Mapping a Prairie Wetland

Grade: 6th **Season**: Fall **Time**: 1-1/2 hours
Group Size: 1 class **Ratio**: 1 adult to 5 students

For the Teacher:

Overview	As a class, students design and conduct a systematic field investigation related to mapping a prairie wetland. Their investigation uses scientific inquiry and accurately uses appropriate technology. Students present or explain their data in graphs and tables and interpret the meaning of their results.
Subjects Covered	Science, Social Studies, Math, Art
MN Academic Standards Supported	This lesson helps support 4 standards. See section "Minnesota Academic Standards in Science" and "Minnesota Academic Standards in Language Arts"
Skills Used	Questioning, investigating, measuring, collecting and recording data, interpreting data, answering questions, creating graphs and tables, team work, scientific method, mapping, listening, observing, writing, discovering, concluding, organizing, spatial relationships, following directions, choosing, reflecting
Performance Objectives	After completing this activity, students will be able to… • Work as a team to design and conduct a simple field investigation with appropriate questions • Create an accurate, complete, hand-drawn map of a wetland including common map features (compass rose, key, title, and colors) • Accurately measure distance, water depth, temperature, and/or time or other factors using appropriate technology • Present and explain data in tables and graphs
Vocabulary	Field investigation, mapping, compass rose, key, data, teamwork, compass, science, technology, prairie wetland, graph, table, observation, prediction, inference, landmark

For the PWLC Instructor:

PWLC Theme	The Prairie Pothole Region
Primary EE Message	The prairie pothole region is valuable and in need of restoration and protection.
Sub-message	Habitat: The prairie pothole region is a unique and rare ecosystem.
PWLC EE Objective	Use scientific methodology to explore the environment (ask questions, hypothesize, collect data, analyze data, form conclusions, make recommendations). (Wildlife and Habitat)
Materials	Compasses, thermometers, meter sticks, masking tape, watch, colored pencils, graph paper, overhead projector, graph paper overhead, tubs, nets, keys
Location	Classroom and wetlands nearby such as Mallard Marsh, Center Pond, Frog Pond, and/or Adams Pond

Background Information

The purpose of this lesson is to provide students with practice in designing and conducting an investigation and to practice making and using maps. The KWHL chart and method often used in reading is applied to science, providing structure to their investigation. The specifics of their investigation are driven by the questions they generate and by the thinking they use for determining their protocol in the field within the context of mapping a wetland. Investigating and mapping wetlands creates an authentic learning opportunity in the local environment, a chance for students to apply what they have learned in the school classroom about scientific inquiry, wetlands, and

cartography. Student maps become a relatively effective and efficient communication tool, a small representation of a larger geographic area. An important skill itself, part art, part science, mapmaking becomes a vehicle for making discoveries about prairie wetlands, their shapes, sizes, depths, plants, vegetation patterns, landmarks, distances, and wildlife. The exact details will be driven by their inquiry when setting up the investigation.

Prairie wetlands are one of three major wetland types in Minnesota; the other two are forest wetlands and peatlands. Vegetation zones around prairie wetlands appear as rough concentric circles transitioning between the drier prairie surrounding the wetter wetland and are easily mapped. From wet to dry, those zones may include permanent open water, deep marsh, shallow marsh, wet meadow, and low prairie. Certain plants are characteristic of each zone, and not all wetlands have all five zones, depending upon water depth and the contour of the basin.

Maps are vital tools used in education and in natural resource management. For example, at the PWLC:

- Sound maps help students focus on listening, relative direction and distances, orientation, biodiversity, and if conducted seasonally, changes over time.
- Color maps allow students to observe patterns in vegetation, underlying causes, and if conducted seasonally, changes over time.
- Trail maps help visitors orient themselves to the site and navigate through the prairie
- Locator maps of snow study stations ensure students return to the same location as their investigation is repeated through winter
- Aerial photos overlaid with trails (thanks to GPS technology) help students and staff plan scientific research to improve prairie restoration techniques
- Systematic grid frame maps and hand drawn meter plot maps help students document changes in biodiversity studies over time and evaluate prairie restoration techniques

Maps of course have historical significance as well. Many naturalists drew maps which are still used today.

- Lewis and Clark's maps help us envision extensive habitats which have since succumbed to plowing and paving.
- John Muir's maps of glaciers in Alaska help us understand and document climate change today as those glaciers have receded extensively since the 1800s.
- Ernest Thompson Seton volunteered for the Canadian government on a 2,000 mile canoe trip across northern Canada. He created vegetation maps of Manitoba with only a good compass. His maps were used into the 1950s and are still considered highly accurate.
- Aldo Leopold's maps applied elements of pattern, process, and connectedness in the landscape and contributed to his early spatial conservation theory. He applied this theory to wildlife management and cooperative conservation practice. These applications are used in landscape ecology, design, and biodiversity management today.

In our increasingly electronic and indoor culture, map making provides an authentic avenue for turning the classroom outward and for providing foundations in later use of virtual, abstract technology like Global Positioning Systems. Exploring and mapping a wetland helps students become better observers and provides them with a positive, outdoor activity they can practice anywhere.

"Mapping an area is often like staking a claim. The mapping energy expended by the children serves to get them invested in what happens here in the future."

David Sobel, Mapmaking With Children,
Sense of Place Education for the Elementary Years.

Teacher Preparation

- Help save paper. Bring your students' science notebooks or journals to record their field data and discoveries in. If science notebooks are not available, please inform the PWLC staff that you will need paper and clipboards when booking your date.
- We highly recommend conducting one or more of the suggested extensions before your visit in order to integrate this field investigation into the classroom study of plants, ecological succession, nature, cartography, naturalists, scientists, science, wetlands, or other topics. We believe such integration enhances student motivation for learning in other curricular areas. Please see section, "Teacher-Led Extensions/Adaptations/Assessment Ideas."

PWLC Staff Preparation

Organize and prepare materials. Estimate or measure and memorize landmarks for a 100-meter distance for benchmarking.

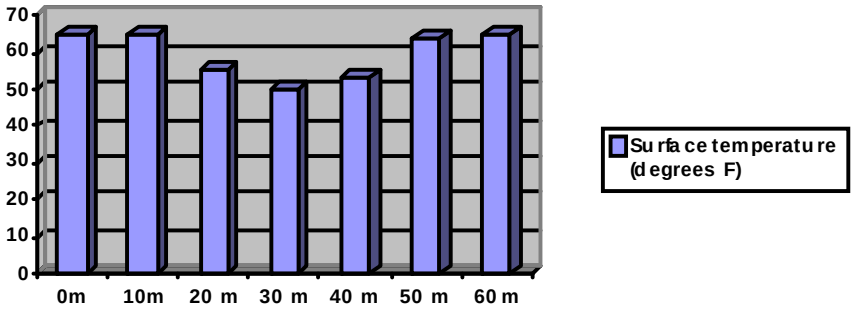
Field Investigation Procedure

1. In the classroom, welcome students, teachers, and chaperones to the Prairie Wetlands Learning Center.
2. Organize students into small groups, each led by a chaperone, and inform chaperones of their role in following through on instructions for students.
3. Inform students that today they are visiting the PWLC to design and conduct a wetland investigation using mapping. They should open their science notebooks to the next blank page, title it "Wetland Mapping," and include the date and location at the top.
4. Ask a teacher for assistance in recording student responses on the white board. Students should also jot down a few notes as the lesson progresses. What do they already know about maps? About wetlands? What kinds of things should maps include?
5. When mapping a wetland today, what would they like to find out about wetlands? The teacher should record the responses in a second column. Review the questions brainstormed by students and together select the questions that are

most appropriate for a field investigation.

6. In a third column, record the ways in which students suggest they can find out the answers to their questions. What kind of equipment will they need? How will they use it? What kinds of procedures would they need to follow? What kinds of features will they investigate and depict on their maps? Which wetland(s) should they investigate?
7. Demonstrate how students should set up their field data in their notebooks. One page should be reserved for the map and include a title, key with colors, and a compass rose. Another page can be reserved for other data collection that may be needed depending upon their questions (such as water depth, temperature, names or sketches of plants, tally marks for estimating distances, observations, etc.)
8. Demonstrate the proper use of equipment and distribute materials to each chaperone to share within each small group.
9. After lining up in small groups with chaperones at the door, remind everyone that they are naturalists and should practice being naturalists in the field. How should they behave? In the field, they must stay in their small group with their chaperone but will be able to go off trail, spread out – leave no trace.
10. Allow for as much time as possible in the field. Start by making sure students include a few obvious landmarks such as the barn or bridge. Also make sure that everyone orients themselves and their maps correctly using the compass. If students need a guide to estimate distances, provide them with the average of 15 steps per 10 meters (counting steps of both the left and right feet). Show students your 100-meter benchmark. Move from group to group to answer questions, model good map making, and assist students in collecting and recording their data and drawing their maps.
11. Back indoors, start to wrap up by sharing and processing data and interpreting the meaning of the data. Provide graph paper. On the overhead, guide students in making a table and a graph to depict one set of data. For example, if students measured surface water temperatures at 10 meter intervals across Mallard Marsh using the bridge, the table and graph might look like these:

Distance (meters)	Temperature (degrees F)
0 m	65
10 m	65
20 m	55
30 m	50
40 m	53
50 m	64
60 m	65



12. Answer the questions generated earlier using the data they collected. Students should copy all of this information into their notebooks.
13. Ask a few students to share their discoveries with the class. Ask everyone to write a one-sentence discovery in their notebook. Offer some sentence-starters for them, such as, "Today, I discovered…" or "I never knew…" Ask a few students to share with the class. Ask them how or who they could share their discovery with when they return home? (Tell a friend or relative, write a poem or paint a picture to give away, etc.) Encourage them to keep going outside anywhere they are to explore; it is free and keeps them occupied. Keep making maps of their school grounds, neighborhood, lake, or campsite – it helps you observe better!
14. Thank them all for coming to the PWLC and invite them to return again.

Weather Alternatives

Field investigations take place rain or shine. Everyone should dress appropriately for the weather. In the event of unsafe weather (lightning, high winds) or pouring rain, everyone must come indoors. PWLC staff make every effort to make your travel worthwhile despite the weather and prepare indoor, developmentally-appropriate plans. PWLC staff welcome teacher input into these plans. Some possible alternatives might include:

- Conduct a map scavenger hunt using 12 different kinds of maps and the "Exploring Maps" Scavenger Hunt sheet. Use the star map, street maps, WPA maps, historical map of NW Minnesota, the aerial photo of the Prairie Wetlands Learning Center, and GIS maps, as available.
- Present the "History of Mapping" PowerPoint.
- Pass out a map of the PWLC (the white copy). Ask students to look at the map and find what's wrong with or missing from the map (a scale, a legend, a compass rose, what the different trails are called, etc.) Show the other map of PWLC (the yellow copy). Are there any other differences or improvements they can see by comparing the two? Use their responses to generate a list of the parts of a map: title, scale, legend, cardinal directions/compass rose.
- Provide students with two joined meter sticks. In the prairie below the deck, ask students to randomly set down their two meter sticks to make a right angle. Imagine the complete outline of one square meter. Imagine you can shrink down to the size of an ant. Students then design a map for this mini-wildlife refuge.

Their maps need to have all the map elements; they also need to provide habitat for wildlife and recreation for people (hunting, fishing, education, interpretation, wildlife observation, photography). They should make a second locator map. Trade both maps with another student to see if they can find your wildlife refuge and all of the features in it as depicted in your map. What helped? What could be improved?

- Read Owl Moon by Jane Yolen. Students create a map that illustrates the journey taken in the story by the father and child in search of owls. Their maps should show the standard map elements.
- Distribute copies of a Fergus Falls map (for Fergus Falls students). Ask students to locate the PWLC on the map as well as their school and home. Write directions predicting how the school bus will travel back to school from the PWLC. Observe while riding the bus – which way does the bus travel? Did the bus driver happen to follow the directions predicted by one of the students? Students can then use the same map to follow along the route home from school. What other familiar landmarks can they find that are depicted on the map? How many wetlands did they record on their maps?

PWLC Staff-Led Extensions

- If an additional 45 minutes is available beyond the needed 90 minute lesson time, this extension helps students more completely experience map making and map use as a communication tool. Please inform PWLC staff when booking if you would like to include this extension. As students participate in the map making lesson, PWLC staff provide an item for each student to place on the ground and mark the corresponding location on their map (such as a poker chip). Collect maps and re-distribute so that each student uses someone else's map to locate and retrieve the poker chip. Discuss which map features helped to locate the chips and improvements that could make the chips easier to find. (Chips must be visible, not buried or hidden.)
- Distribute PWLC trails maps. Challenge students to use that map and their own together. What is the name of the wetland they visited according to the PWLC map?

Teacher-Led Extensions/Adaptations/Assessment Ideas

- To maximize outdoor classroom time at the PWLC, teachers may conduct steps 3 through 5 in the section "Field Investigation Procedure" at school. Upon arrival at the PWLC, teachers may provide PWLC staff with a written list of what students know and wonder for quick review before continuing with the remaining steps.
- At school, make maps of the school grounds. Provide an item for each student to place on the ground and mark the corresponding location on their map (such as a poker chip – they must be visible, not buried or hidden). Collect maps and re-distribute so that each student uses someone else's map to locate and retrieve the poker chip. Discuss which map features helped to locate the chips and improvements that could make the chips easier to find.

- Assign homework for students to create a map of their yard including habitats and animals observed. Create a large scale map of your community that includes their yard maps, perhaps using the gym or lunch room floor or playground.
- Create a raised relief map from the paper maps created during the field investigation. Include the wetland as well as the elevated topography of prairie hills surrounding the wetland. Use clay, sand, water, sponges, whatever materials are available and make sense. Refer to Mapmaking With Children, Sense of Place Education for the Elementary Years by David Sobel for more details.
- Read Follow the Drinking Gourd by Jeanette Winter as students create a map that depicts the journey and as represented in the words of the song. Their maps should show the standard map elements.
- Discuss the meaning of Aldo Leopold's "blank spot." "*Of what avail are forty freedoms without a blank spot on the map*? (A Sand County Almanac, 1949)
- To help students benchmark distances, show them how to determine their average pace. Using 10 meter sticks or a meter tape, mark out 10 meters in length on the school yard. Students walk from one end to the other, counting their steps (both the left and the right foot each time it steps). Carrying a clipboard, paper, and pencil, they jot down the number of steps and repeat the process two more times. Using the three numbers, students calculate their average number of steps in 10 meters. Then they may practice walking longer distances, counting their steps, and estimating how many meters they have walked. For example, if a student walks 15 steps in 10 meters, that same student would need to walk 150 steps to cover 100 meters. Allow them to pace out 100 meters on the ground outside so they can see what that distance looks like, a convenient benchmark for map making.
- Encourage students to bring a parent to the PWLC after school or on the weekend. Can that parent use the student map to navigate to and around the same wetland studied during the field investigation? Would students make any changes to their maps as a result?

Minnesota Academic Standards in Science

This lesson helps support the following state standards…

Strand I. HISTORY AND NATURE OF SCIENCE

Substrand B. Scientific Inquiry

Standard: The student will understand that scientific inquiry is used in systematic ways to investigate the natural world.

Benchmark 1. The student will identify questions that can be answered through scientific investigation and those that cannot.

Benchmark 2. The student will distinguish among observation, prediction and inference.

Benchmark 3. The student will use appropriate tools and Système

International (SI) units for measuring length, time, mass, volume and temperature with suitable precision and accuracy.

Benchmark 4. The student will present and explain data and findings from controlled experiments using multiple representations including tables, graphs, physical models and demonstrations.

Strand I. HISTORY AND NATURE OF SCIENCE

Substrand C. Scientific Enterprise

Standard: The student will know that science and technology are human efforts that both influence and are influenced by society.

Benchmark 1: The student will describe the types of questions asked, the products, and the methods of investigation used to distinguish science from technology.

Benchmark 2. The student will explain why scientists may work in teams or work alone, can collaborate and, at times, compete.

Minnesota Academic Standards in Language Arts

This lesson helps support the following state standards…

Strand SPEAKING, VIEWING, LISTENING, AND MEDIA LITERACY

Substrand Speaking, Viewing, Listening, and Media Literacy K-5

Standard Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

Benchmark 5.8.1.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.

Strand LANGUAGE

Substrand Language K-5

Standard Demonstrate knowledge of the conventions of standard English capitalization, punctuation, and spelling when writing.

Benchmark 5.10.2.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. d. Use underlining, quotation marks, or italics to indicate titles of works.

References and Resources

For Adults

- Brief History of Maps and Cartography, http://academic.emporia.edu/aberjame/map/h_map/h_map.htm
- Mapmaking With Children, Sense of Place Education for the Elementary Years by David Sobel
- Minnesota's Natural Heritage, an Ecological Perspective by John R. Tester

For Students

- Follow the Drinking Gourd by Jeanette Winter
- Owl Moon by Jane Yolen
- Lewis and Clark as Naturalists, http://www.mnh.si.edu/lewisandclark/index.html?loc=/lewisandclark/home.html

Credits

This field investigation was developed and written by Prairie Wetlands Learning Center Staff, U.S. Fish and Wildlife Service. (Thanks to Prairie Science Class naturalist Tia Thysell for reviewing this lesson plan.) Thanks to the following teachers for reviewing this lesson plan: Jean Dirckx and Stacy Lundquist, Battle Lake; Diane Wisness, Morning Son Christian School, Fergus Falls.

Student material follows.

EXPLORING MAPS -- Scavenger Hunt

1. Which map would you use to find constellations in the night sky? Map #_____.
   Locate the constellation ORION. What are the two brightest stars in that constellation?
   _____ and _____.

2. Which map of Otter Tail County was taken using aerial photography? Map # _____.
   What is the name of the largest lake in the county? _____.

3. Which map could you use if you wanted to locate National Wildlife Refuges throughout the United States? Map # _____.
   Name a state with the largest National Wildlife Refuge. _____.

4. Which map could visitors to Prairie Wetlands Learning Center use to help them choose a hiking trail? Map # _____. Mallard Marsh is north of Muskrat Marsh, True or False? _____.

5. Which map shows the areas of the world that use the most amount of lights during the night? Map # _____. What symbol is used on this map to represent light from fires? _____.

6. Which map would you buy if you were planning a backpacking trip to the Chiricahua Wilderness Area? Map # _____.
   Is this Wilderness Area in Arizona or New Mexico? _____.

7. Which map would you use if you wanted to drive to some of the scenic sites in Otter Tail County? Map # _____. If you wanted to stop at museums along the scenic route, what symbol would you look for on the map? _____.

8. Which map would you use if you were driving to the Minneapolis Airport to pick up your relative who was visiting from a different state? Map # _____.
   Which major river runs between Minneapolis and St. Paul? _____.

9. Which map could biologists study to determine where the density of duck pairs is the highest? Map # _____. The density seen most frequently on the map is _____ duck pairs per square mile. (Hint: What color do you see the most of?)

10. Which map shows the major biomes (plant and animal communities) on each continent of the world? Map # _____. How many different biomes does America have? _____.

11. Which map would be helpful if you were planning to take your boat up to Rainy Lake for a camping trip? Map # _____. Is there a campsite on Big Island in Rainy Lake? _____.

12. Which map shows the routes of early explorers? Map # _____.
    Which explorer was the first to reach Antarctica's South Pole? _____.