

WOOD BISON CURRICULUM

2 STEM EXTENSION LESSONS

Optional STEM lessons that accompany
"Where Will the Wood Bison Roam?"



Photo by Doug Lindstrand

Grade Level: 7-8

Subjects: Science and Math

Duration: Approximately 3 class periods

Materials:

- Four 20 m strings or ropes
- four markers
- four quadrats (framed area like a 2m² frame made out of wood or card board, or circles like hoola hoops)
- calculators
- Student Pages
- Ecology Cards
 - For teachers who wish to identify vegetation to species

Vocabulary: data, extrapolate, habitat, quadrat, random sampling, replicate, resources, transect,

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Synopsis:

Extension Lesson 1: CREATURE FEATURE Student groups first invent a terrestrial "creature", describing the resources that their hypothetical creature needs to survive and reproduce. After groups share their creature with the rest of the class, they evaluate whether their school yard could provide habitat for the creatures. Simulating field experiments conducted by wood bison biologists, student groups collect habitat data along randomly placed **transects** in a study site (school yard, natural area, open space, etc.). Combining data from all groups, students individually calculate averages and graph data from 20 sample plots. As a class, students discuss findings.

Extension Lesson 2: CALCULATE IT! Students calculate the average amount of food consumed daily and annually by individual bulls and cows, as well as that consumed by a herd of 70 bison.

Objectives:

1. Students actively participate in the process of discovery, as they collect data along a habitat transect and answer questions
2. Students learn about random sampling and replication, both of which are central to science
3. Students organize and graph real data and interpret results
4. Students work individually and cooperatively as they create a "creature", problem solve, hone critical thinking skills, and brainstorm
5. Students hone skills in communication as they present findings to their peers
6. Students calculate the average amount of food required to feed individual wood bison, and a herd of 70 bison, daily and annually
7. Students have the opportunity to share findings with their peers on the "virtual creature feature" page on websites hosted by both Alaska Wildlife Conservation Center and Bear Trust International

Extension Lesson 1: Creature Feature!

Background Information for Teachers

In the "Where Will the Wood Bison Roam?" lesson, we learned that the wood bison biologists wanted to know how much wood bison forage was available in meadows within each of the six potential restoration sites. How did they measure the availability of wood bison forage? Did they collect data on EVERYTHING in EVERY part of each meadow?

Scientists like the wood bison biologists often do not have the time or resources to count or measure EVERYTHING in EVERY part of a study site. Instead, they collect **samples** of data from a defined area and use it to extrapolate the information to the study site. There are many techniques for collecting sample data in the field. The wood bison biologists used a **transect**, which is a line used to survey the biota and abiota in a study area.

For the wood bison study, the biologists first randomly selected meadows in each of the six potential restoration sites, and then randomly placed transect lines in these meadows. Along these transect lines, the biologists estimated percent cover of wood bison forage, and they assessed meadow conditions.

For example, in the Minto Flats site the wood bison biologists randomly selected at least three meadows to sample. In each of these meadows in the Minto Flats site, the biologists randomly selected a location to place a 10m x 1m transect line. Along these transect lines, they then estimated percent cover of forage and assessed meadow conditions.

Your students will simulate this field experiment as they collect data along transect lines in the school yard to determine whether their school yard provides suitable habitat for the "creature" that they have invented. Students will use a 20 meter transect. For simplicity, students will estimate resource availability in 5 quadrats (a framed area) along the transect rather than estimate resource availability within a 20m x 1m transect belt (which is what wood bison biologists did). Why? It is much easier to estimate percent cover of resources in several small quadrats than to estimate percent cover of resources in an entire 20m x 1m transect belt.

Random Sampling

Sample data collected along transect lines should be representative of the **population** in a study site. For many studies, it makes sense to systematically place transects so that they run the entire study site, are placed at equal distances apart, and are parallel to each other. For this activity, students will simulate what the wood bison biologists did and randomly select where they place their transects in the school yard. Randomly selecting placement of transect lines helps prevent conscious or subconscious bias on the part of the data collector. There are several methods that can be used to select random locations for transect placement.

For general lessons on random sampling, see the following resource:

http://www.math.uakron.edu/amc/DataAnalysis_Statistics/OldDataStat/RandomSampling.pdf

Replication

Replication means a "repeated measurement". It is important to collect data in more than 1 **sample** in order to maximize the chances that the **sample** data will represent the **population** of interest. When using data to conduct statistical analyses, biologists collect data in at least 3 samples (sometimes they must collect data in at least 30 samples).

For this activity, your students will work in four different groups. Each group will collect data along one transect line. Therefore, there will be four different transect lines. Along each transect line, each group will collect data in five quadrats. The total number of sample quadrats (replicates) that will be averaged to estimate the population in the study site (school yard) will be 20 (4 transect lines x 5 quadrats/transect line).

Materials Needed

- Four large pieces of paper, one for each group to create their "creature"
- Four 20 meter strings or ropes, one for each group
- Four measuring tapes, one for each group
- Four markers, one for each group
- Four quadrats, one for each group. The quadrat could be a framed square (2 m x 2 m) made out of cardboard, wood, etc. Alternatively, the quadrat could be a circle like a hoola hoop. The important thing is to make sure all groups have the same size and same shape quadrat.
- Student Pages: Creature Feature! Part I
- Student Pages: Creature Feature! Part II (includes Transect Data Sheet)
- Ecology Cards generously provided by Alaska Department of Fish and Game
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Procedure Steps

Class Period 1:

1. Divide your students evenly into four groups. Hand out one copy of PART I of the "Student Page" (Creature Feature: Create Your Creature) to each group. Ask groups to fill in the names of group members at the top of the Student Page.

Allow groups enough time to read the instructions, create their CREATURE, and answer the questions on their group's Student Page.

2. Ask each group to assign a group representative, who will be responsible for presenting their CREATURE to the class.

Class Period 2:

3. Put students back into the same groups that they were in for Part I of this activity. Hand out one copy of PART II of the "Student Pages" (Creature Feature: Transect Activity) to each group.

Allow students time to read the Background Information and Instructions for the Transect Activity.

4. As a class, create a list of rules that all groups will follow during field data collection so that data collected will be consistent among groups. For example, will students group all flower species into one "flower" category, or will they differentiate among flower species?

For teachers who wish to have students identify vegetation along transects to species, we are including Ecology Cards, which provide information and pictures about Alaskan flora. These Ecology Cards were developed as part of the Alaska Wild Curriculum by the Alaska Department of Fish and Game.

4. Give each group a 20 meter string or rope, a marker, a measuring tape, and a quadrat. Ask them to make a mark on the string or rope at each of the following intervals: 0 meter, 5 meters, 10 meters, 15 meters, and 20 meters. These are the points along the transect line where students will place quadrats and collect data.

5. Tell your students that they will be randomly selecting where in the school yard they will place their transects, as well as randomly selecting which direction their transects will run. If your students are already familiar with different random sampling methods, you can let each group determine how they will randomly select their transect placement and direction. Otherwise, you will need to help them come up with a method for determining how to randomly select transect placement and direction.

To learn more about randomly selecting samples, please see:

http://www.math.uakron.edu/amc/DataAnalysis_Statistics/OldDataStat/RandomSampling.pdf

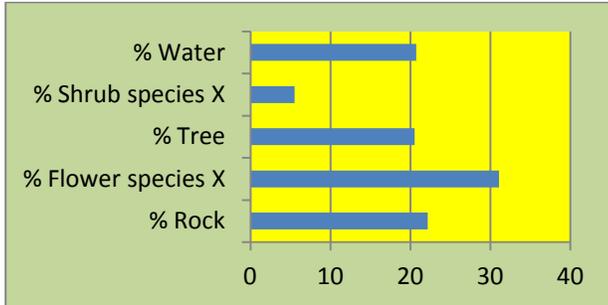
6. Go outside to the study site (school yard, natural area, open space, etc.) and allow groups time to randomly select the beginning point and direction for their transect. Ask students to lay down the "0 meter" end of their transect line at the beginning point, and then extend the transect line in the randomly selected direction. At each of the five marked points along the transect line, ask students to collect information about what is available in the quadrat. Students can record what they find in the Transect Data Sheet, which is part of their Student Pages.

7. When all groups have collected data in their 5 quadrats, go back inside and AS A CLASS begin compiling all data collected in all 20 quadrats (5 quadrats per group). The compilation sheet **could** look something like this (note: your specific column headings will depend on vegetation available in the natural area you choose to sample):

Quadrat #	% Rock	% Flower species X	% Tree	% Shrub species X	% Water
1	25	15	30	0	30
2	0	30	0	0	70
3	0	65	10	10	15
4	80	20	0	0	0
5	0	100	0	0	0
6	10	75	10	0	5
7	25	25	25	0	25
8	15	0	75	10	0
9	25	25	0	0	50
10	50	0	25	25	0
11	0	0	75	0	25
12	15	0	75	10	0
13	25	25	0	0	50
14	50	0	25	25	0
15	80	20	0	0	0
16	0	30	0	0	70
17	0	65	10	10	15
18	25	15	30	0	30
19	0	30	0	0	70
20	0	65	10	10	15

Class Period 3:

8. Make sure each student has a copy of the compilation sheet and ask them to create a bar graph depicting the **average percentage** of each resource in the study site (school yard). To do this, students will first need to calculate the average for each data category. In the example above, the average % rock = 22.17%. Based on the data in the example table above, a corresponding graph would look something like this:



9. After all students have completed their graphs, have a class discussion. Based on field results from all 4 groups, would the school yard provide suitable habitat for any of the "creatures" ? Did this field experiment provide the data you need to answer this question? Why or why not? Did any resources in the school yard get "missed" during this field experiment? If so, which ones? How might you design a future field experiment that would avoid missing some resources? Do you think 20 quadrats (replicates) was enough to capture what is available in your school yard? What would have happened if you had only collected data in 1 or 2 quadrats?

10. If students wish to share their creatures with other students worldwide, they can upload a jpg file to the "virtual creature feature" on websites hosted by Alaska Wildlife Conservation Center and Bear Trust International. Please send jpg files to: melissa@beartrust.org.

Student Pages: Creature Feature!

PART 1: Create Your Creature

Group Members: _____

Instructions for this Activity

You should be in one of 4 groups. Your group is a team of wildlife biologists that has just discovered a **new species** of terrestrial animal (it lives on land). No one except members of your team has ever seen this animal before!

Step 1. On a separate piece of paper, draw a picture of this amazing new creature

Step 2. Now, use the space below to describe your creature and its habitat

Habitat is the place where an animal lives
Habitat provides all the resources an animal needs to survive and reproduce

The **resources** that all animals need to survive and reproduce include: food, water, shelter, den or nest sites

- What does your creature eat?

- How much water does your creature need?

- _____
- What type of shelter (house, den, tall grass, etc.) does your creature need?

- _____
- Where does your creature nest or den (raise babies)?

- _____
- Do other animals depend on your creature for food (i.e., do other animals EAT your creature)?
- _____

Step 3: Pick one person from your group, who will give a short presentation about your creature to the other 3 groups in your class. Make sure to describe what habitat your creature needs to survive and reproduce (i.e., provide information about food, water, shelter, and den sites that your creature needs).

Student Pages: Creature Feature!

PART 2: Transect Activity

As a group, read the background information carefully before beginning this activity.

Background Information:

Your group is interested in determining whether your study site (i.e., your school yard, natural area, open space, etc.) could provide suitable habitat for the creature you discovered. Specifically, does your study site provide food, water, shelter, and den sites that your creature needs?

Can you determine this answer just by **LOOKING** at your study site, or should you measure or estimate what is available in your study site? If you decide to measure habitat availability in your study site, how do you go about doing that? Do you collect information about **EVERYTHING** in the study site?

Hmmm.....the wood bison biologists who worked on identifying suitable sites for wood bison were faced with this exact question. They knew they needed to measure **availability of wood bison forage** in meadows for each of the 6 potential restoration sites, but they also knew they couldn't possibly record **EVERYTHING** in each meadow. It would take too long!

So, they **estimated** the availability of wood bison forage in meadows. There are lots of different scientific ways to estimate the availability of resources in a habitat. One way is to use a transect line and estimate resource availability in sample plots (quadrats) along the transect line.

A **TRANSECT** is a line used to survey the biota and abiota in a study area.

A **QUADRAT** is a framed area in which data are collected.

So, here's how this method works: a transect line is laid out somewhere in a study site. At equally-spaced intervals along the transect line, **quadrats** (a small framed area) are placed and biologists collect data about plants and/or animals within the quadrats.

For this activity, your group will be collecting data along a 20 meter transect in a study site. Your teacher will determine whether your study site is the school yard, an open space somewhere, a natural area, or some other place outside.

At five equally-spaced intervals along your transect line, your group will place a quadrat. In each quadrat, your group will collect data (information) about what things are present inside the quadrat. Using the Transect Data Sheet, record what you find, and also record the estimated percent cover of each thing you find. This data will help you determine whether or not your study site provides resources that your creature needs.

Random Sampling

Sample data collected along transect lines should be representative of the **population** in a study site. In many studies, it makes sense to systematically place transects so that they are parallel to one another. For this activity, your group will simulate what the wood bison biologists did and **randomly select** where you place your transects in the school yard. This helps prevent conscious or subconscious bias on the part of the data collector. There are several methods that can be used to select random locations for transect placement. Your teacher will help you determine how to randomly select where in the study site your transect will be placed, as well as the direction that your transect will run.

Replication

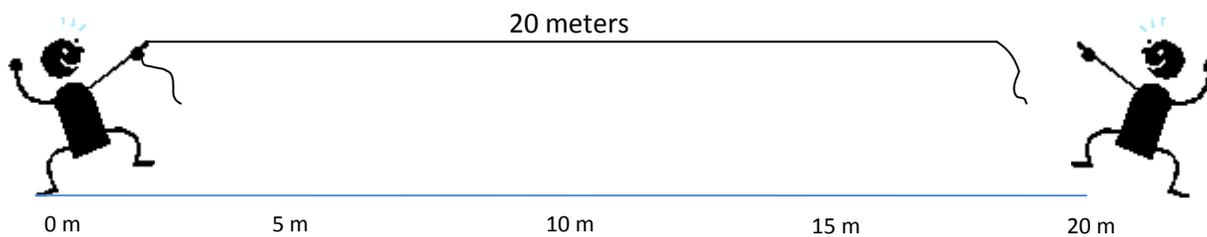
Replication means a "repeated measurement". It is important to collect data in more than 1 **sample** in order to maximize the chances that the **sample** data will represent the **population** of interest. When using data to calculate statistical analyses, biologists collect data in at least 3 samples (sometimes they must collect data in at least 30 samples).

For this activity, your class is organized into four different groups. Each group will collect data along one transect line. Therefore, there will be four different transect lines. Along each transect line, each group will collect data in five quadrats. The combined total number of sample quadrats (replicates) that will be averaged to estimate the population in the study site will be 20 (4 transect lines x 5 quadrats/transect line). Let's get started!

Instructions for the Transect Activity:

Your group will need one 20 meter string or rope, one marker, one **quadrat** (a 2m x 2m square frame made out of card board, wood, etc. or you can use a circle like a hoola hoop), pencils and the Transect Data Sheet for recording what you find in the quadrats.

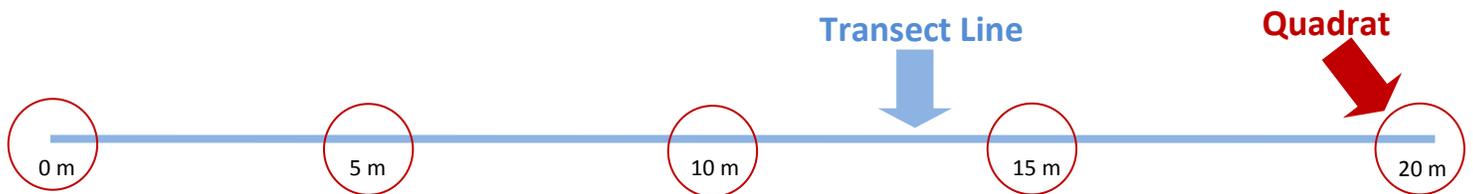
Along the 20 meter rope, use the marker to make a mark at each of the following intervals: 0 meter, 5 meters, 10 meters, 15 meters, and 20 meters. These are the 5 points along the transect line where you will place a quadrat and collect data.



Next, you need to randomly select where in the study site you will start your transect line. You also need to randomly select which direction your transect line will run. Your teacher will provide instructions on how to randomly select transect placement and direction.

When you get outside to the study site, lay down the "0 meter" end of your transect line at the randomly selected beginning point, and then extend the transect line in the randomly selected direction.

Then, begin collecting data. You will not collect data along the entire transect, only in the **5 quadrats** that are located at the 5 points along the transect line. In the example below, the **5 quadrats** are represented by circles, or hoola hoops:



Within each quadrat, record what you find using the Transect Data Sheet. For each item you find in the quadrat, estimate what percent each item takes up within the frame (example: Item A takes up 75% and Item B takes up 25%). Things that take up very little area can be recorded as <1%.

When you are done collecting data, your teacher will provide instructions on how to combine data from all groups into one table, after which you will graph the data.

Transect Data Sheet

Date: _____

Location of Study Site (school yard, etc) : _____

Group Members: _____

In each of the 5 quadrats located along your group's transect, document what you find and the percentage of each item. For example, if quadrat #1 has 25% water, then fill in "25" under the column "% water" for Quadrat #1.

The first 2 column headers have been labeled for you as an example. Fill in the names of other resources for the remaining 8 column headers, according to the resources or things that you find in your quadrats.

Quadrat #	% Rocks	% Water	% _____	% _____	% _____	% _____	% _____	% _____	% _____	% _____
1										
2										
3										
4										
5										

Extension Lesson 2: Calculate It!

Background Information for Teachers

Wood bison are generalist herbivores, and they graze for plants high in protein first. The Wood Bison diet is comprised of approximately 93% **graminoids**, 5% **forbs** and 2% **browse**. **Graminoids** include sedges and grasses. Graminoids are usually tufted or sod forming herbaceous plants with narrow elongated leaves. The most nutritious sedge for wood bison throughout the year is slough sedge (*Carex atherodes*) and bison select slough sedge when it is available.

Forbs are herbaceous plants with broad leaves; many people refer to forbs as weeds or wildflowers. **Browse** includes plants with a woody stem, with a thin bark that can be peeled off. For example, wood bison peel off the bark from willow trees.

Now that we know WHAT wood bison eat, let's figure out HOW MUCH wood bison eat. Wood Bison spend most of their day grazing. They eat and then rest and continue this cycle throughout the day, 9 to 11 hours! Like cattle, Wood Bison have a multi-chambered stomach (four chambers) that makes them very efficient at digesting food. Wood Bison eat approximately 1.6% of their body weight each day.

Materials Needed

- Calculator

Procedure Steps

1. Ask your students to calculate approximately how many pounds of food an adult bull and an adult cow consume each day.

Assume that an average bull weighs 2,000 lbs and an average cow weighs 1,200 lbs. On average, bulls and cows consume 1.6% of their body weight every day.

(Answer: bull: $.016 \times 2000 = 32$ lbs cow: $.016 \times 1500 = 24$ lbs)

2. Ask your students to calculate how many pounds are consumed by an adult bull and an adult cow per year.

(Answer: bull: $32 \times 365 = 11,680$ lbs/year; cow: $24 \times 365 = 8,760$ lbs/year)

3. Ask your students to calculate how many pounds of food are consumed annually by a herd of 35 adult bulls and 35 adult cows. Assume no population growth during the year.

(Answer: $(35 \times 11,680) + (35 \times 8,760) = 715,400$ lbs/year)