

### **LENGTH: 60 MINUTES**

MONGOLIA WOLVERINE EXPEDITION

**GRADES/AGES: GRADES 3-7** 

### **Lesson Overview:**

Discover how biodiversity is calculated by using candy, then calculate biodiversity of a model of northern Mongolia. Research species that live in the Ring of Darhad and play a whole-class game to explore the biodiversity of the region.

## **LEARNING OBJECTIVES**

Students will be able to:

- 1. Explain how biodiversity is calculated.
- 2. Demonstrate how biodiversity is calculated using simulated ecosystems.
- 3. Identify the importance of a diverse biological world.

### **DIRECTIONS:**

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- 1. Research species of the Darhad region.
- a. Assign each student a different species from the **Darhad Region Species List**. Tell your students that the species on this list are only a small representation of the biodiversity of the region. There are more than 800 species of just plants in this ecosystem.
- b. Have your students use the internet to complete the Darhad Region Species Research worksheet on the species they were assigned. It is important that each student learns how their species is connected to other plant and animal species in this ecosystem. Optional: Have students transcribe their research onto

the smaller species research cards. These can then be turned into nametags for a food web activity.

## 2. Play a species "Who Am I?" game and explore biodiversity.

a. Provide each student with the Darhad Region Species List.

Have one student at a time present their research to

the class. Have each student share three things they learned about their species. Have the other students guess what species on the list they have. (If students already know who was assigned each species, collect the Species Research worksheets and redistribute them randomly. Each student would then present another classmate's research.)

- c. Discuss as a whole group how all of these species are connected.
- d. Define biodiversity or biological diversity (how diverse and healthy an ecosystem is) in a large group discussion. Guide students towards defining the term and provide the definition if needed. Have students conclude the importance of biodiversity in an ecosystem.
- 3. Calculate a biodiversity index by counting candy.
- 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 ways to calculate biodiversity.
- Individually or in pairs, have students calculate the biodiversity of a package of colorful candy using the Candy Biodiversity Worksheet. (Two different difficulty levels are available. Directions are on the worksheets.)
- c. Have students share their final calculations with the rest of the class.
- d. Discuss the biodiversity of the entire classroom's candy. If each bag of candy was a small sample area within the classroom candy ecosystem, was each bag of candy a good representation of the entire classroom? Which bag of candy has the most biodiversity? Which had the least?
- 4. Measure biodiversity of a model of the Ring of Darhad.
- a. Have your students use the same methods from the candy biodiversity activity to calculate the biodiversity index of a representation of the Darhad Region.
- b. Before this activity: Cut small squares of paper and place these squares in four different envelopes using the Biodiversity Model Table as a key. NOTE:



### **BIODIVERSITY MODEL TABLE**

	Red	Orange	Yellow	Green	Blue	Purple	Pink	Brown	Black	White
	Wolverine	Brown Bear	Reindeer	Musk Deer	Sable	Fox	Pika	Ermine	Pipit	Sparrowhawk
A	2	1	12	4	7	4	25	6	14	5
В	0	0	0	3	5	7	3	4	22	8
C	0	2	0	5	6	4	21	8	12	3
D	1	0	4	7	4	5	18	5	10	3

Each envelope represents a different sample area of study. Different colors indicate different species. Each square in each envelope is one organism.

- c. Explain to your class that in this activity, they will be imagining that they are analyzing data collected from the Ring of Darhad Mongolia Wolverine Expedition. During the expedition, the adventurers collected data from four sample areas (A, B, C, and D).
- Individually or in pairs, have students calculate the biodiversity of one of the four study areas using the **Darhad Biodiversity Worksheet.** (Two different difficulty levels are available. Directions are on the worksheets).
- e. Have students share their final results with the class.
- f. Discuss the biodiversity of the entire Ring of Darhad model. If each envelope represents a small sample area within the Ring of Darhad ecosystem, was each area a good representation of the entire ecosystem? Which area has the most biodiversity? Which had the least? Why do scientists collect data from multiple sample areas?

### **Tips and Modifications**

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

2. Older students can complete this guessing game individually by numbering a piece of lined paper and writing down their answers.

3 and 4. Use the appropriate worksheet to adapt these two activities to your students' abilities.

### **Assessment:**

Review Darhad Region Species Research Worksheets for accuracy and completion.

Review Candy Biodiversity worksheets for accuracy and completion.

Review Darhad Biodiversity worksheets for accuracy and completion.

Have students write a one-sentence summary of why biodiversity is important to ensure a healthy ecosystem.

## **Extending the Learning:**

Complete Activity 5 of Lesson 7 of the unit. This activity has students analyze the biodiversity of their schoolyard based on data collected in earlier activities.

Conduct or participate in a BioBlitz.

Research, read about, and discuss the biodiversity of local ecosystems. Have your students learn about threatened species, how their decline impacts other species, and what conservation projects are planned to ensure your local biodiversity.

Have students look at the numbers and composition of species in their Mongolia biodiversity samples. Can they infer which samples come from which elevations based on which animals they see in the sample? What methods might be used to determine whether their inferences are correct?

## **PREPARATION:**

### **MATERIALS YOU PROVIDE**

- Pencils
- Small pieces of colored paper divided into four envelopes

### **RESOURCES PROVIDED**

### Audio and Video

None

#### Handouts and Worksheets

- Darhad Region Species Research Worksheet (one per student) and Species Research Cards
- Darhad Region Species List (one per student)
- · Candy Biodiversity Worksheet (one per student)
- Darhad Biodiversity Worksheet (one per student)

#### **REQUIRED TECHNOLOGY**

- Internet Access: required
- Tech Setup: several computers for student research

### **Other Notes**

Lesson 7 of this unit, 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:**

### **BACKGROUND INFORMATION**

In Mongolia, as in the Yellowstone region, different species are found at different elevations. This means that biodiversity levels may change within a small area, depending on the altitude at which a researcher takes measurements. Wolverines, pikas, and reindeer are restricted to high elevation regions because they are adapted to cold conditions. Other species, such as pipits and fox, thrive in lower, grassland conditions. Some animals avoid humans, which may also influence wildlife distribution. Most human habitation occurs in lower elevation valleys between high mountains, which means that wildlife may select higher regions to have greater security. The Darhad expedition will take measurements primarily in the mountains, which have low levels of human use.

Biodiversity measures all the different kinds of living organisms in an ecosystem or area. Biodiversity includes all life, even microscopic organisms. Biodiversity is measured using different biodiversity indexes. These calculations vary from simple to complex, but all include the number of different species and the number of individuals in the area of study. Biodiversity can also include genetic diversity among a species.

Ecosystems with greater biodiversity are generally stronger and more resistant to disaster than those with fewer species. When disease, fire, or climate change affects an ecosystem, those communities with greater numbers of different species have a higher likelihood of having species that are able to survive under the new conditions. Biodiversity is important because all living things are connected. When one species is removed from an ecosystem, those areas with greater biodiversity are more likely to succeed. Cold northern ecosystems tend to be naturally less diverse than tropical ecosystems. Some scientists suspect that northern ecosystems will be less resilient in the face of climate change because the loss of even a single species will have a greater effect on the system.

Humans affect biodiversity by destroying natural habitats and adding to climate change. As habitat size decreases, ecosystems can hold fewer individuals and genetic diversity decreases. A greater variety in genes among a population can help species survive disease and changes in habitat. Around the world, people are helping to protect biodiversity by protecting threatened species and habitats.

For more information from National Geographic on biodiversity visit: <u>http://education.nationalgeographic.</u> com/education/encyclopedia/biodiversity/?ar\_a=1

## **Prior Knowledge**

Ecosystems

### **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

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Basic Biodiversity Index	noun	The number of species in the area divided by the total number of individuals in the area.
Biodiversity		
	Noun	A measurement of how diverse and healthy an ecosystem is by measuring all the different kinds of living organisms in an ecosystem or area.
Biodiversity index	Noun	A formula that describes the amount of species diversity in a given area.
Genetic diversity	Noun	The variation in genes and combination of genes within a population.
ndividual	Noun	A single organism.
Drganism	Noun	An individual plant, animal, or other form of life.
Population	Noun	Many organisms of the same species in one geographic area.
Simpson Index of Diversity	Noun	$D = \sum_{i=1}^{S} \frac{n_i (n_i - 1)}{N(N - 1)}$
Species richness	Noun	The number of different species in an ecosystem

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## **CANDY • BASIC BIODIVERSITY INDEX**

Calculate the biodiversity index (or how diverse and healthy an ecosystem is) of a bag of candy. Each different colored candy is a different species in your candy ecosystem. The number of each colored candy is the number of organisms of that species in the candy ecosystem.

### Directions:

Count how many different colors of candy you have. Record the name of each color in the first column. Record the total number of colors in the last box of the first column.

Count how many of each color candy you have. Record that number in the second column.

Count the total number of candies. Record that number in the last box of the second column.

CANDY COLOR	# OF THAT COLOR CANDY
(Species)	(Population)
TOTAL # OF COLORS:	TOTAL NUMBER OF CANDIES:

How many different colors of candy do you have?

How many candies total do you have?

Calculate the biodiversity index for your candy: TOTAL # OF COLORS ÷ TOTAL NUMBER OF CANDIES = BIODIVERSITY INDEX

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Compare your biodiversity index to your classmates. Is your bag of candy rich in diversity? Why or why not?

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## **CANDY • SIMPSON BIODIVERSITY INDEX**

Calculate the biodiversity index (or how diverse and healthy an ecosystem is) of a bag of candy. Each different colored candy is a different species in your candy ecosystem. The number of each colored candy is the number of organisms of that species in the candy ecosystem.

### Directions:

Count how many different colors of candy you have. Record the name of each color in the first column. Record the total number of colors in the box A of the first column.

Count how many of each color candy you have. Record that number in the second column.

Count the total number of candies. Record that number in box B of the second column.

Calculate n(n-1) for each number in the second column. (Subtract each number in the second column by 1, then multiply it by the original number.) Record each answer in the third column.

CANDY COLOR (Species)	# OF THAT COLOR CANDY (Population)	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 you 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/colors (number in box A) by 1.

Multiple this number by the total number of species/ colors (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 bag of candy and how you came to your conclusion.

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## **DARHAD • BASIC BIODIVERSITY INDEX**

Calculate the biodiversity index (or how diverse and healthy an ecosystem is) of the Ring of Darhad. Each square in each envelope is one organism.

The different colors of squares are different species in the ecosystem.

The population is the total number of each colored square.

The total number of squares is the total number of organisms (of all species) in the ecosystem.

#### **Directions:**

Pick one of the four envelopes. This is one sampling area of the Ring of Darhad ecosystem.

Count how many different types species are in the envelope. Record the name of each species in the first column. Record the total number of species in the last box of the first column.

Count how many of organisms of each species are in the envelope. This is number is the population. Record that number in the second column.

Count the total number of organisms. Record that number in the last box of the second column.

SPECIES	POPULATION
(Colors)	(# of squares of each color)
TOTAL # OF SPECIES:	TOTAL NUMBER OF ORGANISMS:

How many different species are in your sampling area?

What species has the largest population?

How many organisms total are in your sampling area?

Calculate the biodiversity index for your sampling area: TOTAL # OF SPECIES ÷ TOTAL NUMBER OF ORGANISMS = BIODIVERSITY INDEX

EPSCOR

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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# **DARHAD • SIMPSON BIODIVERSITY INDEX**

Calculate the Simpson Biodiversity Index (or how diverse and healthy an ecosystem is) of the Ring of Darhad. Each square in each envelope is one organism.

The different colors of squares are different species in the ecosystem.

The population is the total number of each colored square.

The total number of squares is the total number of organisms (of all species) in the ecosystem.

### Directions:

Pick one of the four envelopes. This is one sampling area of the Ring of Darhad ecosystem.

Count how many different types species are in the envelope. Record the name of each species in the first column. Record the total number of species in box A of the first column.

Count how many of organisms of each species are in the envelope. This is number is the population. Record that number in the second column.

Count the total number of organisms. Record that number in box B of the second column.

Calculate n(n-1) for each number in the second column. (Subtract each number in the second column by 1, then multiply it by the original number.) Record each answer in the third column.

COLOR	# OF THAT COLOR	n(n-1)
(Species)	(Population)	
(A)	(B)	(C)
TOTAL:	TOTAL:	TOTAL
(Richness)		

Calculate the Simpson Index of Diversity for your sampling area.  $\delta = \langle 0, 0, 0 \rangle$ 

area. 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 you 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.





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## **RING OF DARHAD SPECIES LIST**

### Mammals

Wolverine (Gulo gulo) Elk (Cervus elaphus) Moose (Alces alces) Wild Reindeer (Rangifer tarandus) Brown Bear (Ursus arctos) Siberian Musk Deer (Moschus moschiferus) Ibex (Capra sibirica) Wolf (Canis lupus) Sable (Martes zibellina) Eurasian lynx (Lynx lynx) Siberian Weasel (Mustela sibirica) Fox (Vulpes vulpes) Eurasian otters (Lutra lutra) Altai mole (Talpa altaica) Ermine (Mustela ermine) Red Squirrel (Sciurus vulgaris) Pika (Ochotona alpina)

## Fish

Stone Loach (Naemacheilus barbatulus) Siberian taimen/salmon (Hucho taimen)

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### **Birds**

Altai snowcock (Tetraogallus altaicus) Capercallie (Tetrao urogallus) Northern Goshawk (Accipiter gentilis) Eurasian Three-toed woodpecker (Picoides tridactylus) Eurasian Sparrowhawk (Accipiter nisus) Tree Pipit (Anthus trivialis)

## **Reptiles**

Viviparous lizard (Zootoca vivipara) Common European Viper (Vipera berus)

### Plants

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Siberian Larch (*Larix sibirica*) European aspen (*Populus tremula*) Rhododendron (*Rhododendron parvifolium*) Reed Grass (*Calamagrostis epigeios*)

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# **DARHAD REGION SPECIES RESEARCH**

Find the following information about the species you were assigned that calls the Ring of Darhad home.

Common name:

Scientific name:

Plant/Animal Family:

Type of habitat:

Physical characteristics:

#### **Animals only:**

Circle the term(s) that best describe this species: Herbivore / Carnivore / Omnivore Predator / Scavenger / Prey Diet:

**Plants only:** Animals that feed on this plant:

One interesting fact about this species:

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Draw a picture of the species:



## THE RING OF DARHAD

Common name:

Scientific name:

Plant/Animal Family:

Type of habitat:

Physical characteristics:

Animals only:	Plants only:
Circle the term(s) that best describe this species:	Animals that feed on this plant:
Herbivore Carnivore Omnivore	
Predator Scavenger Prey	
Diet:	

One interesting fact about this species:

Draw a picture of the species:



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## THE RING OF DARHAD

Common name:

Scientific name:

Plant/Animal Family:

Type of habitat:

Physical characteristics:

Animals only:	Plants only:
Circle the term(s) that best describe this species:	Animals that feed on this plant:
Herbivore Carnivore Omnivore	
Predator Scavenger Prey	
Diet:	
One interacting fact about this	•

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One interesting fact about this species:

Draw a picture of the species:

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Common name: Scientific name:

Plant/Animal Family:

Type of habitat:

Physical characteristics:

Animals only:	Plants only:				
Circle the term(s) that best	Animals that feed on this plant:				
Herbivere Carpivere Ompivere					
Prodator Sociedar Prov					
Diet:					
Diet:					
One interesting fact about this species:					
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Draw a nicture of the species:					
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## THE RING OF DARHAD

Physical characteristics:

Animals only:	Plants only:
Circle the term(s) that best describe this species:	Animals that feed on this plant:
Herbivore Carnivore Omnivore	
Predator Scavenger Prey	
Diet:	

One interesting fact about this species:

Draw a picture of the species:



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