Rediscovering North America Experiential Learning Curriculum Project

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?* (Delano, 2016, Rediscoverna.com)
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
dividual 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 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.

CITE REFERENCES


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).
Emotions and Memory
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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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 they have a certain view on this topic?
- Actual Risk- What it is, why it is 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.

CITE REFERENCES


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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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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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 meteors 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 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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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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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.

**CITE REFERENCES**


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 leaves. Also because the colder temps these trees also have alcohols inside their trunks to protect from freezing (MDNR, 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 sorotinous. 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.

CITE REFERENCES


  file:///C:/Users/User/Downloads/Boreal%20Forest%202015%20(1).pdf
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.

CITE REFERENCES


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 oftentimes they will use the sun (Hook, 2017).

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