THE RING OF DARHAD
MONGOLIA WOLVERINE EXPEDITION

LESSON 6: CLIMATE CHANGE AND THE WOLVERINE

Length: 60 minutes

Grades/Ages: Grades 3-7

Lesson Overview:

Study various climates around the world by exploring global data and comparing different cities. Identify how your actions contribute to climate change and how the wolverine is affected by warming temperatures. Take action to help protect the wolverine.

LEARNING OBJECTIVES

Students will be able to:

1. Compare and contrast climates around the world.
2. Describe the climate wolverines inhabit.
3. Explain how the wolverine is impacted by global climate change.
4. Make a pledge to help reduce climate change.

DIRECTIONS:

1. Define and identify weather and climate around the world.

a. Review the difference between weather and climate as a large group.

b. Use National Geographic's Map Maker Interactive to explore global winter and summer temperatures.
   - Have students navigate to the Map Maker Interactive by visiting: http://education.nationalgeographic.com/education/mapping/interactive-map/?ar_a=1
   - On the left toolbar, click on "Physical Systems – Climate."
   - Have students explore climate zones, as well as rainfall and seasonal temperatures both around the world and in their hometown and northern Mongolia.
   - Students can place a "marker" on northern Mongolia and their hometown during this exploration so they can compare the climates easier.
   - As a whole class, compare and contrast northern Mongolia with hometown and other cities of interest using the Map Maker Interactive.

2. Students study the impacts of climate change on wolverines.

a. Tell students that many animals around the world are being affected by climate change including the wolverine. Briefly review with students the causes of climate change and how it is affecting ecosystems worldwide.

b. Color in the climate where wolverines live on the **Student World Map.** (Note: Students may use the map from Lesson 2 if this lesson is being completed as part of the Ring of Darhad unit.)

c. Based on student explorations of the Map Maker Interactive from the previous activity, have students discuss the climates of the regions where the wolverine is found. What do these regions have in common?

d. Have students read the **Climate Change and the Wolverine article.**

e. After reading the article, have students use what they read to identify adaptations of the wolverine and effects of climate change from each adaptation on the **Climate Change and the Wolverine worksheet.**

f. Review student answers and discuss the impacts climate has on the wolverine as a class.

3. Take action to protect the wolverine.

a. Brainstorm with your students what daily activities of theirs contribute to climate change.

b. Discuss how their actions can affect species and ecosystems worldwide including the wolverines in Mongolia.

c. Ask each student to make a pledge to change just one behavior to reduce climate change. Have each student fill out the **Climate Change Pledge form** and post them the classroom.

Tips and Modifications

To adapt this lesson to an older age group, use the following modification:

2.d.. Have students read one of the following scientific articles on how climate is affecting biodiversity instead of the article on Climate Change and the Wolverine. Have these students write a summary of what they read instead of completing the Impacts on the Wolverine worksheet.

> *Kerr, J. and Packer, L. The Impact of Climate Change on Mammal Diversity in Canada. Environmental Monitoring and Assessment, February 1998, Volume 49, Issue 2-3, pp 263-270.* http://link.springer.com/article/10.1023%2FA%3A1005846910199#page-1
>
> *McKelvey, Kevin S., Jeffrey P. Copeland, Michael K. Schwartz, Jeremy S. Littell, Keith B. Aubry, John R. Squires, Sean A. Parks, Marketa M. Elsner, and Guillaume S. Mauger. 2011. Climate change predicted to shift wolverine distributions, connectivity, and dispersal corridors. Ecological Applications 21:2882–2897.* http://www.fs.fed.us/rm/pubs_other/rmrs_2011_mckelvey_k001.pdf

Assessment:

Have students compare and contrast the climate of their hometown with northern Mongolia in a short paragraph.

Review students' coloring on the Student World Maps of wolverine habitats for accuracy and completion.

Review students' Climate and the Wolverine worksheets for accuracy and completion.

Extending the Learning:

1. Complete Activity 6 of Lesson 7 of the unit. This activity has students analyze the impacts of climate change on a chosen species that lives in their schoolyard.
2. Complete the National Geographic Activity: Latitude, Longitude, and Temperature to learn how latitude and longitude affect climate. (http://education.nationalgeographic.com/education/activity/latitude-longitude-temperature/?ar_a=1)
3. Have students convert temperatures from Fahrenheit to Celsius.
4. Revisit student Climate Change Pledges after a designated period of time. Discuss the challenges students faced and if they were successful. Have students expand upon, modify, or continue their pledges.
5. Have students measure their carbon footprint.

PREPARATION:

MATERIALS YOU PROVIDE

- Pencils / colored pencils

RESOURCES PROVIDED

Audio and Video

- None

Images

- None

Handouts and Worksheets

- Student World Map (one per student)
- Climate Change and the Wolverine article (one per student)
- Climate Change and the Wolverine Worksheet (one per student)
- Friend of the Wolverine Climate Challenge Pledge (one per student)

REQUIRED TECHNOLOGY

- Internet access: required
- Tech Setup: Several computers for Map Maker Interactive activity

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

The climate in northern Mongolia is similar to that of the northern Rocky Mountains in North America – cold and dry. This continental climate is characterized by annual variation in temperature due to the lack of significant bodies of water nearby. Instead of being influenced by a body of water, temperatures are affected by a high barometric pressure center which often sits over northern Mongolia. Winters are very cold and long, while summers are warm and short. January averages can be as low as −22 °F. In the winter, extreme cold fronts from neighboring Siberia collect in river valleys and low basins in northern Mongolia causing very cold temperatures. At the same time, slopes of mountains are much warmer due to temperature inversions (temperature increases

VOCABULARY

Term	Part of Speech	Definition
Carbon dioxide	Noun	A colorless, odorless greenhouse gas.
Carbon footprint	Noun	The amount of carbon dioxide emitted into the atmosphere by a person, group of people, or event.
Climate	Noun	The average weather for a particular area.
Climate change	Noun	Major changes in temperature, precipitation and weather patterns measured over a long period of time.
Fossil fuels	Noun	Coal, oil and natural gas.
Emissions	Noun	A discharge of something into the air or atmosphere.
Pledge	Noun/verb	A promise to do something.
Weather	Noun	The specific state of the atmosphere at a particular time in a specific location including temperature, wind, and precipitation.

with altitude). Most precipitation falls in the summer. The mountain relief gives rise to a high diversity of microclimate conditions and temperature inversions.

Climate is the long-term weather patterns for a particular geographic region. Climate varies for different parts of the world. Climate can be influenced by latitude, bodies of water, land masses, elevation, and local topography. Climate determines the types of plants and animals that are able to survive in a particular region.

For more information from National Geographic on climate visit:

http://education.nationalgeographic.com/education/encyclopedia/climate/?ar_a=1

For more information from National Geographic on climate change visit:

http://education.nationalgeographic.com/education/encyclopedia/climate-change/?ar_a=1

Prior Knowledge

Weather and Climate

Climate change

Recommended Prior Activities

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

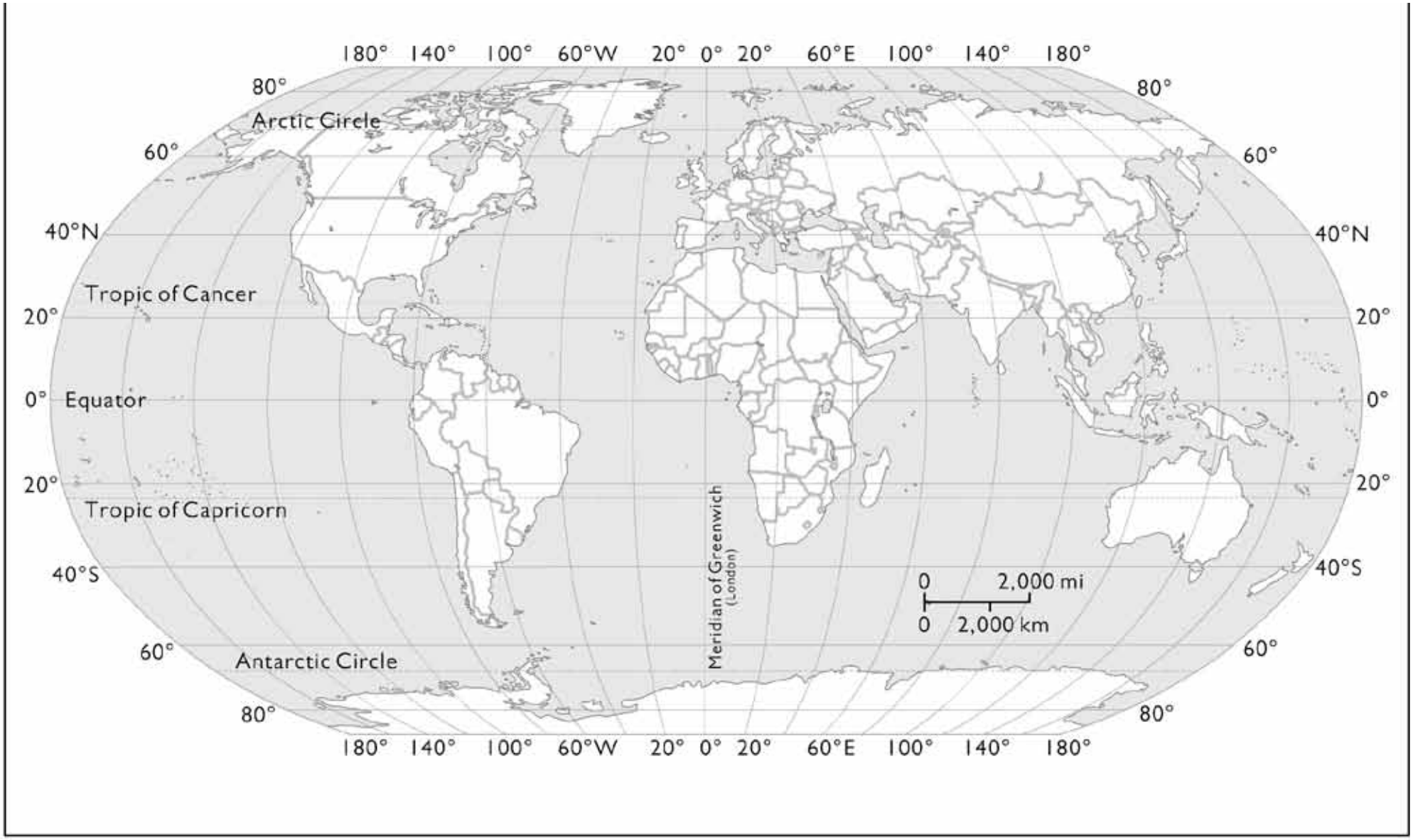
Lesson 2 of the Ring of Darhad unit: Discover the Darhad

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

WORLD MAP



THE WORLD

NATIONAL GEOGRAPHIC education

CLIMATE CHANGE AND THE WOLVERINE

BY REBECCA WATTERS

Species that are adapted to the cold and live in alpine or arctic environments are at risk of being affected by global climate change. The wolverine (*Gulo gulo*) may be especially sensitive to warming trends in the global temperature.

Wolverines possess many adaptations for survival in cold climates. This member of the weasel family has thick, oily, frost-resistant fur to help keep it warm in frigid temperatures. Large, snowshoe-like feet help the wolverine travel across snow in some of the world's harshest environments. During winter, wolverines find food in these stark habitats by sniffing out animals that have died in avalanches or by other causes. Scientists hypothesize that wolverines have an incredible sense of smell in order to be effective at finding these food sources.

During the summer, wolverines stash carrion in cool areas under boulders, which helps keep the meat fresh for later meals. Since the cold climate regions they occupy are relatively unproductive, wolverines must defend a large home range in order to secure enough food, and they therefore exist at a very low population density. Wolverines must travel farther to find a mate and do not reproduce as often as other carnivores such as bears and wolves. This makes wolverines especially vulnerable to habitat fragmentation, climate change and, in the context of these other threats, trapping and disturbance.

Female wolverines give birth and raise their young in snow dens. Snow dens help wolverine kits survive by providing insulation from cold temperatures and protection from predators. Wolverine kits are usually born in February and do not leave the den until the middle of May, so wolverines are only found in areas with deep snow that lasts through late spring.

At higher latitudes closer to the Arctic, wolverines are evenly distributed across the landscape because deep spring snow exists everywhere. Moving south, deep spring snow and wolverines are found only at higher elevations, in mountain ranges that are separated by large areas of unsuitable lowland. Even during the summer, wolverines stay in cold regions where snow lingers. This could be to avoid summer heat, to be close to avalanche chutes where prey is more abundant, or a combination of both. Wolverines reach the southern extent of their range in the Rocky Mountains of North America and the mountains of Mongolia in Eurasia, the southernmost regions where mountains hold late spring snow. In these areas, wolverines are likely to be especially vulnerable to climate change.

Scientists use models and historical data to predict how climate change will affect spring snow cover and wolverine habitat. Climate models generate examples of what spring snow conditions could look like by using a variety of data and predictions about the future. The models incorporate snowpack data, historical precipitation patterns, future patterns of fossil fuel use, and topography. Using these models, scientists infer that spring snow in the Rockies is likely to decline and snow-covered areas will become fragmented and isolated.

Current wolverine populations are already small. Without connections among subpopulations of wolverines, the genetic diversity of the overall population will suffer. However, snowpack modeling also suggests that some areas may be less affected by climate change and maintain spring snow cover. These areas include northern Washington, the Montana-Idaho border, the Greater Yellowstone Ecosystem, and the high peaks of Colorado.

While no model can predict the exact effects of climate change on the wolverine, its connected species, and its ecosystem, this research suggests that wolverines are susceptible to climate change because of their adaptations to cold environments. As these cold environments warm and disappear, the wolverine will be endangered by the very traits that once helped it survive.

Name:_____

CLIMATE CHANGE AND THE WOLVERINE

Read the article on climate change and the wolverine.

Identify adaptations the wolverine has to help it survive in a cold environment in the first column.

Explain how climate change will impact the wolverine as a result of each adaptation.

WOLVERINE'S ADAPTATION	HOW CLIMATE CHANGE WILL IMPACT WOLVERINE'S SURVIVAL
thick, oily fur	*Wolverines' fur will prevent them from keeping cool as the average temperatures increase.*

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MONGOLIA WOLVERINE EXPEDITION

Friend of the Wolverine Climate Change Pledge

Date: _____

By: _____

Teacher's Name: _____

School: _____

To reduce my greenhouse gas emissions at home and school, I pledge to:

_____

_____

_____

_____

Adventurers & Scientists for Conservation

Montana NSF EPSCoR

Montana State University Extended University

Mountains & Minds