



LESSON 7: SCHOOLYARD BIODIVERSITY STUDY

THE RING OF DARHAD
MONGOLIA WOLVERINE EXPEDITION

LENGTH: 60 MINUTES

GRADES/AGES: GRADES 3-7

Lesson Overview:

Become an adventure scientist by exploring the biodiversity of your schoolyard. Use a field journal to plan and prepare for your adventure, collect data in the field, and draw conclusions from your findings. **NOTE:** This lesson's activities can be completed after each corresponding lesson or as a whole project at the end of the unit.

LEARNING OBJECTIVES

Students will be able to:

1. Select, describe and map an area for study.
2. Use field skills to record observations about an ecosystem.
3. Calculate the biodiversity of an area of study.
4. Explore the effects of climate change on a local species.

DIRECTIONS:

1. Choose your own adventure.

- a. Tell your students that they will be planning and “going on” an “adventure” just like the Ring of Darhad Mongolia Wolverine Expedition.
- b. As a class help your students choose an appropriate place for their adventure. (This adventure will be used as an area of study for the entire lesson.) Begin by giving your students a boundary that will limit their travel. For example, tell your students that the location they choose for their adventure must be within walking distance.

- c. Once the natural area has been selected, ask your students if they need to get permission or permits. Students may need permission to collect data on the species that live in this area from a principal or superintendent, maybe even the property owner. Students may need to get permission to travel from parents or school administrators. If appropriate, include students in the process to get permission, by writing a letter to the appropriate authority figure.
 - d. Distribute a **Field Journal** to each student. Explain that these field journals will be used throughout the study.
 - e. With your class, establish a research question for their study. This question should be focused on one species you know is present in the area. For example, the Ring of Darhad Expedition focused on wolverines. Your schoolyard study can focus on a tree species, bird, or small animal that you and your class want to learn more about. The species you chose must be abundant enough that students will be able to find signs of life from this species in your chosen area.
 - f. Tell your students that part of the mission of the Ring of Darhad Mongolia Wolverine Expedition is outreach or sharing what they learn with people. With your students, determine what outreach your adventure will have. Students may share what they have learned by writing letters home to family, publishing their adventure in a school newspaper or newsletter, posting information on a school bulletin board, or including what they have learned on a class or school blog.
 - g. Have students document the planning and approval process for their adventure using the Project Proposal in the field journal.
- ### 2. Describe own adventure.
- a. Tell your students that part of the planning process for an expedition is mapping the route before leaving. Have your students make map of the study area chosen. (If needed, or if time allows, do this activity at your adventure site.)
 - b. Ask each student to use the blank map template in their field journal to lead them through the map making process by drawing your own version on a white board or chart paper.

- c. Like the Ring of Darhad Mongolia Wolverine Expedition, have your students describe the area they are visiting as part of the preparation process. Have your students use the Study Area Description page of their Field Journal to describe the area's natural characteristics.

3. Diagram the study area ecosystem and learn more about the species of study.

- a. Brainstorm plant and animal species that students expect to find in the study area. Have students record these anticipated species on the Ecosystem page of their field journal.
- b. Ask each student to make an ecological structure diagram of the adventure area's ecosystem using the Ecosystem Pyramid model. (To learn more about this model, see Lesson 3: Explore the Ecosystem of Northern Mongolia of the Ring of Darhad Unit.) Have students use the species the class identified in the research question as the key species of the model (listed at the top of the pyramid at the organism level) and incorporate other identified species in the larger ecological groups including community and ecosystem.
- c. Answer the following questions about what students found in the field journal:
- What are the ecosystems present in your community?
 - Can the concept of ecosystem be used at the microscopic level? Why/why not? Expand on your answer using detailed examples.
- d. Using the Species of Interest page of the field journal, have your students conduct research on the species identified in your research question.

4. Students collect scientific data in their schoolyard.

- a. Tell students that they will be visiting the chosen area and collecting data.
- b. Use the map your class created of entire study area in the previous activity and divide into smaller study areas – one for each small group. If possible, before the lesson, mark these areas for students. Have them draw the divisions onto their field journal maps.
- c. Assign each small group an area (that you have pre-determined and marked on a map) within the larger study area. Have each group circle their area on their map.
- d. Tell your students that when they go outside, they will be looking for signs of life and collecting scientific data to show what evidence of life they found.

- e. Show your students the Data Sheet in their Field Journal. Tell your students that to be a good scientist, they will need to walk slowly and listen and look carefully within their area to find signs of life. Using the examples provided on the data sheet, introduce how each group will collect their data. Go over proper collection techniques (listed in the Background Information) and school rules for the schoolyard.
- f. Visit the schoolyard and make observations and complete worksheets for each smaller area to collect data. In addition to making observations, your students may use additional optional techniques similar to the Ring of Darhad Mongolia Wolverine Expedition by:
- Using GPS units to record the locations of the evidence they find
 - Collecting the evidence they find. (Use tweezers to put hair/scat in plastic bags/envelopes. Use plaster to record tracks. Use cameras to document signs you cannot bring back to your classroom.)
 - Discussing with your students where good locations for wildlife cameras would be for their schoolyard. The Ring of Darhad expedition scouted areas for motion cameras to catch wolverine activity based on where they find the most evidence of wolverines.
- g. Back in the classroom, have each group share what they found. As a whole class, discuss what species are the most common in your schoolyard and how you know. Discuss which species are rare and how you could protect these species (bird houses, natural areas, etc.)
- h. Have students work together to analyze the data they have and answer questions about the population on a worksheet.
- How many different individuals can you estimate are present without DNA analysis?
 - What patterns in behavior can you find for this species?
 - Where are the individuals most abundant?
 - Is the final number of species found by the class all there are? Why/why not?
 - What other ways of collecting are there? What are the advantages/disadvantages of each?
 - Are there any species we did not find a representative of? Why/Why not- explain
- ### 5. Calculate a biodiversity index of your schoolyard.
- a. Explain to students that a biodiversity index is measured by counting the number of species in an

area as well as the number of individuals in each population. Explain that there are different formulas or way to calculate biodiversity.

- b. Have each small group calculate the biodiversity of their study area using the Biodiversity page of the field journal. (Two different difficulty levels are available.) Although students will not know the exact number of individuals of each they found in their area because they do not have access to DNA analysis, they can make their best guess as to if each sign of life they found was from different individuals or the same individual who left multiple signs of life. (For more information on calculating a Biodiversity Index, see Lesson 5: Biodiversity of the Ring of Darhad of the Ring of Darhad unit.)
- c. Discuss the biodiversity of the entire schoolyard area.
- d. Which sample area of the schoolyard was the best representation of the entire classroom? Which sample area has the most biodiversity? Which had the least?

7. Students study the impacts of climate change on your species.

- a. Tell students that many animals around the world are being affected by climate change. Briefly review with students the causes of climate change and how it is affecting ecosystems worldwide.
- b. Have students use their knowledge from the research they conducted in a previous activity to identify adaptations that your species of study has to help it survive in its environment in the first column of the Climate Change and Your Species of Study page of the field journal. Explain how climate change will impact this species as a result of each adaptation using the second column.
- c. Review student answers and discuss the impacts climate has on your species of study as a class.
- d. Brainstorm with your students what daily activities of theirs contribute to climate change.
- e. Discuss how their actions can affect species and ecosystems worldwide including their species of study. Brainstorm what behaviors students can to reduce climate change.

Tips and Modifications

To adapt this lesson to a different age group, use the following modifications:

1-6. Older students may record data in a notebook, creating their own tables and diagrams instead of using the provided field journal. This will be more similar to how data is collected during an expedition.

4.b. For older students, have them be a part of the process to divide the schoolyard. Have them think about where they would anticipate finding more signs of life. Have students mark the boundaries with you in the schoolyard.

5. Use the appropriate worksheet to adapt these two activities to your students' abilities.

Assessment:

Review the Field Journal for completion and accuracy.

Extending the Learning:

Complete other activities from the Ring of Darhad Mongolia Wolverine Expedition unit to learn more about each step of the adventure and science research expedition process.

Research and local conservation issues in your community and how research like your students conducted in this lesson impact decision making.

Conduct or participate in a BioBlitz.

PREPARATION:

MATERIALS YOU PROVIDE

- Pencils
- Clipboards
- Rulers

RESOURCES PROVIDED

Audio and Video

None

Images

None

Handouts and Worksheets

Field Journal (one per student)

REQUIRED TECHNOLOGY

- Internet Access: Required
- Tech Setup: Several computers for student research

Other Notes

This lesson, "Schoolyard Biodiversity Study," provides an opportunity for students to participate in all the steps of the Ring of Darhad Mongolia Wolverine Expedition. This lesson may be completed in portions at the end of the first six lessons to reinforce each lesson's major ideas.

BACKGROUND AND VOCABULARY:

SIGNS OF LIFE EXAMPLES

Tracks
Hair/Fur
Feathers
Scat
Nests
Burrows
Spider webs
Bones
Sounds/calls
Digging and scratching marks on trees
Leaves and branches with pieces missing
Holes in dead trees and logs from insects

PROPER SIGNS OF LIFE COLLECTION TECHNIQUES

- Be careful while you are collecting, making sure not to damage any trees or plants.
- Don't touch scat, dead animals, or trash without a gloved hand.
- Don't put anything you find in your mouth including plants, berries, mushrooms, and leaves.
- Don't reach into places you can't see.
- Return rocks and logs you move to where you found them.
- Wash your hands as soon as you return do your classroom. Do not touch your face without washing your hands first.

WILDLIFE ECOLOGY

DATA COLLECTION METHODS

Following the scientific standards of occupancy surveys for rare, low-density species like the wolverine, the Ring of Darhad Mongolia Wolverine Expedition surveyed large areas with less intensity, rather than smaller areas with more intensive surveys used for sampling common species (Mackenzie et al 2005). Like all wildlife studies, this expedition has modified data collection techniques to fit the unique needs of the location and species. The distance covered by this research expedition corresponds to how wolverine track surveys should be carried out – surveying a very large sampling area with lower search intensity. While this research is a single transect, and not replicated, the expedition also tested whether this survey technique is effective in documenting wolverine presence in an area of presumed but unconfirmed occupancy.

Occupancy studies attempt to determine the proportion of suitable habitat that is inhabited by a species. With repeated surveys, this approach can help researchers and managers understand changes in population over time, and whether a relationship exists between distribution, occupancy, and landscape processes. Many unresolved challenges exist in applying this method to

naturally rare, wide-ranging species like wolverines, since researchers have to search for a single animal over a very large area. Since baseline data on wolverines in Mongolia are absent, the Mongolian wolverine expedition in the Darhad adapted some techniques associated with occupancy studies, and some more basic, naturalist techniques associated with simply determining the presence of the species in a given area. By doing this, we gather information on presence and distribution, and also provide a baseline for future, more statistically intense research and monitoring.

When expedition team members discovered a wolverine track, the team backtracked to seek a DNA sample from fur or scat. “Collecting noninvasive genetic samples from putative wolverine (*Gulo gulo*) snow tracks is an effective method for providing definitive species identification for use in Presence-Absence surveys” (Ulizio, et. al, 2006). DNA is then analyzed to determine species identity, minimum number of wolverines detected, and genetic relationship to other wolverine populations, both in Mongolia's other mountain ranges, and globally.

Mackenzie, D. and Royle, J. 2005. Designing occupancy studies: general advice and allocating survey effort. Journal of Applied Ecology. 442: 1105-1114.

Ulizio, T, Squires, J, Pletscher, D., Schwartz, M., Claar, J., and Ruggiero, L.

2006. The Efficacy of Obtaining Genetic-Based Identifications from Putative Wolverine Snow Tracks. Wildlife Society Bulletin. 34(5):1326-1332.

Prior Knowledge

Ecosystems

Biodiversity

Recommended Prior Activities

Lesson 1 of the Ring of Darhad unit: Meet the Team

Lesson 2 of the Ring of Darhad unit: Discover the Darhad

Lesson 3 of the Ring of Darhad unit: Explore the Ecosystem of Northern Mongolia

Lesson 4 of the Ring of Darhad unit: Become a Wildlife Ecologist

Lesson 5 of the Ring of Darhad unit: Biodiversity of the Ring of Darhad

Lesson 6 of the Ring of Darhad unit: Climate Change and the Wolverine

Vocabulary

This lesson uses vocabulary from the entire Ring of Darhad unit. Please see related lessons for vocabulary terms.



THE RING OF DARHAD
MONGOLIA WOLVERINE EXPEDITION

FIELD JOURNAL

ADVENTURE AND SCIENCE

SCHOOLYARD BIODIVERSITY STUDY

RESEARCHER'S NAME: _____

DATE OF STUDY: _____



ADVENTURE AND SCIENCE RESEARCH PROJECT PROPOSAL:

Team members: _____

Name of study area: _____

Location of study area: _____

Brief description of study area: _____

Permission to study this area given by: _____

Dates of adventure: _____

Method of travel: _____

Permission (permit) to travel given by: _____

Research question: _____

Method of outreach: _____



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MAP OF STUDY AREA (INCLUDING LEGEND)



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STUDY AREA DESCRIPTION

Team members: _____

Name of study area: _____

Location of study area: _____

City: _____

County: _____

State: _____

Country: _____

General description of study area:

Type of habitat (select as many as applicable):

- Grass/meadow – maintained (mowed)
- Grass/meadow/shrub – not maintained (“wild”)
- Savannah/wooded grassland – mixed trees and grass
- Forest – mostly coniferous (needles)
- Forest – mostly deciduous (leaves)
- Forest – even mix of both coniferous and deciduous
- Wetland/marsh
- Sand/beach
- Agriculture/Farms
- Developed – Suburban (houses, some green space)
- Developed – Urban (in the city, little/no green space)
- Water – large pond, lake or ocean
- Other – describe: _____

Sources:

<http://www.fishwildlife.org/files/ConEd-Schoolyard-Biodiversity-Guide.pdf>



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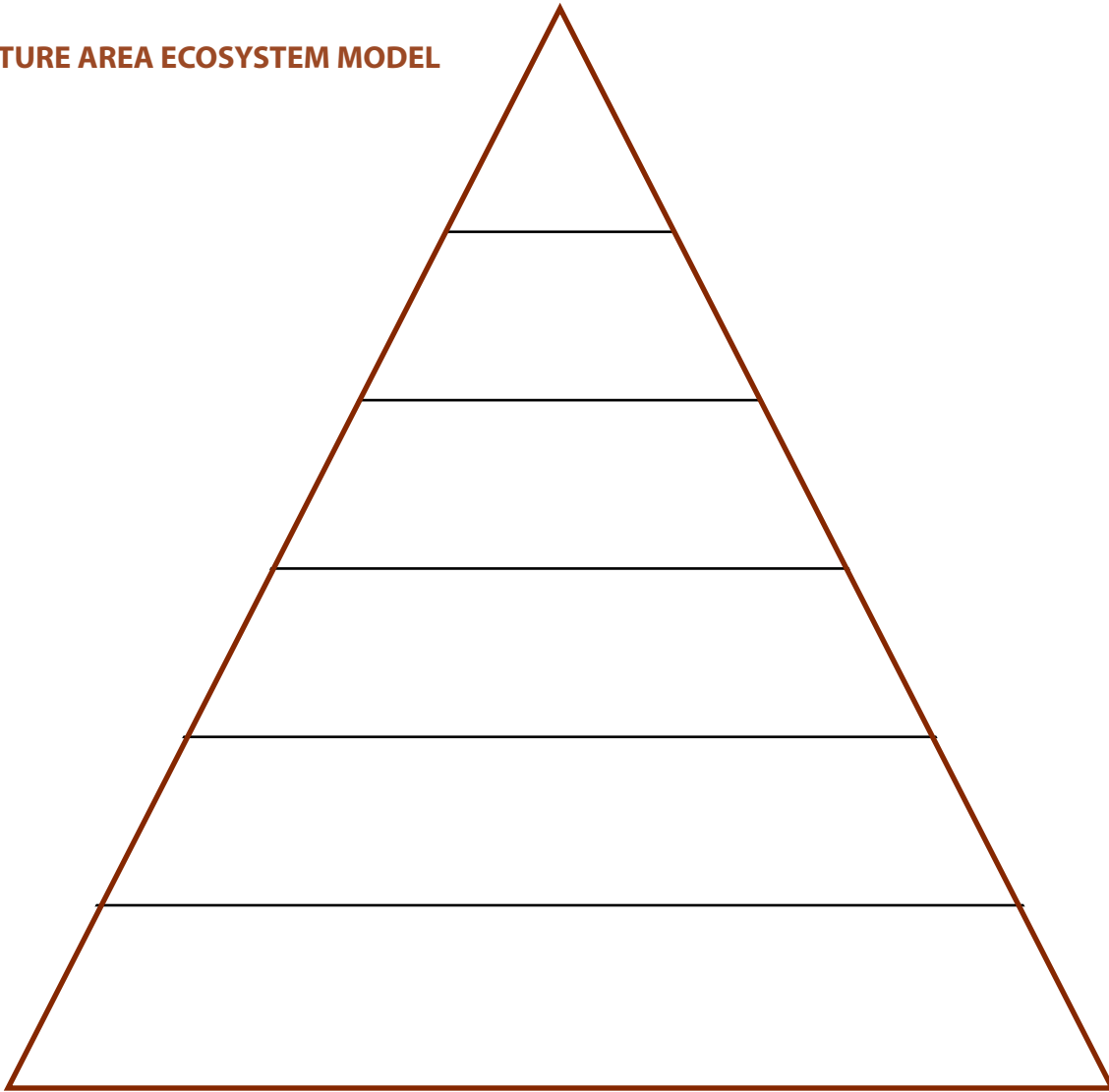


ECOSYSTEM

Expected animal species: _____

Expected plant species: _____

ADVENTURE AREA ECOSYSTEM MODEL



What are the ecosystems present in your community?

Can the concept of ecosystem be used at the microscopic level? Why/why not? Expand on your answer using detailed examples.





SPECIES OF INTEREST:

Common Name:

Scientific name:

Group: Mammal, reptile, amphibian, bird, etc.

Characteristics:

Status (native, threatened, endangered, and invasive)

Connected species:

What role does this species play in the adventure area's ecosystem?

Why is this species important?



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SIGNS OF LIFE DATA SHEET

For each sign of life, write down what you think it is, what animal it is from and what scientists can learn from this specimen.

SPECIMEN #	WHAT IS IT?	WHAT ANIMAL IS IT FROM?	WHAT CAN IT TELL US?
EXAMPLE	A track	Deer	How fast the deer was walking/running, where it was going, how big it is



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SIGNS OF LIFE DATA SHEET

How many different living things did you find?

Where did you find different things?

Were species evenly distributed across your area or did you find a greater variety in a particular location?

If there were diversity differences, what area had the greatest diversity?

Do you think as a whole group you found everything out there?

What factors may have affected the number of species you found?

What was the hardest part of the study?

Were you surprised by anything you found?



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Name: _____

BASIC BIODIVERSITY INDEX

Calculate the biodiversity index (or how diverse and healthy an ecosystem is) of your study area.

SPECIES NAMES	POPULATION (# of individuals found)
TOTAL # OF SPECIES:	TOTAL NUMBER OF ORGANISMS:

How many different species are in your sampling area?

Compare your biodiversity index to your classmates and answer the following questions.

Is your sampling area rich in diversity? Why or why not?

What species has the largest population?

How many organisms total are in your sampling area?

Do all sampling areas have the same biodiversity index?

Calculate the biodiversity index for your sampling area:

TOTAL # OF SPECIES ÷ TOTAL NUMBER OF ORGANISMS =
BIODIVERSITY INDEX

_____ ÷ _____ =

Would taking just one sample of the entire ecosystem give you an accurate picture of the biodiversity? Why or why not?

What can scientists use this biodiversity index for?





Name: _____

SIMPSON BIODIVERSITY INDEX

Calculate the Simpson Biodiversity Index (or how diverse and healthy an ecosystem is) of your study area.

SPECIES NAMES	POPULATION (# of individuals found)	n(n-1)
(A) Total: (Richness)	(B) Total:	(C) TOTAL

Calculate the Simpson Index of Diversity for your bag of candy.

The equation for this method is:
$$D = \sum_{i=1}^S \frac{n_i(n_i - 1)}{N(N - 1)}$$

Where:

D is the index we are calculating

n is the number of individuals of a given species

N is the total number of individuals present in your sample

Calculate the Simpson Index of Diversity. Show your work and answers below.

Subtract the total number of species (number in box A) by 1.

Multiple this number by the total number of species (number in box A).

Divide the sum of n(n-1) (number in box C) by this answer.

The answer is D value which ranges between 0 and 1. With this index, 1 represents infinite diversity and 0, no diversity.

Describe the diversity of your sampling area and how you came to your conclusion.

Compare your biodiversity index to your classmates and answer the following questions.

Is your sampling area rich in diversity? Why or why not?

Do all sampling areas have the same biodiversity index?

Would taking just one sample of the entire ecosystem give you an accurate picture of the biodiversity? Why or why not?

What can scientists use this biodiversity index for?



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