

Natural History of Yellowstone

ZOOGUIDES volume 8

TEACHERS NOTES



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Written by Gina Pisello
Edited by Rob and Anne Ransom

REMedia Inc. 13525 Midland Road, Poway, CA 92064
Telephone 619 486 5030
Fax 619 486 0679
Sales and Technical Support 800 573 6334

Please call or write to us for a copy of our latest catalog.

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INTRODUCTION

The ZooGuide™ series of software from REMedia provides a resource for teachers and librarians on life science topics. Suggested grade levels for this volume are 6 –10. This Teacher's Guide offers suggestions, activities, and references for integrating the Natural History of Yellowstone ZooGuide into your curriculum. Other titles in the series include:

1. Butterflies of the World
2. Whales and Dolphins
3. Mammals of Africa
4. The Rainforest
5. World of Reptiles
6. Life in the Desert
7. Animals in Danger

Use this program:

- as an encyclopedic reference;
- to teach History, Biology and Earth Science topics;
- to understand and appreciate the nature of Yellowstone National Park.

What is in this Guide

The Natural History of Yellowstone Teacher's Guide offers suggestions for incorporating the accompanying CD-ROM into American History, Earth Science and Biology classes. These ideas are appropriate for middle school students and the lower grades of high schools in grades 6-10 and are organized by topic.

In addition, this guide provides information on incorporating the three sections of the program to complete activities and makes Natural History of Yellowstone a richer reference than an encyclopedia is. Read from a chapter, look at and listen to movies and use the chapters on flora and fauna to gain a more complete understanding of Yellowstone's complex ecosystem.

Finally, use this Teacher's Guide as a quick reference for the data provided in the ZooGuide. A list of helpful reference materials is provided with each activity so that your students can do more in-depth research once the program has sparked their imagination and interest.

USING NATURAL HISTORY OF YELLOWSTONE

Navigating

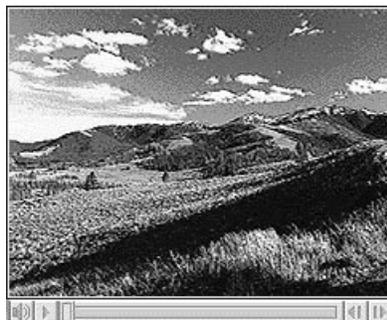
There are buttons on the left and right hand sides of each screen of the ZooGuide.



Each button represents a chapter. Click on any of them to go to that chapter. To see the name of a chapter, move the cursor arrow over the chapter button and its name will appear. To go to a section within a chapter:

1. Click on a chapter button to go to that chapter.
2. Move the cursor over the chapter button of the chapter you are currently in, and a contents menu will pop up.
3. Click once on the section you wish to go to.
4. To choose a different section or chapter, repeat steps 1-3 above.

Playing Movies



Most chapter topics have text accompanied by a movie, animation, or narrated slide show. You can recognise these by a thumbnail picture with a scroll bar underneath it, as shown above. To access these resources, click once on the picture and then press the forward arrow, or play button. Use the other buttons located under the picture to control the volume, to pause, or to jump forward or backward in the movie.

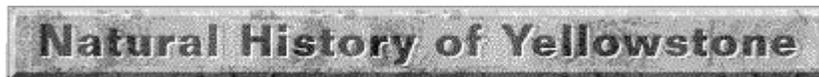
Viewing Pictures



There are photographs accompanying the text for many of the individual animal and plant species. Click on any of the photographs to enlarge them to fill the central area of the screen.

The first section of each of the chapters on the right hand side of the screen contains small pictures of all the animals found in that chapter. You can click on a picture of a particular animal to go to its section or choose the name from the chapter list.

Getting Help



There is on screen help available in the ZooGuide. To access it, click once on the title bar of the ZooGuide. It uses text and graphics to explain the functions of the different sections of the program. Click on the same area again to return to the program. In addition, the Introduction chapter of the ZooGuide explains how the program is set up and the parts and basic functions of the window.

Other Buttons

There are four other buttons in the viewing window. They allow you to:



print the current page of the ZooGuide, or any photograph if it is enlarged to fill the central area of the screen



access the name index and the index of places on the Yellowstone maps



take a quiz for each chapter in the ZooGuide, and



go back to the opening screen of the ZooGuide.

Click once on a button to activate it.

There are also directional arrows available when you view the Tour chapter. They allow you to move to different sections of the map. These arrows appear in the lower right of the screen below the chapter buttons.

INTEGRATING PARTS OF THE ZOOGUIDE

The Natural History of Yellowstone ZooGuide can be used in a number of different ways to access information.

The CD-ROM can be 'read' as a multimedia book

The movies at the start of each of the chapters can be used to give an overview of each topic.

The index can be used to jump to a specific topic of interest

The activities in this guide can be used to help students explore the CD-ROM

The associated internet web site www.remedia.com/yellow.html can be used to branch out to a number of internet sites of interest and relevance.

Using multimedia in the school is a relatively new development, and we hope that you will find the resource material in this CD-ROM disk of use in teaching concepts in Biology, American History and Earth Science. We hope that you and your students will find the story of Yellowstone both exciting and stimulating.

ZOOGUIDE ACTIVITIES

The following are 20 activities created using the Natural History of Yellowstone ZooGuide and integrating its information into three middle school courses: American History, Earth Science, and Life Science. There is one introductory activity, four history, five earth science, and eleven Life Science activities. Some require math and/or writing skills to complete and each one offers a unique approach to the information presented.

Activity 1: Using the Yellowstone CD

Prep Time: 10 minutes
Grade Levels: 6-9
Presentation Time: 1 class period
Content Area(s):

- American History
- Life Science
- Earth Science

Materials:

- Natural History of Yellowstone ZooGuide
- Windows or Mac OS Computers w/ CD ROM
- Paper and pen

Objectives: Students will

- investigate the Yellowstone ZooGuide
- formulate answers to search questions
- identify any areas of the ZooGuide they do not understand

Background Information:

The Natural History of Yellowstone CD was written to provide an interactive look at the nation's first national park; its inhabitants, history, geology, and conflicts about conservation. This dynamic land offers many opportunities to understand complex issues such as whether or not to control forest fires, reintroduce wolves and other predators, and use geothermal organisms for pharmaceutical research.

Students will get the chance to peruse the Yellowstone ZooGuide in this activity. They will become familiar with its parts and information as preparation for future activities. In addition, they will come away from this activity knowing more about Yellowstone than they did before.

Warm up Exercise: (10 minutes)

Ask your students to make a list of all the things they know about Yellowstone National Park. Their answers may include geysers, bison, the park's location, that it was the first national park, etc. Save their list to add to it at the end of this activity.

Activity: (30-40 minutes)

This activity requires students to investigate and answer a number of questions related to Yellowstone National Park based on the information contained in the Yellowstone ZooGuide. Some questions will have straightforward answers while others will require some digging.

The answers are provided below along with the location(s) of the data in the ZooGuide. When students have finished answering the questions, go over them and correct any misconceptions they have. Also check along the way to make sure they are using all aspects of the ZooGuide to aid in finding answers.

1. Who wrote the Yellowstone ZooGuide's text? (Title page)
Answer: Dr. Rob Ransom and Normal Doebel
2. How many mammal species are there in Yellowstone? (Intro.-The Nature of Yellowstone) Answer: 58
- 3a. What type of tree is most common in Yellowstone? (Intro.-The Nature of Yellowstone) Answer: Lodgepole pine
- 3b. Why are they the most numerous? (Plants-Trees)
Answer: They are well adapted to periodic forest fires and only need a short growing season.
4. What percent of Yellowstone is wetland? (Intro.-Fact Sheet)
Answer: 5%
5. How big is Yellowstone (in square miles)? (Intro.-Fact Sheet)
Answer: 3,472 sq. miles
6. Why does President Clinton say that "Yellowstone is more precious than gold"? (Intro.-A Presidential Message)
Answer: Because it is a unique nature preserve that we should keep safe for generations to come.
7. Compare a mountain habitat with a grassland one. Discuss climate, animal and plant differences. (Ecology-Mountain Habitat and Grassland Habitat)
Answer: In the mountains high altitude leads to colder weather and greater snow and rain fall; plants change with altitude from trees to shrubs to mosses and lichens as you ascend; and animals include sheep, goats, bears and squirrels.
There is less rain and snow fall in the grasslands than in the mountains; grass and sagebrush grow in rich soil at warmer temperatures and trees are only present near streams or creeks; animals include herds such as elk, bison, moose and deer and their predators like coyotes and wolves.
8. Find Mt. Washburn on the high resolution map of Yellowstone. Determine the highest elevation using the contour lines. (Tour-High Resolution Map of YP) Answer: 9650 ft.
9. Where is the Teton National Forest in relation to Yellowstone? (Tour-Low Resolution Map of GYE)

Answer: Southwest of the park.

10. What are three effects of increased tourism in Yellowstone?
(Human Impact-Tourism)

Answers: a. Recreational vehicles like snowmobiles damage fragile environments. b. More tourists means more support service providers. c. Communities are encroaching on the wilderness and growing at a record pace.

11. How many wolves were brought to Yellowstone in 1995? Why?
(Human Impact-Wolf Reintroduction)

Answer: 14 wolves were reintroduced to replace the population that was destroyed at the beginning of this century by poachers and hunters.

12. Where are three places in the ZooGuide you can go to get information on wolves?

Answers: a. Index-wolf, gray b. Human Impact-Wolf Reintroduction chapter, c. Carnivores-Gray wolf chapter, d. Carnivores-Meat eating animals, click on the picture of the wolf.

13. What is a caldera? (Geology-The Coming of the Volcanoes)

Answer: It is a collapsed crater of a volcano. It also makes up a large portion of Yellowstone park.

14. Find the following using the Birds chapter:

- a. a bird that can fly backwards. (Answer: hummingbird)
- b. a bird that migrates to Yellowstone. (Answer: Sandhill crane, white pelican, Canada goose, etc.)
- c. a carnivorous bird. (Answer: bald eagle, falcon, owl, osprey, hawk, etc.)
- d. an herbivorous bird. (Answer: Canada goose, Clark's nutcracker, etc.)
- e. the largest Yellowstone bird. (Answer: White pelican)

15. What kinds of wildlife can you see in the Sylvan Pass? (Animal Watch-Sylvan Pass)

Answer: bobcats, lynx, and mountain lions are sometimes spotted, grizzly bears eating cutthroat trout are more common.

16. Answer the quiz questions for the Plant chapter. To do this students need to select the Plant chapter then click on the Quiz button. They should study the information contained in the Plant chapter before trying the quiz. The quiz gives the correct answer for each question.

The Next Step: (20 minutes)

Review student answers to the above questions and discuss any they had difficulty finding. Make sure at this point they are comfortable with the ZooGuide and its parts before going on to specific topic activities. Then ask them to add facts to the list they created in the warm up activity. What have they learned about the park that they didn't know before?

Introduction to Yellowstone ZooGuide Questions

Name:

Date:

Answer the following questions based on your knowledge of the Natural History of Yellowstone ZooGuide.

1. Who wrote the Yellowstone ZooGuide's text?

2. How many mammal species are there in Yellowstone?

- 3a. What type of tree is most common in Yellowstone?

- 3b. Why are they the most numerous?

4. What percent of Yellowstone is wetland?

5. How big is Yellowstone (in square miles)?

6. Why does President Clinton say that "Yellowstone is more precious than gold"?

7. Compare a mountain habitat with a grassland one. Discuss climate, animal and plant differences.

8. Find Mt. Washburn on the high resolution map of Yellowstone. Determine the highest elevation using the elevation lines.

9. Where is the Teton National Forest in relation to Yellowstone?

10. What are three effects of increased tourism in Yellowstone?

11. How many wolves were brought to Yellowstone in 1995? Why?

12. Where are three places in the ZooGuide you can go to get information on wolves?

13. What is a caldera?

14. Find the following using the Birds chapter:
 - a. A bird that can fly backwards.
 - b. A bird that migrates to Yellowstone.
 - c. A carnivorous bird.
 - d. An herbivorous bird.
 - e. The largest Yellowstone bird.

15. What kinds of wildlife can you see in the Sylvan Pass?

16. Answer the quiz questions for the Plant chapter.

To do this you need to select the Plant chapter then click on the Quiz button. You should study the information contained in the Plant chapter before trying the quiz. The quiz gives the correct answer for each question.

History Topics

Activity 2: Expedition West

Prep Time: 20 minutes
Grade Levels: 6-9
Presentation Time: 2 class periods
Content Area(s): American History

Materials:

- Natural History of Yellowstone ZooGuide
- Windows or Mac OS Computers w/ CD ROM
- Paper and pens
- Hayden Expedition references (See Background Information section below)

Objectives: Students will

- plan a scientific expedition west.
- assess the Greater Yellowstone area for natural resources.
- make recommendations to President Grant based on expedition findings.

Background Information:

This activity can be used in conjunction with your American History course when you are teaching western exploration (i.e., Lewis and Clark). Your students will need background information about the Hayden Expedition to Yellowstone and can use the references listed here. The Introduction-History of Yellowstone chapter in the Natural History of Yellowstone ZooGuide can supplement this information.

Warm up Exercise: (15 minutes)

Ask your students the following questions to get them thinking about their expedition.

Have you ever taken a long trip before? What did you bring with you? Why?

Students should respond with a list of items that they brought on their trip and the reasons for their inclusion. Generate a list of common trip necessities on the board or overhead of your students answers. They can group things by type (i.e., toiletries, clothes, games, food, etc.) to organize the compiled list.

Based on their responses, you can ask your students to think about what is required to plan a cross country scientific exploration to a newly discovered place called Yellowstone. They are now ready to begin the activity below.

Activity: Part 1 (30 minutes)

Now that your students have read background information on the original Hayden expedition and completed the warm-up activity; they are ready to plan their own trip to Yellowstone as the "Second Hayden Expedition." They will plan the trip, report their findings, and make recommendations to the President of the USA.

Divide your class into groups of 4-6 students each. Once students are in their respective groups, they should do the following in the order listed.

- Assign roles to each member (i.e., geologists, reporter, photographer, etc.)
- Give each member a specific task to accomplish on the expedition.
- Make a list of equipment, food, and other supplies needed for the trip.

The plans for the trip should be written up in an organized request to the President and Congress and given to you for approval before the students proceed. Check their plans for reasonableness and thoroughness. Approve their plans and request that they submit a written report summarizing what they find at Yellowstone. Each member of the team should write a report based on their area of expertise and in keeping with historical facts. Assign this as homework for Day 1.

Part 2: (45-60 minutes)

Students should meet with their expedition groups and compile their individual findings into a summary report to be presented to the class. Reports can include information about the geology, flora and fauna, natural resources, etc. of Yellowstone. Students can discuss the similarities and differences in their findings once they have all presented their information.

The Next Step: (20 minutes)

As a wrap up of this activity, students can make recommendations for the possible uses of the Yellowstone area to the President and Congress (you). They should base their recommendations on their findings, the information from the ZooGuide and other references. Discuss their reasons for making the recommendations they do and how they differ from the Hayden Expedition's recommendations by answering the following question.

Do you think that Yellowstone would be made into a national park if it was discovered today? Why or why not?

Activity 3: Establishing a National Parks System

Prep Time: 20 minutes
Grade Levels: 6-9
Presentation Time: 1 class period
Content Area(s): American History

Materials:

- Natural History of Yellowstone ZooGuide
- Windows or Mac OS Computers w/ CD ROM
- Paper and pen
- Encyclopedia of US facts

Objectives: Students will

- discover facts related to the National Parks system
- understand the importance of national parks
- create a national parks fact sheet

Background Information:

Yellowstone National Park was the first land in America to be designated as a national park. Congress passed a bill into law in 1872 establishing the park and its function. Other parks followed and today the United States has hundreds of them ranging from historic to scenic places of interest.

Students will need an encyclopedia or other fact source to answer the questions presented in the activity below. The answers given in this Guide come from the 1995 Grolier Multimedia Encyclopedia™. The Introduction-History of Yellowstone chapter in the ZooGuide is also helpful.

Warm up Exercise: (5-10 minutes)

As an introduction to this activity ask your students what national parks they have visited. Make a list of their responses and ask them why they think this area was set aside as a park.

Activity: (30-40 minutes)

In this activity students will answer the following questions about the National Parks System to help them learn more about the motivations for creating it. Discuss their answers when they have completed the questions and debate any differences of opinion.

1. What were some of the early challenges of establishing a parks system?
ANSWER: squatters, poachers, the need to regulate use, protect natural resources or historic sites, etc.

2. Why were parks created? (List at least 3 reasons)
ANSWER: to preserve important historic sites, preserve unique natural wonders, and provide recreational sites for people.
3. What government agency was established to patrol the parks?
ANSWER: the National Parks Service
4. How much of the US is park land? Compare that to the total land mass of the US.
ANSWER: 79 million acres (123,437.5 square miles) compared to 3,787,425 square miles.
5. Name five National Parks.
ANSWER: Yellowstone, Florida Everglades, Grand Canyon, Statue of Liberty, White House, Yosemite, etc.
6. How are parks funded?
ANSWER: Congress appropriates annual funds
7. What government agency oversees the National Parks Service?
ANSWER: The Department of the Interior
8. Who works for the National Parks Service?
ANSWER: rangers, historians, researchers, naturalists, and maintenance workers.
9. During what years did the Army administer the parks system? Why?
ANSWER: 1886-1916 because poachers and tourists were damaging the land and its inhabitants.

The Next Step: (30 minutes)

Now that your students have learned some facts about the National Parks System, they can create a fact sheet including relevant information such as

- how many visitors parks get each year,
- the total number of parks in the system,
- the number of people employed by the parks,
- a US map color coded to show what type (historical, natural, or recreational) of park is located there,
- pick one or two more facts to include.

Fact sheets should be colorful and easy to read. Students can use graphs and charts to display their information.

National Parks System Questions

Name:

Date:

Answer the following questions based on your knowledge of the history of the National Parks System and the references you are given.

1. What were some of the early challenges of establishing a parks system?
2. Why were parks created? (List at least 3 reasons)
3. What government agency was established to patrol the parks?
4. How much of the US is park land? Compare that to the total land mass of the US.
5. Name five National Parks.
6. How are parks funded?
7. What government agency oversees the National Parks Service?
8. Who works for the National Parks Service?
9. During what years did the Army administer the parks system? Why?

Activity 4: History of Yellowstone National Park

Prep Time: 20 minutes
Grade Levels: 6-9
Presentation Time: 1 class period
Content Area(s): American History

Materials:

- Natural History of Yellowstone ZooGuide
- Windows or Mac OS Computers w/ CD ROM
- Paper, pen, coloring materials
- Web sites and other references listed below

Objectives: Students will

- select a picture from the gallery about which to write a story
- identify the different periods of use of the Yellowstone area
- create a picture for the gallery

Background Information:

The area of North America we now call Yellowstone National Park was once inhabited only by wildlife. Next came the Native Americans and finally vacationers. The human history of the park is described in the Introduction-History of Yellowstone chapter of the ZooGuide. This section also contains a virtual gallery with photographs and paintings of people and places important to Yellowstone's history. Students should peruse this chapter in preparation for the activity. They can also get information from the following websites, if you have web access.

- <http://www.yellowstone.net/history.html>
- <http://www.Yellowstone-Natl-Park.Com/history.html>

The following is a list of book references for Yellowstone historical facts, if web access is unavailable in your school.

- The Yellowstone Story: A History of our First National Park (2 volumes), Aubrey L. Haines. University Press of Colorado: Niwot, Colorado, (1996 — revised).
- Yellowstone: 125 Years of America's Best Idea, Michael Milstein. The Billings Gazette: Billings, Montana, 1996.
- The Discovery of Yellowstone Park: Journal of the Washburn Expedition to the Yellowstone and Firehole Rivers in the Year 1870, Nathaniel Pitt Langford. University of Nebraska Press, 1972.
- The Inn at Old Faithful, Susan C. Scofield. 1979.

- “Yellowstone’s Hundredth Birthday” National Geographic (141-5), May 1972.
- Greater Yellowstone - The National Park and Adjacent Wildlands by Rick Reese, Montana Graphic Series, Montana Magazine American & World Geographic Publishing, Helena, Montana

Warm up Exercise: (10 minutes)

Request some pictures of your town/city from your local historical society. Show them to the students and ask them if they can identify any of the places/people shown. Discuss how much the area has changed since Europeans first settled there. Was there a Native American population at one time in the area? Who were they and what happened to them? Discuss student responses in preparation of the activity below.

Activity: (30-40 minutes)

In this activity students will accomplish two of the three objectives listed above. First, they will identify the major periods of Yellowstone’s history and based on that they will choose a picture from the ZooGuide’s gallery about which to write a story.

Students should begin this activity by reading the text in the Introduction-History of Yellowstone chapter in the ZooGuide. They should also peruse the virtual gallery on that page by clicking anywhere on the picture. Once they have looked at all the information provided, they are ready to make a time line of human events that took place in the Yellowstone area. The time line can start thousands of years ago with the first Native settlers or with the Lewis and Clark explorations west. The time line should include important dates, people, and events such as when

- the last wolves were eliminated in the park,
- wolves were reintroduced to the park,
- the National Parks Service started overseeing the park,
- the last “sheep eaters” left,
- the Hayden expedition first arrived,
- they reported their findings to Congress,
- the park became a preserve and not a resort, and
- other important events occurred.

There is a time line located in the <http://www.yellowstone.net/history.html> site that you and your students can use to compare with yours.

Once students have completed the time line and organized major

events by date, they can go back to the gallery and select a favorite picture about which to write a story. The story should be based on the facts provided and embellished by the student's research and imaginations. Post the stories on a bulletin board with the time line for other classes to read.

The Next Step: Homework assignment (optional)

Students can go one step further with this activity by creating their own artwork to add to the CD's gallery. They can choose a person, place, or event to depict in their pictures. They can use the internet references provided in the ZooGuide to research, or if internet access is not available, encyclopedias or the references listed above should provide the necessary information.

Activity 5: Yellowstone Current Events

Prep Time: 20 minutes
Grade Levels: 6-9
Presentation Time: 2 class periods
Content Area(s): American History/Current Events

Materials:

- Natural History of Yellowstone ZooGuide
- Windows or Mac OS Computers w/ CD ROM
- Paper and pens
- Copier
- Word processing program
- Web sites listed below

Objectives: Students will

- investigate recent issues related to Yellowstone Park
- create a newsletter based on current events taking place in the Yellowstone area

Background Information:

(Assign magazine and newspaper articles to read as homework before beginning this activity. Use the ZooGuide CD in class as a reference.)

There are many interesting events that have occurred surrounding Yellowstone Park and the land around it. For example, this winter (1997) bison were killed by the hundreds by ranchers who feared they would infect cattle with brucellosis. President Clinton as recently as 1996 visited the park to give a speech that can be heard in part in the Introduction-a Presidential Address chapter of the ZooGuide. Issues related to preservation of the greater Yellowstone ecosystem happen regularly too.

Students can use the ZooGuide, newspapers, magazines, and the Internet sites related to the Introduction and Impact chapters to find out more. They can compile this information into an interesting and informative newsletter to distribute to schoolmates. Web sites with relevant information include:

- <http://www.yellowstone.net>
- <http://www.Yellowstone-Natl-Park.Com>

Warm up Exercise: (10-15 minutes)

To get students interested in and thinking about this activity, begin by allowing students to “dissect” a newspaper or newsletter from a

local source (i.e., your town's newspaper or school newsletter). They should note the types of articles included, the overall organization, and what other than news items are included. Make a list of the typical parts of a newsletter on which to base theirs.

Activity: (2 class periods)

Now that students have read the information on current events in Yellowstone and decided on a style of organization for their newsletter; they are ready to produce it. To do this divide your class into writers, editors, layout artists, etc. to cover all the jobs needed to produce a newsletter. Base the newsletter on a single topic or have several sections dealing with different issues related to Yellowstone Park. You may want to include a puzzle or fun facts page for readers.

In the first class period, everyone can work on writing articles or making puzzles and games for the newsletter. Articles can be written individually or in groups. At the end of the class period students can take a few minutes to decide which articles to include in the newsletter.

During the second class period, students can edit the articles, layout the newsletter, and print it from the computer. Make enough copies to distribute to other classes. If only a limited number of copies can be made, post them in central places where other students can read them. Wait several days and post answers for the games and puzzles you have included. You can ask for feedback about the newsletter to help your class improve its product should you create another one on a different topic in the future.

The Next Step:

If you have the capability to post data on the World Wide Web, consider linking your newsletter to other current events facts about Yellowstone Park. This exercise will expand your ability to inform others about what's happening in Yellowstone and your students can learn more about the Web as a place for gathering data in this Information Age.

Biology Topics

Activity 6: Yellowstone's Food Web

Prep Time: 20 minutes
Grade Levels: 6-9
Presentation Time: 1 class period
Content Area(s): Biology:
• Ecology/Cycles

Materials:

- Natural History of Yellowstone ZooGuide
- Windows or Mac OS Computers w/ CD ROM
- Food Web diagram (one per student)
- Magazine pictures of Yellowstone flora and fauna (optional)

Objectives: Students will

- develop a food web
- identify the three necessary components of a food web
- combine several webs into a large one

Background Information:

Yellowstone National Park is an ecosystem full of interconnections between plants and animals. There are a multitude of food webs represented within its borders. The Ecology-What is an Ecosystem chapter gives an introduction to the concept of a food web. Using the Index in the Natural History of Yellowstone ZooGuide, students can construct a food web of their own. On the next page you will find a black line drawing of a blank food web. There is space available in the center to place a carnivore and room on several of the branches to include herbivores, plants and decomposers. Students will have to draw or find pictures of plants and animals to include in their webs. You can allow them to choose their own carnivore for the center or you can place one there before making copies to distribute to the class. If you use a single carnivore, it might be interesting to see how many different food webs students can create from that starting point.

Vocabulary:

This activity assumes that students are currently studying or have already studied concepts like producers, consumers, and decomposers; the three types of living organisms that constitute a food web. They should also know the meanings of the following terms:

- herbivore
- carnivore
- food chain

Warm up Exercise: (10-15 minutes)

To introduce the concept of a food web to your students you can do the following exercise. Ask students what they ate for dinner last night. List their responses under headings for plants and animals. Construct a simple food web or chain with them as the center and what they ate as the branches. For animals continue branching out until you reach plants. At the plant level, discuss the need for soil nutrients and where they come from (decomposers).

Activity: (30-40 minutes)

Now that you have your students thinking about what they eat and how it relates to food chains or webs, pass out the picture of a web either with or without a carnivore in the center. Students can use the Yellowstone CD's chapters on the right side of the screen to fill in the blanks for herbivores the carnivore eats and the plants (producers) they eat. Don't forget to include decomposers like fungi which eat dead plant and animal materials and return nutrients to the soil.

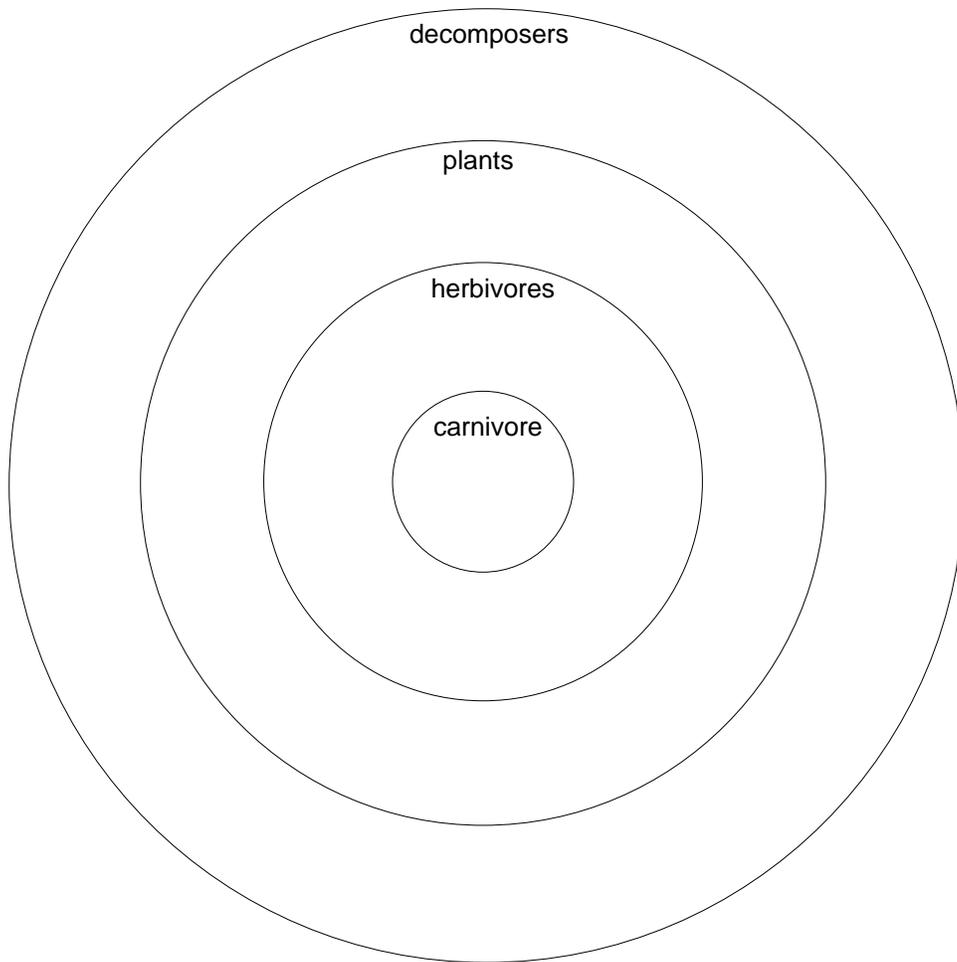
For younger students you may want to use a food chain instead of a food web as it is less complex and easier to understand. To make a food chain, follow a single line from carnivore to herbivore to plant.

Consider making the food chains or webs more interesting by adding pictures of the organisms listed in the available slots. You can get them from nature magazines or print them from the REMedia web site. As a final step in creating a completed food web, have students label the three parts of the web (producers, consumers and decomposers) using a different color for each heading. Display the completed webs or chains on a bulletin board.

The Next Step: (Optional 1 class period activity)

In the activity described above your students have completed several different food webs. Now they can get an even better understanding of why it is called a web by linking several overlapping ones together. For example, if several webs contain the same herbivore (i.e., a bison) connect the two webs with a piece of string, a colored line, or by overlapping the two webs on the bulletin board.

Alternately, you can summarize all of the food webs or chains into one large one that you construct on the bulletin board using pictures of organisms and arrows or strings to show the connections. This can get fairly involved so make sure you have plenty of room. At the end make sure to label the decomposers, producers and consumers in the giant web.



Activity 7: Seasons

Prep Time: 20 minutes
Grade Levels: 6-9
Presentation Time: 2 class periods
Content Area(s): Biology:
• Ecology/Cycles

Materials: • Natural History of Yellowstone ZooGuide
• Windows or Mac OS Computers w/ CD ROM
• Paper and pen

Objectives: Students will

- describe the effects of seasons on plants and animals
- compare and contrast seasonal effects on plants versus animals
- organize their findings into a clearly written diary

Background Information:

In preparation for the activity below students will need to read the information presented in the Seasons chapter of the ZooGuide. This background information on the effects of the seasons on the Yellowstone environment is essential for eventually studying specific species of plants and animals in the park. In addition, students will need to select one plant and one animal species from the right hand chapters on which to focus their research.

Warm up Exercise: (10-15 minutes)

Everyone experiences the seasons, whether you live in the north, south, or desert west; there is a cycle of cold and warm, wet and dry. As a warm-up for the main activity ask your students the following question:

How does the change of seasons effect you?

They should give responses like changes in clothing, types of sports played, fresh food availability in stores, length of daylight hours, etc. Now that they have considered how seasons impact their lives, ask them how they think seasons impact other organisms' lives.

Activity: (First class period)

For this activity students will choose one plant and one animal that inhabits the Yellowstone National Park. They will track each throughout the four seasons and write a diary describing the following information:

- temperature ranges during the year, graphed
- daylight hours per season, graphed
- rainfall in the area that the plant grows during the year, graphed
- what the animals eat in each season (Is diet season dependent?)
- if they go dormant, how and why
- when do they reproduce?
- mating season/pollination
- birth season/seed production
- a brief description of daily life in spring, summer, fall, and winter

The Next Step: (Second class period)

Once students have compiled the information for the plant and animal of their choice, they can compare and contrast the adaptations used by each to maximize benefit and minimize cost per season. For example, many plants and animals go dormant in winter for similar reasons, whereas reproduction may occur in different seasons for plants and animals. Explore these issues as a group based on student's findings from their diaries.

Activity 8: Migration

Prep Time: 20 minutes
Grade Levels: 6-9
Presentation Time: 1 class period
Content Area(s): Biology:
• Ecology/Cycles

Materials:

- Natural History of Yellowstone ZooGuide
- Windows or Mac OS Computers w/ CD ROM
- Yellowstone Map
- Colored pens or markers

Objectives: Students will

- develop a migration map for Yellowstone Park
- understand the importance of Yellowstone as a stop over for migratory animals

Background Information:

Yellowstone National Park is host not only to year round residents such as black bears and wolverines, but to migratory animals like sandhill cranes as well. Students can use the information provided in the Seasons-Migration chapter of the ZooGuide for background information about several animals that migrate within or to and from the park. For more specific information on these animals, students can use the chapters located on the right side of the ZooGuide window. Each species has descriptions, pictures and a button on the title bar that show where this species can be found in Yellowstone.

Vocabulary:

Students should be familiar with the following terms before beginning this activity.

- migration
- home range

Warm up Exercise: (5-10 minutes)

To get your students thinking about migration, ask them to name animal species in your area of the country that migrate seasonally. This list could include such well know migrators as Canada Geese, Monarch Butterflies, San Juan Capistrano Swallows, Robins, Blue Jays, Cardinals, Cattle and Sheep that are moved to different pastures during the year, etc.

Activity: (30-40 minutes)

In this activity students will customize a map using a color coding system to show one bird and one mammal species' migratory route through Yellowstone Park. A different color should be used to indicate each animal's seasonal ranges in the park. If the chosen mammal or bird only spends one or two seasons in the park, indicate where it migrates to for the other seasons. You can do this by using a larger map that shows Yellowstone and the surrounding states or by drawing arrows and names of destinations on the Yellowstone map.

You can assign specific mammals and birds to each student or group of students to insure that many different species are included on their maps. When students complete their maps they can compare ranges and migratory paths and analyze which areas of the park are most heavily used at which times of year. By comparing these "hot spots" with a map showing terrain/vegetation, students can understand why animals choose the locations they do at given times of year. The Tour chapter in the ZooGuide has a high resolution map that can be zoomed in to see terrain details.

The Next Step: (10 minutes)

Once students have created their modified maps and compared different mammal and bird migratory routes, they can answer the following general questions about migration.

1. Do plants migrate? If so, how and why?
Answer: Some plants do migrate in the sense that their seeds move away from the parent plant either by wind or animals carrying them. They do this to spread out in the environment, to find places where there is better soil or sunlight, and to reduce risk from natural disasters such as fire.
2. Why do animals migrate? (Give at least 3 reasons)
Answer: Animals migrate to find better feeding grounds, get away from the cold or heat, and to find water among other things.

Activity 9: Seed Dispersal

Prep Time: 20 minutes
Grade Levels: 7-10
Presentation Time: 1-2 class periods
Content Area(s): Biology:
• Ecology/Cycles
• Botany

Materials:

- Natural History of Yellowstone ZooGuide
- Windows or Mac OS Computers w/ CD ROM
- Magnifying glasses (one per student or group)
- Dissecting microscopes (one per student or group)
- A selection of seeds of different types including:
 - edible fruits (apples, nuts, etc.)
 - wind born seeds (dandelion, pine, maple, etc.)
 - if possible pine cones (from Lodgepole pines) that only open in the heat generated by fire

Objectives: Students will

- investigate how seeds get dispersed from their parent plants
- dissect several types of seeds
- organize seeds into groups based on dispersal practices
- understand the importance of seed dispersal to plant survival

Background Information:

Plants have evolved over time to use animals, insects, wind and even fire to help them reproduce. Flowers are used to attract birds and insects to pollinate plants and sweet fleshy fruits surround seeds inviting animals to eat them. They are then carried to new places where they have a chance to grow. Other plants have adapted to use wind or fire to spread seeds to new places.

Several areas of the Yellowstone ZooGuide are useful for this activity. They include the Ecology-Fire and Plants-Trees chapters. To find out more about other examples of seed dispersal use your biology textbook

Vocabulary:

Students should be familiar with the following terms before beginning this activity.

- dispersal
- germination

Warm up Exercise: (5 minutes)

To get students thinking about this activity, ask them to name as many types of seeds as they can in one minute. Write their responses on the board or overhead. Save this list for the first part of the activity below.

Answers can include any type of fruit or vegetable, nuts, and non edible seeds.

Activity: (1-2 class periods)

Begin this activity with the warm-up exercise list of seeds. Ask students to divide the listed seeds into groups based on how they are dispersed from the parent plant. To do this you should first ask them to list as many ways that seeds can be dispersed as possible. Answers include: animals (mammals and birds), insects, fire and wind

On a sheet of paper have students make a column for each category of dispersal and list the types of seeds for each. Their paper should look something like the sample below when finished.

Mammals	Birds	Insects	Fire	Wind
oranges	sunflower	wheat	lodgepole pine	dandelion

Once they have completed their lists, students can study different seeds using a magnifying glass for larger ones and a dissecting microscope for smaller ones. They should record the name of the seed, where its parent plant is found (climate, types of animals present in the environment, etc.), and make a drawing of its parts. The drawings should be labeled indicating the critical parts that attract mammals, birds, and insects; or the characteristics that help the seeds disperse by wind or fire.

The Next Step: (10 minutes)

To understand the evolutionary reasons for making seeds attractive to animals or adapted for wind or fire dispersion, discuss the following questions with your class.

1. What are some of the advantages of dispersing seeds?
Answers: Seeds that leave their parent plants have a better chance to get necessary nutrients and sunlight in a new location, Seeds can colonize new territory when dispersed, etc.

2. Under what conditions would a plant evolve a fire or wind seed dispersal system?

Answers: This type of dispersal could evolve in areas where large animals are scarce, where fires are common, or in plants that aren't large enough to spend lots of energy making fleshy fruits.

Activity 10: Population Estimation

Prep Time: 60 minutes
Grade Levels: 7-10
Presentation Time: 2 class periods and a half day field trip
Content Area(s): Biology
• Ecology/Cycles
• Population Biology

Materials:

- Natural History of Yellowstone ZooGuide
- Windows or Mac OS Computers w/ CD ROM
- Graph paper
- Access to

<http://www.americanparknetwork.com/parkinfo/ye/index.html>

- Paper and pen

Objectives: Students will

- organize population data into a seasonal graph
- interpret the graph's data
- summarize their findings in writing

Background Information:

Every year in Yellowstone National Park and elsewhere, herds of mammals, such as bison and elk, undergo changes in population size. This is part of the natural cycle of life and is tied to the seasons, availability of food, and number of predators present in the ecosystem. In this activity students will do a population survey to determine the size of a group of animals.

Students can use the Seasons-Migration and the Herbivores-Elk chapters in the Yellowstone ZooGuide to get information on elk herd sizes at different times of year. In addition, they can use the website listed in the materials section above for more information.

Warm up Exercise: (20 minutes)

To get your students thinking about the activity, bring a jar of jelly-beans, marbles, or other small objects to class. Ask students to devise ways of estimating how many objects are present in the jar. Don't let them just guess, they should develop a method for estimating similar to the ones listed below.

Ways of estimating:

- count out 50 objects and see how much space they fill in a similar size jar,

- weigh a known amount of the objects, a jar of similar size, and finally the full jar. Estimate how many objects there are by subtracting the weight of the jar and dividing by the known weight of a set number of objects.
- fill the bottom of a jar the same size as the one in question with the same kind of objects, count how many it takes to make one layer, estimate the total number of layers in the jar, multiply and get your estimate.

Students may come up with other ways to estimate the number of objects. When they have made their estimates, count the number of pieces in the jar and see who had the best estimate. Discuss why their estimate was the closest one.

Activity: (Half day field trip)

Now that your students have some experience with population estimation, explain that estimating population sizes in nature is similar to the activity above. Commonly, naturalists count out a small number of the herd, make a mental note of how big it is, and count how many groups of this size they see altogether. This technique works with birds, mammals, fish and social insects among others.

For this activity you will need to take a field trip to a nature preserve, zoo, or farm. Any of these places should have large enough populations of certain animals to make it possible for your students to practice their new population estimation skills. Have them try counting a group of 10 animals from the larger group then make an estimate of the total number present. They can check their accuracy by comparing answers and consulting a staff naturalist or farmer.

The Next Step: (1 class period)

As stated in the Background Information section above, populations can vary over time because of different factors. When you have returned from your field trip discuss these factors (birth rate, food availability, harshness of winter, predation, etc.) and develop a plausible estimate of what happens to the groups you counted as a result. Students can graph this data for clarification and summarize everything in a short essay. Use the following questions and their answers to guide your students through the process. Use the references listed in the Background Information section to aid in answering these questions.

1. What factors can increase the population you counted?
Answer: births, a higher birth rate than death rate, etc.
2. What factors can decrease the population you counted?

Answers: harsh winter, predation, killing for sport, toxins in the environment, etc.

3. Are there cyclical changes in population size? If so what are they?

Answer: The population tends to increase in spring with the birth of new members, decrease slightly through the summer as some young, old, and weak are killed off, a larger decrease over winter if the area experiences cold weather and food is scarce, then another increase with spring.

4. Is the population stable over time? Why or why not?

Answer: The answer depends on many factors, but if birth rates keep up with deaths due to predation, disease, hunger, etc. then the population will be stable over time. If food is more plentiful some years the population may experience increases in size that may or may not be stable over time.

Population Stability Questions

Name:

Date:

Answer the following questions based on your knowledge of population biology and the references you are given.

1. What factors can increase the population you counted?
2. What factors can decrease the population you counted?
3. Are there cyclical changes in population size? If so what are they?
4. Is the population stable over time? Why or why not?

Activity 11: Fires and Forest Succession

Prep Time: 20 minutes
Grade Levels: 7-10
Presentation Time: 2 class periods
Content Area(s): Biology
• Botany
• Ecology/Cycles

Materials:

- Natural History of Yellowstone ZooGuide
- Windows or Mac OS Computers w/ CD ROM
- Paper and pen
- Fires in Yellowstone website

Objectives: Students will

- describe the importance of fires in forest succession
- summarize the process of forest succession that occurs in Yellowstone
- compare other types of forest succession with Yellowstone's process

Background Information:

The destruction of old growth forests by natural means such as fires leads to a series of events that finally results in a new forest. This process is known as forest succession and occurs everywhere that forests exist. The process can take several hundred years to complete its cycle, making it difficult to observe first hand, so historic records are important for tracing the stages of a succession.

The Yellowstone ZooGuide has two chapter sections with relevant information about fires and their role in forest succession. They are the Ecology-Fires and Plants-Trees chapters. Students should read the information and play the videos in these sections. If you have web access at your school, students can find out more about fires in Yellowstone by checking out the related website at:
<http://www.wyoming.com/~yellowstonejournal/YellowstoneFires.html>.

Vocabulary: Students should be familiar with the following terms before beginning this activity.

- forest succession
- old growth forest

Warm up Exercise: (10 minutes)

Ask students if they have ever watched what happened to an empty field or abandoned lot over several years. They should respond that “weeds” and other wild plants begin to grow in the exposed ground. They may even notice seedling trees starting to grow. Explain that if the area is left alone for many years different types of trees will eventually grow there and a mini forest will develop.

Activity: (30-40 minutes)

For this activity students will answer questions about forest succession and the role of fires in this cycle based on the information they read and listen to in the ZooGuide chapters mentioned above. The questions and their answers are given below. On the next page is a copyable master of the questions to pass out to your students.

1. What causes most fires in Yellowstone?
Answer: Lightning
2. What is the ecological role of fires?
Answer: They clear old growth creating ash rich soil and open areas where new plants can grow.
3. Why was the 1988 fire in Yellowstone so devastating?
Answer: a. There was a lot of old growth because until 1972 all fires were put out quickly.
b. It was a very dry year.
c. High winds fanned small fires into large ones.
4. Why are small fires beneficial?
Answer: They help prevent large fires by creating natural barriers and by consuming fire fuel.
5. How do mammals, birds, and insects benefit from forest fires?
Answer: a. New growth in the cleared area provides good eating for mammals.
b. Birds nest in the burned trees and woodpeckers leave holes in new trees for other birds to nest in.
c. Insects live in and off of the fallen plant matter.
6. What are three immediate effects of a forest fire to plants?
Answer: a. Soil is exposed to sunlight so new trees and plants can grow.
b. Nutrient rich ash is washed into the soil feeding the new plants.
c. Some tree species only germinate after fires (i.e., fireweed, and lodgepole pines).

7. Summarize the stages of forest succession as illustrated in the Plants-Trees chapter animation.

Answer: a. Lightning strikes an old growth forest burning trees down.

b. Lodgepole pine cones release their seeds because of the intense heat.

c. Roots and seeds of flowering plants are protected from the fire underground and quickly grow in the new ash rich soil.

d. Lodgepoles germinate and grow five feet in the first 10 years.

e. Elk, deer and birds like the woodpecker move in and eat the tender new growth.

f. Over the next 100 years trees reach heights of 30-50 feet.

g. Thinning occurs due to competition for nutrients, water and light.

h. Second generation trees begin to grow as spaces open up on the ground and in the canopy.

i. The cycle begins again with lightning.

The Next Step: (One class period)

Take a quick field trip to a site where a field is becoming a forest, if there is one near your school, so that your students can see first hand what happens early on in the succession process. You could also take a series of trips each focusing on one part of the succession process since it is impossible to watch a single area undergo this process in a short period of time.

For older students, there is a website that contains a forest fire simulator at the following address:

<http://www.esd.ornl.gov/ern/embyr/embyr.html>.

They can try it out and see what happens to the forest over time after a fire has occurred.

Forest Succession Worksheet

Name:

Date:

Answers these questions based on your knowledge and the information provided in the Yellowstone ZooGuide.

1. What causes most fires in Yellowstone?
2. What is the ecological role of fires?
3. Why was the 1988 fire in Yellowstone so devastating?
4. Why are small fires beneficial?
5. How do mammals, birds, and insects benefit from forest fires?
6. What are three immediate effects of a forest fire to plants?
7. Summarize the stages of forest succession as illustrated in the Plants-Trees chapter animation.

Activity 12: Predator-Prey Game

Prep Time: 20 minutes
Grade Levels: 7-10
Presentation Time: 2-4 class periods
Content Area(s): Biology
• Adaptation/Evolution

Materials:

- Natural History of Yellowstone ZooGuide
- Windows or Mac OS Computers w/ CD ROM
- Cardboard to make a game board
- 3" x 5" note cards cut in half for game cards
- Markers and rulers
- Game pieces
- one die

Objectives: Students will

- create a board game that explores the predator-prey relationship
- test various game strategies to get the best balance
- interpret game results in relation to reality and modify the game if necessary to make it more realistic

Background Information:

The predator-prey relationship is one of the most basic in nature. It pits speed and agility against strength and cunning. There are many examples of this relationship in Yellowstone National Park such as wolves and bison, grizzly bears and ground squirrels, and bobcats and birds. A balance between predator and prey is essential for the survival of both types of animals.

Students can read about various herbivores (prey) and carnivores (predators) in the right hand chapters of the ZooGuide. They can also read about this topic in their biology textbook.

Vocabulary: This activity assumes that your students understand the meanings of the following words.

- predator
- prey
- herbivore
- carnivore

Warm up Exercise: (15 minutes)

Ask your students to brainstorm factors that are important to the predator-prey relationship. Look for answers like

- availability of plant material in winter,
- number of offspring born in spring (for both predators and prey),
- weather conditions,
- availability of water,
- terrain, and
- general health of the animals.

Activity: (2 class periods)

Begin this activity with the list your class generated in the warm up exercise. Use these factors to help you design a board game that will pit predators (such as wolves) against prey (such as elk). Below is a list of suggestions for structuring your game. Use those you want or create your own.

1. Each side of the board can represent a season, with appropriate squares on each. For example, summer can have squares with lush meadow lands and a few Choose a Natural Event Card spaces.
2. Choose a predator-prey pair from the examples given above or others you find in the Yellowstone ZooGuide.
3. Reserve some squares on each side of the board for Natural Event Cards. These cards can include things like heavy rains/snows, dry weather, lightning storms, fires, disease, etc. with consequences attached. For example, one card could say:
 “Light snows this winter mean more babies born in spring. Add 10 elk or 2 wolves to your herd or pack when you reach spring.”
4. Assign an initial number of predators and prey for the game with students playing one type or the other. They could begin the game with the same or different numbers of each. Play the game through and see what mix of numbers gives the most stable setup. Keep in mind that in nature it takes much more energy to produce a predator and sustain it than a prey species requires. Make sure Natural Event Cards reflect this difference.
5. When a predator and a prey occupy the same square on the board, roll the die to see how many if any prey are killed. An even numbered roll means the predator didn't get its prey. An odd numbered roll indicates the number of prey killed. If predators go once around the board without “killing” any prey, roll the die to see how many die off due to starvation.
6. The board should begin with spring and each time students' predators or prey go past the beginning square, they roll the die to see how many new babies are born to their group. Points are assigned to the number of predators and prey left

when you finish the game. Prey can be worth 2 points each and predators 5 points each.

The Next Step: (1-2 additional class periods, optional)

Refine your version of the Predator-Prey game described above until you have found a good mix of predators and prey. Discuss what strategies worked and what didn't. Are these reflected in nature? How?

You may want to use this activity as a launching ground for discussing adaptations that predators and prey have evolved over time to succeed at being the hunter or the hunted.

Activity 13: Geothermal Life

Prep Time: 20 minutes
Grade Levels: 8-10
Presentation Time: 2-3 class periods
Content Area(s): Biology
• Adaptation/Evolution
• Molecular Biology

Materials:

- Natural History of Yellowstone ZooGuide
- Windows or Mac OS Computers w/ CD ROM
- World Wide Web access for:
<http://www.bact.wisc.edu/bact303/b1>
- Paper and pen or computer word processing program and printer

Objectives: Students will

- research organisms that live in and around hot springs
- write a paper based on their research
- observe thermophiles under the microscope, if possible
- understand that life can exist in a variety of conditions, not just those that sustain humans

Background Information:

Life exists under many different conditions, from subzero high altitudes to high pressure hot underwater vents. Humans and other mammals are limited to a narrow band of temperature, altitude, and other environmental ranges; but there are organisms that can live in boiling, alkaline or acidic water that would almost instantly kill us. These organisms are called thermophiles and are mainly one celled bacteria.

Thermophiles are the subject of this activity and can be found living in hot springs and pools such as those found in Yellowstone National Park. They have been the focus of recent research concerning medical technologies and the origins of life on earth. You can find out more about them in the Ecology-Thermal Habitats and Geology-Hot Springs and Pools chapters of the Yellowstone ZooGuide. In addition, there is a University of Wisconsin website with information about thermophiles located at

<http://www.bact.wisc.edu/bact303/b1>.

Vocabulary: Students should be familiar with the following terms before beginning this activity.

- alkaline
- thermophile
- acidic

Warm up Exercise: (10 minutes)

Ask your students to list environmental conditions that support life and conditions that don't. Write their answers in two columns on the board or overhead. Your list should look something like the one below.

Support Life	Don't Support Life
water	acid
sunlight	high heat
moderate temperatures	high pressure
nutrients	extreme cold
air	volcanoes

Activity: (2 class periods)

In this activity your students' ideas about what environments can support life will be challenged as they research the organisms that live in extremely hot, acidic or alkaline environments in Yellowstone's thermal vents. They will complete research and choose a topic on which to write a report about a specific type of thermophile. Once they have done this, you can ask them to review their list of conditions that don't support life and ask them to give examples of organisms that live in each.

The research can be based on the resources and references listed in the Background Information section above. Students can narrow their research to focus on a particular type of organism, environment that supports it, or both. They can address all or some of the questions listed on the next page during their research.

When they have completed the data gathering phase, they can write a clear, well organized paper of at least 500 words. The paper should answer the questions posed and offer conclusions on what they have discovered about thermophiles.

Questions to guide thermophile research:

1. Describe a typical thermophile's environment.
2. In what temperature range can the thermophile you are researching live?
3. Why do many thermophiles live in "mats"?
4. What makes many of the bacteria yellow, red, or orange?
5. How is pigmentation an adaptation to the environment?
6. What pH does your thermophile prefer?
7. At what depth in the microbial mat does your thermophile live? Why?
8. Where, other than hot springs, can thermophiles live?
9. What changes occur in winter to the thermophiles?
10. What other organisms are dependent on or effected by the thermal environments and thermophiles in Yellowstone Park?

The Next Step: (1 class period)

You, the teacher can try to get samples of thermophilic organisms to show your class in one of several ways. You could try gathering samples that live in home or school hot water heaters. Alternatively, you could try to order live or preserved samples from your favorite biological supply catalog.

Once you have the samples, students can compare them with bacteria, algae, or protozoa that live at temperatures at which humans can live. Are there any observable differences between these organisms? If so, what are they?

Activity 14: Environmental Issues Debate

Prep Time: 30 minutes
Grade Levels: 6-9
Presentation Time: 2 class periods
Content Area(s): Biology
• Conservation

Materials: • Natural History of Yellowstone ZooGuide
• Windows or Mac OS Computers w/ CD ROM
• Paper and pen

Objectives: Students will

- choose an issue to debate
- understand both sides of the issue through the debate process
- summarize the debate outcome

-OR-

- develop a list of questions for the panel members
- identify the main issues discussed
- summarize the panel's ideas and conclusions

Background Information:

There are many environmental issues being debated these days concerning land use, chemicals, conservation of endangered species, and so on. The list seems almost endless and for every environmental issue there is a counter issue of economics or human need at odds with it. Yellowstone National Park, the first national park, is a good example of many of these issues and clashing ideologies at work.

The Human Impact chapter of the Yellowstone ZooGuide offers information on seven important issues effecting the park. These include people, tourism, mining, water, logging, grazing, endangered species, and predator eradication. There are also two sections on efforts to preserve or return the park to its former glory. These include the wolf reintroduction program and the Greater Yellowstone Coalition, a group of concerned citizens working to protect not only the park but the surrounding ecosystem. A good book on the subject is *The Wolves of Yellowstone*, by M. K. Phillips and D. W. Smith, Voyageur Press, Inc.: Stillwater, MN

Warm up Exercise: (10-15 minutes)

Ask your students what, if any, environmental issues are of concern to them and why. Hopefully, some of them will be for an issue and others will be against it. Their answers can range from endangered species to toxic waste, from habitat loss to recycling.

Activity: (Day 1)

Students should read and watch the information presented in the Human Impact chapter and choose one topic on which to hold a debate or panel discussion. Assign groups of students to read and summarize each section of the chapter for the whole class and have them base their choice on which one is most interesting.

For a debate, divide the class into two groups (for and against the issue) and ask them to develop several well thought out arguments supporting their side. They should exchange lists of arguments so the other side can prepare rebuttals for the debate. In the second class period, hold the debate and ask students to answer the following questions when they are finished.

1. Which side “won” the debate? Why?
2. How did this debate help you to understand that environmental issues are complex and that both sides usually have good reasons for their positions?
3. Which side of this debate do you agree with and why?

For a panel discussion, students will need to contact members of your community who can speak about the different aspects of the environmental issue you have chosen. You, the teacher, could contact local leaders of environmental causes, members of local government familiar with the issue, businessmen who have a vested interest in the issue, etc. The panel members should be told what topic they are going to discuss and be willing to answer questions posed by the students. Schedule the discussion at a convenient time and have students prepare a list of interesting questions to ask when the panelists arrive.

The Next Step: (10-15 minutes)

After the panel has left, students can summarize what they learned from the various members and how their feelings have changed about the issue now that they know more about its different aspects.

Activity 15: Environmental Activism

Prep Time: 20 minutes
Grade Levels: 6-9
Presentation Time: 2 class periods
Content Area(s): Biology
• Conservation
American History: Environmental Activism

Materials: • Natural History of Yellowstone ZooGuide
• Windows or Mac OS Computers w/ CD ROM
• Paper and pen
• Computer and word processing program

Objectives: Students will

- investigate local environmental organizations
- write a letter to a local environmental organization
- understand this group's philosophy and its historic context

Background Information:

The Greater Yellowstone Coalition is like many other environmental groups in that it has a mandate to protect, educate, and preserve a particular ecosystem. Your city or town is likely to have local and national environmental groups operating within its borders for similar reasons. The Audubon Society and the Nature Conservancy are two national groups that you might know of locally.

The information contained in the Human Impact-Greater Yellowstone Coalition chapter in the ZooGuide offers information about this specific group and their goals. There is also a website where more information can be found. To get the names and addresses of local environmental groups, check on the Web, if you have access or try your local library for a directory of environmental groups.

Warm up Exercise: (10 minutes)

Ask students to name some local environmental groups and what they try to do, if the students know. How did these groups form and why?

Activity: (1-2 class periods)

In this activity students will first read the information about the GYC found in the Human Impact chapter of the ZooGuide. Using this information and extrapolating it to a more general view, students will write a local environmental group for information about the following:

1. When was this group founded?
2. Why was this group founded?
3. What kinds of environmental issues does this group address?
4. How does this group get funding?
5. What do members of this group do and what benefits does membership offer?

Once students have received replies to their letters, ask them to write a summary of the information to be shared with the rest of the class. Students can display brochures, pictures, etc. with their summaries so that other students can read first hand about a particular group.

The Next Step:

Many environmental groups rely on volunteers to accomplish their tasks. Your class could volunteer to help with a weekend or summer project that one of the local environmental groups is hosting. This will give them a chance to get involved with a hands on experience and to help improve their community.

Earth Science Topics:

Activity 16: Geysers

Prep Time: 20 minutes
Grade Levels: 6-9
Presentation Time: 1 class period
Content Area(s): Earth Science
• Geology

Materials:

- Natural History of Yellowstone ZooGuide
- Windows or Mac OS Computers w/ CD ROM
- Drawing paper and pencil
- Colored pens

Objectives: Students will

- identify the parts of a geyser
- draw a cross-section of a geyser
- describe how a geyser works based on their drawings

Background Information:

Geysers are rare geothermal features that arise only when very specific conditions occur in nature. A subterranean heat source is needed along with water and a narrow opening at the surface to cause water to shoot up to heights of 50 meters or more. Yellowstone National Park has the largest geyser fields in the world.

To learn more about geysers and how they work, students can first read the information contained in the Geology-Geysers chapter of the Yellowstone ZooGuide. In addition students can consult the following websites:

- <http://www.bact.wisc.edu/Bact303/b7>
(shows a cross section of a geyser feature)
- <http://www2.wku.edu/www/geoweb/geyser/about2.html>
(general information)
- <http://www2.wku.edu/www/geoweb/geyser/location.html>
(information on where geysers are located)

Vocabulary:

Students should be familiar with the following terms before beginning this activity.

- geyser
- magma
- rhyolite
- volcano

Warm up Exercise: (10 minutes)

Before students read any information about geysers, ask them how they think a geyser is formed? Discuss their ideas and save a list of them to refer to after they have read the information. How close were they to the real answer?

Activity: (30-40 minutes)

Once students have read about geysers and what parts are needed to make one, they can assemble a list of components. There are four main requirements for geyser formation; water, porous rock, a heat source deep underground (like a volcano) and rhyolite (a volcanic rock that can withstand the pressures of the water jets). From this list they can construct a cross-sectional drawing of a geyser and label its parts. A drawing similar to the one they should generate can be found in the <http://www.bact.wisc.edu/Bact303/b7> website.

Students should label the parts of their diagrams and be able to explain how the geyser works using arrows and text to describe it. Place student drawings on a bulletin board labeled GEYSERS for your other classes to see.

The Next Step: (10 minutes)

Discuss the following questions with your class when they have completed the activity above.

1. What are the important parts of a geyser?
Answer: water, rhyolite rock, heat source underground
2. Why are geysers so rare in nature?
Answer: There are at least two reasons; the rock structure has to be just right to allow pressure to build and push boiling water through a small opening at the surface and areas of geothermal activity are now used as sources of electricity generation which destroys geysers.
3. About how many geysers are there in Yellowstone?
Answer: There are over 400 geysers in Yellowstone, the most found anywhere in the world.
4. Summarize how a geyser works.
Answer: Water trickles down porous rock to a place underground where it is heated by magma, it boils and is forced upward where it heats cooler water. When the upper levels of water boil the steam rises and a pool of hot water is formed. When the pool fills with hot water and pressure is still mounting

from hotter water underneath, the steam is released in a large column of water and steam. This process can take minutes, hours, days, or years to happen.

Activity 17: Water Erosion

Prep Time: 20 minutes
Grade Levels: 6-9
Presentation Time: 2 class periods
Content Area(s): Earth Science
• Geology

Materials:

- Natural History of Yellowstone ZooGuide
- Windows or Mac OS Computers w/ CD ROM
- Clay, sand, water source, and a large deep tray
- Paper and pen

Objectives: Students will

- identify the parts of a waterfall
- devise a way to construct a model of a waterfall
- solve any problems that arise with the model
- understand waterfall formation

Background Information:

Waterfalls are beautiful examples of nature's grandeur. They are graceful reminders of the power of water to change the landscape. They are created when water flows over rock that is harder on the surface than it is underneath. Slowly the lower layers get eroded faster than the upper ones and a falls forms. As the water continues to fall it erodes more of the lower rock layers until the top layer has nothing to support it and it falls to the water bed below. In this way falls move backward over time carving out canyons and deep river beds.

Students can learn more about the formation of waterfalls by reading the information presented in the Geology-The Power of Water chapter in the Yellowstone ZooGuide.

Vocabulary: Students should be familiar with the following terms before beginning this activity.

- waterfall
- differential erosion

Warm up Exercise: (5-10 minutes)

Ask your students if they have ever seen a waterfall. What did it look like and how do you think it formed?

Activity: (1 hr) This activity involves constructing a waterfall from some basic materials so that students can understand how the process of erosion creates them. It is also an activity where students are given the opportunity to creatively problem solve and develop a way to construct a functioning waterfall. Each group of students will need the following equipment:

- a 4 inch deep pan (in which they will need to cut a small hole),
- wet sand (enough to fill half of the pan about 2/3 of the way up the side)
- non-drying clay (enough to place over the top of the sand making a slight indentation in the clay layer to form a river bed) and
- two-gallon sized milk jugs filled with water.

(30 minutes) Your students can experiment with ways to best combine the materials above to form a working waterfall. They should base their attempts on what they have read about natural waterfalls and their general knowledge of erosional processes. Make sure they measure the amounts of all materials used and record this information for later use.

(30 minutes) Once the pan is prepared with hole, sand and clay as described in the parentheses above, students can pour water over the clay river bed and watch what happens to the sand underneath as the water flows. Make sure the water is draining into a sink and that the sand isn't being washed down the drain. Have your students continue pouring water for 5-10 minutes and keep a record of how much sand is lost over time. They can do this by weighing or measuring the sand that they started with and how much is left after 10 minutes, or they can measure the sand that has run off and into the sink at one minute intervals. This way they can graph sand loss over time when they are finished. They can record this data on the chart on the next page.

Students can also make a time elapsed drawing of a cross section of the waterfall. To do this they will need to stop pouring water every 1-2 minutes, look at the side of the waterfall area and draw what they see. This can be done freehand or measurements can be taken using a ruler and copied to the drawing. Use different colored pens for each time check and indicate the time interval used on the drawing.

The Next Step: (15-20 minutes)

From this activity you can discuss other erosional processes like those that created the Grand Canyon. Discuss the long term effects of water erosion on tearing down mountains, creating oxbow lakes from meandering rivers, and changing a coastline.

Waterfall Chart

Name:

Date:

Time	Amount of Sand lost
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Activity 18: Glacier Field trip

Prep Time: 1 hour
Grade Levels: 6-9
Presentation Time: 1 class period and part of a school day
Content Area(s): Earth Science
• Geology

Materials:

- Natural History of Yellowstone ZooGuide
- Windows or Mac OS Computers w/ CD ROM
- Camera (optional)
- Paper and pen

Objectives: Students will

- observe the effects of glaciation on their local landscape
- describe the changes a glacier can create
- understand the power of glaciers and their place in geologic time

Background Information:

Glaciers are slow moving and very powerful erosional agents. They can move mountains, large boulders, and tons of earth. They leave characteristic grooves when they recede and they also create lakes when they melt. Most of North America has been covered by glaciers during one ice age or another. In fact, we are at the end of an ice age now and there are still glaciers at work in far northern latitudes.

Consult a local geology text to find an area that has been effected by glaciation and plan a field trip to the site with your class. Students can read about glaciers and how they shaped Yellowstone Park in the Geology-Glaciation chapter in the ZooGuide. It describes how glaciers have changed the landscape of the park during three separate ice ages. Your Earth Science textbook should also contain general information about glaciers and their effects on the landscape.

Vocabulary: Students should be familiar with the following terms before beginning this activity.

- glaciation
- moraine
- cirque
- till
- erosion

Warm up Exercise: (5-10 minutes)

Ask your students if they have ever seen a large boulder sitting in the middle of a field and wondered how it got there. Explain that it was probably deposited by a glacier that was once covering this area of land and that there are other land features they see every-day that were created by glaciers.

Activity: (Part day field trip and one class period)

Take your students to see an area where glaciers have changed the landscape in the past. It could be a moraine field, a field of boulders, a lake or river carved out by a glacier, etc. Take several pictures of the area to manipulate back in the classroom and describe what the area probably looked like before the glacier changed it. If you do not have a camera students can make sketches of what they see. They can make elevation and overhead drawings of the area showing the changes created by the glacier.

Back in the classroom discuss what the land may have looked like before the ice age changed it. Students can modify their drawings or photographs (using a tracing paper overlay) to indicate what the area might have originally looked like. Students can make educated guesses based on their understanding of glaciation. Label the types of changes the glacier made such as moraines, cirques, or till deposits.

The Next Step: (10 minutes)

Conclude this activity by asking your students to summarize what they have learned. Answer the following questions:

1. What land features indicate glaciation?
Answer: deeply grooved valleys, boulder fields, moraines, recent lake beds, etc.
2. How have glaciers changed your local landscape?
Answer: answers will vary, but can include any of the answers given for question 1 above.
3. When was the last ice age in your area?
Answer: The last ice age to cover North America occurred about 13,000 years ago.

Activity 19: Climate

Prep Time: 20 minutes
Grade Levels: 6-9
Presentation Time: 2 class periods
Content Area(s): Earth Science
• Climate/Weather

Materials:

- Natural History of Yellowstone ZooGuide
- Windows or Mac OS Computers w/ CD ROM
- World Wide Web access or national weather daily readings
- Graph paper, writing paper and pen

Objectives: Students will

- record daily temperature and humidity readings for Yellowstone and their home town
- create a graph showing the temperature ranges over a week
- compare local weather conditions with those at Yellowstone
- explain the reasons for differences in temperature between Yellowstone and home

Background Information:

Climate varies across the United States as a result of differences in land features, wind patterns and air masses. Consequently, the climate in your area of the country may be vastly different from that of another region. The climate at Yellowstone Park is effected by the air flow from the Pacific ocean in spring and summer and by Arctic air flow in the winter. Moisture is regulated by the mountains and other land features that surround the park.

Students should read and watch the information presented in the Seasons-Weather Conditions and Introduction-Yellowstone Fact Sheet chapters of the ZooGuide. In addition, daily weather reports for Yellowstone can be obtained from The Weather Channel's website at:

http://www.weather.com/weather/us/cities/WY_Yellowstone.html

another weather website is at:

<http://cirrus.spri.umich.edu/wxnet/obs/wyoming.txt>

You can also use a national newspaper such as USA Today for the general temperature and moisture readings there. Get your local weather report from the television news or a local newspaper.

Warm up Exercise: (5 minutes)

Ask students to name one reason why a daily weather report is useful to them.

Answer: They will probably answer that it effects how they dress, whether or not they can play ball that evening, whether or not they can go swimming, etc.

Explain that weather reports are crucial for farmers, construction workers, road crews, and landscapers among others. Daily weather and general climate information is valuable for making decisions about when to plant, build or do other outdoor work.

Activity: (30-40 minutes plus homework)

This activity involves students keeping a record of daily weather conditions for two places, Yellowstone National Park and their local area. You can make copies of the chart on the next page to distribute to your class for keeping track of this information. If you have web access, check The Weather Channel's site daily for Yellowstone and your area. Record temperature, rainfall (if any) and any other information you want to compare. If you do not have web access, use a daily national newspaper such as USA Today to get Yellowstone's weather and your local newspaper or television news for yours.

Students should record the necessary information for at least a week. Then they can graph their data on a time/temperature or time/relative humidity scale. Use different colored pens for Yellowstone and home information. Perform a statistical analysis on this information by determining the mean and median for each set of data.

The Next Step:

You can continue this comparison of climates by doing another data set during a different season. Follow the same procedure for collecting and analyzing the data with the addition of comparing the two locations differences in the two seasons.

Weather Chart

Name:

Date:

Date Yellowstone (Temp./Rel. Humidity)

 (Your Home) (Temp./Rel. Humidity)

Activity 20: Using Maps

Prep Time: 20 minutes
Grade Levels: 6-9
Presentation Time: 1-2 class periods
Content Area(s): Earth Science
• Maps

Materials:

- Natural History of Yellowstone ZooGuide
- Windows or Mac OS Computers w/ CD ROM
- Web access for: <http://www.nps.gov/yell/yellmap.htm>
- Copies of Yellowstone Park maps
- Pen or pencil
- Copies of local maps

Objectives: Students will

- analyze map information
- understand how to read a map legend
- interpret map data for everyday use

Background Information:

Maps are useful for everyone from scientists to motorists. They provide information in a visually succinct way that can sometimes prove confusing. Students need to learn to read and understand maps so that they can fully participate in a regions offerings.

Students should familiarize themselves with the low and high resolution maps provided in the Tour chapter of the Yellowstone ZooGuide. They can navigate around the map image using the NSEW arrow buttons on the right side of the screen. They will also find the web-site listed above useful for getting a simple distance map of Yellowstone.

Warm up Exercise: (10-15 minutes)

Pass out maps of your local area and ask students to find the distance from school to their homes. To do this they will need to locate the school, their home street, the map legend for distance conversion, and some way to measure the map distance (a piece of string is often helpful). See which student lives farthest from school and who lives closest.

Activity: (1 class period)

This activity will help your students become familiar with reading a map of Yellowstone park. They will use the maps contained in the ZooGuide's Tour chapter and the maps you have obtained from the

park itself. Students will have to perform the following tasks to demonstrate their ability to read the maps provided.

1. How do you get to Mt. Washburn from the eastern entrance of the park?
Answer: Take rt. 14, 16, 20 west to Yellowstone Lake, go NW to Canyon Village then NNE to the mountain.
2. How many towns are there inside the park?
Answer: 12 — as indicated by the large black dots
3. What color indicates the highest land in Yellowstone?
Answer: Gray/brown
4. How high is the tallest mountain peak?
Answer: Eagle Peak at 11,358 ft. high.
5. How far is it from Old Faithful to Tower Falls?
Answer: 61 miles going north or 73 miles going east then north.
6. What is the deepest part of Yellowstone Lake?
Answer: 300 ft. deep

The Next Step: (10 minutes)

Discuss with your class how maps help geologists, archeologists, meteorologists, and other earth scientists do their work and how important it is to be able to use all parts of a map to do this work.