I found this model to be most beneficial in that it grasps the entirety of what experiential learning is, each lesson that I produced for the curriculum can be used in the Kolb's Model perspective. For instance, after discussing the Leave No Trace (Appendix C.1) lesson, students will be able to use all four parts of Kolb's Model. Understanding their present personal ethic and impact, then every day observing and reflecting on their actions, comprehend certain things they can change, and then better themselves every day beyond that; for example, after days of not burying poo and not packing out poo paper, students, may stumble upon someone else droppings. Observing and reflection on the horrible situation, the student will form abstract concepts that it is best to bury poo and pack out their paper.

Lastly, one of my idols Paul Petzoldt perspectives on group dynamics, expedition behavior, and decision making, has had a tremendous impact on my teachings and development of my lessons. Over the last ten years of my life, the time I have spent in the field, I have had to work with countless individuals, including myself, some as hard headed and stubborn as myself.

However through these experiences with other individuals, I have learned great interpersonal skills, and also understanding the system as whole that each individual is part of the system.

"To train people to make good decisions in the outdoors, you've got to take them into the outdoors, into real situations,and let them face challenges by themselves. They learn soon enough that if they make a foolish decisions, or if they base their decisions on "hope or "faith" that things will work out--they fail. And if they make decisions based on reality, they succeed" (Graham, 1997, p 55).

Curriculum Development

Overall developing the experiential learning curriculum content was a phenomenal experience. Looking back and reflecting on the Rediscovering North America expedition and all of the experiences we endured was quite incredible. Being able to create a future curriculum encompassing these experiences was extraordinary. While researching and creating each lesson, I vividly remember the day to day experiences of each particular topic in which I was writing about.

I did find difficulty in the order in which the lessons should be presented. However, I feel that the final product I have created flows through the progression of the expedition. The primary difficulty I had in producing the curriculum was keeping the focus small. The trip was so vast and covered so many different geographical areas, there is an exponential amount of different topics and ideas that I could have integrated. That being said, the topics I chose and produced, were what had the most influence on me during the expedition. At this time I could write a book specifically on the group dynamic of our team throughout the expedition, how we

made decisions, how some of us didn't get along for months, as well as how in the end, we worked together and completed an expedition worthy to be awarded the Expedition of the Year.

Researching each topic was exciting, for I was able to go back and revisit these places that I experience first hand. I remember watching thousands upon thousands of birds migrating north as we paddled north on the Mississippi. One hundred strong, flocks of Trumpeter Swans, thousands of Canadian Geese and Mallard ducks, following the Mississippi Flyway migration route north for the summer months. Or writing the lesson on the Mississippi Watershed, the longest crossing of the Mississippi River we attained, which took forty-five minutes battling the upstream, was at the confluence of the Ohio River at Cairo IL. I will forever remember the fierceness of the water where these two rivers met.

In the end, it was an incredible experience being able to research these areas and create such a curriculum to be passed on. Not only will these lessons be of great value in the future for myself, but for those interested in such an expedition, as well as many outdoor educators.

Roadblocks

Reflecting back on the entire project and the development of the curriculum there were a number of different obstacles. First, I would say that the idea of the project in my head at first was clear as a mountain stream, however as the project proceeded the water become dirty as the Mississippi River. My original idea was to finish and write my capstone on a manuscript I am currently working on about the Rediscovering North America expedition, although I did not use this model, the research I found will also be implemented in the book. Once I realized that this was too large of an idea and the time frame in which I had to complete the project, it was out of my control. Shifting gears, I decided to instead use my teachings and personal experience to

create the curriculum. At first this was difficult because I was so focused on the project just being about the expedition. However, once I started my literature review, the water slowly became more clear.

Although my experience in the field is extremely beneficial to this project, I found that finding the time to balance the two was extremely difficult. My professional job, teaching at CMC, had me in the field the last two months of this program. Again yes these experiences influence my project, however I was limited on time to research, as well as balance other things in life.

Also, I found that as much as I tried to keep all of my research organized, it seemed as though coming to the finish, that there was a tremendous amount of organization that needed to be done that could have been mitigated earlier.

Future Research

In the coming spring of 2018, I will be part of yet another extended canoe expedition. In April 2018, myself and four other teammates, are attempting to paddle from the Pacific Ocean, just outside of Astoria OR, up the Columbia and Snake River of the Northwest. Portaging via bikes roughly three hundred miles over the Continental Divide to the Missouri River, downstream to the Gulf of Mexico, following the Gulf shores to the Florida Keys. We aim to complete this 4,700 mile expedition in roughly eight months. Calling the expedition Coursing Through America, we just recently won the Dream Adventure contest through Canoe and Kayak Magazine. This sponsorship and many others are going to ultimately make this trip a reality. Although my curriculum was designed for the Rediscovering North America expedition, all of

the research that I conducted will and can be used and seen as I paddled across the United States of America.

While on the Coursing Through America Expedition, I plan on making daily observations, including water quality testing of all waterways used through our journey. To follow our written and video blog of the expedition as we continue. Visit, www.coursingthroughamerica.com for more information

Conclusion

In conclusion, after years of personal experiential learning, teaching outdoor education, researching a plethora of ideas, and different ideals I have produced what I feel answers the main question: *what are the benefits of college level students participating in an experiential learning expedition?* Through research of my literature review in Chapter Two, each viewpoint from such perspectives as, David Kolb, Paul Petzoldt, and John Dewey, reinforce the benefits of experiential learning through; using your senses, staying physically active, interacting socially, creating and exploring sense of self, and lastly creating an ethic through sense of place and becoming a proper steward of the land. As well as the creation of the Rediscovering North America experiential learning curriculum, I feel that each lesson (see Appendix A-C) will help not only my future instructing, but also any other outdoor educators in the experiential field, and students interested in an experiential learning class.

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APPENDIX A

Brain Function

Systems Thinking

INTRODUCTION AND CENTRAL FOCUS: As the expedition continues, our daily lives will be lived through systems. I feel that having a lesson specifically focused on systems thinking is extremely beneficial for students as we make our way up the North American continent. Everyday, everything we do is part of a system, by incorporating this lesson students will be able to understand the nonlinear world through a systems thinking lense. Looking at our personal systems like thinking system, food system, canoe system, sleep system, and also bringing the topic of systems thinking into the ecological realm.

LEARNING OBJECTIVES

When looking at the learning objectives of the systems thinking lesson there is an abundance of outcomes the students will receive.

- What is systems thinking?
- How do we think in systems?
- What are positive and negative feedback loops?
- What are system traps?
- Importance of open mindedness
- Adaptations and Resilience

LESSON SCOPE AND SEQUENCE

- **Systems Thinking-** To understand systems thinking and how we think in systems we must first understand what a system is. The Rediscovering North America

expedition is a system, its parts consist of each individual, our food, and gear. These parts are crucial in the achievement of the overarching system goal of paddling from the Gulf to the Arctic. For the expedition to be successful the system has to function correctly, each part has to be functional, adaptive, dynamic, and resilient.

- Also, students must be able to identify that there are systems within systems. On a macro scale, we look at the Rediscovering North America expedition system, on a micro scale we look at the system within that system, such as our cooking system.
    - Cooking system: humans need calories to function properly, we consume food to function and to perform properly. Everyday we will need to eat a breakfast, lunch, and dinner. It is only fair to distribute tasks to make the cook system work, for instance, if there was only one cook for the entire trip, this individual may not function as highly for they are exhausted from cooking. By designating each individual with certain tasks on a day to day basis this will spread out the workload of the cook system. One individual will be the “Head Chef” for one day, and another will be the “Assistant Chef”. The Head Chef’s tasks are to set up the kitchen, cook, and clean, make breakfast, lunch, and dinner. The Assistant chef will help with these tasks. The following day the

Assistant chef will be the Head Chef and a new student will be the Assistant Chef. This will be the system process of cooking.

- Understanding the interconnectedness of systems is important for students, for if systems are failing or not functioning at a reasonable rate, we need to be able to determine and find what part of the systems isn't functioning properly. Each part of a system is full of information, or feedback loops, this information helps us comprehend how the system is functioning or not. Through positive and negative feedback loops we understand the information of the system. For instance, let us breakdown our sleep system
  - Our sleeping system consists of many different parts; tent, sleeping bag, sleeping pad, and who we sleep with. Sleep or rest is crucial for the brain to properly function. To mitigate any issues among students we will continually switch who sleeps together, this will help for a number of reasons. Let us look at a negative feedback loop in our sleep system. If you have a hard time sleeping with someone that snores you will not sleep well, which will impact your participation because you are tired from lack of sleep. The negative feedback loop is that the person you are sleeping with is causing you to have decent rest. You must adapt, although you still have to sleep with this person, you could use earplugs to help drown out the sound. Or say the sleeping pad that you have been sleeping on slowly deflates throughout the night, because of this

you need to fix the leak of the sleeping pad to get decent sleep. In the end, if one individual is not getting enough rest their production to the larger system is going to be lower thus impacting the entire expedition system (Meadows, 2015).

- **Feedback Loops**: Now conversely let us look at positive feedback loops, which give us information on how this is helping the system as a whole. For this, we shall dive into the daily routine of the paddling schedule. As I stated before how important rest and sleep is for us, we will always give ourselves eight hours of time to sleep or rest. As for paddling, we will find a rhythm that works for everyone, for us on our last expedition we found that breaks were necessary. Here is how we broke our paddling system schedule up. First "push" was for two hours of paddling, break for thirty minutes, second push was for two hours, Lunch was forty five minutes, third push was two hours, third brake was thirty minutes, and last push was for two hours. This paddling system lasted and worked for the entire trip, this would be an example of a positive feedback loop. While finding our rhythm we saw that paddling for two hours was just the right amount of time and that thirty minute break was the perfect amount of time. Day in and day out, this feedback loop of taking breaks and paddling for this amount of time was proven to work. We continued this schedule from the second week of the expedition until the end. However, as we learned earlier systems macro and micro are not static, they are dynamic, as well

as we live in a nonlinear environment. Meaning that change is always happening, change is constant, which brings us to our next topic of the resiliency of systems (Meadows, 2015).

- **Resiliency**: For systems to keep functioning, they must be able to adapt to change, through the negative and positive feedback loops information is received, this information is used and helps mold the system's functionality. Any system is subject to change for as I said before systems are not static, and to cope with change, systems must be resilient. Resilience is the system's ability to bounce back into functioning shape, after being pressed or stretched in negative or positive ways. By having an open mind and willingness for change, a system will be resilient. For example, we will examine the paddling system schedule again. Although this set time frame system works, there are oscillations, each canoe has two members of the expedition, each canoe will move only as fast as the individuals paddling (Meadows, 2015). So if there is a combination of paddlers that are partnered together that are slower, they will arrive minutes later to the break, thus having to paddle longer than the two hour window, as well as they will have a shorter break because the first boat stopped at an earlier time. Instead of keeping a stringent schedule you must adapt, in this case, to create a resilient system that will survive and persist within this variable environment we must be open to change. The break time will not start until the middle boat gets to the break, or if this is

still too much of a time range, then the break will not start until the last boat reaches the breakpoint. The expedition behavior saying for this would be “you are only as fast as your slowest person”, in this case, canoe.

- **Traps**: We have an understanding of what systems are, how they work, who they adapt, but there is yet another part of understanding systems, traps. System traps are intervention to the working system, these traps are called archetypes. This trap will influence different parts of the system and will create a feedback loop that may be positive or negative, more often than not traps will have an immediate influence on the overall system. For instance we look the daily routine of of the expedition. We paddle roughly eight hours every day, and break for roughly two hours. This paddling system has worked day in and day out, however, we meet a day where the weather is hindering us from paddling; it's cold, snowing or raining, there is a massive head wind. We continue our system that works day in and day out, however in the end of the day we end up completely wet, cold, one of the boats flipped due to a large wave from the wind. This trap would be a seeking the wrong goal. In all reality we should have known better and just sat the day out, instead we suffer the consequences of our choices. Because we fell into the trap that we would continue what works day in and day out. Again, we revert to being able to adapt to changing environments, seeking resiliency through open mindedness in sitting out a day rather than suffering the elements which we cannot control. We will

dive into more system traps when looking at group dynamics and expedition behavior (Gonzales, 2004).

- **Ecological Systems**: As we continue our journey north, students will be journaling and documenting about the natural world that surrounds us, as well as learning about different ecological systems. We will look at water quality of a stream. Students will use systems thinking when looking at the stream, its watershed, and how pollution has an impact on species habitat and survivability.

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APPENDIX A.1

Brain Development, Structure, Function, and Response

INTRODUCTION AND CENTRAL FOCUS

An introduction to understanding how the brain functions is key for anyone spending time in wilderness settings, as well as in the front country. To start this lesson, we will first go over how our brain has developed, then understand how our brain functions through our five senses that help us to understand the world that surrounds us. Then followed by how this all impacts our decision making processes.

LEARNING OBJECTIVES

Senses- what are they, how they work, and how they impact our brain?

Brain Structure- different parts of the brain and its processes

Development- how your brain has developed

Emotion- how and why the brain reacts in certain situation

Memory- how and why the brain reacts

Decision Making- how and why the brain functions

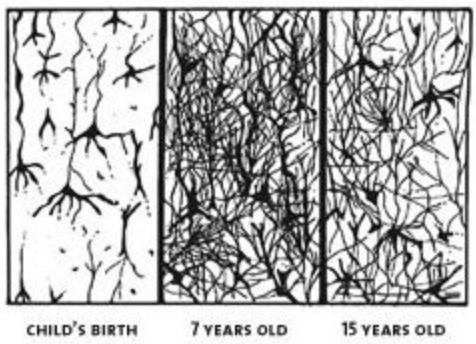
MATERIALS/RESOURCES

Everyday Survival Laurence Gonzales “The Untied Knot” (20-32)-Lynn Hill Mental Models/Behavioral Scripts

LESSON SCOPE AND SEQUENCE

- **Development**- Everything in the brain is growing as one grows from childhood to their teens. During the years 2-10, neural cells are rapidly being created, growing dendrites, or messenger cells, which make connections all over different parts of

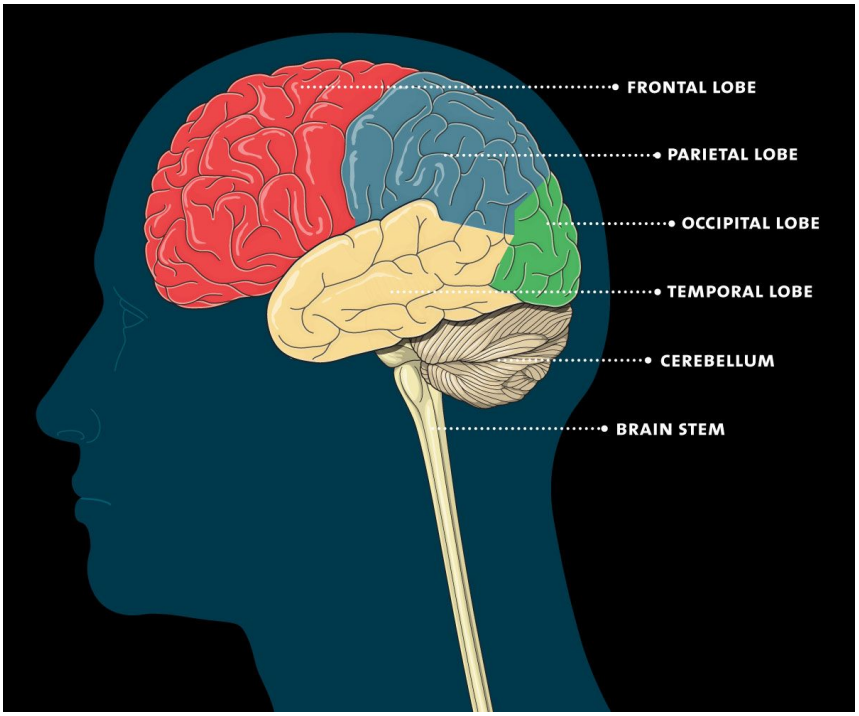
the brain. While the person uses these different connections they are reinforced and maintained. As well as if the person is not using different areas, they are slowly losing connections elsewhere. Most connections during this stage of life are those in motor skills, abstract thinking, and language. As you grow older from 10 until your current age at 20+ years old, even more connections are being created rapidly in the cortex. Even further, the pruning process starts doing away with neural connections that are less active (DeSalle, 2016). What you have done throughout your life up to this point, has created how your brain functions. If you have been involved in athletics most of your life, your brain has built itself for you to be strong in the area dealing with motor skills or reaction time. If you have been a bookworm, reading a lot, your brain has developed stronger connections in the language networks rather than motor skills.

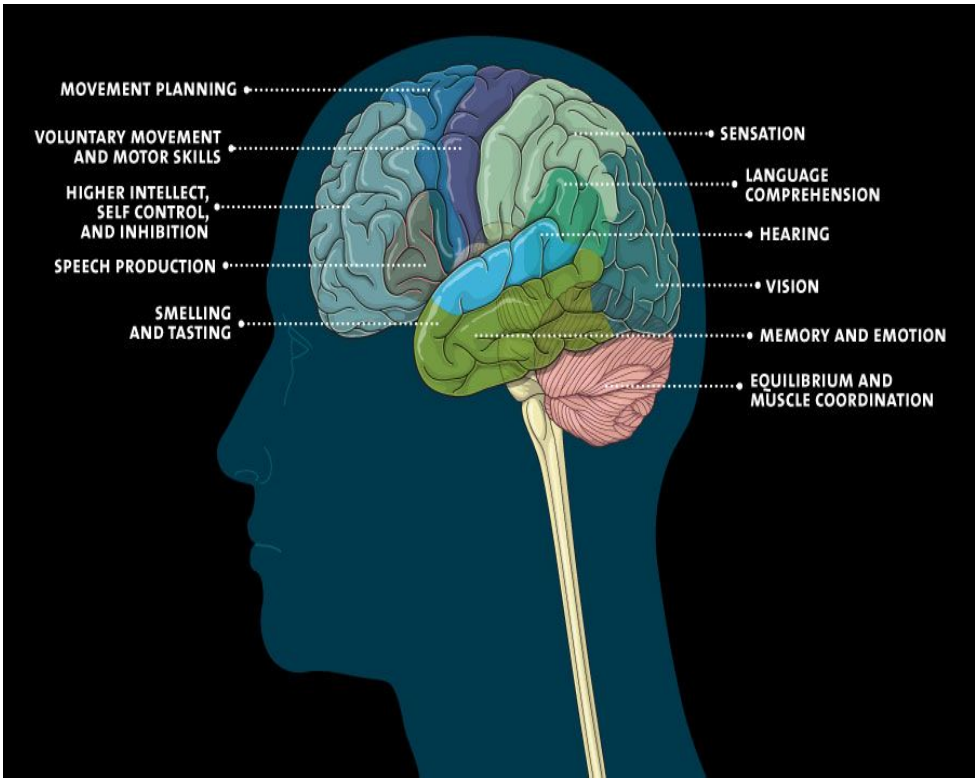


(DeSalle, 2016)

- **Structure**- The brain is structured into two different hemispheres the right and the left. When looking at an image (seen below) what we mainly see is what is called the cortex and the cerebral cortex. Inside the cortex though there are different lobes which help us function and perform different tasks. All of which have specially designed functions. Each lobe or area receives neurotransmitters or

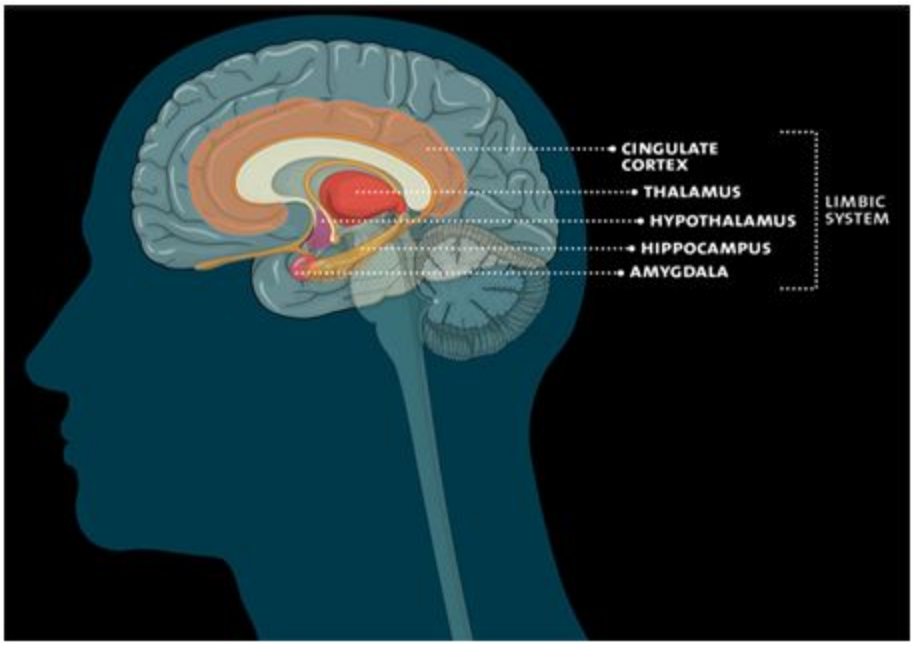
"action potentials", which triggers the brain to do certain things (K, 2017). The different lobes consist of the cerebral cortex (seen below) involves four regions, frontal, parietal, occipital, and temporal lobes. Each lobe helps us in decision making, planning, speaking, navigating, recognizing, hearing, developing memories, and creating an emotional response (DeSalle, 2016).





(Hrisch, 2016)

- **Emotions and Memory-**



(DeSalle, 2016)

Inside our brains we have what is called the Limbic System (see image above). This has the important areas such as the Hippocampus and Amygdala. The Hippocampus is where short-term, long-term, and spatial memory is stored. The Amygdala is where emotional information is stored. Information is sent through your five senses and transmitted via neurotransmitters or, action potentials, to the Amygdala and Hippocampus. Looking at the development of these areas through chemical processes such as dopamine and serotonin we can have a better understanding how we perceive certain situations. When an individual experiences a situation different chemicals, neurotransmitter or action potentials, (dopamine, serotonin, and cortisol), are sent to the limbic system creating a response such as feeling stressed, anxious or on the opposite pleasure. Throughout these experiences the brain has been trained to recognize different situations and remembers through memory storage in the hippocampus. As stated earlier our amygdala is our emotional response, involving all facial communication, the amygdala is also where our "fight or flight" response is located.

- **Senses**- Delving into how it is the brain receives information, through our five senses we start with smell.
    - Smell- Our sense of smell helps us understand what may be close to us in our environment. Our bodies have evolved over time to use our nose as our main source to understanding the smells of molecules that are floating

around. By taking air in through our nasal passages and into our olfactory nerve. Pretty simple one might say, not necessarily, each nasal passage has over fifty million sensory receptor cells that help send information to our brain. Using our olfactory receptors and mucus, as we breathe in air molecules from the environment around us, our brain sends information of each molecule that has entered. Each air molecule comes into the nasal cavity and is captured by tiny hairs or nerve fibers. Let us look first and the smell of a delicious food, the action potentials that is transmitting to the brain will bring feedback. That air molecule smell is sent to the limbic system where our emotion and memories are stored, we remember that specific smell as being delicious. Whereas if we were paddling by a decaying deer carcass, the powerful stench might send the opposite action potentials informing that something is rotting (DeSalle, 2012).

- Taste- Inside our mouths we have one of the strongest muscles of our body, the tongue. The human tongue has tiny bumps called, fungiform papillae getting its name because they are shaped much like a mushroom. Of the roughly ten thousand bumps each have fifty to a hundred receptor cells. Each taste bud and cell help us know what is being put in our mouth. Different taste buds also help the brain understand whether something is salty, sweet, sour, or bitter. These tastes help us crave certain nutrients needed for the body. Once a certain receptor is triggered, transmitters are sent to the olfactory region, same as where our sense of smell is translated.

- Sight- Our vision is arguably one of the most prized senses. Sight is directly dictated by light. To see we use eyeballs, inside the eyeball the retina is what receives the light. Inside the retina there are photoreceptors called rods and cones, of the over seventeen million different photoreceptors, they receive light waves. Once different colors of light waves are received they are then sent inwards as action potentials to the optic nerve. The optic nerve then sends these waves further to the thalamus which is part of the limbic system. Once in the limbic system our brains are told how to react to what we see (Boynton, 2017).
- Hearing- Hearing is also one of the most important and prized sense. Our brains process sound waves through our ears. Being able to hear allows us to properly communicate through sound waves which are interpreted. The ear and how we hear is extremely complex. Let us get a better understanding how it is that we can properly interpret sound.The human ear is made up of three parts, the outer, middle, and inner. Sound waves first enter the outer ear leading to the eardrum. Once they reach the eardrum it will vibrate which helps the hammer continue to push the waves through the air filled middle ear. Once the waves reach the inner ear where liquid is present the waves are pressured inside the cochlea. Alright now if I haven't lost you stay with me. To better understand how we process different frequencies we are going to enter the cochlea, which is located in the inner ear. Once the pressure waves go inside the cochlea

there is a basilar membrane that vibrates depending on sound wave frequencies. High pitches, small, loud, and soft pitches are all processed and sent to a different part of the basilar membrane. When the certain frequencies vibrate the basilar membrane inside to cochlea, the fifteen thousand hair cells receive them and send action potentials, to the auditory region of the brain located in the thalamus inside the limbic system.

    - Touch- The largest organ of the human body is our skin. Our skin has three different layers, the Epidermis, Dermis, and Hypodermis (DeSalle, 2012). In these layers there are many different types of receptors that send information to the brain to help us understand certain sensations like, pressure, vibration, temperature, pain, and smoothness or roughness. Whatever receptor is triggered it is then connected to an action potential in the brain helping us understand what it is that we have encountered (Boynton, 2017).

- **Decision Making**- Once students have an understanding of how it is that their brain has developed in different areas, and how their experiences in life have shaped their emotional response and memory, we can move forward to how the decision making process works. When making a decision your brain is firing neurotransmitters in all different directions to different areas of the brain. Decision making is extremely complex. Three main things are going on in the brain, you are thinking spatially, logically, and controlling your movement. Once the brain has received the information of the situation via your senses, you start

decompressing and comprehending it. Tracking your thoughts, and memories, your brain is trying to come up with the best solution to your specific situation. In the end then you will act moving your body to make a decision. Pretty simple right? Well any normal human being today would tell you that making the "right" decision can be hardest of all, especially in sticky situations. Making the decision to eat a cookie is much easier than making a decision to ski on a slope that has high potential for avalanches. Paul Petzoldt said

> "To train people to make good decisions in the outdoors, you've got to take them into the outdoors, into real situations,and let them face challenges by themselves. They learn soon enough that if they make a foolish decisions, or if they base their decisions on "hope or "faith" that things will work out--they fail. And if they make decisions based on reality, they succeed" (Graham, 1997, p 55).

All of the decisions made by each individual and as a team on this expedition will have effects on the outcome of the overall expedition. Looking further into this topic we will dive into expedition behavior, group dynamics, and perceived risk vs actual risk, and our decision making ultimately producing the outcome of our success.

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APPENDIX A.2

Perceived Risk VS Actual Risk

INTRODUCTION AND CENTRAL FOCUS

After learning lessons about the brain function we can now look at perceived risk vs actual risk in the field. The importance of knowing how it is we view our worlds, risk plays a huge part in our decision making. Our emotions, memory, decision making, and development all play a huge part when looking at our perceived risk and actual risk. Understanding the differences between perceived and actual risk will help students throughout our journey.

LEARNING OBJECTIVES

Below are some focus questions students will be able to answer and have a good comprehension of the study area. As stated above in the introduction students should be able to understand and demonstrate a number of different ideas when looking at the topic of risk·

- Perceived Risk- What it is, why it is it they have a certain view on this topic?
- Actual Risk- What it is, why it is it they have a certain view on this topic?
- Why is it that I see perceived risk vs actual risk differently than someone else?
- Why is it important to understand the difference between the two?
- How has the development of my brain impacted my view of perceived risk vs actual risk?
- Why do my emotions and memory impact my view of perceived risk and actual risk?
- How does my decision making process impact perceived risk and actual risk?

LESSON SCOPE AND SEQUENCE

- **Perceived Risk**- In the outdoor field, perceived risk is happening at all times. Each individual has a higher and lower level of perceived risk. It is important to

understand that perceived risk is the perception of how dangerous the activity or situation is or could become. One's belief that the activity is extremely dangerous and accidents could happen is having a high perceived risk viewpoint. The brain is sending many neurotransmitters to different areas of the brain to help understand the situation and view its perceived risk.

- Perceived risk is how students look at a certain situation. One student's perception of tipping in a canoe could be high. Sitting in a canoe for the first time the boat seems unstable and wobbly. Their perceived risk is that the boat will tip and in a worst case scenario they will drown. Or in another instance, let us say we are paddling our canoes, and we have to make a three mile crossing. On a lake from one island to the next there is three miles of only water, the perceived risk is that if wind picks up it could possibly push our boats in the wrong direction stranding us out in open water, the other is that high winds create large waves which can tip the canoes miles from shore.

- **Actual Risk**- Now looking at Actual Risk in the outdoor field, which is also happening at all times. Each individual every day in the outdoor field is subject to actual risk. Actual risk is the concept that perceived risk truly could happen and that the result would be detrimental to the student or the class as a whole.
    - Looking back at the first example of the canoe tipping and the student drowning; the actuality of the canoe tipping over is low, yes it is possible however unlikely, and in the event of the boat tipping, there are certain

self rescue protocols to follow to not drown, one to wear a lifejacket. Or looking at the other situation where we have to make a three mile crossing from island to island in open water. The actual risk is that yes winds could pick up and push us out further into open water, however we will take great measures in decision making to minimize this risk. Or, yes the winds could actually pick up and create waves that could tip the canoe, but again we take measures in minimizing this actual risk. If the winds were strong the actual risk would potentially be high.

- **Understanding Our Risk**: The difference between perceived risk and actual risk is the perception of what seems risky and what is actually risky. Everyone's perception is extremely different, perceptions of perceived risk and actual risk is mostly dependent on experience and knowledge. Most beginners in any field will perceive the actual risk to be much higher than what it truly is. The more you experience something through knowledge gained you will better understand that the actual risk is low thus you're perceived risk will become lower (Davis-Bermen, 2002). Looking at how the brain is developed throughout life and how this could impact their view of perceived risk and actual risk. Stress Homeostasis theory helps us understand more of this idea of perceived risk and actual risk and how we make decisions. Gerald Wilde explains"The *homeostatic* element in the theory of risk homeostasis is located in the notion that there is a feedback loop between the population accident rate and the level of perceived accident risk: changes in the accident rate are followed by changes in the level of

risk perceived and thus cause subsequent changes in behavior, as well as *vice versa"*(Wilde, 2017). Our decisions that we make during a situation do relate back to our direct emotional and memory response. I would then have students read chapter four "A Gorilla in our Midst" *Deep Survival* written by Laurence Gonzales (Gonzales, 2004, p 69-77). I feel that these pages explain how our brain processes our current "risky" situations but also how the brain can fool us. Students that have been involved in "risky" situations will have different responses to certain situations. If the brain processed previous "risky" situations in a pleasurable way the memory will remember this. Whereas if the person had a bad accident in a "risky" situation they may have a different response in remembering the stress or pain of the situation. How does this impact one's view on perceived risk and actual risk? Your brain is already hardwired to have a reaction through the hippocampus where memory is stored. You will have a certain perception of the situation based off past experiences. Thus moving forward as one has more experience in a certain field the perceived risk will be lower in having previous knowledge that the experience doesn't have a high actual risk. Moreover if an individual had an experience of actual risk happening in a prior experience, their amygdala will produce stress hormones when in the situation again. This would create a higher perceived risk.

In the article *The Genetics of Being a Daredevil*, Gretchen Reynolds of the New York Times, discusses those that have been had experiences in high production of dopamine during a risky experience, are more likely to continue in

risky situations (Reynolds, 2014). Now looking back on the decision making lesson let us see how this has impact on an individual. The student that has had interactions in risky situations and has liked it, created dopamine, teaching the brain that this person enjoys being in risky situations even if the actual risk is low. Where as if there is a student that is, say afraid of heights, the brain will produce stress hormones like cortisol, thus teaching the brain that they are uncomfortable and maybe need to flee the situation. The decision to participate in a risky situation, such as paddling across a mile long section in high winds with six foot waves, will first tell the brain to be afraid. Students level of perceived risk will be through the roof! Once they have successfully made the crossing and everything is fine, dopamine will be produced in excitement that they are not dead, slowly teaching and training the brain to be less afraid of certain situations by having a pleasurable experience (DeSalle, 2016).

- **Decision Making**- When looking at making a decision about a sticky situation the group must weigh all options. They must understand how high is the actual risk compared to the perceived risk, as well as what are the benefits of the decision made. If the risk outweighs the reward is it a proper decision to act? Through experiences of pushing certain boundaries, one will understand proper decision making in the backcountry due to outcomes. That is if you are still alive to tell the tale.

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APPENDIX A.3

Group Dynamic and Expedition Behavior

INTRODUCTION AND CENTRAL FOCUS

Group dynamics and expedition behavior are the utmost important topic when in a backcountry setting. These two topics alone are why expeditions fail or succeed. The group dynamic of an expedition is the specific relations amongst individuals participating in the expedition. The expedition behavior is students behavioral impact on the expedition. At the end, of the day students are not able to leave and go home, they are spending day in and day out their time with other individuals. Paul Petzoldt, the founder of National Outdoor Leadership School, coined the term "Expedition Behavior" and researched the topic throughout his career.

LEARNING OBJECTIVES

What is Group Dynamics?

What is Expedition Behavior?

Who is Paul Petzoldt, and what impact has he had?

Where do I fit?

My actions cause what?

What are the stages of groups?

Why is it important to remain flexible?

Why is it important to adapt?

LESSON SCOPE AND SEQUENCE

- *Finer Points* by Howard Tomb is a reading that I would start this lesson with. The reason for this is because the topic of group dynamic and expedition behavior

have direct relations to each individual on the trip. Therefore instead of starting the lesson by “calling” people out on flaws, or showing “favorites” by describing correct behaviors we want to make things light and poke fun at both sides (Howard, 1994).

- Paul Petzoldt- Founder of National Outdoor Leadership School and Wilderness Education Association, was the grandfather of expedition behavior and group dynamics. Coining the term “expedition behavior” Paul studied for his entire career, the interrelations of individuals on an expedition. Through his research and findings, he saw that expedition's success and failure depend almost directly to the interactions amongst the expeditions group. He once said that “Poor expedition behavior is a breakdown in human relations caused by selfishness, rationalization, ignorance of personal faults, dodging blame or responsibility, physical weakness, and in extreme cases, not being able to risk one’s own survival to insure that of a companion” (Harvey, 1999, p. 169).
- Expedition behavior encompasses the interactions of each individual’s behaviors as a group. The Rediscovering North America expedition is a system, within this system there are individuals that interact, and make conscious decisions, the outcome of these interactions and decisions made by individuals to the group is in essence expedition behavior. As a team, each individual plays a role in the success of each goal. On a macro scale our goal is to paddle from the Gulf of Mexico to the Arctic ocean, each day every individual has to work with the group and other individuals to succeed. On a micro scale, we look at one individual

letting the small things not bother them and selflessly puts the group first. An example, at the end of the day the group is tired, finding a place to camp can be surprisingly difficult, individuals are tired and hungry, the landscape may not present a decent place to sleep, although you may want to camp somewhere else, for the better of the group you camp on the uneven rocky slope. Being aware of all the group's relationships, individuals can have and demonstrate proper expedition behavior, which will ultimately lead to the success of a group goal; whether that is paddling from the Gulf to the Arctic or making a decision on where to camp (Harvey, 1999).

- Group dynamics is the breakdown of the interpersonal behavioral relationships and interactions amongst the group and how there impacts. There can be good group dynamics and bad group dynamics, all of these stem from the interactions had on a day to day basis (N, 2017).
    - Individual to Individual- The interaction of my personal behavior towards another individual on the expedition.
        - Good Hygiene- cleaning your hands, keeping good health, etc.
        - Be considerate of Others- help each other out, if the chefs have yet to set up their tents because they are busy cooking food and it's pouring rain, help set their tent up. Do miscellaneous chores, treat someone else's water.

        - Manage conflict effectively- at times there will be disagreements, but by being able to agree to disagree and move on goes a long way.
        - Keep a laid back personality and don't take offense- although you may feel like you may being picked on, or someone is telling inappropriate jokes, learn to bite your tongue, or not to take offense. Be easy going, but also know when to say something.
    - Individual to Group- The interaction of my personal behavior towards the rest of the group as a whole.
        - Stay organized and Timely-knowing where your items are at, and being organized will help your timing. Being timely on an expedition is extra important, and if you are always the slow one adjust things.
        - Be aware of your own traits-understand that maybe you are the one who is continuously telling inappropriate jokes, maybe you are the slow one, know when to hold back or speak up.
        - Help where needed- help set up kitchen, pack boats, clean gear, treat water, etc.
        - Speak up about personal needs- although you don't want to hold the group back, you need to speak up for whatever may be causing issues won't resolve until attended.

    - Group to Individual- The interaction of the group's behavior towards an individual.
        - Do not "Gang up" on an individual
        - Don't hold a grudge
        - Don't blame- by pointing fingers to individuals in singles that person out, yes one person may be at fault. However, we are a team and each individual's actions impact the group.
    - Group to Group
        - Intra groups are small groups within the larger group. For instance canoe pairs, tent mates, cook groups, etc.
        - Inter groups are groups outside our group or other users.
- We all have different backgrounds, viewpoints, skills, ethics, perceptions, bodies, comforts, hopes, fears, and goals, but in the end, we are all part the same system. Until each individual of the system or expedition has the viewpoint of "us" rather than "me" the expedition will have bumps. Bruce Tuckman researched and introduced his theory of group development in 1977. The moment we start the expedition, our group dynamic and expedition behavior will have a direct impact on our day to day lives. Tuckman produced five phases on how groups work together (Rodd, 2014).
    - Forming- Each individual of the team or group is getting to know each other, understanding where each comes from, figures out strengths and weaknesses.

- Storming- individuals or the group to an individual start communicating viewpoints or disagreements. Hostility begins to show, or individuals that do not get along start clashing, verbal disagreements start, maybe physical disagreements as well.
- Norming-The group and individuals start to accept they are a team, working together is the only way to achieve goals. Taking personal responsibility and working with others. A problem with norming can be that an individual may avoid conflict, which may go back to storming by not voicing opinions. In time this may grow and eventually come back to storming.
- Performing- The group and individuals work together as one well oiled machine, trusting each other, flexible, and there is no hierarchy.

These four phases of the group are in no particular order, at any given time a group or individuals can revert and go back to different stages. Ultimately by having good expedition behavior the individuals and group will hopefully reach goals together. By taking responsibility, adapting, doing what needs to be done, staying organized, voicing opinions, pushing individual and group limits, learning from mistakes, being kind, honest and accountable, the Rediscovering North America team will be successful in a goal.

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APPENDIX B

Environmental Topics

LEAVE NO TRACE

INTRODUCTION AND CENTRAL FOCUS

Throughout our eight month expedition, we will be practicing Leave No Trace ethics every day. This is an interactive activity, each individual will participate every day using these ethics. In the natural world, Leave No Trace are a set of eight principle ethics outdoor enthusiast use. Practicing Leave No Trace is extremely important in building better awareness of your interactions to the land and becoming a proper steward of the land, bringing awareness of how we as recreationist impact the natural world, and how we can help lessen our impact.

LEARNING OBJECTIVES

- What is Leave No Trace?
- History of Leave No Trace
- The Eight principles of Leave No Trace
- Why Leave No Trace is an important practice?
- How to educate others

MATERIALS/RESOURCES

LESSON SCOPE AND SEQUENCE

- What is Leave No Trace? Leave No Trace Center for Wilderness Ethics based out of Boulder Colorado was established in 1990's. Leave No Trace (LNT) was first coined and used by the United States Forest Service, this was used in attempt to minimize visitor impact to the Uinta Mountains in the state of Utah. In the late

90s the Educational Review Committee, revised all principles of LNT, finalizing the list to seven main principles (Tilton, 2015, p 6). With special consideration LNT also uses an eighth principle when in desert country, Protect Water Resources, the thing about this topic is that it should be added as the eighth and final principle. Although LNT does not recognize this as an eighth principle I find it just as important to the rest of the seven, that being said as a certified Master Educator of Leave No Trace, I teach eight principles.

- **Ethics**

"Those of us with a stake in the future of wilderness must begin to develop an agenda which will place a clear, strong, national focus on the question of the responsibility of the wilderness user to the wilderness" -Paul Petzoldt (Tilton, 2015, p 66)

The definition of ethics is the body of moral principles or values governing or distinctive of a particular culture or group. Or moral concepts held or rules of conduct followed by an individual. Throughout our lives, we have grown through experience. Our set of morals and ethical principles have been established through life experiences, education, and relationships. Each individual is different, no one person is going to have the same set of ethics, for we all view the world from a different perspective. Through the lense in which we view the world, is where our ethical principles come from. Every day in every interaction our ethical goals are being molded. It is important for students to understand that the eight LNT principles are a set of ethics, they are not set in stone, they are

guiding principles to help educate individuals to bring awareness to the natural world. People and individuals that are interested in participating in outdoor activities, should be educated in these ethical principles. Through experiences each individual will be able to grow and mold their own perspective of each principle (Tilton, 2015, p 66).

- **Eight Principles**
    - PTDLMRBP- I always like to use the saying "Pass The Donuts Left My Righteous Brother Paul" as a way for students to remember the eight principles of LNT.
    - **1. Plan Ahead and Prepare**- To increase the safety, maximize comfort, and minimize impact it is important that we Plan Ahead and Prepare before heading out in the wilderness.
        - Use Proper Gear- Have extra gear, replacement gear, proper clothing, know the weather and research the area. Find any information on permits or specific restrictions of area.
        - Take Responsibility- Always inform others of your trip, create an Emergency Action Plan, know your physical limitations, always register at trailhead
        - Plan Your Meals- Repackage meals to minimize waste
        - Develop Skills- Be in physical shape for whatever activity you choose to participate in. Have an understanding of the activity that

you are participating in. Have proper navigation tools, and know how to use them.

- **2. Travel and Camp on Durable Surfaces-** What are durable surfaces? Watercourses or drainages, snow, rock, designated trails, established campsites,
  - Concentrate Use in Popular Area
    - Campsites- Camp in designated campsites, use high use campsites; do not make a new campsite next to an established campsite, clean up any trace before leaving.
    - Disperse use in pristine areas- If there is no other option in pristine areas, disperse individual use to not damage one spot specifically. If there is no trail, spread out, unless on extremely fragile soils like Biological Soil Crusts.
- **3. Dispose of Waste Properly**
  - Pack it in, Pack it out- Whatever is brought in needs to be brought back out. Any trash, wrappers, or food should be packed out.
  - Sanitation- Always use proper sanitation techniques especially when dealing with human waste. Properly washing hands after doing the deed. The fecal oral pathway is how these pathogens spread, unsanitized poopy fingers are used to eat food, clean your hands.
  - Human Waste Disposal

- Avoid Polluting water sources- spreading of illnesses such as Giardia happens when we do not dispose of human waste properly.
- Minimize social impacts- bury human waste at least six inches deep. Pack out any toilet paper used.

- Wastewater- After cooking when cleaning pots, use a strainer to collect any “Micro” trash, be sure to get all of the noodle giblets.

- **4. Leave What you Find**- The feeling of discovery is just one of the many reasons people travel out in the wilderness. If each individual were to take one thing at a time soon there won't be anything left.
  - National Antiquities Act of 1906 - This act protects anything older than fifty years. The Antiquities Act was created on June 8, 1906. The Act was produced to protect certain areas of the United States. The Act gives the President of the United States immediate action with no review to, protect any special historical, cultural, or natural area, creating what is called a National Monument.
  - Preserve the Past- Leave any archeological findings, be conscious of camping in undisturbed places.
  - Leave natural features undisturbed- This brings up the point of rock stacking. Rock cairn creation has become a popular thing in wilderness settings. A rock cairn is used to help navigate when in the backcountry, usually seen as three rocks stacked on top of each

other. This is used on non regulated trails to help people navigate. The thing about this is now there is a new movement, meditation through rock stacking or an art form called Rock Art (Bonner, 2017). This is creating handfuls of issues for now there are rock Cairns littered everywhere. Research is being conducted showing that the displacement of rocks from streams are disturbing the ecological systems which the rock gives habitat to (Martin, 2015).

- 5. **Minimize Campfire Impact**- Be conscious of fire impacts, how they scare the land, and how it influences other users to use one specific area. For instance we look at collecting firewood in one area like the boundary waters. Over decades of use trees have been stripped clean for burning up to out of reach limbs. Be aware of any fire bans in the area, as well as any regulations of fires in the area.
  - Stove Use
  - Use dead and downed wood- Collecting firewood leaves trees damaged, also if you have a fire it should be what we like to call an LNT fire. Logs should be no larger in diameter than your wrist, as well as be sure the wood is dry. This helps the logs burn completely down to ash so there is no log reminisce.
  - Manage Campfire- Always watch your fire, unattended fires are subject to spread, especially in dry areas.

        - Use Established Fire Rings- If needed build your own, after use always clean any materials used; disperse any rocks, cold ashes, and any unburned sticks.
    - 6. **Respect Wildlife**- One of the main reasons outdoor recreationist travel in the backcountry is to "spot" wildlife; hunting, birding, and fishing.
        - Keep distance- Do not approach wild animals, animals are quick and on the move, do not attempt to follow animals. There may be babies in the area and if you were to scare the parents away from young, they may not return.
        - Consider seasonal stresses- Always be aware of any closures for specific species. Looking at the world's fastest bird, Peregrine Falcon, capable of speeds up to 200mph! The Peregrine was gravely endangered due to poor reproduction in the 1940's. The chemical DDT was creating soft eggs. Many areas that hold mating Peregrine Falcons have closures during mating season (Kaufman, 2016).
        - Do not feed- Human food is not part of animal's natural diet. Animals can become aggressive or destructive in pursuit of food.
        - Store food and trash- "A fed bear is a dead bear" is the saying we like to use. Storing food in animal proof bags, take measures to make sure food is hung in trees out of reach.

- 7. **Be Considerate of Other Users**- Outdoor etiquette is extremely important.
  - Respect others- Give space to other groups, our experiences in wilderness vary group to group. Respect the space of others in the area. Do not camp close to other groups.
  - Yield to others- Step aside and let other users have the right of way. Understand proper trail etiquette, always allow pack animals like horses or donkeys to have the right of way unless otherwise informed by owners. Let uphill climbers pass when descending.
  - Low profile- Keep camp small.
  - Let nature's sounds prevail- “Supreme over all is silence.” John McPhee (Tiltion, 2015). Avoid any distracting things like bright lights, electronics like music or instruments. Also know how to bite your tongue, for instance there is a different group camping a few hundred yards away, at 7 am they decide to crank their favorite Bob Marley song, although you do not want to hear this and it disrupts your wilderness experience, avoid conflict.
- 8. **Protect Water Resources**- Lastly and most importantly we need to be conscious of our water resources. Water is life!
  - Camp a reasonable distance from water- There may be animals in the area that rely solely on this water source, and if you impede on their only water source you may cause harm.

- Do not Pollute- Do not bath in pristine water sources. Bury any human waste at least 100 yards away from water sources.
- Time your visitation- Do not spend too much time at water sources.

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APPENDIX B.1

Watershed

INTRODUCTION AND CENTRAL FOCUS

As the Rediscovering North America expedition continues its journey from the Gulf of Mexico to the Arctic Ocean we will encounter many different rivers, streams, and lakes. Through geological processes in North America these streams, rivers, and lakes have shaped the landscape we see. The next lesson of the Rediscovering North America expedition is looking at the different watersheds we will be on and their impact on the environment around us. Through the Mississippi River watershed will navigate through what watersheds are, how watershed impacts the rivers around us, and how they were formed..

LEARNING OBJECTIVES

- What is a Watershed?
- What are the impacts of the Watershed?
- How were Watersheds created? Geological History
- What is the Mississippi Watershed?
- What is the significance of CFS (Cubic Feet Per Second)

LESSON SCOPE AND SEQUENCE

To understand how watershed basins have been created we must look at the geological processes of the North American continent, specifically the origins of the Rockies mountain range and glacial events that have occurred.

- Earth History-. 4.5 Billion Years ago the planet was only a gaseous ball. Over the next 700 million years the gases attached themselves creating a solid surface. During this time there was meteorite bombardment. The metros that were colliding with early earth had a number of different gases which help create an atmosphere. These cosmic gases that were received were mostly water vapor, carbon dioxide, ammonia, and methane. The surface and core contents of the planet were extremely hot and molten. New gases crashing onto the planet created a reaction which caused the planet to grow. The release of gases from volcanoes slowly broke down. This created oxygen and the breakdown of water vapor. This process continued for the next billion years. Slowly the earth created an atmosphere strong enough to hold debris. This clouded and blocked the sun which helped water vapor cool and sink. After about two billion years there was a strong enough atmosphere to block just enough ultraviolet rays. Through a number of different elements that combined and mutated and organic molecule formed (Mathez, 2004).
- Geological processes throughout the Southern Rocky geological history have come and gone. Roughly 2 billion years ago while all land connected as a super continent Pangea, the Rocky Mountains were present. For the next few billion years through plate tectonics landmasses broke apart. Until about 200 or so Million years ago these processes continued. Bringing us closer to the creation of the modern day Rocky Mountains. Creation of the Rockies is important to this

watershed lesson because, the Colorado Rockies are home the largest divides for the Mississippi watershed basin (Mathez, 2004).

- **Laramide Orogeny**- Started about 72 Million years ago and lasted until about 40 million years ago. The Laramide Orogeny was a series of mountain building events (Mathez, 2004). Geologist believe that this was a shallow subduction angle from the Kula and Farallon Plates that were sliding under the North American tectonic plate. Forty million years ago to present day the Rocky Mountains have gone through a number of different stages. Catastrophic volcanic eruptions occurred for the next 30 million years. This event and last mountain building era are what has created the continental divide (Benedict, 2008).
- **Glacial events**- While there was still uplift of the southern Rockies the climate started to change. Massive glacial events have carved and shaped how we see the landscape around us. The last significant glacial event was the Wisconsin Glaciation Episode which lasted from about 85,000 years ago to 11,000 years ago (Benedict, 2008). The Wisconsin Glaciation Episode has had a great impact on most of Canada and parts of the Midwest of the US. This glacial event flattened the earth's crust and also deposited many lakes, including three that we will be traveling on, Athabaskan, Winnipeg, and Great Slave Lake. As well as while the climate started to warm, the glaciers started to melt, throughout this melting process the water slowly started to make its way through valleys,

one major river system this glacial event created was the Mississippi River Watershed (Middleton, 2017).

- **Watershed**- The simple answer to what a watershed is, the total area of land that water drains to. Using the Mississippi River Watershed we can see a macro scale of what watershed is (Pearlman, 2016).

(Carr, 2017)

The more complex answer to a watershed is, all surface area of the surrounding land that drains water to its closest source, including springs, creeks, streams, rivers, lakes, estuaries, and wetlands.

- Mississippi River Watershed- The Mississippi River Watershed basin is the third largest in the world, encompassing a total of 1.2 million square

miles of land. Roughly 41% of the US land area flows into the Mississippi River. In the picture above you can see that the Mississippi River watershed includes seven different river basins. The main river sources that impact the Mississippi River Watershed are the Missouri, Ohio, Arkansas, and Illinois rivers (NPS, 2017).

- Rivers are also measured are by its total volume or CFS Cubic Feet Per Second. All water that drains in the Mississippi River Watershed collects and flows to the Gulf of Mexico. To understand CFS measurement I like to always explain it in that if you were to cut a one foot section of the river all the way across, the number of total basketballs that you see and count are the cubic foot of water, as the river flows then per second. So at the largest part of the Mississippi the CFS is roughly 500,000!
- Ohio River- Starting outside of Pittsburg PA the 981 mile river flows down to Cairo IL, where it meets the Mississippi. Water comes from a total of five different states, and has twenty different human made dams. This river flows at roughly 260k CFS (ORF, 2017).
- Arkansas River- Starting outside of Leadville, CO at the Continental divide of the Colorado Rockies, the Arkansas River flows 1,469 miles. The river goes through five different states and enters the Mississippi at Napoleon, AR. The Arkansas River has a total of forty-four dams, and flows at 40k CFS (Arkansas, 2016).

- Missouri River- Starting in the Rocky Mountains in Brower Springs, Montana, the Missouri is the longest river in the US at 2,341 miles in length, entering the Mississippi north of St. Louis, MO. There are a total of fourteen major dams on the river, and it flows at 87k CFS.

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APPENDIX B.2

Damming Our Waterways and Human Impact

INTRODUCTION AND CENTRAL FOCUS

Since humans have inhabited the US waterways, the constant urge to control them has been of utmost priority. This is due to a number of reasons, population growth, logging, commercialization, trafficking goods, hydropower, water supply, etc. For the last two hundred years, we have slowly dammed the entire Mississippi River basin, for the better of the human species. This has created many issues environmentally, economically, and socially. This lesson will focus specifically on the dams of the Mississippi, their history, their impact on the environment, and the history of the Army Corps of Engineers (Alexander, 2012).

LEARNING OBJECTIVES

- History of Dams
- How many Dams are on the Mississippi
- What are the purposes of these Dams?
- Who controls the Dams?
- What impact have these Dams created?
- What are the differences in the Upper Mississippi Management and the Lower Mississippi?

LESSON SCOPE AND SEQUENCE

- **Mississippi River**

- For over two hundred years the Mississippi River and its tributaries have been used as the main water resource for water supply, commercialization, and transporting goods. The Mississippi River is split into two different sections, the Upper Miss and the Lower Mississippi. The Upper Mississippi starts at Lake Itasca and ending at Cairo, IL. The Lower Mississippi starts at Cairo, IL, also where the Ohio confluence is, and flows to the Gulf of Mexico. The Upper Miss has a total of twenty-seven lock and dams, the last one in St. Louis MO. The Lower Mississippi is a free flowing river from the last dam to the Gulf of Mexico. Although the Lower Miss is "free flowing", there still has been structures implemented to help keep shipping lanes deep enough for travel. The Mississippi provides large enough shipping lanes, for barges to carry such goods as coal, soybeans, corn, steel, petroleum, and aluminum. Estimated to be 460 million tons of goods are shipped up and down the Mississippi each year (NPS, 2017).

- **Damming the Upper Mississippi**
  - Dams and all river engineering is in accordance of the United States Army Corps Of Engineers. Although the first few dams were constructed on the Mississippi in St. Paul in 1906, and Keokuk Iowa in 1910. The rest of the larger dams, which created reservoirs or drop pool systems, were constructed from 1932 to 1969. The largest push for the creation of these

dams was to help with water supply to the expanding cities, irrigation for agriculture, recreation, flood control, and hydropower (Alexander, 2012).

- **Managing the Lower Mississippi**
    - Although the Lower Mississippi is “free flowing” this does not mean there is any management done. Due to the regulation above on the Upper Mississippi there was need for construction of different structures to help the flow of the water. These constructions were in the form of Wing Dikes and Revetment on or extended from the shorelines. Revetments are concrete structures lined along the shorelines of the river for bank stabilization from erosion. Dikes aka Wing Dikes, are large piles of boulders, riprap, metals, wood, and any other hard material, that stick perpendicular to the riverbanks, directing water flow to a concentrated channel. Dikes are used to help keep a deep channel for shipping, as well as to help flood control (Alexander, 2012).
- **Impacts**
    - When looking at the socioeconomic side of the river management thus far it has helped tremendously. On the flip side, when looking at the ecological side of things there has been great degradation. To start this we must first understand that this large of a river system is extremely complex when looking at any impact. Usually, a river is mainly impacted by natural phenomena such as climate and precipitation. The human impact from river management infrastructure takes decades to see. Through complex

ecological feedback loop systems we are seeing plenty of backlash due to these dams, dikes, and revetments. Alterations of the channels due to water flow have reduced sediment replacement and changed the overall design of the river's natural form. Due to low water flows fish communities have also taken a beating (Alexander, 2012). High sedimentation deposits in the pools of the Upper Miss, are creating low water levels. Roughly 25% of fish species have declined since humans have been “controlling” the river's natural processes. The need for flood control has also kept low wetland areas to not be rejuvenated, only during major flood events which usually makes things worse by scoring the land (Buckner, 2017). Wing dike and revetment construction has not allowed proper erosion for fresh nutrients to come into the river system. Consequently the overall control of the Mississippi river system has lead to what is called the “Dead Zone”, at the mouth of the river and the Gulf of Mexico. The “Dead Zone” is roughly the size of the state of New Jersey. A Dead Zone is an area of water that is no longer habitable for life due to low oxygen levels. Chemicals such as nitrogen and phosphorus, create algae blooms that use all oxygen in the water, creating a hypoxic environment (Smith, 2017).

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APPENDIX C

Phenology

INTRODUCTION AND CENTRAL FOCUS

Once the expedition starts, students will be immersed into the natural world. It is important that students start observing the daily world which surrounds them. This lesson will explain what phenology is, how it's used, why it is important, and how to document it. Each day students are to make a journal entry of one observation they see.

LEARNING OBJECTIVES

- What is Phenology?
- Why is Phenology important?
- How will we practice Phenology while on the expedition?
- How to properly make a scientific journal entry.
- Have a better understanding of the connectedness of the natural worlds processes.
- How to read the environment by observation
- Become more aware
- Build and mold a ethic to the environment that surrounds them
- Be able to properly identify species

LESSON SCOPE AND SEQUENCE

- Phenology is the study year to year of seasonal changes in the ecological world that surrounds us. Looking specifically at the timing of flora and fauna, and their

relationships with the weather in a specific area. In a nutshell being aware of your surroundings is phenology. Through the observation of phenology, the ecological world tells us a story of what is happening. In the spring the budding of the trees, the migration of certain birds, the appearance of insects, melting of ice, growing of specific plants, all of which tell a tale. Phenology has a direct effect of the distribution of species diversity, certain ecological cycles, it's the key component of life on earth! Phenology is the overall study and observation of recurrent phenomena in the biological world based on climate or weather patterns. The most important factors which make these natural events occur are sunlight, temperature, and precipitation (Schwartz, 2015).

- **Why? Importance?**
    - Phenology has a direct effect on the distribution of species diversity and certain ecological cycles. In a deeper sense, we can observe and discover the health of species which in turn tells us the health of the ecosystem. Watching each species and reflecting it on the area's food chain we will find certain information. It is up to us to collect data from the world that surrounds us, then translating it to the day to day story it is telling us. The USA National Phenology Network, (USA NPN), is a collective of volunteers, researchers, and students who help observe and tell the phenology story (USA NPN, 2017). Through the USA NPN organizations, and other observers collect information and have a place to put it. I feel this is an absolutely incredible resource for it is putting the

power in everyone's hands. This is extremely important now for how politicians are currently trying to cut out science and research of our natural world (NWF, 2017).

Documentation

- Students will observe a certain area every day for a certain time. In a short period you will be able to observe a few things, however this will hopefully instill an understanding of short and long term phenology practices. We will be moving at a snail's pace along the shorelines of the continent.
- Location – Explain where you are ie river, stream, lake, island, state.
- Weather notes – Give details regarding temp, precipitation, and wind. You can list the daily changes if that is easier, but tell us how it affects what you see.
- Birds – List the types you see and explain what they are doing, where are they going, what are they eating, and how many are there.
- Mammals – List types, behaviors, habitat, food, etc.
- Insects – Types, where, how many.
- Flora – Explain any changes you see in trees and ground species.

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APPENDIX C.1
Biomes

INTRODUCTION AND CENTRAL FOCUS

As the crew makes its way up the US and into Canada, they will experience a few different Biomes. The next lesson focuses on what a biome is, where they are located, and why. Also explaining the three different biomes in which we will be paddling through, which are, the Deciduous Forest, Prairie, and Boreal Forest biomes. Examining each biome and its characteristics, including their adaptations, seasons, and human impact.

LEARNING OBJECTIVES

- What is a biome?
- How are biomes created?
- Why are biomes located where they are?
- What are the three different biomes we will be traveling through?
- What are the characteristics, adaptations, seasons, and human impacts of each biome?

LESSON SCOPE AND SEQUENCE

- Biomes- A biome is classified as a certain area or zone of natural communities that consist of similar organisms, flora and fauna, and adaptations that correlate to the area's climate and vegetation. There are a handful of different biomes worldwide. You could say that individually there are roughly seven different

biomes; these include the Tundra, Coniferous Forest, Desert, Rainforest, Shrubland, Grassland, and Temperate Deciduous Forests. Let's not forget also there could be an eighth biome which would be an Aquatic. These biomes are forever changing since the beginning of earth's life (Wood, 2017).

- Biomes are created from a number of different systems large and small. A few of these are climate, soil, and the topography of the land. All of which have impacts on organism of the area. Due to the changing of topography from, the rock cycle and plate tectonics, the climate will change. All the while due to the rock cycle and the changing of climates soil will in turn change as well. Biomes will shift depending on its surrounding environment and what is happening (Wood, 2017).
    - The largest system impacting the earth's biomes is the Cosmological System. Inside our universe, there is one main source of energy that impacts us greatly, the Sun! The spinning of Earth on its axis is known as the Coriolis effect. Because the Earth is spinning as well as revolving around the Sun at times it is closer or further away from this energy source. Due to both of these we have the movement of air masses hot and cold. These air masses help create weather, and our seasons. Each Biome is highly adapted to its area and its weather patterns. Seasons and precipitation are always shifting as the earth is spinning and rotating from the sun. Once again the location of these biomes all happens for a reason. Certain species of plants and animals have adapted to cope with shifting changes in the weather. Three major air masses that help create biomes in

the midwest are Arctic air masses, North Pacific air masses, and the Gulf tropical air masses. Depending on the location of the earth in the cosmos and rotation, the seasons will change. These seasons are directly affected by these air masses moving across the land. Depending on the time of year each air mass will continually bring cold or warm air masses. Once again due to these cold or warm air masses not only are temperate changing but as is precipitation, leading us back to weather topic. Deciduous forest, Prairie Grasslands, and Coniferous Forest. These biomes have adapted specifically to its location. During the different seasons biomes cope with a number of different factors. For instance, the midwest biomes, annual precipitation is 18-34 inches. Total snow accumulation is 36-68 inches with some snow on the ground in areas for as long as 160 days!!!!!

- Looking at the geology of the land will dictate which biome will be more likely to thrive. As the rock cycle creates different soils there will be different plants that will be able to inhabit the area. The composition of the soil is extremely important for the plants. The factors have effects are physical composition, water holding capacity, and chemical (nitrogen) content. Depending on which soils are in the area will dictate which species of plants will thrive.

- Deciduous Forest Biome is characterized by its trees. These trees range in size, massive and small sized trees shed their leaves at the end of every growing season! Deciduous Forest Biome has the highest biodiversity of flora and fauna of

any of the other biomes! The native species of this biome play a huge roll some of these species include; Mapel-basswood, Aspen, Birch, Oak, Hardwoods, Trillium, Hepatica, Virginia Waterleaf, Zig-Zag Goldenrod, Cottonwoods, and Boxelder. The vast diversity help the biome contain roughly 70% of carbon present in living things (Wood, 2017)! The biome has three to four layers from bottom to top; Herb Layer, Shrub Layer, Understory layer, and the Canopy Layer. The layers of the deciduous forest are an important piece to this biome for a number of reasons. The bottom layer grows quickly during the spring and early summer. The flora that grows on the floor must complete its growth cycle before the Canopy layer grows fully blocking all sunlight to reach the bottom layers.

- Seasons- There are four distinct seasons that affect the Deciduous forest; Fall, Winter, Spring, and Summer. During these four seasons the weather is constantly changing which highly impacts the flora of the biome. The species in this biome are highly adapted. Trees become dormant during winter, holding sugars as antifreeze in the sap internally to ward off freezing. The summer season is long and warm giving plentiful amounts of sun for photosynthesis and precipitation. Average annual temperatures are 37-45 degrees.
- Adaptations- Flora species have adapted to this biome by dropping their leaves every growing season. The dropping of these leaves provides a layer of slowly decaying matter which stores and restores nutrients into

the soils and the tree itself. To list a few nutrients maple leaves put phosphorus, calcium and magnesium back to the soil.

- Human Impact-The Deciduous Forest Biome is one of the most degraded from human civilization. Because of the highly nutritious soils the biome creates humans have cleared many stands for farmland and other uses. Not only have humans disrupted this biome by destroying it completely from deforestation but also through pollution.Before degradation of this biome it used to amount to 12 million acres in MN but has now been depleted to 2 million (M DNR, 2017)!

- Prairie Biome-The Prairie biome is one of my favorites. The topography of the land is flat or rolling hills as far as the eye can see, completely covered by different grasses. These seas of grass can be vegetated sand dunes, wet meadows, or tall eight foot stands of grass! Prairie lands cover roughly 1.4 million square miles of land (M DNR, 2017). The prairie biome can be split into three different sections; Wet Prairie, Dry Prairie, and Mesic Prairie. Wet prairies often have poor water drainage which helps plants in the growing season. The Mesic Prairie has decent drainage, because of this this prairie is most likely to be converted to agricultural land. Lastly the Dry Prairie has decent drainage and is often found on uplands or slopes (Schaffner, 2010).
    - Seasons-The climate in the prairie biome has drastic changes during its four seasons; Summer, Fall, Winter, and Spring. Prairie lands experience cold winters and hot summers. Because there is not much protection due

to being flat, and lack of trees, there are regular high wind events. High winds and warm temperatures create a high evaporative rate drying out the land!

- Adaptations- The biggest adaptation that prairie biomes has is soil stabilization, specifically from native grass species of the prairie biome is crucial. Each native species has adapted to thrive in its environment. These species include Big Bluestem, Sideoats Grama, Kentucky Bluegrass, and Smooth brome. Each provides great long term erosion control. Because most of these grasses have extremely long root system they can grow in poor soils for the roots can reach needed nutrients and water deep down (M DNR, 2017).
- Human Impact- Prairie lands exist because of three distinct factors; Seasonal drought, Fire, and Grazing. Since settlers have come over the last two hundred years the Prairie biome has been crushed. The degradation to the prairie lands is highly due to lack of bison to graze, fire suppression, and using the land for agriculture. From the year 1500 to 1901 the iconic prairie specie the Bison has been decimated. Due to over hunting and no regulations. The elk, bighorn, and wolf were all species of the prairie biome until humans came (M DNR, 2017).

- Boreal Forest Biome- or also what could be the Coniferous or Taiga Biome is dominated by Conifers. The boreal biome finds itself in a transition zone often. Transition zones or integrated biomes are an area where two biomes are mixing

with each other. The boreal biome often reaches into the Deciduous, Prairie and Desert Biomes! To list some of the important native indicator species starting with pines; Red and White Pine, Spruce, Fir, Aspen, and ferns. One of my most favorite is Blueberry! One of my most favorite things on the planet the Lichen has a large impact on the boreal forest as well. Covering what is thought to be 6% of earth's surface the lichen is made up of algae or Cyanobacteria, and fungi! Lichen helps the forest by covering the forest floor holding soils, trapping seeds, as well as reflects heat. Im liken the Lichen (Wood, 2017).

- Seasons- Climate is crucial for the Boreal biome! The climate is cool and moist with cold winters and mild summers. The average temperature is 36-41 degrees. Because the climate is so mild it only lends a short growing season; why trees have adapted to have needles instead of leafs. Also because the colder temps these trees also have alcohols inside their trunks to protect from freezing (M DNR, 2017).
- Adaptations- Conifers are highly adapted to its surrounding environment. Coniferous trees are cone bearing trees. They have adapted to have thick waxy needles that are resistant to cold conditions and minimize water loss. Instead of having large leaves these needles help shed snow during the heavy winter (M., 2015). Another adaptation is it is fire dependent. Most tree cones are what is called sorotenous. This means that cones will not expose seeds and not be able to reproduce until a wildfire has brought the

cone to a certain temperature. Not only is it important for seeds but also to replenish the soils.

- Human Impact- Due to humans moving into these biomes fire suppression has become a major issue for this biome. By not having annual or fires in general, the soils have lost important nutrients, as well as serotunous cones have not been able to reproduce. Other threats besides fire suppression is climate change, logging, and development of oil and gas. Specific species of pine are great for building houses as well as for burning in the fireplace. As the earth's climate begins to warm the southern part of the boreal forest will have a hard time coping with higher temperatures. The development of oil and gas also is a threat because of deforestation and pollution.

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APPENDIX C.2

Species Development-Dragonfly Development

INTRODUCTION AND CENTRAL FOCUS

Every day we are on the expedition the ecological environment around is in constant fluctuation, from weather patterns, to river speed, and different flora. All of these are influencing certain things we may or may not see. As temperatures warm different species start to emerge, from trees budding in the spring, to nymphs morphing into dragonflies. While taking our observations on a day to day basis we will start to see such things. This lesson will examine the dragonfly life and development. During the expedition in 2015 over thirty days, we watched the progression of the dragonfly's life stages.

LEARNING OBJECTIVES

- What is species development?
- Dragonfly species development
- Observing the development of the dragonfly
- Understand the importance of species like the dragonfly on the environment
- What is needed for the dragonfly species

LESSON SCOPE AND SEQUENCE

- Species Development- As the season’s change, warmer temperatures, precipitation, and other climate changes affect the development of life.

- Dragonfly- Although the dragonfly has evolved throughout time to be a master of flight, it spends most of its life in the water. The Dragonfly's development has three different life cycles, the egg, nymph, and adult dragonfly. The transformation of this species development is called incomplete metamorphosis.
    - Egg- Starting first as an egg, laid by a female adult dragonfly, in a freshwater ecosystem. More often than not they are laid in calm waters. Female dragonflies can lay hundreds of eggs during its short few week lifespan. The male dragonfly protects the female dragonfly as she lays its eggs. Eggs hatch within two to five weeks after being laid.
    - Nymph- Once hatched from the egg, they are in the form of what is called a Nymph. A dragonfly nymph is specialized to be an aquatic insect. The nymph has many adaptations for it to survive in a hostile water environment, first it has gills like a fish. Second, the nymph has claw like lower lips to help catch food. They are also fast swimmers, by pushing water through their abdomen they can propel themselves quickly to escape other predators. Nymphs may go through a total of fifteen different molting cycles. Because Nymphs have an exoskeleton they are constantly growing and changing forms. Each molting cycle or what is called an instar, the Dragonfly Nymph grows in size each time. Depending on the area of the nymph the life cycle can last anywhere from a few weeks to a few years, this is because of the temperature of the water.

- Adult Dragonfly-The final stage of dragonfly development is the most dangerous, the nymph crawls out of the water, completely exposed, the last instar cycle begins. Usually because of predators, the insect tries to expose themselves at night. The now dragonfly emerges from the exoskeleton. The body of the dragonfly has to take shape and harden before it can take flight to safety, this usually takes up to a week. Once the dragonfly is fully developed and hardened it takes off to mate. Male dragonflies are known to be territorial and extremely protective of their mates.
- A Dragonfly has four wings specialized in moving in all directions. Capable of flying up to thirty miles per hour, the dragonfly, is one of the fastest flying insects. Dragonflies also have compound eyes, meaning they have eyes within eyes, taking up most of their head structure they can see in all direction.

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APPENDIX C.3

Species Migration

INTRODUCTION AND CENTRAL FOCUS

The last lesson of the phenology section will be on migration and their different patterns. While on our trip we will encounter a number of different species that migrate, we will see the end of the migration of birds heading south for the winter, and as we continue into the summer months we will then see the migration heading north. This lesson will encompass different species that migrate; Trumpeter Swan, Canada Goose, Ducks, Butterfly, etc.

LEARNING OBJECTIVES

- What is migration?
- What is bird migration and why birds migrate?
- What are the different "flyway" migration zones in the US
- Different types of migration.

LESSON SCOPE AND SEQUENCE

Now that we have an understanding of the different biomes in which we will be paddling through we can look at migration patterns.

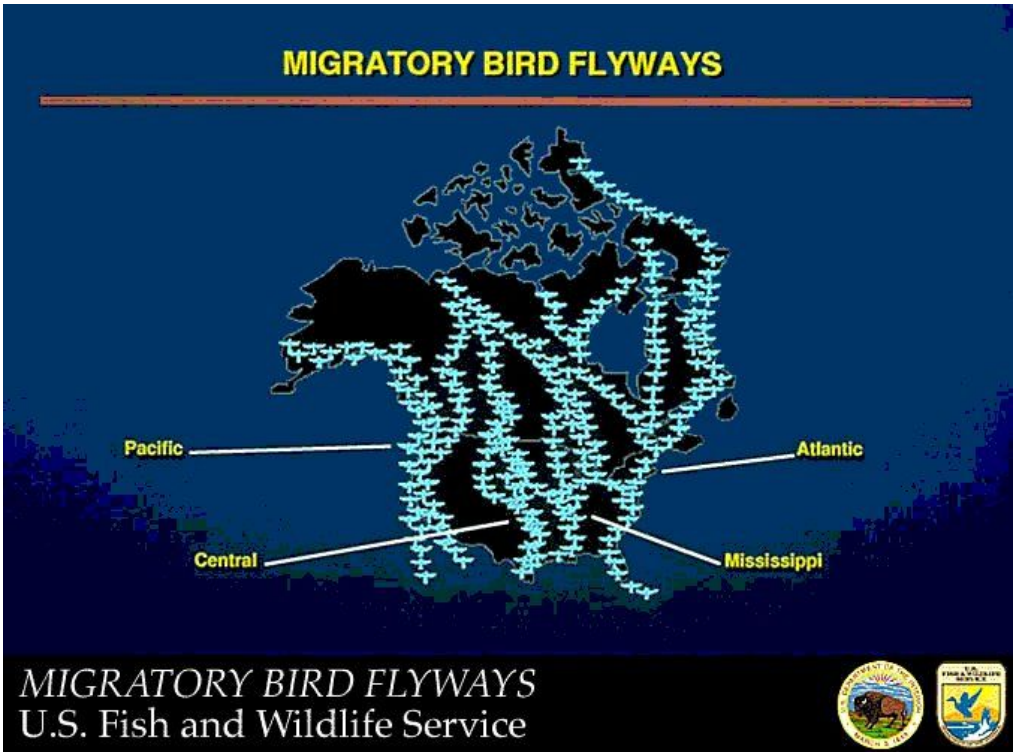
- Migration- The technical term of migration is the seasonal movement of a species from an area or region to another. In our case, we will be looking at species that

move from biome to biome due to a number of reasons. Some species move due to seasonal climate changes, the weather becoming cooler or warmer and food abundance (Frieden, 2008).

- Types of Migration- There are different types of migration amongst species, altitudinal migrants, and latitudinal migrants. Altitudinal migrants are species that migrate from high elevation to lower elevation, usually because of snowfall during winter seasons, or when fish move to different depths of water. Latitudinal migrants are species that migrate from a north to south region or during seasonal shift the opposite, migrating south to north; primarily these migrants are those who have adaptations to help them cover land, like flying.
- Timing- When looking at the timing of the migration it usually coincides with seasonal changes. First starting with the length of the day. Most bird species metabolisms will increase as the days get shorter, in turn making the bird fatter, to be able to sustain the long travel from region to region. Also on the flip side of things at the end of the migration, birds will need a sufficient amount of time to breed, develop, and gain weight for the next seasons migration.
- Types of Migrators- There are two different types of migrators diurnal and nocturnal migrants. Diurnal Migrants, like the Eagle, Cranes, and storks, migrate during the day. This is because their flight pattern and technique is all based off of thermal updrafts. During the day the sun heats the ground, pushing warm air up. On the opposite side, some species are nocturnal migrants, which is when they migrate at night. These species migrate at night because it is harder for them to fly

through the warm turbulent updrafts, from the heating of the earth's surface. Also flying at night it is cooler, and there are fewer predators.

- Formation- Typically bird species fly in flocks, they do this not only for navigation, numbers, but also to conserve energy. They fly in V formation which helps birds cut through the air, making them more aerodynamic. The strongest bird will lead and the weakest bird will be on the ends of the V formation. This formation often seen by Canadian Geese help them fly roughly 70% further than solo migrants (Frieden, 2008).
- Flyways- There are four distinct flyway zones or routes that species take during migrations. These flyways are used primarily by birds, butterflies, and bats. Different species pertaining to different biome needs will use one of the four flyways to migrate. Most flyways are oriented around geographical features of land, such as mountain ranges, rivers, and wetlands.



(Freiden, 2008)

- Pacific- Running along the west side of the Rockies and the Pacific Ocean, the Pacific Flyway runs from Alaska to Mexico.
- Central- This flyway zone follows the Continental divide of the Rocky Mountains, also connects with the Mississippi Flyway.
- Mississippi- Arguably the largest flyway route in the world, the Mississippi flyway runs north to south or south to north depending on the season. Starting at the Arctic Ocean in Alaska and running south to Patagonia. The main geographical feature of this flyway is the Mississippi River Basin Watershed, it is mostly flat with no large obstructions like mountains (Frieden, 2008).

    - Atlantic- The Atlantic Flyway covers a large majority of the North American Continent. Running from the Northwest Territories, over the Hudson Bay, down the Atlantic coastline to the Bahamas.

- Navigation- Of course one of the most interesting pieces to migration is how these species know where to go. There are many different theories to answer this question. The first is that species use geographical features as waypoints, through generations they pass down these locations. Another theory is that some species have a sense of the magnetic pull from the North and to the South. Some features include rivers, oceans, mountains, and often times they will use the sun (Hook, 2017).

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