Climate Change: Ways of Knowing

Last Updated: 1/11/2023

Program Type: STEM, Cultural

Grade Level: 9th - 12th

Location: East side of DH

Data collection Locations: Pred/Prey Field, Big Prairie, Survival Prairie

Inclimate Weather: Science Classroom

This class requires that there be milkweed available

Essential Understandings:

- Information can be shared in all kinds of ways, even scientific information. When we consider multiple modes of knowing, the conclusions we can draw are all the more sound.

Cross-Cutting Concepts:

- Students will be able to gather information about and communicate the methods that are used by various cultures, especially those of Minnesota American Indian Tribes and Communities, to develop explanations of phenomena and design solutions to problems.

MN Science Standard:

- 4.2.2 Students will be able to gather information about and communicate the methods that are used by various cultures, especially those of Minnesota American Indian Tribes and communities, to develop explanations of phenomena and design solutions to problems.

See specific standards in Background Information

ELL considerations are in the background information section for now

SEL Connections:

- Self-awareness: Understanding through practice one's personal power to act on behalf of one's self and others in need, be they people, water, land, or other species
- Self-management: Striving to collect complete and accurate data to achieve the goals of MAREN
- Social-awareness: Recognizing how prevailing and social norms have led to incomplete ecological knowledge, which has led to ecological destruction, particularly in marginalized communities.
- Relationship skills : Working with others to contribute to a common goal

Essential Questions:

- What are different ways that knowledge can be shared?
- How can considering multiple ways of knowing enrich our understanding of the environment and how we study it?

Learner Goals:

- Learners will learn about how milkweeds are host species for the monarch butterfly, and act as refuges and nurseries for many other invertebrates

- Learners will learn how to identify common milkweed
- Learners will explore different ways of knowing
- Learners will compare various forms of data and observations and form an analysis
- Learners will be introduced to the concept of community science, and then will participate in the MAREN community science project.MAREN Goals- participants will be able to:
    - *identify milkweed and the community of insects with which it interacts.*
    - *make observations and generate questions about milkweed phenology and the impact of milkweed phenology on herbivory and/or pollination.*
    - *use data they and others collect to make evidence-based predictions about the effects of shifting plant phenology on the interactions between milkweed and consumers.*

The Milkweed Adaptation Research and Education Network is a collaborative project that aims to understand the impact of restoration practices for common milkweed through the integration of structured research into participants' learning experience. Training Videos

Materials:

- Milkweed Pod (or something similar)
- Clipboards (1 for each learner)
- Pencils (1 for each learner)
- Paper (1 for each learner + a few extras)
- Magnifying glasses
- Monarch Butterfly Migration Map
- Nanabosho and the Butterflies by Joe McLellan and Matrine Therriault
- A copy of Mazina'igan
- A copy of the MAREN Phenology Project Protocols for the instructor
- Laptop with google sheets version of the Phenology and Herbivory Form downloaded
- OWELC REDACTED Phenology and Herbivory Lab Data Sheet (Printable)(1 for each plant, double sided) If there's a high population of spanish speaking participants, have the espanol version available.
- Meter sticks (1 per group or minimum 2 to share)
- Hard surface boards with color copies of the "Supplemental Phenology and Herbivory Cards" clipped to them (1 for every 2 learners)
- Pencil sharpener

It's important that you fill in as much of the data in the first section as possible before printing. It's most helpful to print in color to differentiate the sections, but is not necessary.

The OWELC Redacted sheet was created to remove anything the participants would not need to do. For example, Section 4, which was entirely optional, was removed since there is no time to do this in the time provided. Other information can be entered by the instructor in the digital version en masse and does not need to be individually recorded.

Set-up:

- Nature Journaling:
    - Sharpen pencils, collect paper and clipboards, and put everything together near where the nature journaling will take place.
    - Have object ready to pass around from a milkweed plant or know where you're going to grab it quickly
- Data Collection:
    - Be familiar with the MAREN Phenology Project Protocols
    - Put out at least 30 numbered pin flags in 3 locations, or 40 pin flags in 2 of the locations listed above. Once they are out there, leave them there until November
        - Pin flags should be placed in numerical order, not too far off the path, at the base of each milkweed plant. Give at least 5 feet between each flagged plant to allow for participants to move around.
    - Prep and print Phenology and Herbivory Forms (data collection sheets)

        - It's important that you fill in as much of the data in the first section as possible before printing. If there is data that you are not planning to collect (ex: it's fall so you will not be collecting spring time data), delete the words from those cells before printing.
        - It's helpful to print in color to differentiate the sections.
    - Use binder clips to attach the Supplemental Phenology and Herbivory cards to the boards. It's helpful to keep these boards separate from the ones used during nature journaling to save time during class.
    - After the phenology and herbivory form has been downloaded onto your computer, it's helpful to fill it out as much as possible.
        - Type in Plant numbers
        - Write "0" for all invertebrates. They should not be left blank except column R
        - If you are not going to certain sections on the data collection sheet, black out those sections on the submission form if a participant is going to be working on it. DO NOT DELETE THE INFORMATION! It will throw off the pivot tables!
        - Fill out AT-AW

LESSON OVERVIEW

LC Stage(s)	Activity	Timing
Invitation	Introduction	10 min
Exploration	Nature journal and Story Walk	40 min
Concept Invention	MAREN Data collection reasoning and process	10 min
Application	Data collection and interpretation	55 min
Reflection	Wrap-up	5 min

Key Vocabulary:

Tier 1 (ELL)	Tier 2 (Academic)	Tier 3 (Content-Specific)
Knowledge Scientist	Common Milkweed Invertebrate Nature Journal Observation	Habitat Restoration Climate Change Phenophase Mollusc Herbivory

The first time the vocab word is mentioned in the lesson plan, there is a hyperlink that will jump to the background information section where it is defined

Invitation (10 min)

Introduction:

1. Have participants tell you their name, pronouns if they care to share, and ask them "*How can knowledge be shared?*"
    a. Some examples of answers might include: the internet, someone tells me, video, journals, books, photos
2. *There are many ways of knowing and sharing information. Sometimes it looks like a graph or a book, and sometimes it's having a conversation with someone who has had a lived experience with something, or is an elder. Today we are going to explore some different ways of collecting, exploring, and sharing knowledge, wrapping up with an activity that will contribute to a current scientific study relating to habitat restoration and climate change.*

Exploration (40 min)

Nature Journal:

3. *The first way of knowing that we are going to explore is called first hand observation. We are going to hone our observation skills and record our findings as a nature journal entry.*
    a. *Writers, naturalists, and scientists use journals to preserve their thoughts, observations, and actions. You do not have to be artistic to do nature journaling- you just have to slow down and observe what's around you on a deeper level. Observation, curiosity, and creativity are skills that you can develop.*
4. *A quality nature journal entry is descriptive, which means it has details based on observations that can be made about the object.*
    a. *An observation is different from an opinion in that it uses your senses. I'm going to pass this thing around the circle and when it comes to you I want you to share one adjective to describe it. (options in notes)*
        i. An adjective is a descriptive word that gives a characteristic or attribute to a noun, ie the *tall, green* tree.
    b. Next, bring the participants over to a milkweed plant and show them generally what a common milkweed plant looks like.
    c. Give participants a set amount of time (no more than 10 minutes) to draw and record as many observations about a milkweed plant in the area as they can. Remind them to use descriptive words as well as drawings. You might offer the use of a meter stick.
        i. When their time is up, call them over to a patch of common milkweed and have willing participants share one thing that they observed about their milkweed plant. Tie in any of their observations into how to identify a milkweed. (see background information for ID information)

Spring: unopened umble, Summer: Single flower, Fall: Seed pod

Keep in mind that many participants have internalized negative messages about their drawing or writing abilities.

Be gentle and supportive, without being disingenuous in your compliments.

5. *You can choose to keep your Nature Journal entry or you can hand it to me if you do not want it. I will keep them in this binder as a snapshot of what was happening today, so that we can look back on it in future years and see how it compares!*

    a. Instruct participants to put their pencils and clipboards back where they got them. Don't forget to bring the pencils with you for data collection.

Story Walk:

6. *Another way of knowing is through something intangible: Story telling.*

    a. *Storytelling is more than just verbal communication, it's a way to creatively relay experiences, lessons learned, and hypotheses for the future.*

    b. *We are on ceded land of the Ojibwe and Lakota, who historically cared for the land and carried its stories. They continue to be community members to this day, and share their stories verbally, as well as in books such as this one.*
        i. *As we walk to our next location, we are going to read the story of Nanabosho and the butterflies by Joe McLellan, Matrine McLellan, and Jackie Traverse*
            1. It works well to have 3 stops

    c. Once you get to your destination:
        i. *In the book we learned a few things. We learned from the grandmother some traditional knowledge about how the butterflies were made, about the value of doing things for yourself, and finding joy in nature. We also learned about how the grandmother lived in a residential school and was not allowed to share stories such as these.*

Scientific Process:

7. *However, the Ojibwe don't just share information about the past via stories. Just like butterflies are still around today, the Ojibwe are still here. They share their stories, continue to care for the land, and continue to make new stories, sometimes with the help of Scientific Processes.*

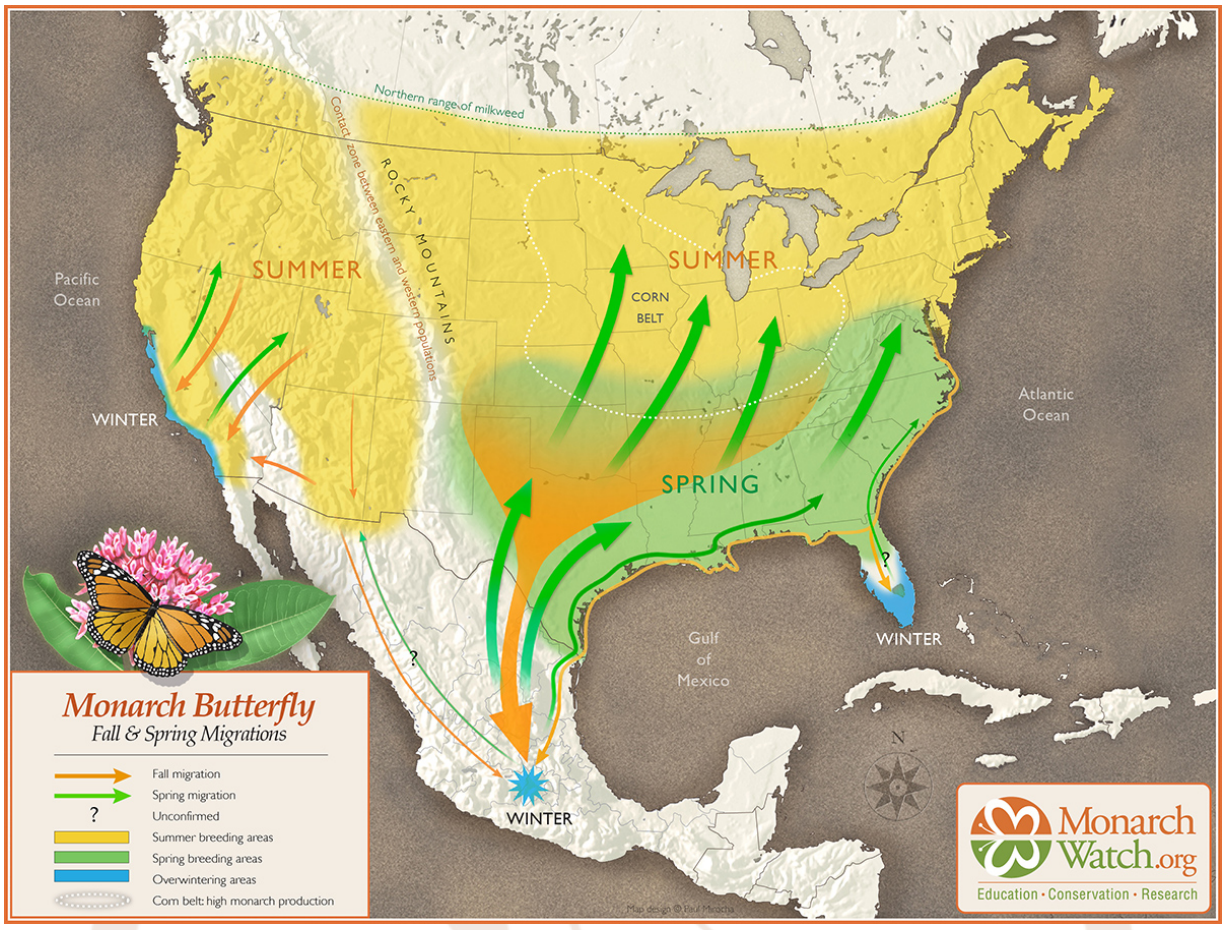
    a. Show the participants a copy of the Great Lakes Indian Fish and Wildlife Commission's Mazina'igan. Explain what's in this edition and how they can get free copies sent to them (especially if the school is located within ceded territory.

Concept Invention (10 min)

8. *When I say scientific processes, I mean the science that we learn about in school. There are many methods to perform different kinds of studies, and we are going to participate in a study today!*

MAREN Data Collection reasoning:

9. *There are 146 different kinds of butterflies in MN, one of which is the Monarch. The monarch is a particularly interesting butterfly to study because it undergoes a major migration every year. We are located in the Northern most area of their breeding range.*



10. *Because Monarchs can be found in all different kinds of places at different times, they are considered an indicator species for climate change. By looking for changes in how they go about their lives, we can get an idea of what changes are happening now, and my predictions for the future.*
11. *We are working together with St. Olaf University and a network of K-12 schools to collect information about the common milkweed and the invertebrates that call that plant home!*

MAREN Data Collection procedure:

12. *At this site I have marked 30-40 plants with these flags. Each flag is positioned at the base or around the stem of a milkweed and has a number written on it.*
13. *I am going to divide you into groups of 2 or 3, and each of you are going to collect data for at least 2 plants.*
14. *Each group will get a data sheet with a plant number on it and that's how you know which one to look for. When you find it, determine who is going to be the "measurer" and who is going to be the "recorder". Once you are done with this plant, you will flip the sheet over and do the next one, switching who is the recorder if both of you are comfortable being up close and personal with the insects. When you finish the second one, bring the sheet back to (insert name of leader who will be roving around helping)and if it's completely filled out, they will give you a new sheet for 2 more plants. If your sheet is not completely filled out, you will be sent back to your plant.*
15. *This sheet has 4 different sections to fill out:*
    a. *Section 1:Site information*
        i. *This will be mostly filled out, but you will need to fill in the "recorder"and "measurer" portion*
    b. *Section 2: Invertebrate Observations*

i. *Next you will look to see who is visiting the plant! If there are any invertebrates on it, we want to know!*
    1. *Invertebrates are critters that do not have spines. Insects and snails (molluscs) are the invertebrates we are looking for today.*
ii. *Each group will be given a card that has the different critters on there and what some of their signs look like. If you have a question of what you are seeing, please call me over!*
    1. *Not all invertebrates that can be found here are listen on the sheet. If you know what they are, you can write its name down in the "other invertebrates observed". This might not be added to the larger MAREN data since they are interested in certain insects.*

c. *Section 3: [Plant] growth and development*
i. *This section has some acronyms and symbols that I want to make sure are clear.*
    1. *% Stem wLvs = percent stem with leaves*
        a. *If a leaf is yellow or brown, poke it gently. If it falls off, don't count it.*
    2. *Leaf Color B, Y, G, NA = Brown, Yellow, Green, Not applicable*
        a. *Base this off of the oldest leaf*
    3. *Phenophase: circle one of the letters. They correspond with the number to their left on the sheet*
        a. *Newly Emerged (NE)-only the first pair of leaves present*
        b. *Vegetative Growth (V)-more than one pair of leaves but no buds*
        c. *Buds (B)-some umbels with green or pink flower buds visible, but no open flowers*
        d. *Flowers (Fl)-some umbels have begun to display open flowers. Note that the first flowers to bloom tend to be lower on the stem. Continue to use this category, even if some of the flowers have wilted, until there are no more flowering umbels, or until the fruits begin to appear.*
        e. *Post-Flowering (pF)-all flowers have died but no fruits are yet formed*
        f. *Fruits/Pods (FrP)-some flowers have begun to form fruits*
        g. *Seed Dispersal (SD)-some seed pods have opened to allow seeds to disperse*
        h. *Empty (E)-all seed pods are open or dead*
        i. *Dead Stem (D)-All that remains is a dead stem*
    4. *#Mwds in 1 m2 = number of milkweeds in 1 square meter.*
        a. *Put the middle of the meter stick next to the milkweed plant and see how many other milkweeds are next to it.*
    5. *# = number*
ii. *Anything that isn't bolded is optional, but everything that is bolded needs to have something in there. **If not, the data is not complete and we can not submit this sheet.***

16. *When you turn in the data sheet to the roving staffer, they will make sure it's complete and then will give it to the person supervising the laptop. They will attempt to put in as much data as they can.*

As you are talking about each section, point out the sections on the datasheets.

Based on what you are seeing in the field, prompt the students which letter(s) they are most likely going to encounter.

Stress the importance of complete data. If they skip something or if you have a question about something, follow up with them!

a. *By the end of class, this data will automatically turn into some charts to illustrate our findings. These charts help to tell the story of the data, and we are going to have you try to interpret that story.*

Application (55 min)

MAREN Data Collection:

17. Have participants find their partner, making sure that at least one of them is willing to get up close and personal with insects.
18. Each group will get a clipboard, pencil, meter stick (if there are enough), invertebrate and damage guides, and an observation sheet.
19. The OWELC instructor will go around and make sure participants are filling out the sheets properly. They will also collect the completed sheets. Some roles additional OWELC staff/chaperones can take on include
    a. Laptop supervisor: They insert the data from the participants into the computer.
    b. Meter stick keeper: Each sheet requires us to measure the height of the milkweed. This person walks around to the different milkweeds and measures the milkweed for the observation group.
    c. Photographer: Photos are a necessary part of this grant, and if the participants are signed off as being able to have their photos taken, then go for it! Bonus points if they have iNaturalist and post the critters that we find on there.

MAREN Data Analysis:

20. Click on the "Graphs" tab to see what has been generated. Read what was found in the plot that the participants are working in, then have the participants compare their data to the other graphs. You can even compare and contrast older graphs that were made by other schools.
    a. If there is enough data:
        i. *Let's take a look at the charts that were created with the data we collected.*
            1. *What do you notice about the graphs*
                a. Making the charts more similar to read:
                    i. Right click chart>axis> Horizontal axis> select or deselect "reverse axis order" to try and get the phenophases in the same order

ii. Right click chart>axis>vertical axis> you can add a max number to make the scale the same.

iii. Note: The legend colors are auto generated and might not be the same.

2. *What do you wonder about the graphs*

3. *Listening to the data I hear…*

    a. *Do we have evidence for different herbivore communities in different places?*

    b. *Do we have evidence that phenology affects herbivory?*

b. If there was not enough data in the sheet for a graph to look interesting, have the participants popcorn share things that they found.

i. *Who found plants in (insert specific phenophase)?*

ii. *What kinds of insects did they see and how many?*

iii. *What might happen in the next few days? Weeks?*

1. *What might our data look like then?*

21. (Optional) Bring out data from previous classes or other sites. Have participants compare and contrast the graphs with their neighbor for a couple minutes.

    a. *What conclusions can we draw based on comparing these graphs?*

Reflection (5min)

Wrap up:

22. *Today we looked at three different ways of knowing:*

    a. *Making and recording your own observations in a nature journal, using drawings, writing, and numerical data*

    b. *Hearing/ reading stories based on both lived experiences and traditional knowledge*

    c. *Collecting data using a standardized form and recording it in a numerical manner to generate graphs; something that's necessary when using the scientific process*

23. *All of these ways of knowing are valid ways to keep and share information. When we use multiple forms of knowledge we can gain a more holistic view of the past and present, so we can create a better future.*

24. *As we walk back, think about some ways that you have learned or shared a skill or tradition. If you care to share, please do!*

Background Information and Additional Activities:

Vocabulary:

- Climate Change: *"Climate change describes a change in the average conditions — such as temperature and rainfall — in a region over a long period of time. NASA scientists have observed Earth's surface is warming, and many of the warmest years on record have happened in the past 20 years." (NASA Climate Kids)*
- Common Milkweed: Common milkweed (*Asclepias syriaca*) is a Minnesota native wildflower that blooms in midsummer. Its lovely fragrance often precedes seeing the flowers. Common milkweed is a native, perennial herbaceous plant in the milkweed family. It commonly grows in sunny areas and ditches and is a primary part of the monarch butterfly's diet. (UMN Extension)
- Habitat Restoration: means to return the site's hydrology, topography and natural vegetative communities to historic predisturbance conditions so that the site provides food and shelter for wildlife, and performs natural processes including reducing the volume and velocity of runoff, and increasing the water infiltration rates. (Law Insider)
    - It's important to note that the definition of "predisturbance" varies depending on the organization's goals for the site.
- Herbivory: The consumption of herbaceous vegetation.
- Invertebrate: Any animal that lacks a vertebral column, or backbone, in contrast to the cartilaginous or bony vertebrates. More than 90 percent of all living animal species are invertebrates. (Britannica)
- Knowledge: the fact or condition of knowing something with familiarity gained through experience or association. (Merriam-Webster)
- Mollusc: also spelled mollusc, any soft-bodied invertebrate of the phylum Mollusca, usually wholly or partly enclosed in a calcium carbonate shell secreted by a soft mantle covering the body. Along with the insects and vertebrates, it is one of the most diverse groups in the animal kingdom, with nearly 100,000 (possibly as many as 150,000) described species. (Britannica)
- Naturalist: a person who studies plants and animals as they live in nature (Britannica)
- Nature Journal: A nature journal is a lens that focuses our attention and crystalizes our observations, thoughts, and experiences.Nature Journaling is collecting and organizing your observations, questions, connections, and explanations on the pages of a notebook using words pictures, and numbers. (John Muir Laws)
- Observation: something you notice by watching and listening (Merriam-Webster)
- Phenophase: An observable stage or phase in the annual life cycle of a plant or animal that can be defined by a start and end point. Phenophases generally have a duration of a few days or weeks. (National Phenology Network)
- Scientist: A scientist is someone who systematically gathers and uses research and evidence, to make hypotheses and test them, to gain and share understanding and knowledge. All scientists are united by their relentless curiosity and systematic approach to assuaging it. (Science Council)

Online Resources:

- Gikinoo'wizhiwe Onji Waaban (Guiding for Tomorrow) "G-WOW" Changing Climate, Changing Culture
- Mazina'igan Database
    - 2022 Ziigwan (Spring) Mazina'igan: Anishinaabemowin and climate change; winter camps and games; omashkooz; Mille Lacs Lake; Ma'iingan protections restored; birch restoration; sugarbush; Gichigami; Nibi; Spirit Island; fisher; otter; bobcat; makwa; mizise; waawaashkeshi; walleye and musky mercury maps
- MAREN Phenology Project Protocols
    - Phenology, Damage and Invertebrate Guide: MAREN

- iNaturalist: Common Milkweed
- Traditional Ecological Knowledge from Great Lakes Indian Fish and Wildlife Commission
- Niizhoo-gwayakochigewin | Bemidji State University: Possible resource for furthering this class
- Native Skywatchers - Resources

Milkweed Identification

Site Selection and Milkweed Identification :

- Common milkweeds typically have one round main stem. On some plants, additional stems may branch off the main stem, but this does not always occur. Common milkweeds have opposite leaves, meaning they always come in pairs, one on each side of the stem. Leaves are green, usually darker on top and lighter on bottom, and oblong ovals, typically with pointed ends. Leaves and stems are often covered with small hairs, called trichomes, especially on the underside of the leaf.
- During different times of the seasons, milkweed will look slightly different, developing flowers and fruit. Common milkweed has purple, pink, or white flowers that form in large ball-shaped clusters, called umbels. Fruits or seed pods are tear drop shaped and usually 3-5 inches long with soft, spikey bumps. Flowers and fruits are found branching off of the top portion of the stem/plant.
- All milkweeds exude a white, milky substance called latex when leaves or stems are crushed or cut. Try tearing a leaf in your identification process to see if a white substance emerges!
- Be aware of dogbane, a related plant that looks like common milkweed, especially early in the season. Dogbane also has opposite leaves and milky sap. However, common milkweed has hairy stems, but dogbane does not. The flowers of dogbane are whitish green and in much smaller clusters.

Plant Profile from Project Wingspan (Printout pg 24-26)

MN Science Standards

Grade	Strand	Substrand	Standard	Content Area	Benchmark
1	4 Communicating reasons, arguments and ideas to others	4.2 Obtaining, evaluating and communicating information	4.2.2 Students will be able to gather information about and communicate the methods that are used by various cultures, especially those of Minnesota American Indian Tribes and communities, to develop explanations of phenomena and design solutions to problems.	Physical Science	1P.4.2.2.1 Communicate solutions that use materials to provide shelter, food, or warmth needs for communities including Minnesota American Indian Tribes and communities.* (P: 8, CC: 2, CI: PS1, ETS2)
2	4 Communicating reasons, arguments and ideas to others	4.2 Obtaining, evaluating and communicating information	4.2.2 Students will be able to gather information about and communicate the methods that are used by various cultures, especially those of Minnesota American Indian Tribes and communities, to develop explanations of phenomena and design solutions to problems.	Physical Science	2P.4.2.2.1 Obtain information and communicate how Minnesota American Indian Tribes and communities and other cultures apply knowledge of the natural world in

					determining which materials have the properties that are best suited for an intended purpose.* (P: 8, CC: 2, CI: PS1, ETS1)
3	4 Communicating reasons, arguments and ideas to others	4.2 Obtaining, evaluating and communicating information	4.2.2 Students will be able to gather information about and communicate the methods that are used by various cultures, especially those of Minnesota American Indian Tribes and communities, to develop explanations of phenomena and design solutions to problems.	Earth and Space Science	3E.4.2.2.1 Gather information and communicate how Minnesota American Indian Tribes and communities and other cultures use patterns in stars to make predictions and plans. (P 8, CC: 1, CI: ESS1)
4	4 Communicating reasons, arguments and ideas to others	4.2 Obtaining, evaluating and communicating information	4.2.2 Students will be able to gather information about and communicate the methods that are used by various cultures, especially those of Minnesota American Indian Tribes and communities, to develop explanations of phenomena and design solutions to problems.	Earth and Space Science	4E.4.2.2.1 Obtain and combine multiple sources of information about ways individual communities, including Minnesota American Indian Tribes and communities and other cultures, use evidence and scientific principles to make decisions about the uses of Earth's resources.* (P: 8, CC: 4, CI: ESS3, ETS1)
6	4 Communicating reasons, arguments and ideas to others	4.2 Obtaining, evaluating and communicating information	4.2.2 Students will be able to gather information about and communicate the methods that are used by various cultures, especially those of Minnesota American Indian Tribes and communities, to develop explanations of phenomena and design solutions to problems.	ESS: Earth's Place in the Universe	6E.4.2.2.1 Communicate how a series of models, including those used by Minnesota American Indian Tribes and communities and other cultures, are used to explain how motion in the Earth-Sun-Moon system causes the cyclic patterns of lunar phases, eclipses and seasons. (P: 8, CC: 1, CI: ESS1)
7	4 Communicating reasons, arguments and ideas to others	4.2 Obtaining, evaluating and communicating information	4.2.2 Students will be able to gather information about and communicate the methods that are used by various cultures, especially those of Minnesota American Indian Tribes and communities, to develop explanations of phenomena and design solutions to problems.	LS: Ecosystems: Interactions, Energy, and Dynamics	7L.4.2.2.1 Gather multiple sources of information and communicate how Minnesota American Indian Tribes and communities and other cultures use knowledge to predict or interpret patterns of interactions

					among organisms across multiple ecosystems. (P: 8, CC: 1, CI: LS2, ETS2)
9-12 Earth and Space Science	4 Communicating reasons, arguments and ideas to others	4.2 Obtaining, evaluating and communicating information	4.2.2 Students will be able to gather information about and communicate the methods that are used by various cultures, especially those of Minnesota American Indian Tribes and communities, to develop explanations of phenomena and design solutions to problems.	ESS: Earth and Human Activity	9E.4.2.2.1 Apply place-based evidence, including those from Minnesota American Indian Tribes and communities and other cultures, to construct an explanation of how a warming climate impacts the hydrosphere, geosphere, biosphere, or atmosphere. (P: 8, CC: 4, CI: ESS3)
9-12 Life Science	4 Communicating reasons, arguments and ideas to others	4.2 Obtaining, evaluating and communicating information	4.2.2 Students will be able to gather information about and communicate the methods that are used by various cultures, especially those of Minnesota American Indian Tribes and communities, to develop explanations of phenomena and design solutions to problems.	LS: Ecosystems: Interactions, Energy, and Dynamics	9L.4.2.2.1 Obtain and communicate information about how Minnesota American Indian Tribes and communities and other cultures construct solutions to mitigate threats to biodiversity.* (P: 8, CC: 7, CI: LS2, ETS1)
9-12 Chemistry	4 Communicating reasons, arguments and ideas to others	4.2 Obtaining, evaluating and communicating information	4.2.2 Students will be able to gather information about and communicate the methods that are used by various cultures, especially those of Minnesota American Indian Tribes and communities, to develop explanations of phenomena and design solutions to problems.	Chemistry - PS: Matter and Its Interactions	9C.4.2.2.1 Communicate and evaluate claims by various stakeholders, including Minnesota American Indian Tribes and communities and other cultures, about the environmental impacts of various chemical processes on natural resources. (P: 8, CC: 2, CI: PS1)

Redacted Phenology and Herbivory Data Sheet (For reference)

Phenology and Herbivory Lab Data Sheet

Section 1: Site Information								***Bold Cells Required***	
Site Name:	Osprey Wilds ELC	**Species Name:**	Common Milkweed	**Date:**		**Plot #:**		**Plant#:**	
Recorder:		**Measurers:**							
Section 2: Invertabrate Observations : *Record 0, 1, 2, 3-5, 6-10, 11-20, 21-50, > 50, or 0.5 if there is clear evidence but no organism*									
Monarch Eggs:	Monarch Cats:	Tussock moth larvae		Red milkweed beetles		Swamp Mwd Leaf Beetle		Weevils	
Mollusks (Snails/ slugs)		Japanese Beetle		Milkweed bugs (MWD Bug)		Aphids		If aphids present: color? Green/Brown [ ] Clear/Orange [ ] Bright Yellow [ ] NA [ ] Other [ ]	
Bees		Ants		Spiders:		Ladybeetles:			
Other invertabrates observed:									
Section 3: Growth and Development									
%Stem wLvs: 0 [ ] 1-25[ ] >25%[ ]		***Leaf Color*** *(3=B,2=Y,1=G,NA):*		**Height (cm):**		**Leaf #:**	***# leaves w/ chewing damge:***		
Phenophase (circle): 1. NE, 2. V, 3. B, 4. Fl, 5. pF, 6. FrP, 7. SD, 8. E, 9. D					*#Mwds in 1 m²:*	***OR*** *% Lvs w/ chwng damge: (0, 1-5, 6-25, 25-50, 50-75, 75-99, 100)*			
Summer Observations Only					**Fall Observations Only**				
# Non-flowering Umbels:					**# Unripe Fruit**			MWD Bug #	
# Flowering Umbels:					**# Ripe Fruit:**			MWD Bug #	
# Wilted Umbels:					**# Empty Fruit:**			MWD Bug #	
Pecent Open Flowers: (0, 1-5, 6-25, 25-50, 50-75, 75-99, 100)					**Total Fruit #**				
Notes:									

Laboratorio de Fenología y Herbivoría						
Sección 1: Información del sitio						***Se requieren células en fuente negra***
Nombre del sitio:	Osprey Wilds ELC	**Nombre de la especie:**	Algodoncillo comun *(Common Milkweed (MWD))*		**Parcela #:**	**Planta #:**
Fecha:		**Escribiente:**		**Persona que mide:**		
Sección 2: Observaciones de invertebrados: Registre 0, 1, 2, 3-5, 6-10, 11-20, 21-50, > 50, o 0,5 si hay evidencia clara pero no hay organismo						
Huevos de monarca *(Monarch eggs)*:	La oruga de monarca *(Monarch larvae)*:	Larvas de polilla de mechón *(Tussock moth larvae)*:	Escarabajos rojos de algodoncillo *(Red Milkweed Beetles)*:		Escarabajo de algodoncillo en un pantano *(Swamp Milkweed Leaf Beetle)*:	Gorgojos *(Weevils)*:
Moluscos (caracol/ babosa) *(Mullusks (snails/slugs)*:		Escarabajo japonés *(Japanese Beetle)*:	Insectos de algodoncillo *(MWD Bug)*:		Afidos *(Aphids)*:	Si Hay alfidos del color? Verde/Café [ ] Transparante/Naranja [ ] Amarillo Vivo [ ] Otra [ ]
Abejas *(Bees)*:		Hormigas *(Ants)*:	Arañas *(Spiders)*:		Catarinas *(Ladybeetles)*:	
otros invertebrados observados:						
Sección 3: Desarrollo y crecimiento						
% tallo con hojas: 0 [ ] 1-25[ ] >25%[ ]		***color de hoja (3=café, 2=amarillo, 1=verde, N/A):***	**altura (cm):**		**hoja #:**	***# hojas consumedas por invertebrados:***
fenofase (dibuja un círculo): 1. NE, 2. V, 3. B, 4. Fl, 5. pF, 6. FrP, 7. SD, 8. E, 9. D				*#algodoncillo en 1 m²:*	***O** % de hojas con daño: (0, 1-5, 6-25, 25-50, 50-75, 75-99, 100)*	
Observaciones del verano				**Observaciones del otoño**		
# Umbelas sin flores:				**# Fruta inmadura**	Insectos de algodoncillo #	
# Umbelas con flor:				**# Fruta madura**	Insectos de algodoncillo #	
# Umbels marchitas:				**# Fruta vacía:**	Insectos de algodoncillo #	
% flores abiertas: (0, 1-5, 6-25, 25-50, 50-75, 75-99, 100)				**Numero total de frutas #**		
Notas:						