

HOW DOES TEACHING IN OUTDOOR CLASSROOMS IMPACT SECONDARY  
STUDENT LEARNING OF ENVIRONMENTAL SCIENCE CONCEPTS?

by

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A capstone project submitted in partial fulfillment of the requirements for the degree of Masters  
of Arts: Natural Science and Environmental Education

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## Project Summary

This curriculum project was developed to improve student's understanding of foundational habitat terminology necessary for further development of a solid understanding of wildlife management concepts through experiential learning. Experiential learning (EL) creates the opportunity to learn through doing and works through the ability of experiences to transform individual understanding. Jose, Patrick & Moseley (2017) explained that experiential learning is learning that happens when students use hands-on activities and relate to previous knowledge. Dewey (1963) also explained that "All education comes through experience" (p. 25). Because environmental science is usually taught in the classroom, these educational experiences often are lacking in depth. Experiential learning is inherent in outdoor education, James and Williams (2017), noted that "Application of environmental science concepts in experiential, real-life contexts is extremely valuable" (p. 59). Meighan & Fuhrman (2018), described how learning outside provides "a visual aid and allows students to vividly contextualize the presented information." (p. 40). Outdoor classrooms and environmental education together offer students the opportunity to learn in the context. These experiences work together to create opportunities for deeper learning and more connections to occur. Begum (2012) stated "a science teacher should teach environmental education in the science classroom by using the environment as a teaching-learning aid because environmental education helps to develop relational understanding." (p. 12). Given the increasing importance of environmental awareness, it is imperative that educators find more impactful and effective methods to create better learning experiences. Keeping this in mind, the purpose of this research and curriculum project was to determine *how does teaching in outdoor classrooms impact secondary student learning of environmental science concepts?*

This curriculum project is specifically designed for 9-12 grade high school students enrolled in an environmental science or biology class. The curriculum aims to address the points raised by the relevant literature through a unit on basic habitat terminology that utilizes the framework: “backwards design” (Wiggins & McTighe, 2011). “Backwards design” is based on the concept that the curriculum developer identifies the essential outcomes of a unit first and builds content around those outcomes. The habitat terms the unit is based on are foundational concepts in developing an understanding of wildlife habitat and wildlife management. A key component of this unit as suggested by the research is to use the outdoors as an additional tool for teaching the habitat concepts to create the contextual learning experiences that the literature suggests are necessary. The eight lessons in the curriculum unit are developed to bring students to a basic understanding of habitat. Two lessons are outside of the classroom to allow for experiential learning to occur. One of those lessons requires a trip to a local area that offers different wildlife habitats for students to identify and analyze. Students are also given the opportunity to showcase their learning and understanding through the creation of a habitat improvement project of their school grounds.

## Scope and Sequence

	Lesson Title	Lesson Objectives
Lesson 1	Introduction to Habitat Basic Terms	<ul style="list-style-type: none"><li>- Define and explain the following terms<ul style="list-style-type: none"><li>- Habitat</li><li>- Organism</li><li>- Community</li><li>- Ecosystem</li></ul></li></ul>
Lesson 2	Elements of Habitat	<ul style="list-style-type: none"><li>- Identify the elements of habitat and explain their importance</li></ul>
Lesson 3	Food Web and Food Chain	<ul style="list-style-type: none"><li>- Differentiate between a food web and a Food chain</li><li>- Create a food chain and food web-based on local species</li></ul>
Lesson 4	Biomes	<ul style="list-style-type: none"><li>- Define and explain the following terms<ul style="list-style-type: none"><li>- Biome</li><li>- Coniferous Forest</li><li>- Deciduous Forest</li><li>- Tallgrass Prairie</li><li>- Aspen Parkland</li></ul></li></ul>
Lesson 5	Habitat Succession	<ul style="list-style-type: none"><li>- Define the following terms<ul style="list-style-type: none"><li>- Habitat Succession</li><li>- Biological Succession</li></ul></li></ul>

		<ul style="list-style-type: none"> <li>- Primary Succession</li> <li>- Secondary Succession</li> <li>- Pioneer Species</li> <li>- Climax Community</li> <li>- Niche</li> </ul>
Lesson 6	Habitat in the Field	<ul style="list-style-type: none"> <li>- Identify biome types and successional stages</li> </ul>
Lesson 7	Final Habitat Project	<ul style="list-style-type: none"> <li>- Analyze habitats for wildlife suitability and</li> <li>- Create a habitat improvement plan</li> </ul>
Lesson 8	Final Habitat Project Presentations	<ul style="list-style-type: none"> <li>- Review habitat improvement plans and offer suggestions for improvement</li> </ul>

# Lesson 1: Introduction to Habitat Basic Terms

Grades: 9-12

Duration: One class period

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## Objectives

Students will:

Be able to define and explain the following terms

- Habitat
  - Organism
  - Community
  - Ecosystem
- 

## Preparation

- Make copies of student knowledge assessment
  - Review terminology
- 

## Vocabulary

- Habitat
  - Organism
  - Community
  - Ecosystem
- 

## Materials

- Basic Habitat Terms materials
  - Student knowledge Pre-Assessment
  - LCD Projector
- 

## Overview

- Ask students what they know about habitat and have a short discussion to gauge student knowledge
- Transition to “*Habitat Basic Terms*” presentation materials and present materials
- Handout *Student Knowledge Pre-Assessment*
- At the end of check for understanding by asking students
  - What is a habitat?
  - What are the basic things an animal needs in a habitat?

# Lesson 2: Elements of Habitat

Grades: 9-12

Duration: One class period

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## Objectives

Students will:

Be able to identify the elements of habitat and explain their importance

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## Preparation

- Visit with building administrators to let them know students will be outside on the school grounds.
  - Make copies of the *Habitat Scavenger Hunt Activity Worksheet*
  - Review terminology
  - Post *Fish and Wildlife* Chapter three assignment on Google classroom
- 

## Vocabulary

- Elements of Habitat
    - Food
    - Shelter/Cover
    - Space
    - Water
    - Arrangement
- 

## Materials

- *Habitat Scavenger Hunt Activity Worksheet*
  - LCD Projector
  - Google Classroom page
  - Student's cell phones
  - Fish and Wildlife Textbook
- 

## Overview

- Explain the task for the day. We will be going outside and looking for the elements of habitat around the school grounds.
- Remind that there are classes going on and that they need to be respectful of the other students
- Students will be instructed to review the *Habitat Scavenger Hunt Activity* worksheet
- Students will then head outside of the classroom to look for the elements and take a

picture of the elements they find. When they complete the scavenger hunt they will upload their pictures to the course Google Classroom page. Students will be given fifteen minutes to complete the scavenger hunt and upload the pictures.

- When students return to the classroom the pictures will be reviewed and placed into the five elements of habitat categories
  - Food
  - Shelter/Cover
  - Water
  - Space
  - Arrangement
- Discussion of school grounds habitat- what's present on the school grounds and what's missing?
- With the remaining time, students will work on the *Fish and Wildlife*, chapter three.



# Lesson 3: Food Webs and Food Chain

Grades: 9-12

Duration: One class period

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## Objectives

Students will:

- Be able to
  - Differentiate between a food web and a Food chain
  - Create a food chain and food web-based on local species
- 

## Preparation

- Coordinate transportation for the upcoming field trip
  - Review terminology
  - Post assignment on google Food Web and Food Chain on Google Classroom
- 

## Vocabulary

- Food Web
  - Food Chain
  - Primary Consumer
  - Secondary Consumer
  - Tertiary Consumer
  - Decomposer
  - Energy Transfer
  - Herbivore
  - Carnivore
- 

## Materials

- *Food Chain and Food Web* presentation materials
  - *Food Chain and Food Web* Worksheet
  - LCD Projector
  - Google Classroom page
  - Fish and Wildlife Textbook
- 

## Overview

- Introduce the concept of Food webs and Food Chains
- Transition to “*Habitat Basic Terms*” presentation materials and present materials

- Introduce the *Food Chain and Food Web* Worksheet and give students time to complete
- Remind students to work on (Fish and Wildlife Chapter 3) for students to work on at home or at the end of class if time allows.
- Handout permission slips

# Lesson 4: Biomes

Grades: 9-12

Duration: Two class periods

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## Objectives

Students will:

Be able to define and explain the following terms

- Biome
  - Coniferous Forest
  - Deciduous Forest
  - Tallgrass Prairie
  - Aspen Parkland
- 


## Preparation

- Make copies of student knowledge assessment
  - Review teacher materials
  - Post Chapter Four assignment
- 

## Vocabulary

- Biome
  - Coniferous Forest
  - Deciduous Forest
  - Tallgrass Prairie
  - Aspen Parkland
  - Flora
  - Fauna
- 

## Materials

- Google Classroom
  - Student's Laptop
  - Minnesota DNR Webpage
  - LCD projector
  - *Biomes* notes sheet
  - *Biomes* Presentation
  -  Minnesota Biomes
- 

## Overview

- Students will be asked for characteristics of habitat that they have learned about over the last few days.

- Students will also be asked if they have noticed differences of habitat types throughout their travels.
  
- Students will be given the definition of biome and directed to work for fifteen minutes with their group partners to find the following characteristics about the biome their group is assigned
  - Average temperature and precipitation
  - Flora and Fauna (Plants and Animals)
  - Where found in Minnesota
  - Key characteristics
  - A good picture
  -
  
- A group member will explain their findings as the class together works through the *biome notes sheet*.
  
- 
  
- With remaining time students will be directed to work on chapter four from the *Fish and Wildlife* textbook

# Lesson 5: Habitat Succession

Grades: 9-12

Duration: One class period

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## Objectives

Students will be able to define

- Habitat Succession
  - Biological Succession
  - Primary Succession
  - Secondary Succession
  - Pioneer Species
  - Climax Community
  - Niche
- 

## Preparation

- Review terminology
  - Post *Biological Succession* Worksheet
- 

## Vocabulary

- Habitat Succession
  - Biological Succession
  - Primary Succession
  - Secondary Succession
  - Pioneer Species
  - Climax Community
  - Niche
- 

## Materials

- *Biological Succession* Worksheet
  - *Biological Succession* Presentation Materials
  - LCD Projector
  - Student's Laptop
- 

## Overview

- Ask students what they know about habitat change over time and have a short discussion to gauge student knowledge
  
- Transition to "*Biological Succession* " presentation materials and present materials

- Assign *Biological Succession* Worksheet for students to work on for the remainder of the class period.

# Lesson 6: Habitat in the Field

Grades: 9-12

Duration: One class period (depends on travel time)

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## Objectives

Students will:

Be able to identify biome types and successional stages

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## Preparation

- Make copies of *Habitat in the Field* worksheet
  - Review terminology
  - Organize travel and school logistics at least a week prior to the trip depending on the school policies regarding field trips
- 

## Vocabulary

- Habitat
  - Biome
  - Cover/Shelter
  - Food
  - Shelter
  - Water
  - Succession Stage
- 

## Materials

- *Habitat in the Field* worksheet
  - Clipboards
  - Permission Slips
  - Transportation (may be needed depending on distance to park)
- 

## Overview

- Students will travel to a local park that has different habitat types and different levels of succession.
- Students will work to complete the *Habitat in the Field* assignment in groups of two to three, being sure to identify biome type, succession type, and make observations of plant and animal life.
- Students will be walked through the first habitat type and helped to answer questions they have regarding the activity

- Students will work to complete the remaining questions on the worksheet as they explore the park.
- After everyone has completed the stations and is back on the bus to return to school, students will be asked to briefly discuss similarities and differences between the areas they surveyed.



# Lesson 7: Final Habitat Project

Grades: 9-12

Duration: Two class periods

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## Objectives

Students will:

Be able to analyze habitats for wildlife suitability and create a habitat improvement plan

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## Preparation

- Post *Habitat Improvement Plan* on Google Classroom
  - Review terminology
- 

## Vocabulary

- Habitat
  - Organism
  - Community
  - Ecosystem
  - Cover/Shelter
  - Food
  - Space
  - Water
  - Arrangement
- 

## Materials

- *Habitat Improvement Plan* Assignment Sheet
  - Student computers
- 

## Overview

- Reviewing the entirety of the lesson, students will now be given the task of improving the school grounds for wildlife that would typically be found in the area (being sure to refer back to animals found in the biome)
- Students will be reminded of the park that we visited yesterday.
- Ask students about what they observed in terms of how park managers have or haven't worked to change or improve the habitat.

- Students will also be reminded that as the school is a multiple-use space, they will need to accommodate those needs in their plan.
- In groups of two students will work to complete the habitat improvement plan
- Check-in with students to determine group progress as they work through the requirements of the project.

# Lesson 8: Final Habitat Project Presentations

Grades: 9-12

Duration: One class to two periods

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## Objectives

Students will:

Be able to review habitat improvement plans and offer suggestions for improvement

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## Preparation

- Review terminology
  - Review student's *Habitat Improvement Plans*
  - Make copies of *Student Knowledge Assessment*
- 

## Vocabulary

- Habitat
  - Organism
  - Community
  - Ecosystem
  - Cover/Shelter
  - Food
  - Space
  - Water
  - Arrangement
- 

## Materials

- Student's *Habitat Improvement Plans*
  - *Student knowledge Assessment*
  - LCD Projector
- 

## Overview

- Students will present their habitat improvement plans for the school grounds.
- Their classmates will note on their assessment sheet three characteristics that add to wildlife habitat, in practical ways to the school grounds and identify one part of the plan which are not helpful or practical.
- Upon completion of the presentation, hand out the *Student knowledge Assessment* and collect when completed.

## **APPENDIX B: INTRODUCTION TO HABITAT- CURRICULUM MATERIALS**

## **Habitat Terms**

### **Habitat**

An animal's home

### **Elements of habitat**

- Food
- Water
- Cover/Shelter
- Space
- Arrangement

### **Organism**

A plant or an animal.

### **Community**

Includes all of the populations of organisms that live within a defined area such as a woodland, wetland, or cornfield.

### **Ecosystem**

A community of living organisms in addition to all of the nonliving features of the environment such as water, air, sunlight, and soil.

### **Biosphere / Ecosphere**

Consists of all of the ecosystems on earth capable of supporting life.

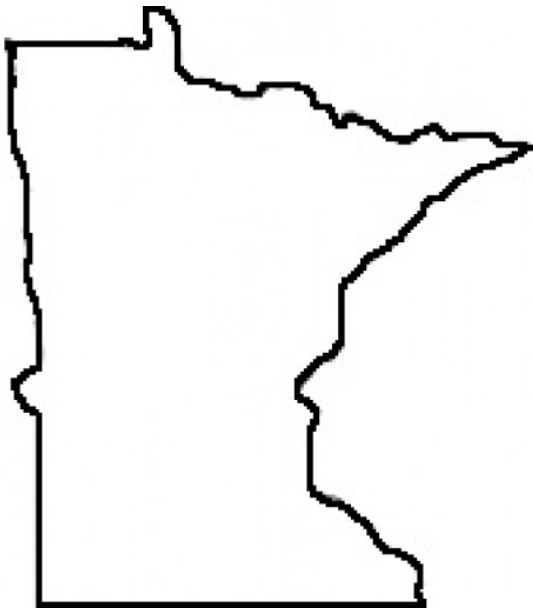
**1. Define the following terms**

- a. Habitat**
- b. Organism**
- c. Ecosystem**
- d. Biological Succession**
- e. Pioneer Species**
- f. Climax Community**
- g. Biome**

**2. Draw a habitat for a Mallard, White-tailed Deer, or Sunfish (Circle one) and include and label, cover/ shelter, space, water, food**

3. Draw food chain and food web-based on local species and label the parts using the appropriate terms.

4. Draw out and label the locations of the biomes in Minnesota



# **Food Chain and Food Web Notes**

## **Food Chain**

**A group of plants and/ or animals related to each other by the fact that one feeds or depends on the next**

## **Food Web**

**The interconnectedness of or relationships between plants and/or animals**

## **Producer**

**Green plants that manufacture food through the process of photosynthesis**

## **Decomposer**

**Organisms that help organic material to degrade.**

## **Herbivore**

**Animals that feed on plants**

## **Carnivore**

**Animals that feed on other animals**



**Food Chain and Food Web Project**  
**25 Points Possible**

Name: \_\_\_\_\_

Objective: To create an accurate food chain and food web representing species that would be found in Minnesota biomes using pictures from the internet

You need to include the following:

**Food Chain**

- Producer (2pts)
- Primary Consumer (2pts)
- Secondary Consumer (2pts)
- Decomposer (2pts)
- Arrows indicating which way the energy is going (2 pts)

Be sure to include the sun and water. (5 pts)

**Food Web**

Include at least two of the following

- Producers (2 pts)
- Primary Consumer (2 pts)
- Secondary Consumer (2 pts)
- Decomposer (2 pts)
- Arrows indicating the connections between the species(2 pts)

## **Minnesota DNR: Minnesota Biomes Summary**

### **Coniferous Forest**

Coniferous- cone bearing

Needles are retained for two- fifteen years and can begin photosynthesis as temperatures are warm enough.

Thin glacial deposits of soil on top of bedrock

Peatlands occur in large areas as a result of glacial lakes

Climate cool and moist. Temperatures are maintained by arctic air masses. Humidity levels are maintained by summer rain and heavy winter snowfall.

### **Deciduous Forest**

Most were cleared for towns and agricultural purposes.

Deciduous trees lose leaves in fall and will regrow in the spring.

Wide variety of forest types exist across the biome ranging from dense sugar maple forests, to the floodplain forests, to the oak savannas.

Soil and topography vary depending on glacial activity ranging from gentle rolling hills with rich fertile soil to steeper hills with gravel pockets and in the driftless region in the southeastern corner.

Climate is impacted by air masses from the Gulf of Mexico bringing moisture and heat.

### **Tallgrass Aspen Parkland**

Patchwork of bur oak and aspen trees and prairie grassland and wetlands

Transitional area between the dry prairie to the west and the more moist coniferous forest to the north and east.

Soil is rocky and poorly drained making row-crop agriculture challenging in much of the biome.

Evapotranspiration is greater than precipitation

Windy and dry. Hot summers and cold winters.

### **Prairie Grasslands**

Treeless area. "A sea of grass."

Flat or rolling grassland with sparse vegetation to tall grasses up to eight feet tall.

Prairie plants have adapted to this drier habitat through the development of extensive root systems that can be three times as deep as the plant is tall.

Glaciers left deep soil resources across much of the biome.

Drier and hotter than other biomes.

Three main forming factors

-Fire

Most trees and shrubs are fire intolerant and fire prevents their establishment while prairie species have deep established root systems that can recover from fire.

-Bison

Prairie plants' deep root system allows for regrowth after grazing.

-Drought

The deep roots allows for plants to access moisture deep in the soil. This helps plants survive through dry spells.

## **Biological Succession Notes**

### **Biological Succession**

Changes that occur as living organisms replace other lower order organisms in an environment.

### **Primary Succession**

Development of an ecological community in an area where living organisms were not previously found.

Example: A newly formed volcanic island.

### **Secondary Succession**

The gradual change in species of plants that live in an area during the time that a damaged ecosystem is returning to its original state of ecological development.

### **Pioneers Species**

The first plants to grow in an environment.

### **Climax Community**

The plants that occupy an environment when the succession of species is complete and the plant population becomes stable.

### **Niche**

A specific role or function within a habitat that is performed by an organism.

## Biological Succession

Name: \_\_\_\_\_

### Instructions:

1. Go to  
<https://www.nature.com/scitable/knowledge/library/succession-a-closer-look-13256638/>
2. Read the article
3. Answer the following questions
  1. What is biological succession?
  2. What causes succession?
  3. What causes disturbances in succession?
  4. Draw out in the space below what ecological succession would look like in our area.
5. Can ecological succession take place in the same way that it would have happened before the settlement of this area?
6. How can habitat managers utilize succession as a management tool?

## Habitat in the Field

Names: \_\_\_\_\_

**Instructions: Your task is to walk through the park today and take note of the different habitat types and the plant and animal species you see today.**

### Example

1. Habitat or biome type:
  - a. Cover/Shelter
  
  
  
  
  
  - b. Food
  
  
  
  
  
  - c. Water
  
  
  
  
  
  - d. Succession Stage
  
  
  
  
  
  - e. Animals Present
  
  
  
  
  
  - f. Plants Present
  
2. Habitat or biome type:
  - a. Cover/Shelter
  
  
  
  
  
  - b. Food
  
  
  
  
  
  - c. Water
  
  
  
  
  
  - d. Succession Stage
  
  
  
  
  
  - e. Animals Present

- f. Plants Present
3. Habitat or biome type:
- a. Cover/Shelter
  
  - b. Food
  
  - c. Water
  
  - d. Succession Stage
  
  - e. Animals Present
  
  - f. Plants Present
4. Habitat or biome type:
- a. Cover/Shelter
  
  - b. Food
  
  - c. Water
  
  - d. Succession Stage
  
  - e. Animals Present
  
  - f. Plants Present

5. Habitat or biome type:
  - a. Cover/Shelter
  - b. Food
  - c. Water
  - d. Succession Stage
  - e. Animals Present
  - f. Plants Present
6. What did you see today that you already know?
7. What did you see today that was surprising or new?



## Habitat Improvement Plan

Names: \_\_\_\_\_

**Background:** Over the past two weeks we have been learning about habitat, specifically types, and elements of habitats. We've looked at a local park and discussed biomes present in Minnesota and beyond. We've also examined the school grounds. By now, you should better understand how to make the area more wildlife-friendly while still allowing for all of the users that use the school to continue to do so with minimal interruption.

**Instructions:** Your task is to develop a plan that makes the school grounds more inhabitable to a minimum of five species that could realistically find their home around the school.

Your plan must include:

- Habitat improvement goals
- A list of species for you wish to improve the habitat and their habitat requirements
- A way to include or increase the space/ amount each one of the elements of habitat
- An aerial view of the school grounds with areas you choose to create habitat improvements
- An explanation of why you think your habitat improvements will bring about the changes you have suggested and set about in your goals
- All of the above in a Google presentation or Prezi ready to present in two days

**For more ideas see the webpage below**

<https://www.dnr.state.mn.us/privatelandhabitat/index.html>

## **School Grounds Improvement Plan Review**

**Instructions: Today we will review your classmates' School Grounds Improvement Plans.**

**For each plan, you will need to do the following**

- 1. Write down the name of your classmate**
- 2. Write down two things that you like about their plan**
- 3. Write down one thing you think could be improved or you have questions about**

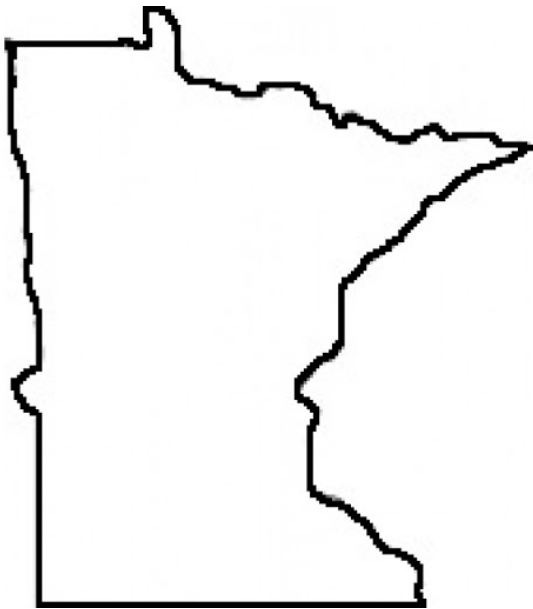
**5. Define the following terms**

- a. Habitat**
- b. Organism**
- c. Ecosystem**
- d. Biological Succession**
- e. Pioneer Species**
- f. Climax Community**
- g. Biome**

**6. Draw a habitat for a Mallard, White-tailed Deer, or Sunfish (Circle one) and include and label, cover/ shelter, space, water, food**

7. Draw food chain and food web-based on local species and label the parts using the appropriate terms.

8. Draw out and label the locations of the biomes in Minnesota



## **APPENDIX C: CURRICULUM SOURCES**

## **Bibliography**

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