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Utilizing Jicarilla Apache knowledge to enrich the watershed watch program curriculum for the benefit of the Jicarilla Apache youth

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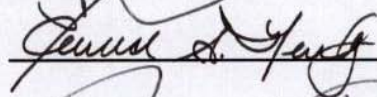
Rebecca Rae
Candidate

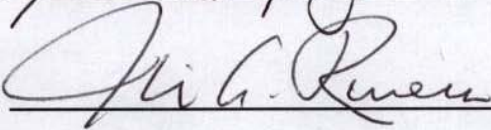
Community and Regional Planning/ Water Resources
Department

This thesis is approved, and it is acceptable in quality
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Approved by the Thesis Committee:


_____, Chairperson





**UTILIZING JICARILLA APACHE KNOWLEDGE
TO ENRICH
THE WATERSHED WATCH PROGRAM CURRICULUM
FOR THE BENEFIT OF THE
JICARILLA APACHE YOUTH**

BY

REBECCA RAE

**THEODORE JOJOLA
DAVID S. HENKEL, JR
JOSE A.RIVERA**

THESIS

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Requirements for the Degree of

Master of Community & Regional Planning

Master of Water Resources

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I would first like to honor my ancestors for their endurance, perseverance, knowledge, and wisdom for without them I would not exist today. It is through their hard-work and survival that my people strive today. I honor my grandfather, the late Gerald Vicenti, for instilling the cultural grounding that has guided me through life. I have learned who I am as a Jicarilla Apache through my grandfathers enduring love, endless storytelling, cultural teachings, and laughter. I thank him for being an influential and guiding force in my life. I dedicate this thesis to him for my love of storytelling and cultural teachings emerged from him. I also honor my late grandmother Winona Vicenti for being the backbone of the family. She was the epitome of a strong Jicarilla Apache woman and I will always honor her endless love, dedication to family, and support of my educational endeavors.

I want to thank my mother Jo Morning-Star for teaching me love and respect and always supporting me. My educational pursuits have kept me away from the rez for long periods of time but I'm always welcomed home with loving and enduring arms from my mother and relatives. My educational success would not be possible without that support from my family—grandparents, uncles, aunties, brothers, sisters, cousins, nephews, nieces. I thank them all sincerely for maintaining the livelihood back on the rez. I love you all dearly. I want to thank my Uncles Tyrone and Troy Vicenti for sharing their stories and knowledge with me, which have also contributed to this thesis.

I want to thank Jasmine Vigil for her artistic contribution to this thesis. Her illustrations of the emergence story brought my vision to life and captured the essence of the story. The illustrations are extremely beautiful and riveting and I could not have asked for more. Thank you Jasmine for going above and beyond what I imagined was possible.

My gratitude goes out to all the influential teachers in my life—from academia, from work, from friends, and from the community. Thanks to their consistent sharing of knowledge and wisdom I am always learning and growing. Lastly, I'd like to thank my thesis chair Ted Jojola for never giving up on me. There were times when it seemed this thesis would never come to be, but Ted's consistent support meant a lot to me. Thank you Ted for challenging my thoughts, providing guidance and support, and for allowing time to just conversate.

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CHAPTER 1: INTRODUCTION & PURPOSE

“Being sensitive to culture in a philosophical context has implications for how instructors instruct, how families are contracted, how meetings are run. Culture as a foundational medium means to actively pursue diverse ways of knowing and to acknowledge the wide spectrum of experience and ritual. Culture is both process and content of a conscious wilderness school. It helps staff and students recognize the importance of place and history and the implications for all areas of programming and delivery.”

—Manulani Aluli Meyer 2003: 37

This is a thesis that is grounded in a Community-Based Indigenous Planning paradigm. I combine my knowledge of the two disciplines—Community & Regional Planning and Water Resources—to create a comprehensive thesis that acknowledges and promotes the principles of both disciplines. The thesis explores and promotes the knowledge found within my community (Jicarilla Apache Nation) for the benefit of the community. Community-Based Indigenous Planning recognizes and honors the knowledge within the community and provides the space for communities to determine their own development based on their values and principles. I developed the thesis with this notion.

This thesis focuses on building a framework for developing a cultural component to the New Mexico Watershed Watch Program for the Jicarilla Apache Nation. The cultural component was initiated by exploring stories and tales told by the Jicarilla Apache people. After exploring multiple stories, the thesis took one story and additional information about riparian plants important to the Apache people as exemplars to insert into several lesson plans to educate the Jicarilla Apache youth about the cycles of water,

vegetation, and culture. By educating the Apache youth through Jicarilla Apache tales and Indigenous knowledge the students embrace their cultural existence while connecting to the natural environment.

Description of Project

The New Mexico Watershed Watch Program (WWP) is a program that was established in 1999 through the New Mexico Department of Game and Fish. It was created to provide students, teachers, and the general public throughout New Mexico with information and education on aquatic ecosystems prevalent to the overall health of the watershed. The WWP works directly with middle-school and high-school students in developing their awareness about riparian systems and its role in the watershed as well as the impact of land-use practices on the riparian systems. Students are engaged in this process through hands on data collection in a local riparian area. Students learn data collection techniques used to monitor riparian health and establish an on-going monitoring system. The students' collected data can then provide a concrete analysis of the health of their local watershed for fish, wildlife, and humans.

The WWP is science based and its program objectives focus on: 1) involving secondary school students in hands-on, real-life projects in which students monitor watershed health and water quality in their communities; 2) encouraging an interdisciplinary approach to studying the interaction between water quality and the human impacts of land use; 3)

developing credible field methodologies to create long-term database on watershed health and water quality in streams near selected secondary schools in New Mexico.¹

By developing monitoring programs with local schools across the state the WWP is collecting data on watersheds that most agencies don't have the staff or funding to monitor. The students not only learn and engage in their watershed but the data they collect contributes to helping maintain healthy watersheds across New Mexico. Such factors can be very empowering to students and can contribute to their self-development as well as remaining stewards of the natural environment.

I chose to utilize the WWP because it provides a solid curriculum for teaching youth about the natural environment. In analyzing the WWP I realized it would need a cultural component, specific to the Jicarilla Apaches, to discuss and expand on the empirical knowledge of the place. This community/cultural knowledge not only tie the Jicarilla Apache people to the land, but to who we are as Jicarilla Apaches. Thus, in order for the Jicarilla students to gain a full understanding of their local watersheds they need to understand how they as Jicarilla Apaches are connected and have a responsibility to their environmental surroundings. Utilizing this established curriculum allowed me to interpret, develop, and present the same material through the lens of the Jicarilla Apaches. Therefore this thesis developed a framework for incorporating a cultural perspective that explores the multidimensional realm of Indigenous knowledge into the WWP.

¹ New Mexico Watershed Watch Workbook; A Watershed Ecosystem Approach to Water Quality Education

Conceptually, by connecting Indigenous teachings with Western scientific teachings the students will gain a greater understanding of their watershed with relevance to their heritage. Through this process the hope is that the students develop a greater sense of identity with their environment and with themselves as Jicarilla Apaches. In theory, I hope this process will establish an ongoing dialogue with the youth, parents, and elders in my community. Exposing the students to different Jicarilla Apache stories and lessons will hopefully stir their curiosity to question their parents, aunts, uncles, and grandparents about the content learned. In this respect, it stimulates dialogue between the elders, adults and youth about various cultural teachings of the Jicarilla Apache. However, the intention of this thesis was not to collect data on the implementation of the enhanced curriculum, but to provide a framework for how to develop a full curriculum.

How this framework for a curriculum was developed is outlined in Chapter 2, the methodology section. I talk about the relevance of the selected creation/emergence story utilized for constructing a lesson plan around the water cycle. The limitations of utilizing traditional stories for educating about the environment are also addressed. The selected creation story is broken down into sections for analysis and creation of the first lesson plan. For the second lesson plan, the development and usage of a plant wheel is described.

Chapter 3 is designated for the literature review where I discuss decolonization, Indigenous knowledge, empirical knowledge of place, and the hybridization of knowledge as supporting concepts for the enhanced curriculum suggestions. Each

concept is defined and clearly drawn out why they are important to this thesis. The history of the Jicarilla Apache Nation is outlined in Chapter 4. A brief introduction is given to clarify why the history of the Jicarillas is relevant to this thesis. Chapter 5 is dedicated to the created lesson plans. The lesson plans are included to demonstrate how Jicarilla Apache stories/knowledge can enhance the Watershed Watch curriculum. My reflections, conclusions, and recommendations are discussed in Chapter 6.

CHAPTER 2: METHODOLOGY

“How do we see the world, through what windows of language, story, and cultural practice? When Native Americans and European Americans peer out through the matrices of their beliefs and assumptions, do we all see the same world? If, despite our different practices, our worlds are really the same, how can that world be described without distorting or diminishing it? And if our worlds are different worlds, what are those differences, what do we make of them, how can we celebrate and honor them, what can we learn from them about how we ought to live?”

—Viola Cordova 2007: 47

Rationale

Initially when I began to develop my ideas for this thesis I wanted to focus on oral stories collected from elders in my community. Reflecting on memories of my grandfather telling me stories inspired me to seek other stories. I wanted to collect these stories to learn more about my culture and to develop them into teaching tools to share with the youth in my community. Apache stories in general are teaching tools, so I wanted to expand on the lessons within the stories. However, I was unable to interview any elders 1) due to it being the wrong season for collecting stories; and 2) the elders I addressed were not comfortable with me writing the stories out. Out of respect for the cultural beliefs I decided to resort to Jicarilla stories that have already been written and shared in the published book: *Myths and Tales of the Jicarilla Apache Indians*. An anthropologist collected these stories from four Jicarilla Apache men in 1934-35.

At first I was a little skeptical about using these stories because I was unsure of the validity of the stories. I asked a few people in my community, including elders, about the validity of the stories and they all stated that the stories were within reason but different

versions existed to some of the stories. I fully understand that Jicarilla Apache stories will fluctuate between different families and clans. Jicarillas traditionally lived in small bands divided by clans and families, so it makes sense that the stories would have various versions. However, if the stories, no matter what versions, do not get told then they are lost all together. Therefore, I believe it is important for our people to step beyond the fear of criticism and share what knowledge they have available. Tradition, no matter what culture you come from, is always fluctuating and developing with the changes of time. My ancestors understood this concept and it is reflected in our stories. For this reason, I decided to proceed with utilizing the stories from the aforementioned book.

As I increased my knowledge about the history of my own people I became frustrated. Frustrated about the wrongdoings my ancestors endured, frustrated about the history I was taught in school as a child, frustrated that I'm learning about my history through a book, and frustrated that today our youth are still not learning our history. Instead of internalizing my anger, I'm using it as my driving force to expand my knowledge about who I am as a Jicarilla Apache woman. Part of this role is to nurture and ensure that future generations of Jicarilla Apaches thrive with an understanding of where we come from and who we are.

My perspective coming into this research acknowledges that I myself am a subject in this research process. This is part of an honorable tradition of post-colonial and Indigenous research where my perspective and role is inserted. It is through this process that I'm honoring the teachings passed onto me from my grandparents and family. It is honoring the ways of knowing through Indigenous perspectives. Historically there were no

“formal” methodologies to outline Indigenous research for it is developed within the context of every Indigenous community. However, today methodologies are being generated by many Indigenous researchers and community members worldwide. Indigenous approaches focus on exposing “our voice” in matters pertinent to our communities as expressed by Lester-Irabinna Rigney (2006: 43):

Indigenist research arises out of Indigenous social experiences, which celebrate the courage and determination of Indigenous people to survive. Therefore, Indigenist research acknowledges Indigenous peoples as resisters to racialization not victims of it. This approach challenges the power and control that traditional research methodologies exerts and directs attention toward ones that are compatible with Indigenous worldviews...Indigenist research is research undertaken by Indigenous communities themselves who determine their own research priorities and agendas.

The need to expose “our voice” sparked the development of a literature review that focused on decolonization, Indigenous knowledge, and empirical knowledge of place. Exploring and discussing these concepts were critical to this thesis because they provide the foundation and rational for tying in the Jicarilla Apache historical and cultural context. Through the literature review process ideas emerged and contributed to solidifying the created lesson plans. The rational for utilizing Indigenous worldviews and knowledge as a teaching mechanism is outlined further in Chapter 3—Literature Review.

Method

To develop the two following lesson plans I internally utilized an Objective Reflective Interpretive Decisional (ORID)² dialogue method. ORID has foundations in the Freirean

² Healthy Native Communities Fellowship Week Two Handbook

pedagogy, which works to create and understand the purpose of meaningful dialogue, transforming traditional teacher-student relations, and incorporating local knowledge into the classroom (Bartlett 2005: 345). ORID is a process that creates an open and comfortable space that allows for meaningful conversation to emerge by asking questions around a shared experience. ORID is usually a process that occurs after a teaching experience to help a group collectively process and reflect on that experience. However, I utilized ORID as an initial process to develop and create the lesson plans.

I started the process by reading through stories in the book *Myths and Tales of the Jicarilla Apache Indians*. I found numerous stories that had potential for development into a lesson plan that could be applied to an experiential science-based environmental application. In this framework I started to objectify what I saw related to principles that exemplified Indigenous and Euro-Western concepts of environmental/watershed management and health.

Images and ideas resonated in my mind as I deconstructed the stories. Reflecting on the ecological/watershed concepts within the stories I felt that everything kept going back to the emergence portion of the creation story. As I reflected on this it made sense to start with the creation story because it is the foundation for how all things came to be. I started to visually interpret the creation story and configure a way to depict it into a simpler form that was engaging and integrated the various senses of seeing, hearing, feeling, smelling, and tasting. I made a decision that creating images to correlate with the emergence portion of the creation story would provide visuals to bring the story to life. Through each phase the hydrologic cycle lesson plan slowly came together.

Process

In search of the appropriate stories to utilize in the curriculum I read through most of the stories in the book *Myths and Tales of the Jicarilla Apache Indians*. I began footnoting certain stories that had relevant lessons and themes that could be incorporated into the WWP curriculum. Some of the initial stories that I began to think about incorporating into the curriculum were:

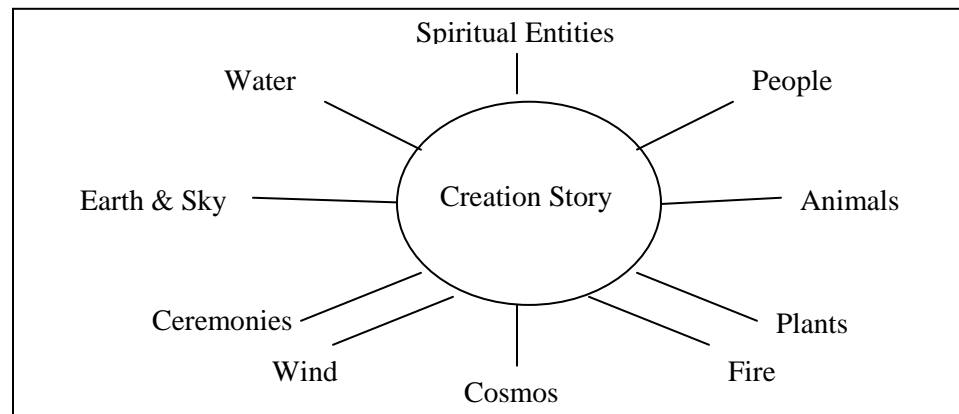
- The Man who Floated Down the River in a Log or the Origin of Agriculture
- The Quarrel Between Cyclone and Thunder and the Ceremony of Rain
- Prairie-Dog and Rain
- The Moccasin Game for Day or Night

Each of these stories talked about the emergence of how and why things came to be. I wanted to focus on stories that reflected the emergence of entities within the natural environment because they reveal the knowledge that my ancestors possessed. My ancestors had a precise understanding of the physical and unknown factors of the natural world. For my people the stories helped bring those physical and unknown factors together for full consciousness of how every living thing fit together. Traditionally in order for Jicarillas to understand how they were connected to entities in the natural world they needed to know how those relationships began. Once that relationship was understood a respect was formed and it is this respect that binds the people to the environment. For this reason I realized that I needed to begin with the creation story because it lays the foundation for how things came to be.

The Jicarilla Apache creation story is lengthy and it explains how the world came to be, how our people came to be, and how our ceremonies came to be. Creation stories also lay the foundation for our value system. Because the creation story is lengthy I began to

break it down to sections that were relevant to the curriculum. I started to pull out some of the essential elements highlighted in the creation story, shown in Figure 2-1. Each element is pertinent to one another and one could not be created without the other. For example the animals helped create the people. As one listens to the creation story one begins to understand the connectedness of all the elements. For this thesis and for creating the framework of the curriculum, I focused on the emergence portion of the creation story, which involves many of the elements in Figure 2-1.

Figure 2-1. Essential Elements in Jicarilla Apache Creation Story



Summary of Creation Story

The creation story is lengthy and can be told over a couple of days, but for the relevance of this thesis a shortened version was utilized to hone in on the emergence piece. The creation story starts by explaining how the earth, sky, animals, and people came to be. The *Hactcin* (Holy Ones) created the world first, then the earth, the underworld, and lastly the sky was created. All the people dwelt in the underworld and they first existed as spirits. The Black *Hactcin* existed in the underworld and he first formed animals using clay. He created all sorts of animals and they could all talk. The animals collected

material for the Black *Hactcin* to create man and with these various materials he created a man in his image. He then created a woman in the similar manner to be his companion. Generations passed and more people and animals came to be, but they lived in darkness. Holy Boy tried to make the sun but was having little success. He was informed that White *Hactcin* had the Sun. White *Hactcin* gave him the sun and instructed him to get the moon from Black *Hactcin*. Black *Hactcin* gave him the moon with instructions of how to make the sun and moon rise. With the instructions Holy Boy, White *Hactcin*, Black *Hactcin*, and Red Boy sang songs to make the sun and moon rise. White *Hactcin* and Black *Hactcin* released the sun and moon and they followed the path that Holy Boy and Red Boy created with pollen. There was finally light and things could be seen clearly. . .The animals started bringing seeds, leaves, needles, and other food and shelter sources to the *Hactcins*. White *Hactcin*, Black *Hactcin*, Holy Boy, and Red Boy pulled together four different color piles of sand and put the various seeds, fruits, needles and leaves that the animals brought in each pile. The Holy Ones then filled a black clay pot with water and placed it by the piles of sand for the mountains need water to grow. All the animals and the Holy Ones began praying and singing and singing and singing until fruits started to emerge and the mountains started growing. Once the mountain stopped rising the Holy Ones went up to the top and they could see that there was still a little way from the sky and the hole to the other earth. So they sent the fly and the spider up to where the sun was and they pulled the rays down to the mountain top as ropes and the Holy ones used these rays to create a ladder...

The Emergence

...Now the fly and the spider went upward again on that ladder. They saw a great deal of water up there. They could see no ground at all. The spider made a cylinder of web which protected them and they went up to the top through this. Spider then wove four webs on top of the earth of four different colors and stretching in four directions so that the four Holy Ones could ascend.

The four came up. Black Hactcin stood on the black web to the east and the others took their places too. They talked of what to do, for the sun was past the middle of the sky already. Then they said, "Let us make four hoops of the different colors, one black, one blue, one yellow, and one glittering. They did so and threw the black one to the east, the blue one to the south, the yellow one to the west, and the glittering one to the north. Every time they threw one, the water rolled back and grew less where they were stood. The water had receded from the land and had made the oceans as they are now.

But everything was still muddy. So they sent for the four Big Winds of the different colors and for the little winds too. The winds blew and made it all dry. But the winds couldn't dry off certain places where the springs and rivers were. When the wind was hurling the water back and exposing the land, it lifted the water high in the sky and held it there. Over by the oceans the water is still held there by the wind. High in the air there are four winds: the black wind from the east makes the water warm, the blue wind from the south makes it cool and fresh, the yellow wind from the west freezes the water and turns it to snow, and the glittering wind from the north turns it to ice and hail. These four people are always there handing around the moisture of the air. When it is handed to the wind

of the north, it turns to ice. Then, when it handed to back to Black Wind of the east, he warms it and it turns to water again. That is why we have the moisture of the air in all these forms.

White Hactcin said to the wind, "Hold the water there and when it is needed we will let you know and you must blow and bring the rain." Hactcin talked to the thunder, "You must lead," he said, "so people will hear and know the rain is coming and get ready. They will prepare buckets to fill and be ready to receive the rain." Then he spoke to the sun saying, "You must shine on the lakes and rivers so that the steam will arise and turn to water and give rain. But Wind, you will always carry the water in the air; you are responsible for it. If the heat does not pick up the water but heaves it around on the earth in the same way all the time, the water will become dirty and unfit for use. But by changing it in this manner it will be made pure and good for the people. (Opler, 1994: 14)

Development of Lesson Plan #1

After I read the emergence portion of the creation story I knew immediately it could be transformed into a lesson plan. The watershed watch curriculum has a lesson plan to teach about the hydrologic cycle. Here was a story that my ancestors told that explained how the hydrologic cycle came to be and its importance. I envisioned various ways to develop this story into a lesson plan. I had to consider whether the lesson would be conducted inside the classroom or outdoors. I decided to develop the lesson plan as a classroom activity that could later be developed into an outdoor exercise. The classroom exercise will prepare the students for further dialogue and hands on activities in the

outdoors. However, the lesson plan is flexible and can be adapted to fit an outdoor setting if the teacher chooses to.

I wanted visuals to go along with the story to highlight its richness and to capture the attention of the students. I broke the emergence story into four sections that I felt could be captured in an image. I contacted an artist friend who is also Jicarilla Apache and asked her if she could do illustrations for me. We met on several occasions and together outlined our visual interpretations of the emergence story. The artist and I knew we were treading new grounds for neither of us had seen visuals of the *Hactcins*, so we created our version of the holy ones. The results are beautiful images that the artist solidified in vibrant colors that correlate with the highlighted emergence story. From the story and images I created questions to engage the students in dialogue.

Development of Lesson Plan #2

I searched the internet and other watershed curriculums to garner ideas for further enhancement of the watershed watch curriculum. I came across an activity found in the online curriculum *A World in Our Backyard: A Wetlands Education and Stewardship Program* for creating a wetland plant wheel. I liked that the wheel was interactive and divided into four tiers to describe the plants. Within the four tiers the outer portion of the wheel identifies the type of plant it is, the next level down describes the plant, followed by the plant name, and the inner most part of the wheel identifies what the plant looks like. The objective is to match the right plant with its proper characteristics.

I took this plant wheel and modified it slightly. Instead of four tiers I opted for three tiers by combining the plant name (along with its scientific name) with the type of plant it is in

the outer portion of the wheel. I kept the description of the plant and what the plant looks like in the same area of the wheel. The details are outlined in the lesson plan in Chapter 5. Once I made these logistical changes I decided to focus on four plants that are found within riparian zones and are essential to Jicarilla Apaches. The four plants I chose were coyote willow, chokecherry, gamble oak, and threeleaf sumac.

Within the plant wheel I wanted to highlight the importance and usage of each plant to the Jicarillas. I decided that the wheel needed to have two sides, one side to describe the plants through western science and the other side through Indigenous knowledge. The western science side identifies the plant name, its scientific name, what type of plant it is, and describes the plant based on its physical characteristics. The other side of the wheel identifies the plant by its Jicarilla name and describes the plant based on its identification and usage by Jicarillas.

CHAPTER 3: LITERATURE REVIEW

‘It is time to change the educational outcomes for Aboriginal youth by fully integrating their knowledge and heritage into an education system that values and respects Indigenous ways of knowing and allows Aboriginal students to embrace and celebrate who they are instead of making them doubt themselves.’

—Marie Battiste 2002: 28

This literature review is divided into four main concepts: Decolonization, Indigenous Knowledge, Empirical Knowledge of Place, and Hybridization of Knowledge. Each topic is specific to its meaning but intertwines and collectively builds a framework essential for supporting the ideas expressed throughout this thesis. The suggested curriculum enhancements outlined in this thesis are built upon from learning and developing these four concepts from other professional researchers, community members, scholars, etc. Each concept in its own right has extensive ideologies, theories, and teachings and is ever evolving. I acknowledge this complexity and do not attempt to explore every facet but merely to highlight and address the main points related to this thesis.

Decolonization

To address the topic of decolonization, I first ask: “What is Decolonization?” A simplified definition of decolonization is to be free from colonial status. Perhaps easily defined, however; the process of decolonization is far from easy.

Addressing the ideologies of decolonization is important for acknowledging the historical wrongdoing toward Indigenous people in this country and worldwide. To understand

Indigenous people today it is important to understand the oppressive and forced way of colonial thinking upon Indigenous people. Through the colonial process Indigenous people suffered a shift in living and thinking due to a loss of land, language, culture, natural resources, and personal autonomy (Duran & Duran 1995, Deloria 1969, Smith 1999, Battiste 2002). There are direct links to this loss and the current social ills that impact all Indigenous communities. Some of these links are tied to the historical trauma theory which argues that individuals can be traumatized by events that occurred before their birth (Duran & Duran 1995).

Many decolonization movements and thought processes are occurring within Indigenous communities worldwide. Literature on decolonization, once non-existent, can be found in many scholarly articles and books dedicated solely to decolonization methods. Poka Laenui (2000: 152), one attributed scholar, outlines a process of decolonization through five distinct phases that are:

- 1) Rediscovery and Recovery—of one's history, culture, language, identity is essential for decolonization and sets the basis for the next phases,
- 2) Mourning—a time when a people are able to lament their victimization and is an essential phase of healing,
- 3) Dreaming—ability to explore own cultures, own aspirations for future, considering own structures of government and social order which encompass and expresses hope,
- 4) Commitment—will culminate in people combining their voices in a clear statement of their desired direction and
- 5) Action—is not a reactive but a proactive step taken upon the consensus of the people.

Poka acknowledges that people will move through the phases in a fluid manner and revisiting phases can be essential at times. Indigenous communities are no longer solely relying on “outside” help to address social ills rather traditional knowledge is being sought to combat these ills. This is a form of decolonization. Indigenous scholars and

community members are actively engaging in many innovative ways of decolonization. Indigenous scholar Winona Stevenson (Stevenson 2002: 212; qtd. in Hollrah 2004) outlines some goals of decolonization:

*A large part of decolonization entails **developing a critical consciousness about the cause(s) of our oppression** [my highlight], the distortion of history, our own collaboration, and the degrees to which we have internalized colonialist ideas and practices. Decolonization requires auto-criticism, self-reflection, and a rejection of victimage. Decolonization is about empowerment—a **belief that situations can be transformed, a belief and trust in our own people’s values and abilities, and a willingness to make change** [my highlight]. It is about transforming negative reactionary energy into the more positive rebuilding energy needed in our communities.*

“Developing a critical consciousness about the cause(s) of our oppression” is one of my main objectives in Chapter 4 of this thesis. As I began conceptualizing why a cultural component would benefit the Watershed Watch Program, I started to wonder at what point our cultural teachings started dwindling. I made an initial assumption that the discovery of oil and gas on the reservation contributed to the cultural decline. In my research, however, I realized the cultural decline started as early as the first contact with settlers. This history is discussed further in Chapter 4.

Little did I know I was actively engaging in a form of decolonization through my personal research to understand the history of my people. As I read through historical accounts I started to understand why certain dynamics exist on the reservation today. I had some understanding of our history, but lacked the details of the interaction between my ancestors and outsiders who came into the region. These interactions ultimately explain how and why my people ended up on our current reservation. The atrocities my people experienced, survived, and continue to struggle with today are attributed to this

history. Part of moving Indigenous communities forward in a positive direction while fostering cultural growth involves understanding our own history. This is the rediscovery and recovery process of decolonization that Poka Laenui outlined. Angela Wilson and Michael Yellowbird (2005: 3) express this process as:

The first step toward decolonization, then, is to question the legitimacy of colonization. Once we recognize the truth of this injustice we can think about ways to resist and challenge colonial institutions and ideologies. Thus, decolonization is not passive, it requires something called praxis. Brazilian liberatory educator Paulo Freire defined praxis as “reflection and action upon the world in order to transform it.

Decolonization sets the framework for one purpose of this thesis—“a belief that situations can be transformed, a belief and trust in our own people’s values and abilities, and a willingness to make change.” Part of this process is to “reframe, reclaim, and rename” (Smith 1999) our agendas for our communities. For this thesis, the reframing process is educating Jicarilla Apache youth about their environment utilizing Indigenous knowledge, reclaiming our stories as the teaching tools, and renaming our environments through our language and interpretations of the landscapes.

Growing up listening to stories from my grandfather instilled the necessary respect, pride, and love for my people and culture to survive beyond the reservation boundaries without losing a sense of self. Change is inevitable and my ancestors always adapted with the changing of times. However, they adapted while keeping our culture intact. Culture wasn’t a fad; it was the way of life. Today keeping Indigenous culture intact while developing economically and intellectually with mainstream culture is a challenge. Our Indigenous culture is constantly threatened; without our culture we lose our identity as Jicarilla Apaches, ultimately resulting in full immersion into mainstream culture. If we

cannot identify ourselves beyond mainstream culture, we will slowly lose our rights to be sovereign. At this point colonialism is victorious.

I fear losing my grandfather's and ancestors' legacy, thus I accept my responsibility to help keep our culture alive by continuously learning about it and sharing that knowledge. Looking to Jicarilla Apache stories and knowledge to educate our youth about the natural environment is acknowledging the intelligence our ancestors possessed. Retelling our stories ensures their continued life while preserving that internal knowledge that my ancestors passed on for centuries. It is about rejoicing and celebrating that our stories survived the colonial persecution as highlighted by Michael Pavel (2005:132):

One of the many strategies to decolonize the Indigenous Peoples is to remember the ancestral teachings and master the art of storytelling.

Bringing the Indigenous knowledge in my community into the educational system is one process towards decolonization. Utilizing stories as a means for teaching youth about the environment integrates more than just scientific understanding of the natural environment. The stories link direct relationships to all living entities. Through these relationships lessons are taught, ultimately setting the moral guidelines for how to interact with the environment and with one another (Cajete 1994, Deloria 1999, Basso 1996, Meyer 2003). Respect and compassion become the backbone for these social and spiritual interactions. Fostering Indigenous knowledge is resurging the past to develop an optimistic future through a process that Angela Wilson regards (Wilson qtd. in Wilson 2004: 362) as:

The recovery of Indigenous knowledge is deeply intertwined with the process of decolonization because for many of us it is only through a consciously critical assessment of how the historical process of

colonization has systematically devalued our Indigenous ways that we can begin to reverse the damage wrought from those assaults.

Indigenous Knowledge

“What is Indigenous Knowledge?” My personal understanding of Indigenous Knowledge (IK) is an innate connection between spirituality and knowledge gained from ancestors/elders, personal relationships and personal experience. I believe that spirituality is a critical component of IK because the belief that every living thing possesses a spirit requires believing in things that are not tangible. Yet it is these non-tangible beliefs that connect Indigenous people to the land, to ceremonies, and to one another. However, spirituality should not be romanticized in this context. Indigenous spirituality is often romanticized and taken beyond context. There are no dogmatic religious principles to follow. In the context of this thesis spirituality is honoring and learning from all entities.

IK is dynamic and elusive and can be interpreted on many levels. However, the values and principles underlying IK are fairly universal in their teachings. Respect, honor, balance, harmony, and reciprocity are some examples of the values and principles that IK elicits. This is important to highlight because it is these universal values and principles that connect peoples of all cultures as expressed by Battiste (2002: 8):

Indigenous knowledge comprises all knowledge pertaining to a particular people and its territory, the nature or use of which has been transmitted from generation to generation. This knowledge includes all kinds of scientific agricultural, technical, and ecological knowledge, including cultigens, medicines, and the rational use of flora and fauna.

My search for a universal definition of Indigenous knowledge left me understanding that IK is applied to many aspects of life and cannot be summed up in one definition.

However, Marie Battiste and James Henderson (qtd in McGregor 2004: 388) present these thoughts on IK:

*Perhaps the closest one can get to describing unity in Indigenous knowledge is that knowledge is the expression of the vibrant relationships between people, their ecosystems, and other living being and spirits that share their lands...All aspects of knowledge are interrelated and cannot be separated from the traditional territories of the people concerned...To the Indigenous ways of knowing, the self exists within a world that is subject to flux. The purpose of these ways of knowing is to reunify the world or at least to reconcile the world to itself. Indigenous knowledge is the way of living within contexts of **flux, paradox, and tension respecting the pull of dualism and reconciling opposing forces** [my highlight] ...Developing these ways of knowing leads to freedom of consciousness and to solidarity with the natural world.*

It is this understanding of “flux, paradox, and tension, respecting the pull of dualism and reconciling opposing forces” that required keen observation of the natural world. Indigenous ancestors recognized understanding the dynamic forces of the natural environment meant survival of their people. Preparation and awareness of migratory game patterns, location of roots, berries, herbs, and knowledge of the weather were key elements for survival. Therefore the natural environment was the classroom. Survival required the use of cognitive, social, and critical thinking skills. Much research has been conducted indicating that these skills are essential factors for developing well rounded scholarly individuals.

IK develops these skills in individuals through experiential learning which is “learning by observation and doing, learning through authentic experiences and individualized instruction, and learning through enjoyment” (Battiste 2002: 18). It is learning by being directly involved with another individual, with the community, and the natural environment. Critical to this learning process is the reflection piece that allows

individuals to process their perceptions collectively to enhance the whole as expressed by Ted Jojola (2000: 18):

The essence of indigenous scholarship is native self. True indigenous scholars and activists do not suffer from cultural amnesia! In the spirit of idealism, indigenous people adapt their ideas from experience. As proven time in and time out, indigenous people excel in the process of deconstruction as characterized by reflection and introspection.

The reflection component is where the deep learning occurs through an internal process and through the collective sharing. In the literature, IK is also referenced as Traditional Knowledge (TK). I came across this definition of TK (Hansen and VanFleet 2003: 3) as:

The information that people in a given community, based on experience and adaptation to a local culture and environment, have developed over time, and continue to develop. This knowledge is used to sustain the community and its culture and to maintain the genetic resources necessary for the continued survival of the community.

Because knowledge was passed on orally it was crucial to observe, absorb, and retain the information being taught. Repetition and trial and error were also critical elements in ascertaining the skills necessary for survival. All these elements are a facet of Indigenous knowledge.

Importance of Indigenous Knowledge to Thesis

“Why is it important that IK be incorporated into the Watershed Watch curriculum?” Utilizing Jicarilla Apache stories to enhance the WWP curriculum is more than just teaching youth about the environment. Stories were told to connect people to the land, to the animals, to the plants, and to one another. Stories enrich the learning experience and provide a personal connection to that learning experience which triggers a deeper development of self. The lessons in stories help to establish the integrity of a person as articulated by Vine Deloria (1999: 139):

The old ways of educating affirmed the basic principle that human personality was derived from accepting the responsibility to be a contributing member of a society. Kinship and clan were built on the idea that individuals owed each other certain kinds of behaviors and that if each individual performed his or her task properly, society as a whole would function.

However due to the impacts of colonization relationship building is not practiced as frequently. There is a disconnection in Indigenous communities to the point where youth are unsure who they are related to. This detachment disrupts the “it takes a community to raise a child” concept. If Indigenous children are disengaged from their relations, then there is a high chance they are disengaged from the social values of the community. Knowing this disconnection exists requires innovative and collective ways of teaching Indigenous children in a more well-rounded fashion. This requires looking at education not as a mechanism for gaining credentials but as a mechanism for fostering the Indigenous knowledge and culture within the community and as a way to heal the social ills within the community as well. Jessica Ball (2004: 457) states that:

Moreover, when a mainstream, standardized, one-size-fits-all curriculum is all that is offered, too often the result is a homogenizing, monocultural, colonizing approach to community and human service development that is inappropriate for the varied social ecologies of Indigenous children and families.

Within Indigenous communities education was never individualistic but communal for “Indigenous knowledge is both empirical (that is, based on experience) and normative (that is, based on social values)” (Battiste 2002: 19). Indigenous teachings instilled that the more skills an individual develops the more equipped he/she will be to provide for their family and community. Therefore, teachings came from elders, aunts, uncles, cousins, and even children. The Eurocentric principles worked to devalue this communal

form of teaching. Western ideologies focused on individuals excelling beyond one another creating competitive environments.

Indigenous people were forced to think that their knowledge was inferior to western ideologies and that the keepers of knowledge required the accreditation of an educational institution. Thus, began the span of boarding schools to assimilate Indigenous children. Children removed from their homes were forced to learn a foreign culture and in the process were missing out on their teachings back home. Family roles were disrupted which steamrolled into dismantling the community social roles and values. Many Indigenous concepts, family, and community roles and values were lost through colonialism. This subjugation is one reason the passing on of traditional stories dwindled. Ironically today, theories such as social learning theory recognize that, “values, emotions, experiences, and cultural contexts are integrally related to learning. Recognition that cultural diversity is associated with diverse ways of understanding how people relate to each other and the world supports the explicit inclusion of culture in teacher education” (Chinn 2007: 1250).

Even though much was lost through the colonial persecution, a profusion of culture and IK remains in tact. However, at times this knowledge and culture can be fragmented within the community; thus the challenge is connecting to those keepers of the knowledge and culture. Many Indigenous communities are implementing ways to keep culture at the forefront of their initiatives for developing healthy and successful communities. Revitalizing storytelling is one component of this initiative. Through

storytelling Indigenous people are empowered by the knowledge their ancestors possessed and realize, as Donald Fixico (2003: 33-36) points out, that:

As the oral tradition is practiced, over time the stories add to the Third Dimension of the Indian point of view. Actually the stories become a sociocultural history about the community in general, conveying values, ideas, beliefs, and proving much insight about the people...The oral tradition is like a metaphorical key for opening a door to the other side of understanding a community and how its people think, conceptualize in their logic, and draw conclusions based on their prior knowledge...A story possesses power and life of its own and it transcends time as an experience comes alive again in the minds and ears of listeners when the storyteller touches the emotions of them...The story has power and energy, and it brings the past into the present.

Stories were told to connect Indigenous people to their environment and helped develop “behaviors like caring for land, caring for plants and animals, naming one’s place and developing relationships to natural entities in that space” (Cajete 2000: 42). Developing that relationship with the natural entities required keen observation and integral interaction. Indigenous people listened and learned from the natural environment for it meant survival of their people. A full spectrum of IK is bridging the metaphysical and physical world together to create a full consciousness of the universe. Indigenous people were scientist, ecologist, meteorologist, etc. prior to the identification of such careers. However, unlike scientist, ecologist, and biologist today Indigenous people were less concerned with dissecting things in nature and more concerned with how certain plants/animals/elements interacted with one another and this knowledge was acquired through observation, not experimentation as described in the following excerpt:

Science forces secrets from nature by experimentation, and the results of the experiments are thought to be knowledge. The traditional peoples accepted secrets from the rest of creation. Science leaves anomalies, whereas the unexplained in traditional technology is held as a mystery, accepted, revered, but not discarded as useless. (Deloria 1999: 135)

This passage describes one difference between Indigenous science and western science. Traditional stories have passages that may be difficult to explain or hard to believe, but it's the faith in the moral and guidelines of the stories that makes them integral to the people. The best comparison in western ideology is the Bible. The Bible has many stories that have unexplainable events, but the people's fate in the metaphorical sense of the Bible makes the stories relevant. It is the same for Indigenous people with our traditional stories and ceremonies. We understand where we come from and we honor all the metaphorical aspects that our stories conjure. It is these metaphorical aspects that transcend Indigenous thinking beyond western paradigms:

As a concept, Indigenous knowledge benchmarks the limitations of Eurocentric theory—its methodology, evidence, and conclusions—reconceptualizes the resilience and self-reliance of Indigenous peoples, and underscores the importance of their own philosophies, heritages, and educational processes. Indigenous Knowledge fills the ethical and knowledge gaps in Eurocentric education, research, and scholarship. By animating the voices and experiences of the cognitive “other” and integrating them into the educational process, it creates a new, balance centre and a fresh vantage point from which to analyze Eurocentric education and its pedagogies. (Battiste 2002: 5)

It is these educational gaps that have hindered Indigenous students from excelling in areas of science and mathematics. Instead of trying to tailor Indigenous students around a curriculum that has been failing them, the curriculum should be tailored to the students learning styles. When educating Indigenous students their cultural values should be considered and incorporated into their teachings. Building that internal Indigenous knowledge into the educational system creates a dynamic learning environment that is conducive to the social and community values.

Incorporating IK into a watershed or any environmental curriculum embodies the same educational concepts, even if the application is implemented different, as summarized in Table 3-1 developed by Kawagley and Barnhardt (1998:13):

Table 3-1: Reconnecting Educational Practice to Indigenous Knowledge

<u>Indigenous View</u>	<u>Educational Application</u>
Long-term perspective	Education must be understood (and carried out) across generations
Inter-connectedness of all things	Knowledge is bound to the context in which it is to be used (and learned), and all elements are inter-related
Adaptation to change	Education must continuously be adapted to fit the times and place
Commitment to the commons	The whole is greater than the sum of its parts

The long-term perspective is an embodiment of thinking and doing to ensure that the seven generations are practicing and have equal access to the same resources and knowledge. The concept of seven generations is representative of the multigenerational family—great-grandparents, grandparents, parents, “you”, children, grandchildren and great-grandchildren. Thus “you” represent the center or the now and your knowledge and actions must be indicative of three generations before you and three generations after you. Through an environmental lens this means caring and knowing the land as your great-grandparents did so your great-grandchildren share that same knowledge. In western science this is known as conservation or preservation. The inter-connectedness of all things is the foundation of cosmology intertwined with stories and observation. The cosmology or worldview of a nation sets the foundation for the people while the stories help solidify how and why things are related and these in turn help an observer hone in on the elements. Understanding this connectedness is known as ecology in western science. Adaption to change is accepting that we live in a dynamic world and

survival is dependent on shifting with the change. This is also a part of ecology. Commitment to the commons is acknowledging the kinship of all elements established in the creation stories and understanding that a hierarchy does not exist between them. Each element is an integral piece for maintaining balance and thus actions should be made for the betterment of all. This is a notion of stewardship in western thought.

Empirical Knowledge of Place

My interpretation of empirical knowledge of place (EKP) is a temporal and spatial understanding of a place that is attained over time. The dictionary definition of empirical is, “depending upon experience or observation alone, without using scientific method or theory, esp. as in medicine.” One definition of knowledge is, “familiarity or conversance, as with a particular subject or branch of learning.” Place is also defined as, “a space, area, or spot, set apart or used for a particular purpose.” Combined together the concept means an observed familiarity of a space, area, or spot.

Empirical knowledge of place builds on the concepts of Indigenous knowledge, except it hones in on the direct relationship to the natural environment. It is through empirical knowledge of place that Indigenous people have survived and adapted with shifting environmental changes as expressed by Hawaiian scholar Manulani Meyer (2003: 98):

*Hawaiians lived in a subsistence economy. The quality of our survival was tied to the **intimate knowledge** [my highlight] we had of nature’s moods, planting secrets, weather patterns, history, and seasonal temperaments. The environment: plants, winds, stones, rain—they were the stuff of poetry, wisdom, healing, food, inspiration.*

It is through this “intimate knowledge” that Indigenous people learned to communicate with the natural environment and with one another. Communication for survival and for

travel was based on the landscape. Stories were told in reference to place as identifiers for plants, animals, water, neighboring communities, enemies, etc. Indigenous people utilized the landscapes, stars, sun, and moon as ways to keep track of time and location. Because these entities were the maps of survival they were held with the upmost respect. Keen observations of how the elements functioned and related to one another coupled with ways to articulate the knowledge in an acute and practical way were the teaching components for “the way a man talks about the physical universe is his only way of knowing anything about it” (George Trager, qtd in Basso 1996: 74). Davidson-Hunt and Berkes (2003: 6) also observed the same with the Anishinaabe:

The basis of how truth statements may evolve in Anishinaabe society is related to the perspective that knowledge is progressively revealed to individuals through their guided experience on the land. An individual is expected to learn through participation in experiences on the land under the guidance of a knowledgeable person, while also engaging in collective experience.

Familiarity with the environment is also rooted in Indigenous languages. Language identifies a people and expressions within the language provide purpose. Therefore, names hold significant meaning for Indigenous people and for their surroundings. Much thought is put into names and because names are so important many Indigenous people hold naming ceremonies. The ceremonies honor the language and the name to be given for it is believed that name ultimately personifies the individual. Thus, the naming of a landscape or entity is also done with purpose as Keith Basso (1996: 74) observed with the White Mountain Apache:

For whenever the members of a community speak about their landscape—whenever they name it, or classify it, or tell stories about it—they unthinkingly represent it in ways that are compatible with shared understanding of how, in the fullest sense, they know themselves to occupy it. Which is simply to note that in conversational encounters, brief

and lengthy alike, individuals, exchange accounts and observations of the landscape that consistently presuppose mutually held ideas of what it actually is, why its constituent places are important, and how it may intrude on the practical affairs of its inhabitants.

When a landscape is named it is named for future generations to understand. One purpose for naming a landscape (place name) is to direct people to it or away from it. Place names “provide a mental image of how a particular place within the landscape looks, how it is related to other places, what occurred at that place and/or what might be found at that place” (Davidson-Hunt, Berkes 2003: 8). Place names bring an area to life visually even before the place is visited. This descriptive visual provides the mapping that is shared amongst the community. Western science developed maps as a directory but “a map is always just a kind of symbol for a place, it is not the place it is meant to describe. Indeed, to know any kind of physical landscape you have to experience it directly, that is, to truly know any place you have to live in it and be a part of its life process” (Cajete 1999: 181).

Being a part of its life process created the intimacy that shaped the area and the people inhabiting the place for “people make a place as much as the place makes them” (Cajete 1999: 187). Sites were named not only by what encompassed the area, but also by what occurred at those sites. Sites with fertile grounds became farming areas, sites with medicinal herbs or sites that embody the spiritual beings of certain ceremonies became sacred sites. Thus guidelines are set for how to interact with each site based on its characteristics and purpose. The guidelines are passed on by teachings, stories, and songs so each generation recognizes the importance of the sites ensuring sustainability for the

community. Through this responsibility and respect for the environment Indigenous people became stewards of the land.

Relationships to the land are also connected to land tenure. Indigenous land tenure developed communal systems for regulating access to medicines, food sources, shelter, and other land-uses for the well being of all. Many of these land tenure systems were developed through family units, tying back to the seven generations concept in which what one inherits will eventually be inherited by those unborn. The identity of the people is shaped by this relationship to the land and to one another. Sense of place signifies “home” which encompasses identity, responsibility, respect, teachings, and temporal & spatial knowledge of that place.

Hybridization of Knowledge

Incorporating Indigenous knowledge into western science is one way to start revitalizing Jicarilla cultural stories and teachings while meeting the accreditation of teaching modern day science. Both ways of teaching are essential and each style stimulates the mind in various ways. Western science gives students the tools needed to explain the fundamental functions of the natural world. Indigenous science does the same thing, but it builds in a sense of personal growth and pride because it relates the natural environment to the establishment and survival of the people:

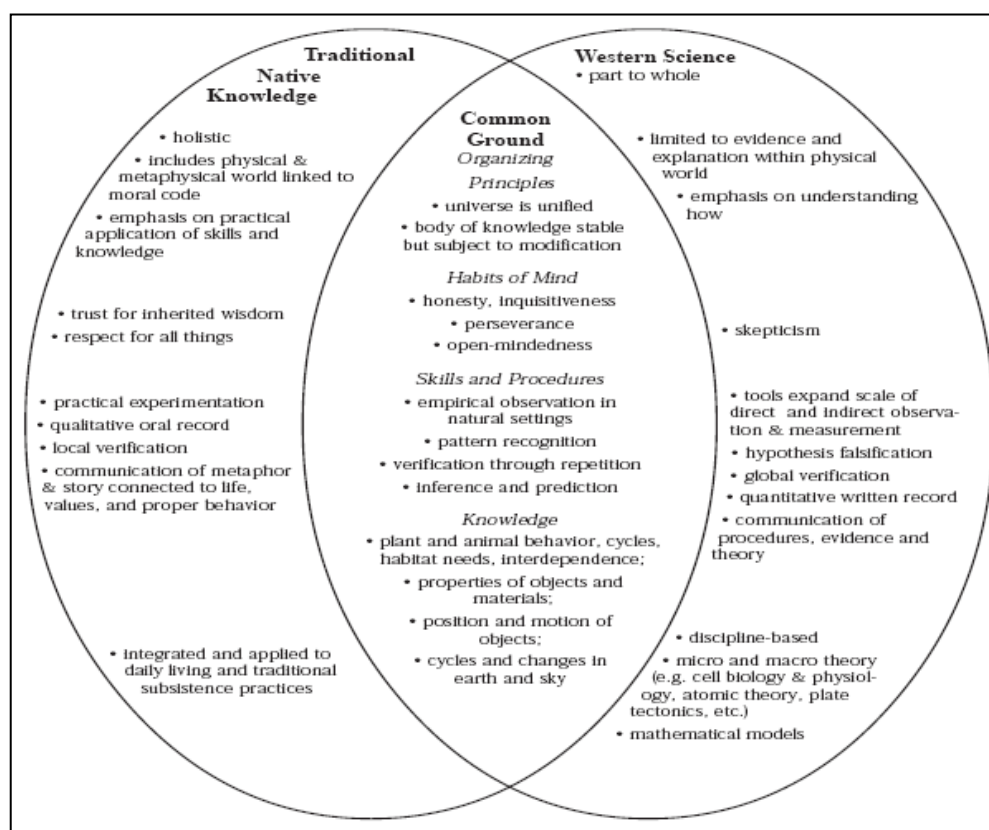
In the Native worldview, this can be thought of as the circle of life. In each Native person's life the central drawing force is the self. The self is grounded in the profound silence of the universe - its sustenance is spiritual, it is love, it is a sense of belonging to a tribe, belonging to the universe, belonging to something greater than ones self. Despite the impact of change in Native worldviews, many of these values have remained intact and are very applicable today. (Kawagley & Barnhardt, 1998: 8)

The values are what add the credibility to the teachings. It is only human nature to care more for something that has a direct impact to oneself. Many science curriculums tend to brush over the values and “portray science as the discovery of universal truths based on evidence gained through objective, reproducible experiments stripped of emotion, cultural contexts, and values” (Chinn 2007: 1251). For example western science focuses on the components of a plant (stem, leaves, cells, etc), but forgets to highlight why the plant is important to the people, animals, or other plants. For many Indigenous cultures they first learn how to identify a plant, when it can be used, and the importance of its uses. All these teachings are science-based because they incorporate understanding the ecosystem, the cycles of the plant, identification of the plant, and botany of the plant.

By first incorporating Indigenous knowledge into a science exercise the student begins to understand the concepts on a functional basis. Once the fundamental aspects are understood the technical western science structure can be incorporated. How the lessons are developed and incorporated for the varying age groups is based on situational learning. Certain stories or cultural lessons are specific to certain times of human development. Sequencing the lessons plans accordingly is essential and in this sense can be tailored to fit the science accreditations for the varying grade levels.

Different approaches are taken for both pedagogies, but they are both trying to achieve a similar outcome as indicated in the common grounds portion of the model (Figure 3-1) created by Sidney Stephens (2000: 11). The model bullets components pertinent to both epistemologies while pulling the commonalities together in four themes: Organizing Principles, Habits of Mind, Skills and Procedures, and Knowledge.

Figure 3-1: Model Comparison of Traditional Native Knowledge and Western Science



Source: Handbook for Culturally Responsive Science Curriculum

Utilizing this model depicts how Jicarilla Apache knowledge can benefit the Watershed Watch curriculum. By building on both epistemologies Jicarilla students will be exposed to teachings that create a well-rounded learning experience. Conveying Jicarilla worldviews and cosmology into the WWP curriculum builds on the *universe is unified* concept within the organizing principles. Bridging both epistemologies helps develop the students' *inquisitiveness* because it allows them to reflect on their personal cultural knowledge and realizing how it can fit into modern day science. Providing students the space to think in such a manner develops their skills in research, questioning, interpreting, and understanding—*inference and prediction*. The students' *knowledge* are then holistically grounded in both epistemologies.

Connecting Literature to Thesis

Since most Native communities no longer rely solely on the land for survival the principles for how to interact with the environment are not being passed on consistently. This coupled with the national trend of kids staying indoors more often has caused a disconnection with youth and the natural environment. For Indigenous youth this also correlates with an identity disconnection. Decolonization literature talks of rediscovering and recovering to reconnect with one's culture, history, language, and identity. Incorporating Jicarilla Apache worldviews into an environmental/watershed curriculum is a process of decolonization. It is validating the Jicarilla knowledge that has sustained the ancestors for millenniums. Strengthening the Jicarilla youths' identity also strengthens their roles as stewards of the land.

Traditional education gives us an orientation to the world around us, particularly the people around us, so that we know who we are and have confidence when we do things. Traditional knowledge enables us to see our place and our responsibility within the movement of history. (Deloria 1999: 143)

One goal, of the Watershed Watch curriculum and many other national environmental programs, is to link the youth back into the environment by taking the classroom to the outdoors. Because this is how Indigenous people have always learned it is only right to bridge the Indigenous knowledge into such curriculums. Not only will Indigenous students be learning about their environments they will connect to their culture and history of their people.

Incorporating the empirical knowledge of place from the Jicarilla Apache perspective into the Watershed Watch curriculum will strengthen the Jicarilla youths' knowledge about the importance of protecting their land. Knowing and understanding the

significance of the land base is essential for planning. Conscience and efficient planning comes from fully considering all the benefits and consequences of developing or preserving an area. If we as Jicarilla Apaches do not remember or value the importance of our land we can foolishly disrupt it for future generations. However, if guidelines for interacting with the natural environment are taught then resourceful planning will ensure sustainability for future generations of Jicarilla Apaches.

CHAPTER 4: CONTEXT

“A critical aspect of the struggle of self-determination has involved questions relating to our history as indigenous peoples and a critique of how we, as the Other, have been represented or excluded from various accounts. Every issue has been approached by indigenous peoples with a view to rewriting and rereighting our position in history.”

—Linda Tuhiwai Smith 1999: 28

History

Discussing the history of American Indians/Alaskan Natives is a marginalized and usually inaccurate practice within the educational system nationally. The histories of the first peoples’ of this country are not being told even with all the known and documented accounts and atrocities that have occurred since the “discovery” of America. Yet it is critical to know this history in order to understand the state of Indian country today. There are many social ills throughout Indian country that are attributed to colonialism and federal policies that worked to annihilate Indian ways of life. As stated earlier the process of decolonization is “developing a critical consciousness about the cause(s) of our oppression, the distortion of history, our own collaboration, and the degrees to which we have internalized colonialist ideas and practices.”

Telling the history of the Jicarilla Apache people is important to this thesis because it provides a transparent picture of the assimilated transformations that led to the increased loss of culture and language prevalent in the Jicarilla Apache youth today. Associated with this loss is that many Jicarilla youth are also relatively detached from the land. Learning this history and acknowledging the losses associated with the history is a

process of decolonization as well as moving forward with a mindset and “trust in our own people’s values and abilities, and a willingness to make change.” That change is recognizing that amongst the losses there are still a high number of Jicarillas that speak the language and possess the cultural knowledge needed to pass on to the younger generation. Tying in language and cultural knowledge into a watershed curriculum is an innovative way to reconnect Jicarilla youth to their identity and to the land.

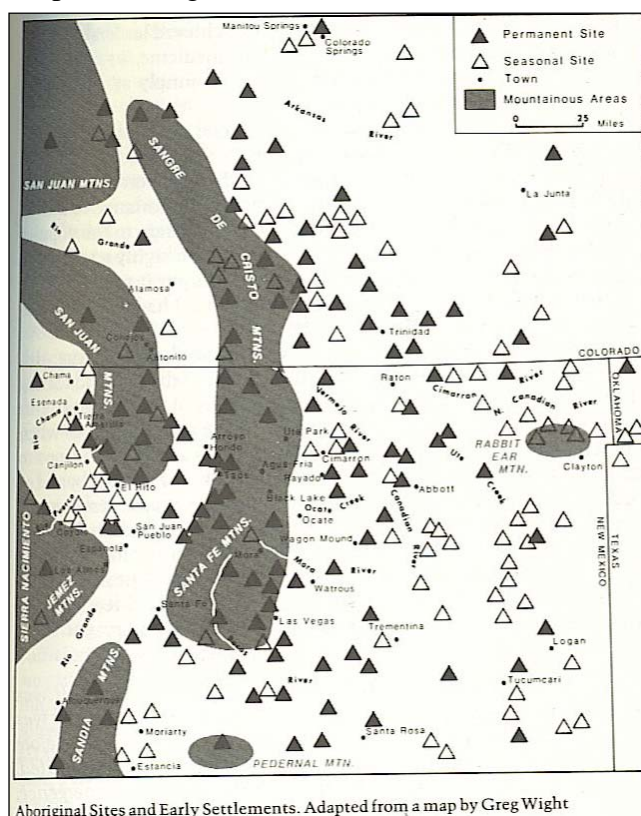
Past 150 Years

The original homelands of the Jicarilla Apache people ranged from the central and eastern parts of northern New Mexico, the southern portion of Colorado, and the panhandle of Oklahoma and Texas. Throughout this vast area the Jicarilla’s had permanent and seasonal settlements. The two Jicarilla bands, the Llaneros and Olleros, were divided throughout this area. The Olleros primarily lived along the Upper Rio Grande and its tributaries, in the valleys, and along the canyons. The Llaneros resided mainly in Mora, San Miguel, and Colfax counties in the northeastern plains of New Mexico and the along the foothills of the Sangre de Cristo Mountains (Tiller 2000: 13). Within each band family units also had their own settlement, which explains the numerous permanent and seasonal sites highlighted in Map 4-1. Sustaining families with food and shelter was easier in smaller family units.

The Jicarillas continued living traditionally in these settlements, through means of hunting and gathering and small-scale farming, relatively undisturbed into the early 1800s. There were minimal Mexican settlements in the area, however enough to provide trading opportunities. After 1846, with the Mexican War coming to an end and the state

on its way to becoming a new governing body, the Jicarilla's traditional way of living was slowly interrupted. New settlements began pouring into the area and the hostility between the new settlers and the Jicarillas grew. The Jicarillas were chastised and reported as "incorrigible, and it is believed they will continue to rob and murder our citizens until they are exterminated. I know of no means that could be employed to reclaim them" (Tiller 2000: 33).

Map 4-1. Original Homelands



Aboriginal Sites and Early Settlements. Adapted from a map by Greg Wight

Source: The Jicarilla Apache Tribe: A History

To try and counteract the hostility a treaty was signed in April 1851 by the Governor and four Jicarilla leaders whom agreed to a specific territorial area that the people could not wander beyond to become farmers and to cease their depredations. The government promised to supply annuities and supplies to the Jicarillas while they lived within the designated boundaries. Within the treaty the Jicarillas were not to go within 50

miles of any settlement or highway. However, the Jicarillas did not fully understand the "defined territory" and with increased dependency on trading for survival it was nearly impossible from entering neighboring villages. The designated agency delegates understood the discrepancy in the treaty and with the Jicarillas remaining peaceful there

was minor stress up until around 1854. A shift in governing delegates, a decrease in funding for supplies/rations, and miscommunication caused a lot of tension between the settlers, the government, and the Jicarillas that eventually led to war. Although the Jicarillas upheld peace as deemed by the treaty, the constant pressure for survival, the increasing death rates, pressure from the settlers, and lack of support from the government eventually led them to take up arms again.

And though the Jicarilla and other Southwestern Indian groups continued assaulting the frontier settlements and wagon trains, it was often out of pure necessity. Their reliance on limited game that had been over hunted by settlers forced the Indians to raid in order to survive. Once the game was depleted, they had no choice but to raid or starve. In addition, the Jicarillas were unable to settle lands due to geopolitical forces beyond their control. (Wazaney 2006: 20)

The years 1855-1872 were a time of confusion and tension between the Jicarillas and the government. The government was steadily trying to confine the Jicarillas to a specific area, but did not provide the people the means to survive. The ration system was established and was suppose to subsidize the loss of wild game and traditionally gathered food that the Jicarilla people depended on. This system was suppose to be a temporary solution, but the increased encroachment of settlers created competition for the limited natural resources. Even though the Jicarillas tried to survive off of traditional means they started to become dependant on the ration system, which “was to have been a provisional and tentative arrangement, became the government’s way of facing up to its responsibilities to its Indian wards. The classic trilogy of Indian dispossession—the encroachment of white settlers, dwindling wildlife, and the uncaring government—left the Jicarillas no alternative but dependency on the ration system” (Tiller 2000: 75).

The search for permanent land holding for the Jicarillas lasted between the years 1873-1886. The Jicarillas were settled from Tierra Amarilla to Abiquiu and continued to travel back and forth to Cimarron country, against the government's wishes. The government was steadily trying to relocate the Jicarillas to the Mescalero Apache Reservation, but they refused to be moved that far from their homelands. After many negotiations and failed attempts to remove the Jicarillas to undesirable lands, an executive order was signed in February 1887 establishing the current Jicarilla Apache Reservation. At last a suitable land base was established for the Jicarillas and in familiar territory. However, as Tiller indicated, "Their victory soon appeared to be hollow, however, because in the next half-century they witnessed some of the worst suffering they had ever known" (2000: 98).

Although a land base was finally in place for the Jicarillas, there were already settlers in the area that were opposed to the situation. The settlers quickly took heed on the quality lands. It was difficult for the Jicarillas to begin establishing farms when the settlers had laid claim to the minimal irrigable lands in the area. Not to mention that the government was trying to implement the Dawes Act on the newly established reservation coupled with corrupt governmental officials the Jicarillas were struggling to survive.

In the midst of the Jicarillas trying to acclimate to the new reservation life, a tuberculosis epidemic hit the people along with trachoma, measles, and influenza. The Jicarillas' immunities were not accustomed to the foreign diseases and as result many Jicarillas died. Inadequate supplies of food, lack of infrastructure, unsanitary living conditions, and insufficient health care increased the death rates. The population steadily declined

from 1898-1920 with the population reaching its lowest point in 1920 as shown in the following table:

Table 4-1: Jicarilla Apache Population Figures

Year	Population	Year	Population	Year	Population
1898	845	1907	776	1916	642
1899	831	1908	776	1917	645
1900	815	1909	791	1918	621
1901	813	1910	743	1919	600
1902	802	1911	720	1920	588
1903	774	1912	723	1921	594
1904	782	1913	669	1922	596
1905	795	1914	659	1923	608
1906	784	1915	642	1924	616

Source: Official Agency Censuses, Tribal and Public Health Records³

Poverty and disease stricken tested the Jicarillas faith in their spiritual healers. Because the medicine men could not heal many of the Jicarilla's sickness they began to feel helpless. Many Jicarillas then converted to Christianity as a means of seeking healing from the grueling deaths rapidly occurring. The Jicarillas felt converting to Christianity would offer hope for a better life. The Jicarillas traditional and cultural ways started declining with many Jicarillas converting to Christianity and by sending their kids to boarding schools as expressed by Van Roxel (1971: 29):

³ Wazaney, Bradford D, 2006, This Land is Your Land, This Land is Mine: The Socioeconomic Implications of Land Use Among Jicarilla Apache and Arden Communities.

Truly in these dark days the “storyteller” could foresee that the old men would be no longer and the young men be as white men...He did, however, foresee the weakening culture as he saw his young people leave for boarding schools. These young people would return for summer, but that was not story-telling time.

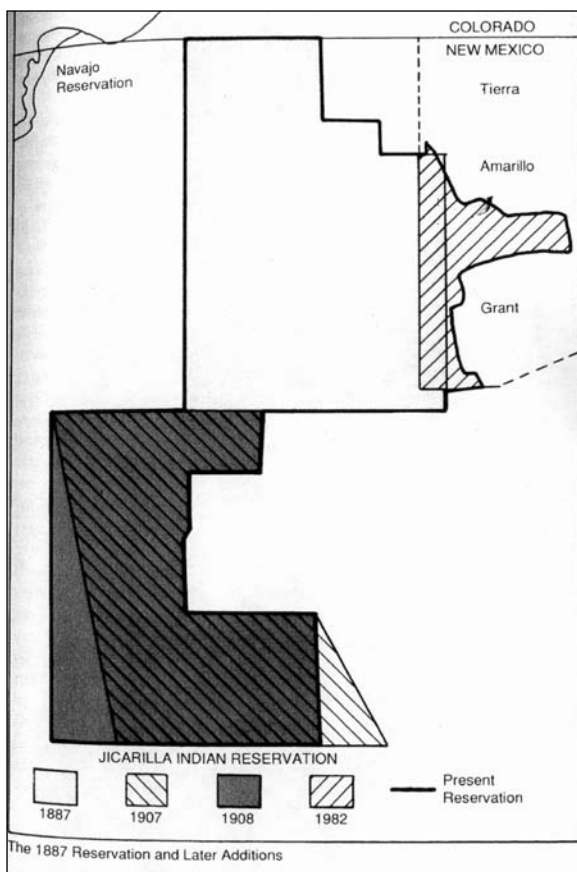
The first thirty years on the reservation really amounted to survival mode for the Jicarillas due to diseases and the rough transition to farming and ranching as a result of the government’s unresponsive and negligent acts of fulfilling their responsibilities. The Jicarillas took to farming but the land was not suitable for farming on a large-scale. The inadequate crops did not provide enough subsistence to offset the rations that were being cut, furthering the Jicarillas’ grim situation.

Farming failed to provide enough food for the people, thus the hopes that the farms would provide a level of income were dissolved. With the farms failing the government was to provide cattle and sheep to the Jicarillas to enhance their livelihood, which was another slow process. The cattle and sheep were to help the Jicarillas sustain their families, but also to introduce them to gaining capital. However, prior to distributing cattle and sheep the government authorized a bill to sell timber on all allotted and unallotted lands. This was another failed mechanism of trying to provide individual Jicarillas with income because the allotment assignments were all mixed up. In retrospect this in the long run became a benefit because the Jicarillas acquired additional lands.

To get the timber operation up and running the Jicarillas relinquished their old allotments and an executive order in 1907 expanded the reservation to include 160 acres of agricultural lands and 640 acres of grazing land. This new order was ratified in 1908,

solidifying the southern portion of the reservation as shown in Map 4-2. The new acquired lands were to be used for the proposed livestock.

Map 4-2: Jicarilla Apache Reservation Land Acquisitions



Source: The Jicarilla Apache Tribe: A History

sales and livestock operations in place the Jicarillas were still facing harsh conditions because of the government's mismanagement of funds.

Living conditions finally improved by the late 1920s into the 30s. The livestock industry grew and brought much needed relief by "improving the Jicarillas' morale. It added a new dimension to their lives, engendered a new feeling of confidence and greater sense of self-worth. As a result, economic conditions improved and, consequently, so did social conditions" (Tiller 2000: 115).

A sawmill was purchased and began operating successfully a couple years after the southern portion of reservation was acquired. The revenues from the mill were to be used to purchase livestock but instead the money was transferred into a federal treasury. It wasn't until around 1914 that the government finally purchased livestock for the people. The Jicarillas quickly took to ranching with each family owning a flock of either cattle or sheep. Even with the increased timber

Changes to reservation life continued into the 1930s with another governmental policy implemented across Indian Country. The 1934 Indian Reorganization Act was too help Indian communities establish their own governments, provide technical, vocational, and professional training, end land allotments, and encourage efforts to restore and maintain cultural practices and language. At first the Jicarillas opposed the new policy but ultimately accepted it and drafted the first Jicarilla Apache Constitution and By-Laws. The first election was held to approve the constitution, which passed with overwhelming voter approval. On August 4, 1937 the Secretary of Interior approved the constitution and created the first Jicarilla Apache tribal government and council.

The first council consisted of 18 men representing both clans—Ollero and Llanero—and majority of them represented and practiced the Jicarilla beliefs (ten were considered medicine men). This was the first time that leaders from both clans were making decisions as a collective for all the people. Even though the governing structure was new the first tribal council adapted quickly and made many critical decisions that helped lay the foundation for the Jicarillas' thriving economic autonomy that exists today. These leaders were not “educated” in western terms, but they were spiritual leaders that led and made decisions for the greater good of the Jicarilla people.

The 1940s-50s marked an era of developing economic stability. The discovery of oil and gas added to that stability, along with the continued revenues from the timber and livestock endeavors. The tribal council embarked in various investment opportunities and developed capital that helped improve the living conditions for the people. Increased finances exceeding the costs of tribal operations allowed for per capita distribution to all

Tribal members; first distribution occurred in 1952. In the mid 50s people began migrating away from their camp districts and by the end of the decade about 90 percent of the people were living in or near the town of Dulce.

The per capita distribution definitely influenced this resettlement and many people had mixed emotions about the per capita. On one hand the monies were needed to improve the living standards, but on the other hand the monies created a dependency that did not exist amongst the people before. Regardless of the criticism, the per-capita helped the people adapt to living in Dulce which at the time lacked adequate housing and infrastructure. The migration to Dulce also decreased the number of Jicarilla ranchers, thus created a need for employment opportunities in town. These employment needs shifted the self-reliant economy to a wage economy.

The 1960s-70s was an era of development and growth, which was supported by the Indian Self-Determination Act—another federal policy era. The Act provided the opportunity for Indian tribes nationally to determine the future of their people through their own governance. Tribes had the opportunity to implement 638 contracts that allowed them to develop much needed infrastructure on the reservations without assistance or approval from the federal government. With monies being generated from the various economic endeavors the Jicarillas were able to develop all types of infrastructure in the town of Dulce such as the tribal building, community center, housing, roads, and all other amenities needed to bring a town to life. The traditional way of living was a thing of the past with all the modern facilities now in place. Acculturation continued with education remaining a priority for the Jicarilla people and

the Dulce Independent School District was formed. The Jicarilla Apaches continued to create changes with the fortitude beckoned by the Self-Determination Act. This is reflected by the sovereignty that the Jicarilla Apache Nation exhibits in today's society.

Today the tribal government continues to govern based on the original constitution—with amendments over the years—and continues to embark on economic endeavors that allow the tribe to be self-sufficient. According to the 2000 census data the population of Dulce was around 2,945 with 2,511 identified as American Indian/Alaskan Native alone. Of the overall population the age percentage is as follows: 5 to 19 years = 32.8%; 20 to 44 years = 35.30%; 45 to 64 years = 17%; and > 65 years = 5.1%. Based on this data, over a 1/3 of the population are around school-aged children. These students make up a high percentage of the population and represent the target range that would benefit from a culturally infused environmental/watershed curriculum. The developed lessons plans could potentially be incorporated into one or all three of the schools—elementary, middle, high school—within the Dulce School District 21.

Repatriation

Providing a concise historical summary of the Jicarilla Apache people is important to this thesis because it highlights the drastic changes that the people went through in the last 150 years. Many changes to the Jicarilla Apache lifestyle occurred through the assimilation process. A lot of good things have happened over the years for the Jicarilla Apache people—out of great leadership from past tribal councils; sadly those gains came with a loss of language and culture.

An initial shift in Jicarilla Apache livelihood began in or around 1846 with the vast amount of settlers invading their area. Analyzing the history from 1846-1887 exemplifies the Jicarillas move from a traveling hunting gathering society to a sedentary state. Within a 40-year time span the Jicarillas were removed from the homelands that sustained them for generations. The move wasn't an easy one, but the Jicarillas gave up their homelands with hopes for a brighter future, sans fighting and war, for generations to come. The next forty years (1888-1930s) proved to be the toughest times for the Jicarillas. The transition to becoming cattle and sheep ranchers was not an easy evolution. It took many years after being settled on the newly established reservation for the livestock economy to sustain the people. As the people became more reliant on the government rations and livestock economy the further they moved away from dependency on the environment.

The passing on of language and certain cultural teachings to the younger generation started declining due to the survival mode that the Jicarillas faced within the first 30 years of acclimating to the reservation life. It was tough to focus on traditional means of living when harsh conditions existed everywhere. Practicing cultural ways was put on the back burner because surviving was more critical; however many Jicarillas did hold strongly to their traditional values and teaching. The dichotomy is that many Jicarillas were assimilating out of necessity—surviving meant assimilating into western culture. Assimilating meant converting to Christianity or another religion, sending kids to schools to learn English and western culture, adopting economic capital, and decreasing cultural practices. The language and culture slowly declined with each decade of assimilation and continued to digress with the new comfortable lifestyles that the 60s & 70s brought.

As a result today my generation and younger Jicarilla Apaches have minimal knowledge of traditional stories, knowledge of cultural teachings, and knowledge of our language. Because this knowledge is minimal in the present day it is essential that steps be made to revitalize and teach the Jicarilla youth and adults their culture and language.

The way cultural teachings and language was passed on and sustained by the people was through consistent practice and storytelling. Youth had to know the language in order to understand the teachings being told to them. As the language declined, so did the passing on of stories. Even though the stories have greater meaning when told in the Jicarilla language it is important to start telling the stories again (even in English) so youth and even adults can begin to learn some of the cultural significance and responsibilities of being Jicarilla Apache.

Native people have traditionally understood that creativity manifests itself in many ways and that this creativity leads to new knowledge and a greater understanding of relationship. Stories, particularly origin and culture hero stories, are mechanisms by which these understandings are conveyed to the next generation. (Cajete 2000: 43)

Cultural stories and teachings express the knowledge and intuitiveness that the ancestors possessed. They lived connected to the environment and they shared their knowledge to ensure prosperity and sustainability for the people. Even though early colonizers didn't recognize the knowledge that Indigenous people possessed, in today's society many non-Indigenous people are looking to Indigenous knowledge for best practices on environmental issues and beyond.

Today there are various initiatives taking place on the Jicarilla Apache reservation that focus on language and cultural revitalization. For example a cultural camp is held every

summer for the youth in which they camp out and throughout the time they are learning cultural teachings, crafts, and stories. Language classes have been offered on and off with hope that a consistent class will remain. It is important that measures as such continue to engage the community with opportunities to learn and share the Jicarilla Apache knowledge.

CHAPTER 5: LESSON PLANS

“The fact that students bring to the classroom ideas based on prior experience and that children of different cultural backgrounds frequently interpret science concepts differently than the standard scientific view, suggested that teachers need to begin the exploration of multicultural science instruction with the prior knowledge that children bring to the classroom. Thus, teachers need to probe for and incorporate the prior beliefs of indigenous children talk about the possibility of multiple perspectives and traditions of science in a classroom that encourages mutual respect as well as appreciation for differing opinions.”

—Gloria Snively, John Corsiglia 2000: 23

Framework

The thesis focused on developing a framework for building a cultural component into the Watershed Watch curriculum. That framework is outlined in the following two lesson plans which are tailored around a portion of the Jicarilla Apache creation story and Jicarilla knowledge of four plants. I focused on developing two lessons plans to highlight how Jicarilla knowledge can be utilized to educate Jicarilla youth about environmental science. The lessons are developed in a generic template, meaning they are not geared towards any specific age group. Reasons are 1) the lessons are frameworks to be built upon and 2) more knowledge needs to be sought from Jicarilla Apache elders and community members. I developed the lessons plans by creatively weaving together knowledge that was passed onto me from my relatives with information I found in books. I recognize that the community knowledge needs to be included to create lesson plans that are inclusive and multidimensional. The following lessons should be viewed as stepping stones for ways to incorporate Jicarilla knowledge into the educational system.

With further dialogue from elders and other Jicarilla community members, the lesson plans can be expanded and tailored to specific age groups and into other educational disciplines. Community members contributing their Jicarilla knowledge ensures that each lesson plan will embody the cultural richness that encompasses the community.



World View

Indigenous worldviews are the cosmologies of the people. The worldviews define the origins and philosophies of the people. They also define a structure for how the people carry and represent themselves with others, with animals, and with the environment. For Indigenous people the worldviews are defined within their creation story. Creation stories talk of the “kinship between non-human and human; reciprocity with nature; intermarriage with animals, earthly, and celestial beings; and youths who play a role in bringing humans and nature into closer relationships” (Cajete 2000: 35). Embedded in these relationships are the workings of multi-levels of science. Because creation stories set the stage of how things came to be it’s only appropriate to begin with the Jicarilla Apache creation story.

The essential elements in the Jicarilla Apache creation story are the spiritual entities, Earth & sky, water, wind, fire, cosmos, ceremonies, animals, plants, and people. Each element serves a purpose and without one the other would not be in existence. Prior to all being created everything existed as celestial beings in the underworld. It was through the power of the *Hactcins* (Holy Ones) that life forms were created. The *Hactcins* provided spirit for all living entities, thus they all co-existed equally. It wasn’t until all entities emerged from the underworld that the equality shifted. The responsibility of keeping

balance with all living beings was placed on the Jicarilla Apaches. The *Hactcins* gave the Jicarillas ceremonies and teachings for keeping this balance, which also meant learning from the environment, animals and plants.

Figure 5-1: Jicarilla Apache Emergence Story

Emergence Story	Images
<p>...Now the fly and the spider went upward again on that ladder. They saw a great deal of water up there. They could see no ground at all. The spider made a cylinder of web which protected them and they went up to the top through this. Spider then wove four webs on top of the earth of four different colors and stretching in four directions so that the four Holy Ones could ascend.</p>	 <p>The illustration shows a spider climbing a wooden ladder that extends from a colorful, patterned ground up to a large, funnel-shaped web. The sky is a deep blue with several bright yellow suns or stars. The spider is positioned near the top of the ladder, about to enter the web.</p>
<p>The four came up. Black Hactcin stood on the black web to the east and the others took their places too. They talked of what to do, for the sun was past the middle of the sky already. Then they said, "Let us make four hoops of the different colors, one black, one blue, one yellow, and one glittering. They did so and threw the black one to the east, the blue one to the south, the yellow one to the west, and the glittering one to the north. Every time they threw one, the water rolled back and grew less where they were stood. The water had receded from the land and had made the oceans as they are now.</p>	 <p>The illustration depicts four figures standing on a large, multi-colored web that stretches across a blue, wavy surface. Each figure is holding a circular hoop of a different color: black, blue, yellow, and glittering. The sun is visible in the sky above them.</p>

But everything was still muddy. So they sent for the four Big Winds of the different colors and for the little winds too. The winds blew and made it all dry. But the winds couldn't dry off certain places where the springs and rivers were. When the wind was hurling the water back and exposing the land, it lifted the water high in the sky and held it there. Over by the oceans the water is still held there by the wind. High in the air there are four winds: the black wind from the east makes the water warm, the blue wind from the south makes it cool and fresh, the yellow wind from the west freezes the water and turns it to snow, and the glittering wind from the north turns it to ice and hail. These four people are always there handing around the moisture of the air. When it is handed to the wind of the north, it turns to ice. Then, when it handed to back to Black Wind of the east, he warms it and it turns to water again. That is why we have the moisture of the air in all these forms.



White Hactcin said to the wind, "Hold the water there and when it is needed we will let you know and you must blow and bring the rain." Hactcin talked to the thunder, "You must lead," he said, "so people will hear and know the rain is coming and get ready. They will prepare buckets to fill and be ready to receive the rain." Then he spoke to the sun saying, "You must shine on the lakes and rivers so that the steam will arise and turn to water and give rain. But Wind, you will always carry the water in the air; you are responsible for it. If the heat does not pick up the water but heaves it around on the earth in the same way all the time, the water will become dirty and unfit for use. But by changing it in this manner it will be made pure and good for the people



Lesson Plan 1: the Hydrological Cycle

The first lesson plan focuses on introducing students to the hydrologic cycle. The Watershed Watch curriculum introduces students to the hydrologic cycle through a handout with a diagram that shows the various components of the cycle. Each process in the water cycle is defined and students are asked to reflect on how those processes work. This lesson plan can be found in Appendix A. I took this lesson plan and modified it by introducing the hydrologic cycle to the students through storytelling. Instead of just giving the students a handout that depicts the hydrologic cycle, they will be immersed into the functions of the cycle by visually piecing it together it while listening to the

story. Inviting an elder from the community to lead the exercise will provide the cultural guidance needed to move the exercise forward appropriately. The elder will provide the cultural expertise needed to answer questions that are bound to arise regarding the emergence story.

Once the story is shared dialogue can be created through a reflective process using an ORID dialogue model. ORID is a process that helps groups collectively talk about a shared experience while allowing individuals to come to their own understanding of that experience. This procedure is an inherent process that many Indigenous cultures already practice, so the elder present may naturally lead the group through this reflective piece. ORID involves asking questions that are **O**bjective (what do you see happening), **R**eflective (how do we feel/have we had similar experiences), **I**nterpretive (why: understanding root causes), and **D**ecisional/action (do: what can we do about this, taking action). Building this reflective piece into the lesson plan is important because it allows the students to share their understandings of the emergence story. This collective dialogue is where the students teach each other and allows for inquisitive conversation with the elder, teacher, and with their families.

The Hydrologic Cycle

LESSON PLAN

In this lesson students are introduced to the hydrologic cycle through storytelling. Students will listen to a portion of Jicarilla Apache creation story and learn how the world was created according to their ancestors. It is recommended to have an elder from the community present to tell the story and for cultural guidance. The lesson can be conducted indoors or outdoors depending on weather and accessibility to an outdoor setting. The intent is to keep the lesson experiential and interactive.

Purpose of Activity: To learn about the basic concepts of the hydrologic cycle from a cultural perspective. The contents of the lesson include engaging in storytelling to learn from the Jicarilla Apache emergence story about how the land and bodies of water were created.

Objectives: Students will explore the dynamics of the hydrologic cycle through cultural teachings.

Materials Needed for Session:

- Print-outs of Jicarilla Apache Emergence Story handout

Background: Many cultures have different worldviews of how the world came to be. Every Indigenous culture has their own stories of how their people came into existence as well as the natural elements of the world. Every religion has its own belief about how the world was created and there is the scientific notion of how the earth evolved over time. The scientific belief is evidence driven and the theories are constantly being tested to prove validity. Unlike the scientific evidence-based world, Indigenous cultures and religions hold onto the stories that bring into existence their worldviews. Within these stories are the teachings that convey the richness of the world in a comprehensive manner. Every story should be respected for they contribute and create an understanding of the diversity that exists across the world.

The creation story of the Jicarilla Apache people tells how things came to be. First the world was created, then the earth, the underworld, and lastly the sky was created. All the people dwelt in the underworld and they first existed as spirits. The Black Hactcin (holy one) existed in the underworld and he first formed animals using clay. After the animals were created, Black Hactcin created the people. All of the creations came into existence in the underworld. When the opening to world above was discovered the fly, spider, and Holy Ones were the first to emerge from the underworld. The Holy Ones began creating earth by pulling back all the water that existed everywhere...

Utilizing the emergence portion of the Jicarilla Apache creation story illustrates how the earth was created by the Hactcins (Holy Ones). The Hactcins had the power and mutual respect with the natural elements that allowed them to create earth. In this creation process are lessons about relationships within the natural environment. It is these relationships that helped establish balance and the natural cycles of all entities.

Prior to introducing this lesson plan to the students, consultation with an elder from the community is recommended. Let the elder know that you are interested in sharing the emergence story pulled from the book, *Myths and Tales of the Jicarilla Apache Indians*, with your class because it illustrates components of the hydrologic cycle. Ask the elder if he/she would be willing to tell this story or the story they know with your classroom.

Share the illustrations, Jicarilla Apache emergence story handout, created for the sections of the emergence story. The story is an excellent teaching tool and would provide a more thorough learning experience than just talking about the hydrologic cycle alone. If the elder cannot come into the classroom, ask if they would be willing to be recorded. Some elders may not be comfortable sharing their knowledge and that is acceptable, however; there are always elders in the community willing to share their knowledge.

Activity: Introduce the elder present to the students. Let the students know that today they will learn about how the earth came into existence based on their ancestors' knowledge. The elder will share a portion of the creation story to illustrate the knowledge their ancestors possessed about the creation of all things and their relationships to one another. Within the story are fundamental science-based applications that can be drawn out when the students reflect back on the story. If an elder cannot be present to share the story, then the pre-recorded audio can be used. Before the elder begins telling the story:

- 1) Establish guidelines around respectful listening when the elder is talking.
- 2) Let students know that various versions of the creation story exist in the community and respect needs to be shown for each version. The purpose of sharing stories is to learn from them, not too show criticism.
- 3) Encourage students to seek out stories from their families.

Allow enough time for the elder to tell the story. After the story is shared the elder may begin asking the students questions or vice-versa. Allow this space for dialogue. If assistance is needed, lead the group through an ORID process. ORID is a method that helps groups collectively talk about a shared experience while allowing individuals to come to their own understanding of that experience. ORID involves asking questions that are:

Objective (what do you see happening)

- What did you hear in the story?
- What do you remember most from the story?
- What did you like about the story?
- What did you see while listening to the story?

Reflective (how do we feel/have we had similar experiences)

- What intrigued you most about the story?
- What kind of feelings did you have while listening to the story?
- Did the story motivate you in any way?

Interpretive (why: understanding root causes)

- What did you learn from the story?
- Why are the winds important?
- How is water transferred around?
- What is this process called?

Decisional/action (do: what can we do about this, taking action)

- What lessons can we take from the story?
- How are you going to use these lessons in life?
- How else can the story be used?

After the story and reflective piece is completed, if there is time left, you can distribute the Jicarilla Apache Emergence Story handout. If there is not enough time, then this portion of the exercise can be continued the next day.

After the handout is distributed allow some time for the students to absorb the visuals. You can ask the students to share what they were visualizing when the story was being told. Once they shared their thoughts you can move into talking about the hydrologic cycle based on the last image of the handout. Ask the students if they know what the arrows represent. How are they described in the story and why are they important? Once they shared their ideas you can provide the technical terminology for each process.

- Precipitation (rain, snow, hail, the source of all our water which becomes these other forms)
- Evaporation (conversion of water into vapor)
- Condensation (conversion of water vapor into droplets of liquid water)
- Transpiration (the process by which plants absorb water to grow and then evaporate the water into the atmosphere as water vapor)
- Runoff (fluid water flowing downstream to streams or lakes)

Any component of this lesson plan can be and is encouraged to be conducted outdoors. Taking the students to the environment stimulates all their senses because they visualize the watershed, smell the environment, touch the ground, etc. Taking the students to an area that has cultural significance will also elevate the lesson due to the significance of the place.

Lesson Plan 2: Plant Identification

The second lesson plan focuses on introducing students to plant identification based on their physical characteristics and uses. To create diverse lesson plans I searched through multiple environmental curriculums and found a lesson in *A World in Our Backyard* on creating a wetland plant wheel (lesson plan located in Appendix B). I modified the plant wheel to incorporate plants that are found in the riparian zones of northern New Mexico, specific to the Jicarilla Apache reservation. I choose to highlight four plants that are

significant to the Jicarillas. In the original lesson plan, the plant wheel challenges students to match the right plant (name and picture) with the right characteristics based on what type of plant it is (tree, shrub, emergent, etc) and its description.

To add the cultural piece to the plant wheel I wanted to focus on the uses and descriptions of the plants based on Jicarilla knowledge. Therefore, the plant wheel will be two-sided; one side giving the scientific descriptions of the plant and the other side highlights the uses and descriptions based on Jicarilla knowledge. Students will understand the significance of the plants from a cultural perspective and scientific understanding.

Plant Wheel

LESSON PLAN

In this lesson students are introduced to four plants that can be found within the riparian zone in northern New Mexico. Each plant is important to the Jicarilla Apaches and each is used for different purposes. It is recommended to have an elder or knowledgeable community member present for cultural guidance. The plant wheels can be constructed in the classroom and used in the field to identify the plants.

Purpose of Activity: To learn about the fundamental characteristics and uses of native plants located within the Jicarilla Apache reservation. The contents of the lesson include plant identification based on its scientific properties and Jicarilla knowledge of the plant uses.

Objectives: Students will be able to recognize local native plants on the Jicarilla Apache reservation during a visit to the Little Navajo River using the plant wheel they construct.

Materials Needed for Session:

- Copies of the plant wheel sections
- Construction paper, cardboard, or manila folders
- Scissors, markers, colored pencils, paper fasteners
- Real plants

Background: Plants are a diverse group of living things that include trees, flowers, grasses, vines, bushes and ferns. Plants play a role in shaping landscapes, the diets of

animals and humans and in shaping cultural diversity. Plants are important to humans because they provide us with oxygen that we breathe and are an essential food source. Plants have many uses beyond simply providing food. Plants can be used for fuel, medicine, shelter, clothing, dyes, and perfumes to name a few examples. Cultures around the world are shaped by their local environments, which include how plants are utilized for their survival. Much knowledge can and has been gained from Indigenous knowledge about plant uses.

Learning how to identify plants is the first step in learning about the plants' uses. Many plants look similar to one another, so it is essential to understand how to identify the correct plant. Many plants can be poisonous to the touch and if ingested, therefore identifying the correct plant can prevent harm to the body.

Before there were stores to buy food and pharmacies to buy medicine Indigenous people looked to the land to provide these necessities. This required having an acute understanding of the local landscapes. Knowing what plants were edible and what plants possessed medicinal properties was knowledge that was passed on from generation to generation.

Prior to introducing this lesson plan to the students, consultation with a Jicarilla elder or knowledgeable community member is recommended. Let the elder/individual know that your class will be learning about local plant identification and you would like to incorporate the local Jicarilla Apache plant knowledge into the lesson plan. Share the development of the plant wheel to illustrate how the students will learn to identify the plants characteristics and uses. Invite the elder/individual to be present in the classroom or in the field to share their knowledge about the selected plants.

Activity: Introduce the elder/individual present to the students. Let the students know that today they will learn how to identify some local plants based on their physical characteristics and uses. They will be constructing two-sided plant wheels that illustrate how to identify a plant based on scientific knowledge and Jicarilla Apache knowledge. The four plants that they will learn about are 1) Chokecherry Tree, 2) Threeleaf Sumac, 3) Coyote Willow, and 4) Gamble Oak.

1. Distribute the hand-out Helpful Facts on Plant Identification to each student. Review the hand-out to familiarize the students with ways to identify plants.
2. After this review the students can begin constructing their plant wheels.

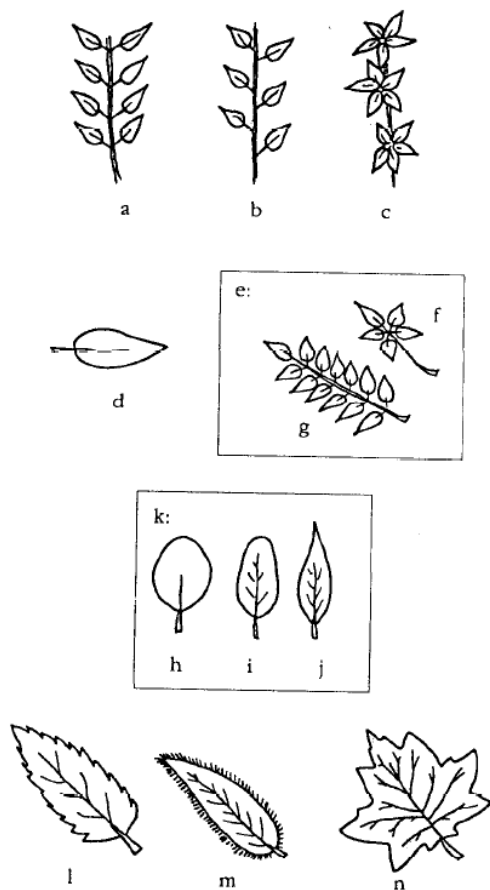
Constructing the Plant Wheel:

- a. Distribute the side-one outer, middle, inner and pie-shaped wheel print-outs to each student. It is recommended to have the students complete one side of the wheel before completing the other side.
- b. Have the students glue the side-one outer, middle, inner and pie-shaped wheels to a piece of cardboard or manila folder.

- c. Once each piece is dried, carefully cut out each wheel.
 - d. Once each wheel for side-one is cutout, distribute the wheels for side-two and repeat steps 2 and 3. Remind students to keep the side-one and side-two wheels separate.
 - e. After each wheel for both sides are cutout, take the side-one outer wheel and side-two outer wheel and glue them together, back-to-back, so that the centers match.
 - f. Align the side-one middle, inner, and pie-shaped wheel with the side-one outer wheel and poke a small hole through the center of all wheels with the paper fastener. Do the same with the side-two middle, inner, and pie-shaped wheel to create a two-sided wheel.
 - g. The middle, inner, and pie-shaped wheels of side-one and side-two should be movable to match the plant with its proper characteristics and picture.
3. Once all the students' plant wheels are completely constructed begin asking the students about each plant. Having the actual plants available would add to the lesson because the students can touch and see the plants up close.
 4. Go through each plant individually. Ask if anyone can identify the chokecherry tree.
 5. Go through each characteristic together, saying the scientific name, how the leaves are shaped, how tall it can grow, etc. Repeat this process for each plant.
 6. After each plant on side-one is identified and characterized, move onto side-two of the plant wheel.
 7. Re-introduce the elder/individual from the community that will be facilitating this section of the lesson.
 8. Allow the invited guest to work through each plant with the students, as they feel best.
 9. Can incorporate an ORID dialogue that focuses on asking questions that are
 - a. Objective
 - b. Reflective
 - c. Interpretive
 - d. Decisional

Helpful Facts on Plant Identification Handout⁴

Review this information with the students before constructing the wheel:

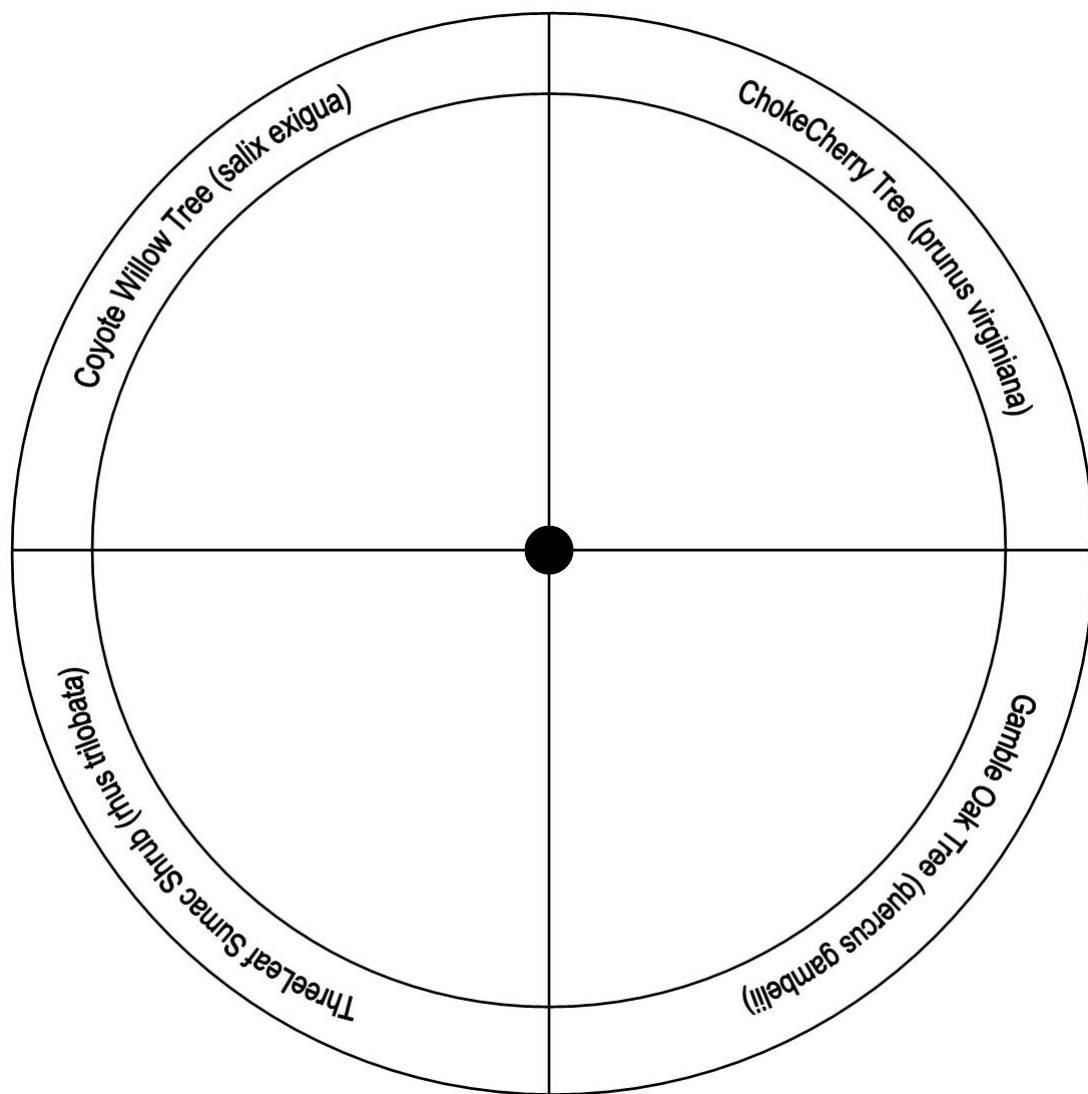


- A plant does not always look the same; it may change with the seasons. In winter, most soft plants *die back*, though some leave behind woody stalks, e.g., a cattail. Many trees and shrubs do not have leaves in winter while some do. *Evergreen* plants keep their leaves in winter; *deciduous* plants lose their leaves.
- Many plants do grow flowers though we *do not call the plant* "a flower." Flowers appear and transform into fruits. Seeds form within the fruits.
- Leaves and twigs are arranged in different patterns on different plants. They may be *opposite* (a), which means that they grow out of the same place on the stem but on opposite sides of the stem. *Alternate* (b) leaves sprout at different places on the stem, alternating from one side of the stem to the other. *Whorled* (c) leaves grow out of the same place on the stem all the way around the stem, like the spokes of a wheel.
- Leaves may be *simple* (d) (one leaf on a stem) or *compound* (e). Compound leaves have several *leaflets* on a stem, arranged in the shape of a hand – *palmate* (f) or like a feather – *pinnate* (g).
- The shape and edges of leaves also are important in identifying plants; leaves may be *round* (h), *oval* (i), *long and/or pointy* (j); edges may be *smooth (entire)* (k), *toothed (jagged edges)* (l), *hairy* (m), *lobed* (n), etc.

⁴ A World in Our Backyard

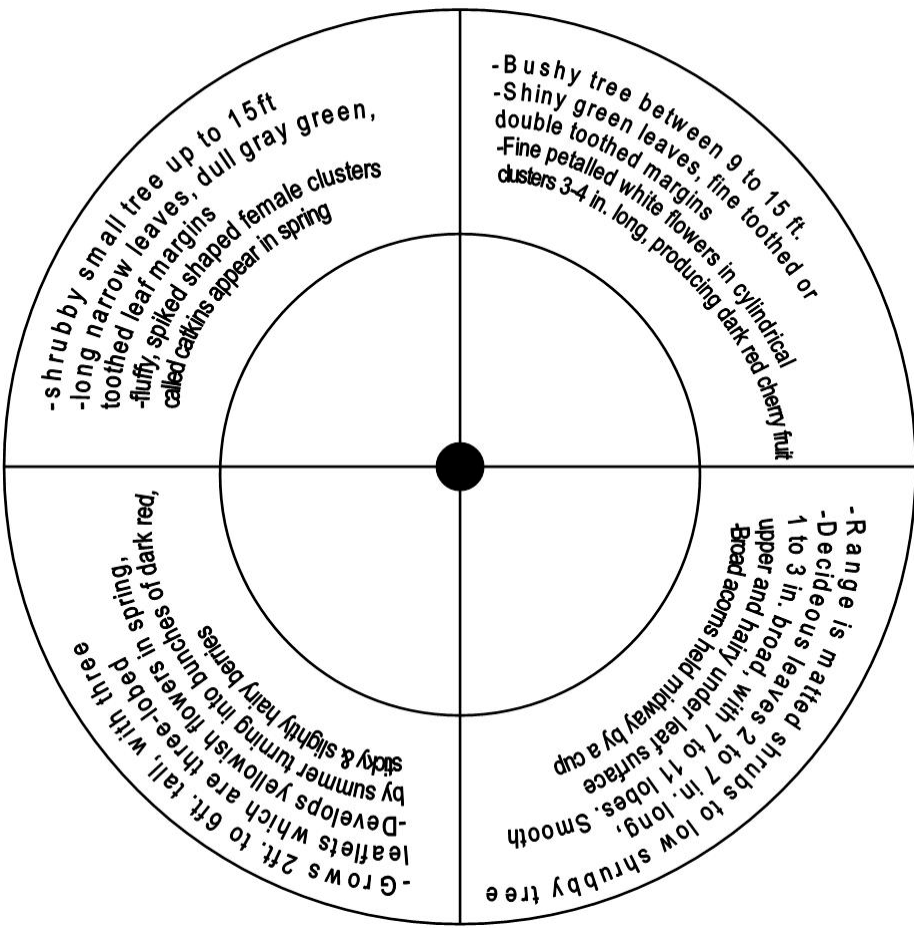
Side-One Outer Wheel

photocopy and cut out



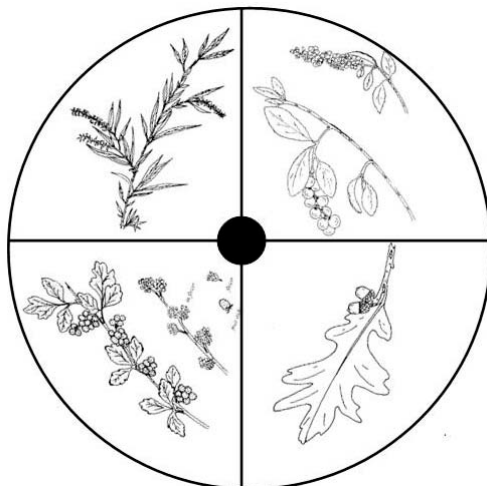
Side-One Middle Wheel

photocopy and cut out

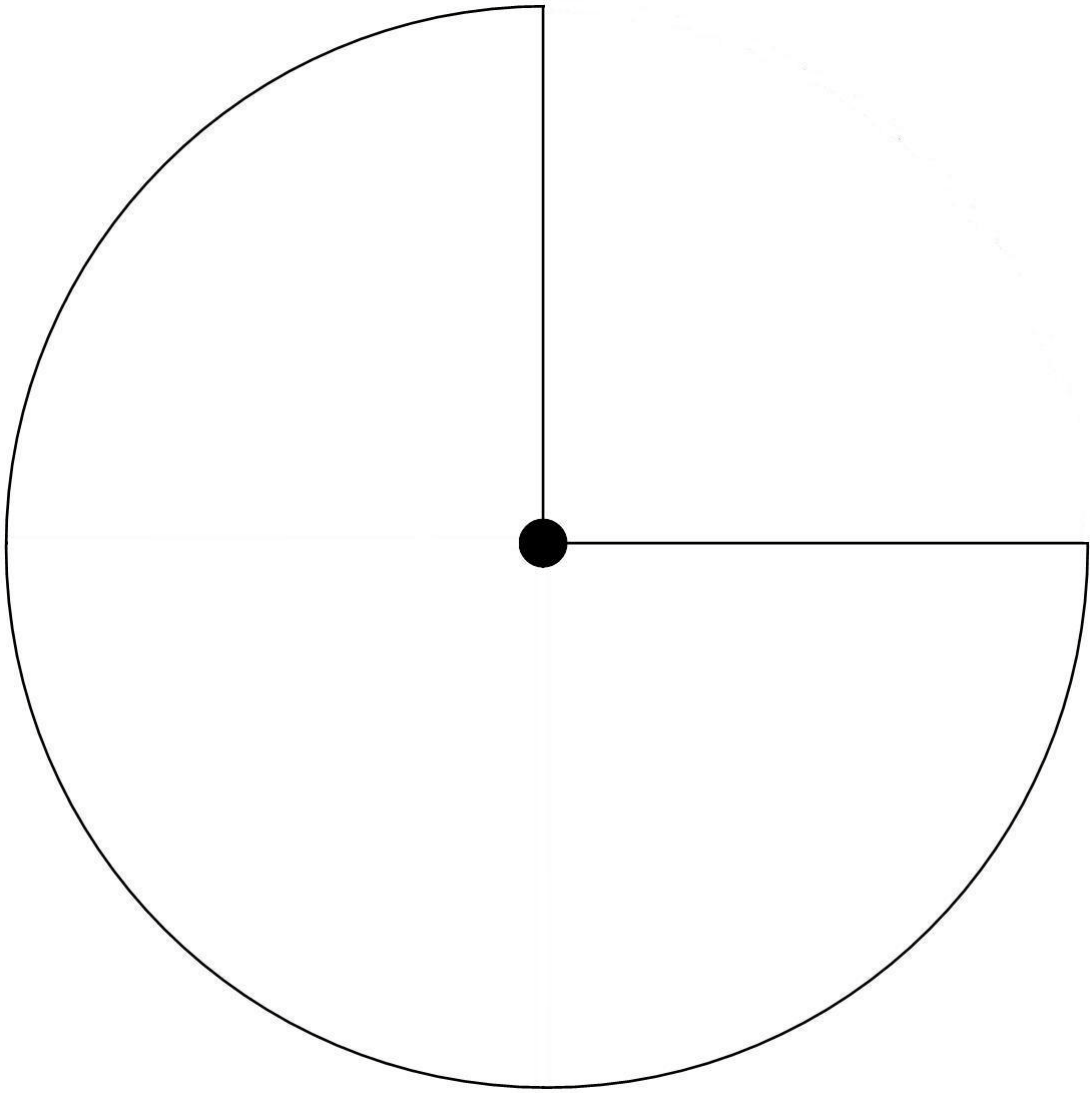


Side-One and Side-Two Inner Wheel

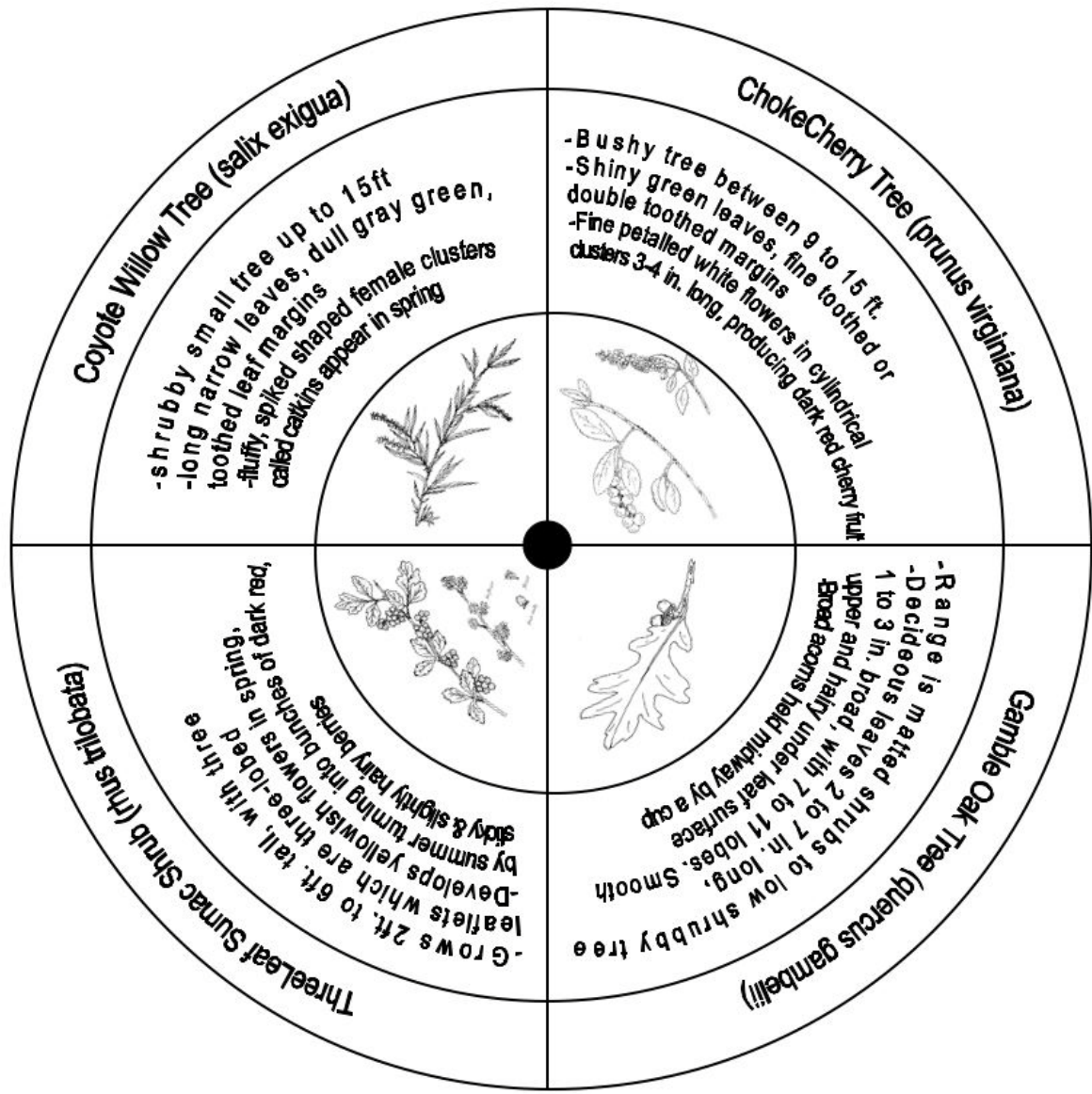
photocopy and cut out



Side-One and Side-Two Pie-Shaped Wheel

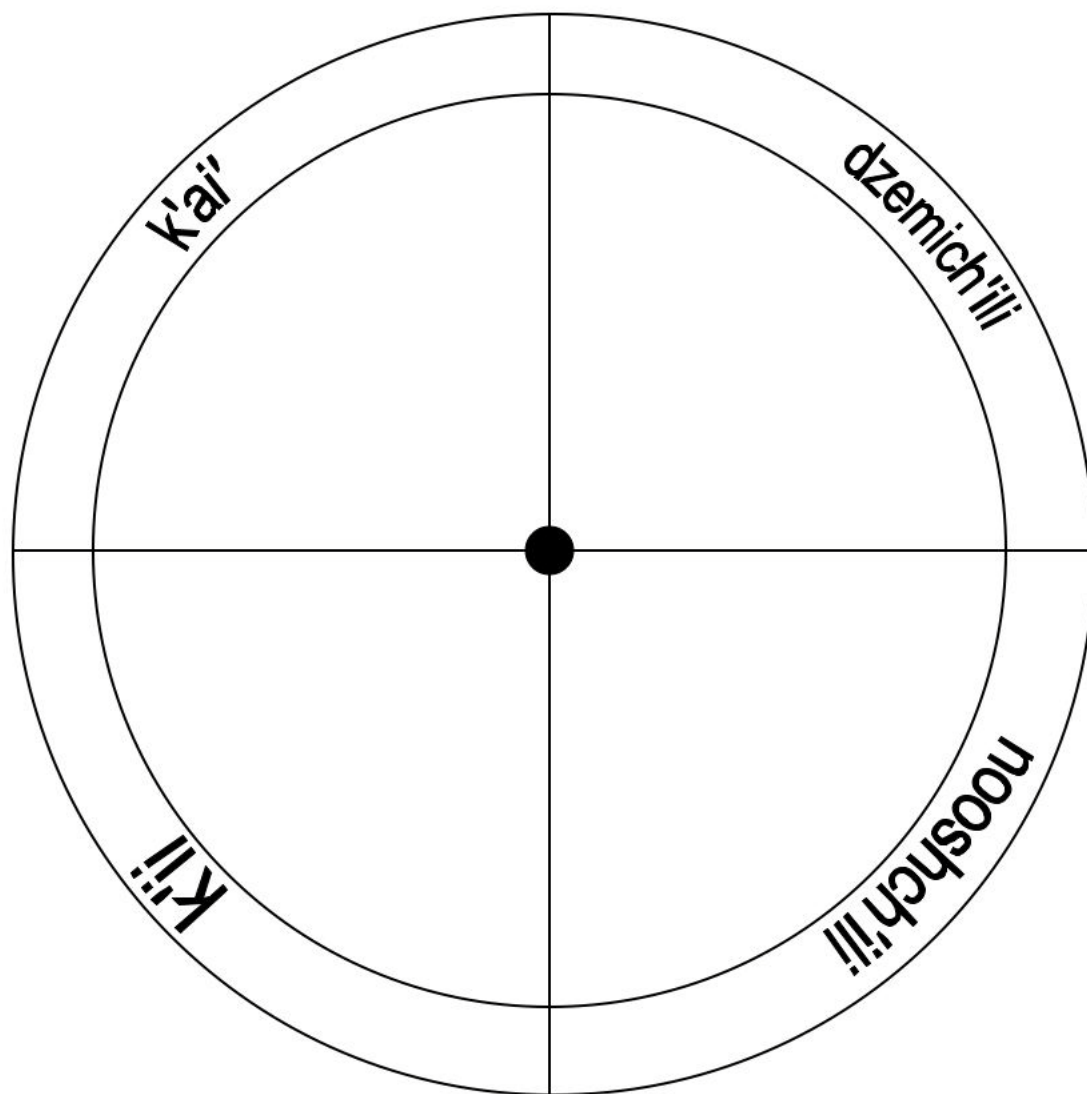


Side-One Teacher Key



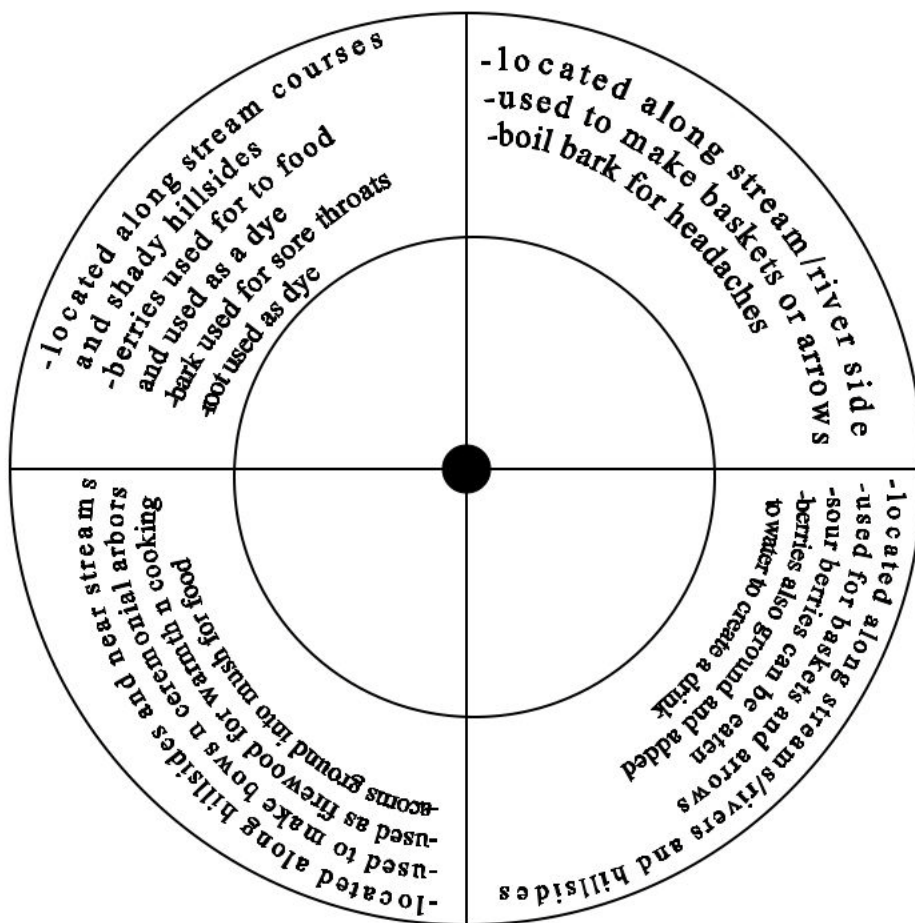
Side-Two Outer Wheel

photocopy and cut out

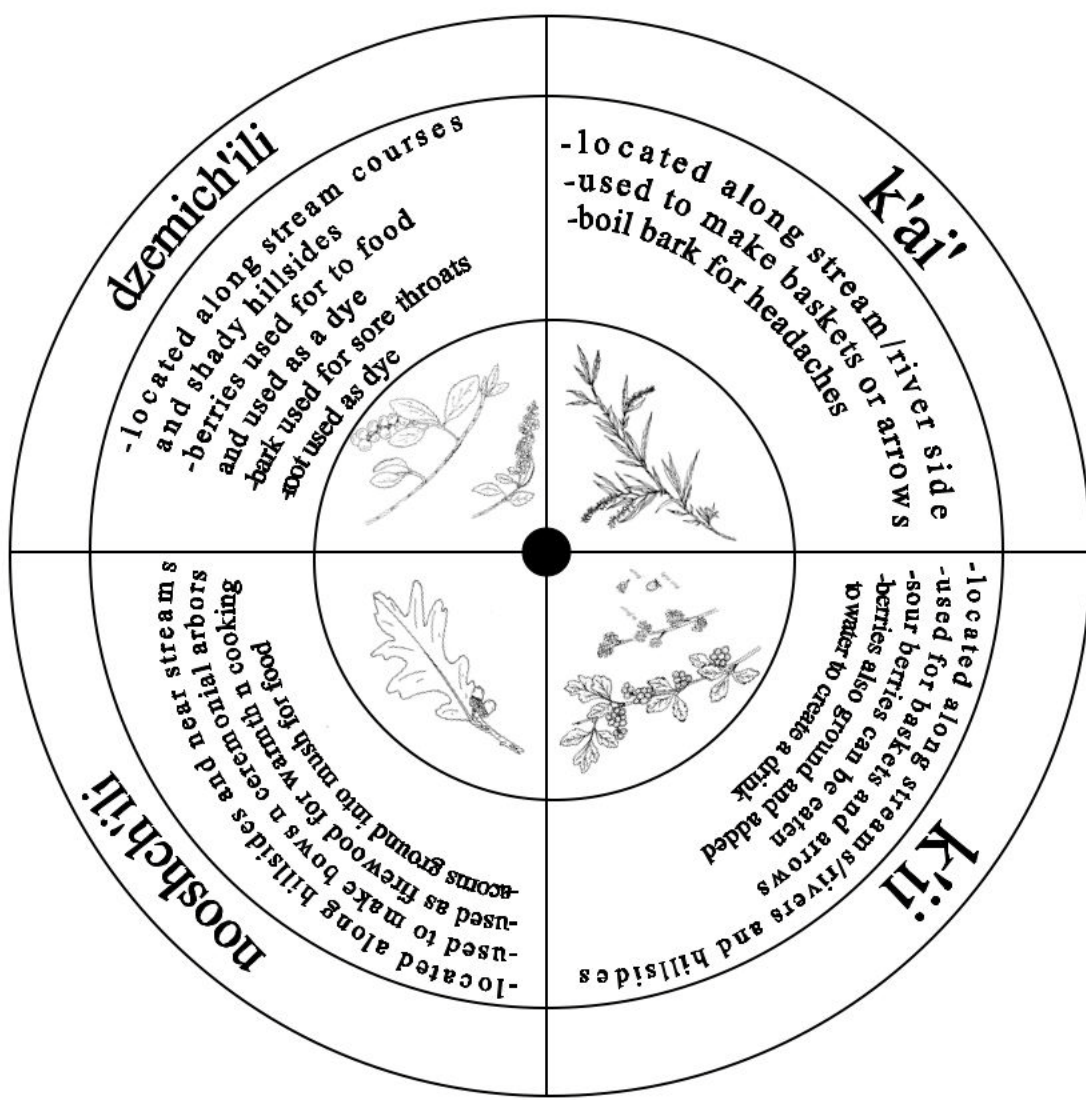


Side-Two Middle Wheel

photocopy and cut out



Side-Two Teacher Key



CHAPTER 6: CONCLUSION

“What makes Indigenous theories of culture distinctive is in part that they are less a matter of theory than of process, and thus we cannot just enumerate the content of the theories more effectively; we must engage their dynamism in creative ways.”

—Michael D. McNally 2004: 604

Progressive

The main purpose of this thesis was to demonstrate that Jicarilla Apache knowledge would enhance an environmental/watershed curriculum. Many progressive educational curriculums exist today that focus on engaging students in dynamic ways of learning. Most of these types of curriculums are experiential based, meaning they promote hands-on learning. Educating in this manner may seem progressive in today’s educational system, but historically this is how Indigenous people educated one another. Yet majority of Indigenous students are educated from a western paradigm that overlooks the inherit knowledge that exists in the students they’re educating. The knowledge and wisdom that their elders and community members possess can contribute to their understanding of science, math, social science, history, etc.

The New Mexico Watershed Watch Program was developed to pro-actively educate and familiarize students with their local watersheds. The program recognized that in order to develop stewards of the environment students needed to be actively engaged with their environment. Therefore, the curriculum uses the environment as the classroom with various activities that teach students how to analyze a watershed’s health and explains why healthy watersheds are important. In the process students learn various data

collecting methods and ultimately become monitoring stations. The data that they collect is shared with the local or state agencies.

By first learning why watersheds are important and then learning how to analyze and monitor the health of watersheds the students are inadvertently introduced to planning methods. Land-use factors play a critical role in the health of watersheds. Students begin to understand that conscious planning benefits the environment. How humans develop homes, roads and other types of infrastructures has a direct impact on the environment.

In order to implement conscious planning an understanding of how the natural environment functions is essential. Nature has its own internal planning that requires certain measures to be in place to assure balance. When nature is unbalanced environmental breakdowns occur. For example, a livestock pasture located close to a stream can impact the water quality if the number of livestock exceeds the area's capacity and the pasture is overgrazed. Overgrazing the pasture can cause high levels of sediment and fecal matter run-off into the stream. The stream has a natural system that breaks down impurities and naturally cleans itself. If toxins are inputted at a rate faster than the stream can breakdown the toxins, it becomes polluted. By engaging students in the environment to monitor such an example the students begin to connect the various components together.

Contribution

The WWP helps students to understand the various human—environmental dynamics as highlighted in the above example. The WWP is effective in educating and engaging students in environmental/watershed health. The purpose of incorporating Jicarilla

Apache knowledge into the WWP is to enhance the learning experience for the Jicarilla Apache youth by teaching about watershed health through a cultural lens. This process provides for a multidisciplinary and multidimensional learning style that focuses on creating meaning in life as oppose to just training students. Students can master all the data collection methods, but if no passion and purpose exist for maintaining the environment then the training is meaningless. Providing cultural meaning breathes spirit into the teachings and it's that spirit that provides value for the Jicarilla students. As the Jicarilla students recognize that many elements in the environment are tied to their identity their values are strengthened. Those values and meanings will transcend into other aspects of their lives creating well-rounded students.

Connecting and teaching youth about the environment through their culture also honors the Indigenous Planning Mission which states that, "The practice of Indigenous planning is predicted on adhering to land-tenure traditions and upholding the unique cultural worldview of Indigenous communities." A couple goals of Indigenous planning include 1) To advocate for the use of cultural values in community development and 2) To support the development of an educational curriculum in Indigenous communities. The developed lesson plans have the potential to grow into a curriculum that truly supports these goals. Right now the lesson plans lay the foundation for supporting the notions of Indigenous Planning, but they require implementation for true fruition.

Recommendations

It is important to remember that the lessons created in this thesis are just a framework for potential development into a full working curriculum. The lessons should be expanded to

further the students' knowledge about their environment and culture. Conceptually, if a WWP were to be implemented in the Dulce schools, I feel it is important to utilize the local Jicarilla knowledge within the lessons. As demonstrated by the two lessons plans inclusion of Jicarilla Apache knowledge enhances the lessons. Students grasp the importance of learning about the environment while coincidentally learning about their heritage.

I developed the two lesson plans from knowledge that was shared with me and through my own inquisitiveness. However, I would have liked to engage Jicarilla elders and community members in the process to gain more cultural insight and knowledge. Travel back to Dulce for community engagement was difficult due to my personal time constraints with school and work. I knew community engagement would require a lot of time and effort and unfortunately I personally could not commit the time needed to pursue such efforts. However, in order to really bring the lessons plans to life and honor Jicarilla knowledge, the community needs to be engaged. One recommendation is to have some open dialogue sessions with Jicarilla elders and community members around the two lesson plans. It is important to hear their input and incorporate any recommended changes they may have. The hope is that more lessons plans would evolve from such dialogue.

Second recommendation is to pilot the lessons plans within the Dulce schools. This would require sitting down with science teachers in the elementary school, middle school, and high school and learning about their curriculums. The two developed lessons plan can be tailored to various age groups so that would need to be organized with the

teachers. The goal is to find a medium within the teacher's curriculum that would support the teacher's goal as well as support the inclusion of the developed lesson plans. This would also require educating the teachers about the WWP and determining how it fulfills their academic requirements. The two developed lessons plans are fluid and are meant to be adapted to fit the needs of the target audience.

Reflections

Writing this thesis was the most challenging experience in my educational pursuit. I began conceptualizing this thesis a couple of years ago never imagining that it would take me two years to pull it together. One of my biggest struggles was transferring the passion I had for the concept of the thesis onto paper. I could talk for hours about the importance of including culture and Indigenous knowledge into an environmental curriculum, but I struggled with transferring those thoughts and beliefs into an academic paper. I've recognized that one of the reasons I struggled with this is because putting my ideas and beliefs onto paper moved the concepts from a practicing method into a theoretical perspective. I had difficulty bridging the practice and theory components together, thus it left me in a state of stagnation for periods of time. Only by continuously engaging in community work and furthering my knowledge of theory from many perspectives of readings was I able to overcome this roadblock. I still have difficulty with theory, but now I understand and recognize its importance as a foundation for many thought processes, as well as an avenue for new thought processes.

What I have enjoyed about writings this thesis is the amount of knowledge that I have accumulated from the readings I did as well as the knowledge gained from my relatives.

I had no idea what I was about to embark on when I decided to develop the notions of decolonization, Indigenous knowledge, and empirical knowledge of place. Once I started researching each concept I was overwhelmed with the amount of literature out there. As I began to read articles and books by other Indigenous authors and the work they were doing in their communities my inspiration for this thesis grew. My thoughts and beliefs were solidified and transcended by the wisdom and expertise of many Indigenous and non-Indigenous authors out there. I honor their work and our Indigenous ways of knowing, learning, and teaching.

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APPENDIX A: WATERSHED WATCH WORKBOOK

**NEW MEXICO
WATERSHED WATCH
WORKBOOK**

*A Watershed Ecosystem Approach
to Water Quality Education*



Prepared by William Fleming and Richard Schrader

Sponsored by:



**The New Mexico Watershed Watch Workbook: A Watershed Ecosystem Approach to
Water Quality Education, 1999 Revision.**

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Cover photo of the Rio en Medio in the Tesuque watershed by Sally Robinson

CHAPTER 2: SUGGESTED LESSON PLANS FOR MEASURING PHYSICAL PARAMETERS

Purpose of the lessons:

These lessons expose students to the basic concepts about hydrology and watersheds. The lessons are composed of several activities which teach skills to understand the fundamental characteristics of watersheds. The contents of the lessons teach (1) basic concepts in hydrology and watersheds, (2) how to measure water flow, (3) and how to find out how much water falls on your watershed every year and where it goes (how much of the rainfall flows out as surface water, evaporates or enters the ground?)

Background information:

The "What Is the Hydrologic Cycle?" and "Knowing Your Watershed" handouts teach basic concepts that can be introduced in class but also need to be discussed in the field where students can see references to the concepts in the landscape. Some students may already have previous exposure to these concepts and do not need significant time to cover them again.

Measuring water flow is one of the standard field monitoring activities that should be done each time that the students get to the river. Like other measurements, the month-to-month change in stream flow data can reveal important information about the watershed such as its hydrologic cycle and its ability to produce water even during months of dry weather.

The concepts taught in the "How Much Water Does A Watershed Shed?" activity can also be introduced during the first field trip but the hands-on mapping component requires focus in the classroom. If you are unfamiliar with how to read topographic maps, make sure you review the handouts provided at the end of the activity description. If you are interested in additional geography activities, you may look at [The Rivers Curriculum Guide: Geography](#) cited in the references on the following page. You can obtain a copy of this book by calling the publisher.

Be aware that the mapping activity requires time and focus to understand how a two dimensional topography map actually represents three dimensions. It has been the authors' experience that this activity can disengage and frustrate some students, especially those that have no or little experience with topographic maps or who don't seem to have developed a keen spatial intelligence. You can make this activity optional for students who are particularly interested in mapping. You can also provide students with other activities such as building a three dimensional shape of a watershed (The Bosque Education Guide, 1995). In addition, the field experience of

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New Mexico Watershed Watch

cross-referencing a map or three dimensional model with a view of the watershed helps students make connections between abstractions and the real thing.

Linkage and sequencing with other activities:

Many of the concepts can be introduced during the first field trip. The hydrologic cycle and "Knowing Your Watershed" concepts can be reinforced throughout the school year in student projects and other activities.

The concept of the watershed boundary and topography can also be introduced with a varying levels of detail during the first field trip depending on the time available and your educational objectives. The purpose of introducing the topography concepts in the field is to provide students with experiential reference points, not to make them competent in doing the skills. In subsequent classes, you can teach the skills to identify a watershed boundary on a map. In class mapping activities can be done during winter months when field activities are more challenging due to cold weather. The skills for identifying a watershed boundary can be helpful for creating a map that illustrates the general location of the watershed in your school's final report.

Time needed during the first field trip to cover basic concepts:

1. "What Is the Hydrologic Cycle" and "Knowing Your Watershed": approximately 20-30 minutes in the field with handouts or less time depending on the student's previous exposure to these concepts.
2. Topography introduction in the field: 20 minutes
3. Watershed boundary mapping: approximately 15-20 minutes

General assessment ideas (There are specific suggestions in handouts or activity descriptions for each activity):

For the rest of the semester, students should be asked to express their understanding of basic watershed concepts on a regular basis through monitoring tasks and analysis of data. Their research projects and/or papers should also interpret the data they gathered in the context of the fundamental watershed concepts.

References and resources cited in activity description:

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Watershed Definition: Physical Parameters

Activity Description for Basic Hydrology and Watersheds: "What Is The Hydrologic Cycle?" and "Knowing Your Watershed"

Materials and preparation:

1. Locate a scenic viewpoint such as one on a road in the upper watershed where the students can view the watershed from afar and readily compare its physical shape with a topographic map of the area. The tallest peaks or ridges and the main valley in the watershed are the highest priority features if you have to make tradeoffs in choosing a viewing site.
2. Understand how to read a topographic map (you can read the handouts attached to the activity description for the watershed boundary to understand the basics, but some practice with a map in the field will be helpful).
3. Photocopies of "What Is the Hydrologic Cycle?" and "Knowing Your Watershed" handouts in the following pages, if helpful.
4. Photocopies of a topographic map of the watershed or a portion of the watershed that can be seen from the viewpoint.

Suggested ways to introduce and discuss concepts:

For the first field trip: Take the students to a scenic viewpoint where they can view all or a significant portion of the watershed. Look for reference points that illustrate the concepts of the watershed as a drainage basin that carries energy downstream.

For "The Water Cycle": Discuss the main processes in the water cycle. Ask students to point to examples of these processes they can see in the watershed such as runoff (streams) or condensation (clouds). Ask students to imagine and reflect on how the water cycle works in the watershed they can see.

For "Knowing Your Watershed": Ask the students to point and name (based on maps or their imagination) the peaks and valleys. Ask them to point to where smaller tributary streams join to make a larger stream. Ask them to locate these confluences on the map. Ask where they think the boundary of the watershed is located above the streams. Hand-out the topographic map and explain the basic ways to read such a map (see topographic map activity description for explanation). Ask them to try and match the landscape they see with particular ridges and peaks on the map. If you can see upland and smaller tributaries fitting within a lower and larger valley, discuss how smaller watershed fits into larger watersheds. Students can highlight watershed boundaries of sub-basins in the watershed with a yellow highlighter pen.

Ask them to compare their view of signs of human occupation and use of natural resources in the watershed with the symbols showing the location of human

New Mexico Watershed Watch

occupation on the map. Note to them how land use upstream can effect the watershed downstream.

Assessment tools:

Here are some suggested assessment questions.

For "The Water Cycle":

1. Describe and/or draw a picture that illustrates how the water cycle would work in the watershed you can see.
2. Describe the path of a water drop as it passes through the water cycle.

For "Knowing Your Watershed":

1. What are names of the tallest peaks and ridges in the watershed that you will study this semester?
2. What is the larger watershed in which your smaller watershed fits? What is the name of the larger watershed? For instance, the Rio en Medio fits in the Nambu watershed. The Nambu watershed fits in the Rio Grande watershed.
3. What are the names of towns located in the watershed?
4. What are some of the land uses in your watershed?

What is the hydrologic cycle?

The hydrologic cycle collects, purifies, and distributes the world's fixed supply of water. The following figure shows a simplified version of how water moves through the cycle.

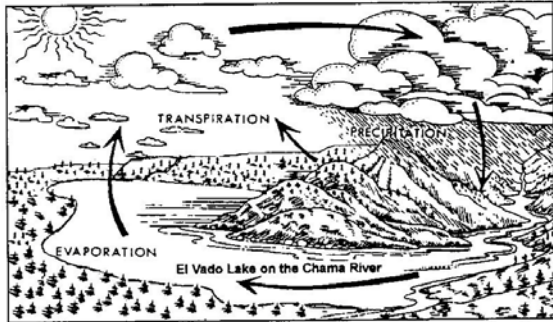


Fig. 5 Diagram of the Water Cycle in the Chama watershed (adapted from The Stream Scene)

Solar energy and gravity convert water from one physical state to another and move water among the ocean, the air, the land and all living organisms. The main processes in the water cycle are:

- *Precipitation* (rain, snow, hail, the source of all of our water which becomes these other forms)
- *Evaporation* (conversion of water into vapor)
- *Condensation* (conversion of water vapor into droplets of liquid water)
- *Transpiration* (the process by which plants absorb water to grow and then evaporate the water into the atmosphere as water vapor)
- *Runoff* (fluid water flowing downstream to streams or lakes)

When water evaporates it may condense and turn into clouds. These clouds create rainfall which plants use for transpiration and growth. If the plants don't use the rainfall, the water either soaks into the ground to a groundwater aquifer or spring, becomes runoff, or evaporates in place. Runoff replenishes streams, lakes and oceans.

Water is an important *medium* for carrying chemicals in and out of ecosystems. Runoff water can move pollutants from sources such as cars, farms and roads into the streams. For instance, if a farm field has limited vegetation growing in it, such as during the winter time, the runoff will pick-up soil that has not been anchored by the roots of plants and move it towards streams. In this situation, the soil-laden runoff becomes a pollutant that deteriorates stream habitat for fish living below the field. Water can carry chemicals into the water cycle when people improperly use such things as motor oil, detergents, fertilizers or pesticides.

More thoughts and explorations.... (if you need more space for writing your ideas and answers write them on a separate sheet of paper)

"The spring flood brings us more than high adventure; it brings likewise an unpredictable miscellany of floatable objects pilfered from up river farms."

- Aldo Leopold, A Sand County Almanac

What are some examples of how humans intervene in the water cycle? For instance, how might surface water in a stream be changed by an upstream irrigation project?

What might be some potential sources for groundwater pollution?

Where does your water come from? From a well, lake, or river? What is the name of the watershed where you live?

APPENDIX B: WORLD IN OUR BACKYARD

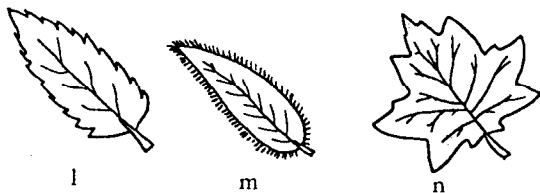
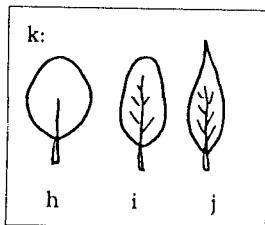
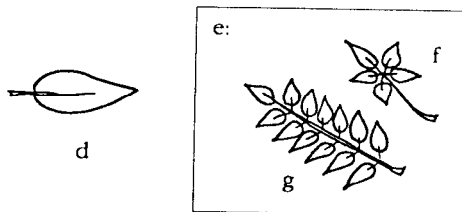
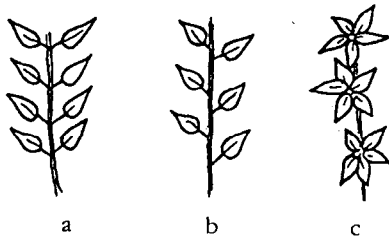
Activity 4: Create a Wetland Plant Wheel

Objective Students will be able to recognize common New England wetland plant species during a visit to a wetland using the wetland plant wheel they construct in class.

- Materials**
- Construction paper
 - Copies of wetland wheels and direction piece
 - Scissors, markers
 - Paper fasteners

Helpful Facts on Plant Identification

Review this information with the students before constructing the wheel:



- A plant does not always look the same; it may change with the seasons. In winter, most soft plants *die back*, though some leave behind woody stalks, e.g., a cattail. Many trees and shrubs do not have leaves in winter while some do. *Evergreen* plants keep their leaves in winter; *deciduous* plants lose their leaves.
- Many plants do grow flowers though we do not call the plant “a flower.” Flowers appear and transform into fruits. Seeds form within the fruits.
- Leaves and twigs are arranged in different patterns on different plants. They may be *opposite* (a), which means that they grow out of the same place on the stem but on opposite sides of the stem.
- *Alternate* (b) leaves sprout at different places on the stem, alternating from one side of the stem to the other. *Whorled* (c) leaves grow out of the same place on the stem all the way around the stem, like the spokes of a wheel.
- Leaves may be *simple* (d) (one leaf on a stem) or *compound* (e). Compound leaves have several *leaflets* on a stem, arranged in the shape of a hand – *palmate* (f) or like a feather – *pinnate* (g).
- The shape and edges of leaves also are important in identifying plants; leaves may be *round* (h), *oval* (i), *long and/or pointy* (j); edges may be *smooth* (*entire*) (k), *toothed* (*jagged edges*) (l), *hairy* (m), *lobed* (n), etc.

Constructing the Wetland Wheel

Use this wheel to help students identify freshwater wetland plants only. Use one of the field guides listed in the *Appendix* for trips to saltwater wetlands.

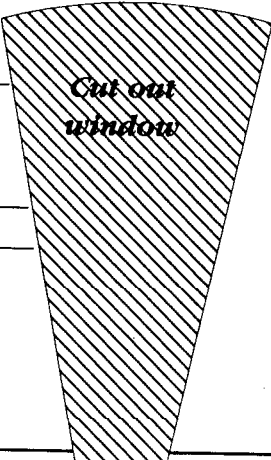
1. Glue each direction piece to a manila folder or piece of cardboard and cut along the solid outline. Cut out the pie-shaped piece to make a window. Place the pieces back to back, match them up, then glue or staple them together across the top only.
2. Carefully cut out each wheel along the solid outline.
3. Glue the two large wheels together, back to back, so that the centers match.
4. Align the smaller wheels with the larger wheels so that the edge of the smaller wheel lines up with the inside circle (line) on the larger wheel. Match up the two wheels that have numbers 1-16; then poke a small hole through the center of *both wheels at once* with the paper fastener. Now match the smaller wheel numbered 17-32 with the other side of the larger wheel; thread it onto the paper fastener. You should now have a two-sided wheel.
5. Now add the direction piece. Place the two-sided wheels between the two pieces of the direction piece. The top edge of the larger wheel should fit just behind the top edge of the window. Remove the paper fastener. Keeping the direction piece flat, poke holes through the center dots to match the holes in the wheel. Fasten the paper fastener again, and your wetland plant wheel is ready for use!
6. Your students can use the wheel to identify plants on their own at home or during an organized field study (see Chapter VI).

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Direction Piece:

Photocopy and cut out **two** direction pieces for each wetland wheel.

Wetland Wheel

What TYPE of plant is it? ⇨	
Description of plant: ⇨	
What is its NAME? ⇨	
What does it look like? ⇨	

Directions:

1. Find a wetland plant to identify.
2. Turn the middle wheel until you find a picture that looks like the plant.
3. Turn the large wheel until you find a description that matches the plant (match the numbers). This will give you the name of the plant!
4. Turn the small wheel until you find the codes that tell you where the plant grows.
5. Hint: Be sure the numbers in the upper right corners of each space in the window are the same.

Remember to look closely at the leaves and stem arrangement of each plant!

Leaf edges may be:

- entire (smooth)
- toothed (jagged) or wavy

Leaves may be:

- simple (one part)
- compound (many parts
 - leaflets):
 - pinnate = like a feather
 - palmate = like a hand

Leaf shape may be:

- round, oval, oblong, egg-shaped, etc.
- lance-shaped (long, pointy) or tapered
- lobed (edges curve inward in places, almost dividing leaf into parts)

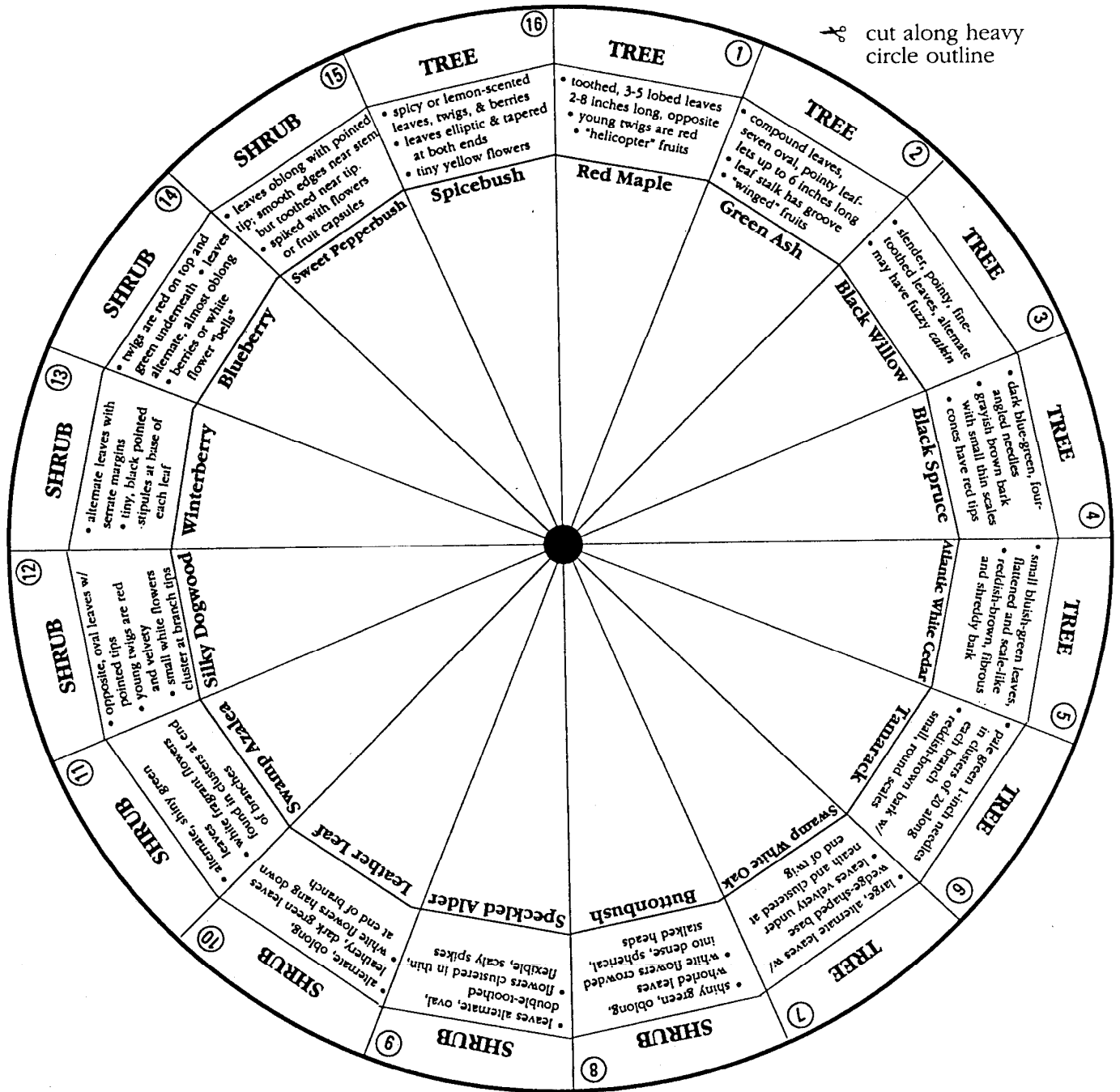
Stems and leaves may be arranged so that they are:

- opposite
- alternate
- whorled (like spokes of a wheel)

✂ cut out on outline

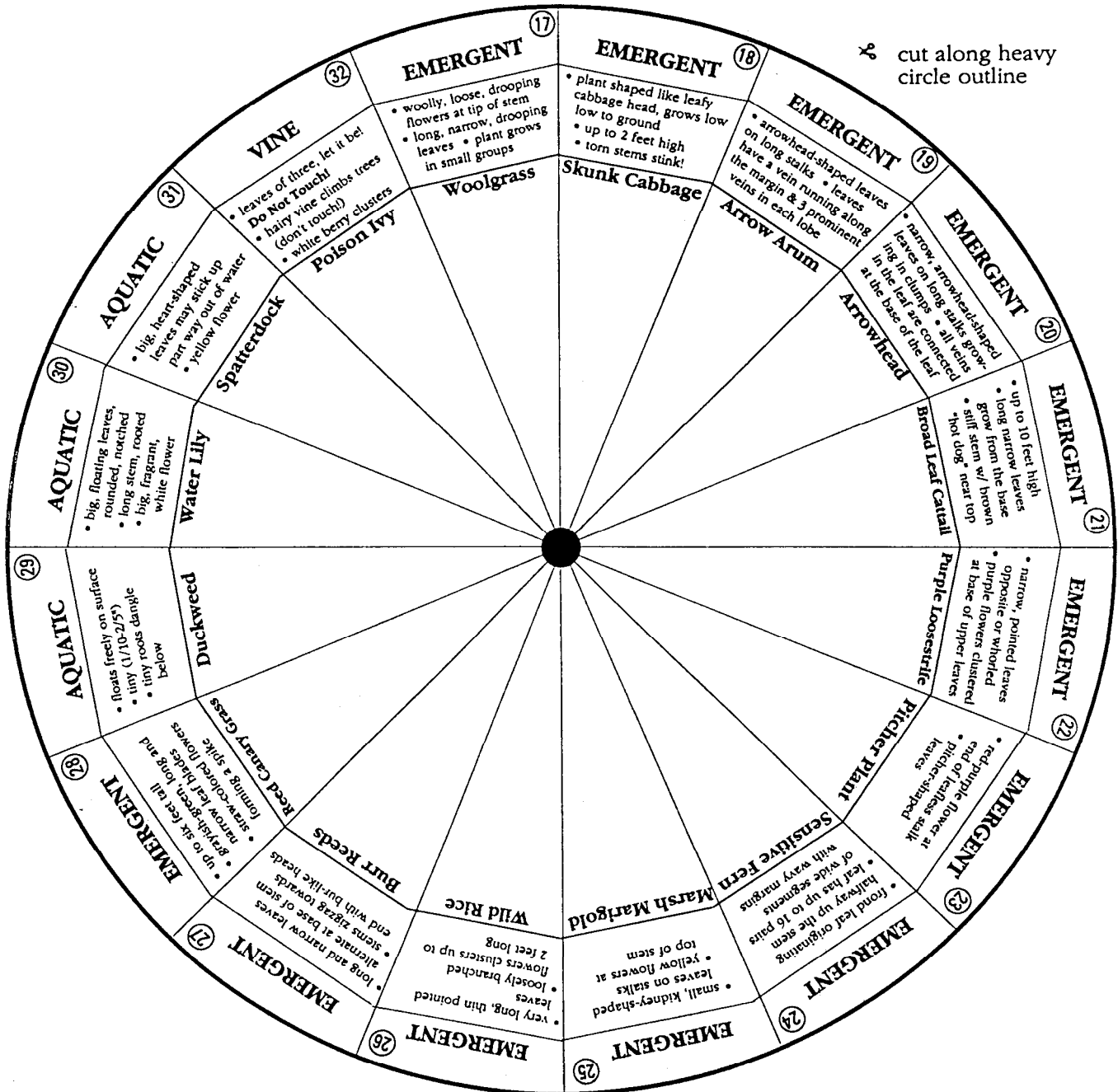
Large Wheel #1:

photocopy and cut out one for each wetland wheel.



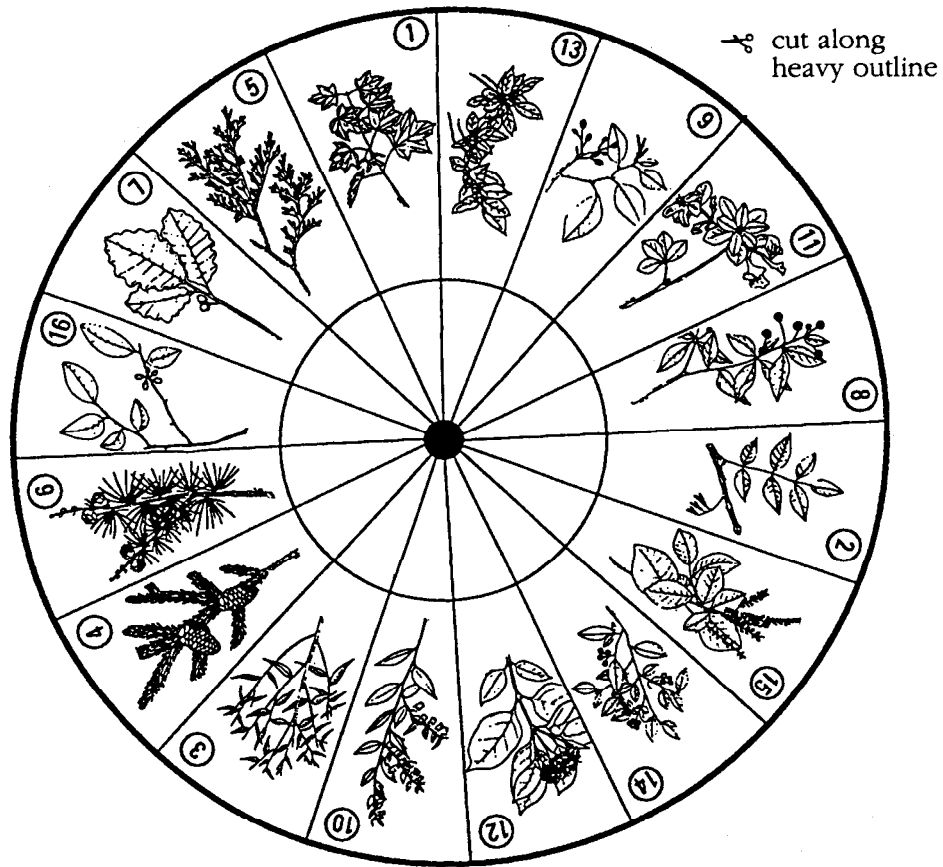
Large Wheel #2:

photocopy and cut out
one for each wetland wheel.



Small Wheel #1:

photocopy and cut out
one for each wetland wheel.



Small Wheel #2:

photocopy and cut out
one for each wetland wheel.

