<u>ACTIVITIES</u>

The following activities are included in this packet to provide your students with some "real world" exercises using skills important in the field of wildlife conservation and in zoos. These skills include mathematical computation, observation, scientific inquiry, arts, reading, writing and communication. The heading for each activity is organized in the following manner:

TITLE OF THE ACTIVITY

Grade Level; Subject Codes

Italicized background information for teachers. **Materials** needed for the activity **Related careers**

Each of these activities is designed to be used independently, although combining several activities can enhance student learning and address a wider range of Washingron State's Essential Academic Learning Requirements (EALRs). We have suggested appropriate grade levels for each activity, but we encourage you to adapt activities for the level of your class. The subject codes list the different core subjects covered by the activity, Codes are as follows:

A = arts C = communication E = social studies - economics F = health and fitness G = social studies - geography H = social studies - history M = math R = reading S = science V = social studies - civics W = writing

If a certain part of an activity addresses a specific component or components under one of the Essential Learnings, the component(s) will be listed in parentheses following that part of the activity. For example, if one section of an activity targets the third component under Essential Learning 2 in the core subject of mathematics, "(Math 2.3)" would be listed after that section of the activity. (Refer to your copy of the Washington State Essential Academic Learning Requirements for listings of the Essential Learnings and components.)



CHART OF ESSENTIAL ACADEMIC LEARNING REQUIREMENTS (EALRS) Though they can help students meet a variety of EALRs, the activities in this packet were developed to address

components of the EALRs that relate directly to career applications:

Reading 3	The student reads different materials for a variety of 3.3 read for career applications	purposes.	
Activities in this packet that address this Essential Learning:	Are You the Best Person for the Job? Reporting Scientific Findings Share Your Knowledge #1 Share Your Knowledge #2 Technology and Wildlife Conservation	Page 56 Page 60 Page 62 Page 62 Page 95	
Writing 2	The student writes in a variety of forms for different 2.4 write for career applications	audiences and purposes.	
Activities in this packet that address this Essential Learning:	Who Has the Skills? Are You the Best Person for the Job? Reporting Scientific Findings Designing a Zoo Exhibit	Page 38 Page 56 Page 60 Page 63	
Communication 4	The student analyzes and evaluates the effectiveness of formal and informal communication. 4.1 assess effectiveness of one's own and others' communication		
Activities in this packet that address this Essential Learning:	ities in this packet ddress this tial Learning:Who Has the Skills? Are You the Best Person for the Job? Share Your Knowledge #1 Share Your Knowledge #2		
Mathematics 5	The student understands how mathematical ideas connect within mathematics, to other subject areas, and to real-world situations. 5.3 relate mathematical concepts and procedures to real-world situations		
Activities in this packet that address this Essential Learning:	hibit StatisticsPage 48st of Feeding AnimalsPage 49laries and Cost of LivingPage 56aphing Trends – Bear WeightsPage 60aking Matches: SSP CoordinationPage 67Id Wise Activities Lesson One – MappingPage 70Id Wise Activities Lesson Two – MappingPage 70		
Science 3	The student knows and applies science concepts and skills to develop solutions to human problems in societal contexts. 3.2 analyze how science and technology are human endeavors, interrelated to each other, to society, the workplace, and the environment.		

Activities in this packet that address this Essential Learning:	Keep Your Eyes Peeled! Observing Cats and Dogs Animal Observations Graphing Trends – Bear Weights Horticulture – Seed Germination Horticulture – Plant Propagation Making Matches: SSP Coordination Wild Wise Activity Lesson One – Field Marks Technology and Wildlife Conservation	Page 34 Page 35 Page 41 Page 60 Page 64 Page 65 Page 67 Page 70 Page 95		
Arts 4	 The student makes connections within and across the arts to other disciplines, cultures, life and work. 4.5 demonstrate the knowledge of arts careers and the knowledge of arts skills in the world of work. 			
Activities in this packet that address this Essential Learning:	Designing A Zoo Exhibit	Page 63		

Source: Essential Academic Learning Requirements, Office of the Superintendent of Public Instruction



ENVIRONMENTAL EDUCATION GUIDELINES FOR WASHINGTON SCHOOLS

This list includes selected goals and objectives that are met by activities in this packet:

GOAL I - The student will develop knowledge about the components of the environment and understand their interactions within natural systems.					
	Objective C: The student will evaluate interactions occurring between humans and the environment.				
Activities in this packet that address this objective:	Making Matches: SSP CoordinationPage 67Technology and Wildlife ConservationPage 95				
	Objective D: The student will examine the implications of resource conservation.				
Activities in this packet that address this objective:	Exhibit Statistics Page 48				
GOAL II - The student will understand how social and natural systems are fundamental in supporting our lives, economy and emotional well-being.					
	Objective E: The student will understand how ideas and technology influence the natural and built environment.				
Activities in this packet that address this objective:	Designing A Zoo Exhibit Technology and Wildlife Conservation	Page 63 Page 95			

Source: *Environmental Education Guidelines for Washington Schools*. Olympia, WA: Office of Environmental Education, Office of the Superintendent of Public Instruction, July 2000.



Imagine a Trip to the ZOO...

Grades K-6

Materials: none Related careers: multiple

• Read this paragraph describing an imaginary zoo visit aloud to your students. While they are listening, students should think about the "behind-the-scenes" efforts that made this zoo visit possible — who are the people that contributed to this experience? How many zoo careers can your students think of that relate to this trip to the zoo?

You get off the bus and enter the zoo's main gate, paying your admission as you enter. You grab a map and stop at the information kiosk to get an idea of what is happening at the zoo that day. You follow the signs to the Tropical Rain Forest exhibit. As you enter the indoor area of the Tropical Rain Forest, you brush past palm trees and hanging vines, enjoying the warm, humid environment. Once inside, you learn about the animals and plants housed in the exhibit from the informative signs. You are fortunate enough to encounter a docent with a bag of interesting educational props. You are fascinated by the information the docent tells you about how the animals in the Tropical Rain Forest are taken care of and how the zoo supports conservation projects in tropical rain forests in Central America. The warmth of the rain forest has made you thirsty, so you head to the café to get a drink. On your way out of the zoo, you toss your can into a recycle bin and set off for home.

• Answers (students may come up with zoo jobs in addition to those listed here): Admissions cashier to sell tickets, accounting staff to keep track of money from ticket sales, graphic designer to develop zoo map, public programs naturalist to develop programs advertised on kiosk, exhibits staff to post kiosk and directional signs around the zoo, development staff to raise money for building exhibits, horticulture staff to plant and maintain vegetation, animal management staff to care for animals, interpretive designers to develop interpretive signs and props, docents (volunteer educators) to present programs developed by education staff, a conservation coordinator to organize and facilitate conservation efforts, food service employees to prepare and sell food, maintenance staff to keep the zoo clean and operating properly, etc.



ZooStore cashier

KEEP YOUR EYES PEELED!

Grades K-5; S

In this activity, students will practice observation skills by paying attention to subtle changes in the appearance of their fellow students. This activity simulates the watchful eye that zookeepers must keep on the animals in their care. Subtle changes in appearance or behavior can alert keepers to health or other problems that the animals may be having. In the wild these obvious signs would alert others of their species or predators that the animal was weak and would make the animal more vulnerable to attack. Animals therefore do not often show obvious signs of sickness or injury. Thus, zookeepers must keep a very watchful eye on the animals in their care for subtle changes in behavior or appearance that might indicate illness or injury. If a zookeeper notices such changes, he/she might request tests to determine if the animal has a problem that requires medical attention. Materials: none

Related careers: zookeeper, field biologist/wildlife scientist

- Explain to your students that they are scientists studying a subject and that they must use their observation skills to learn everything they can about their subject.
- Have your students form a circle on the floor of your room or outdoors. Select one student to stand in the middle of the circle. Allow the other students to observe this "subject" for 20 seconds. Make sure the student in the center of the circle rotates so that the other students can observe him/her from all sides.
- Remove the "subject" from view (out of the room, behind a tree, etc.). Ask the student to change one aspect of his/her appearance, for example: untie a shoe or untuck a part of his/her shirt. Have the student return to the center of the circle.
- Ask the other students to observe their "subject" again. Do they notice any changes? Are their observations correct? Repeat this activity with another student as the subject, this time changing more than one aspect of appearance. Try again, but this time do not make any changes. See if the students think a change has been made.
- Use this activity to generate a discussion about the importance of observation in science. Ask your students to describe how observation skills might be important for a zookeeper or a biologist working in the zoo or in the wild.



Observing Cats and Dogs

Grades 2-5; S

Observation skills, especially in observing animal behavior, are an important tool for people with careers in zoos and in other wildlife fields. Students can use this exercise in observing behaviors exhibited by cats and dogs to practice their animal behavior observation skills. Students can observe cats and dogs at home or at friends' houses, or they can observe species of felids and canids at the zoo. As a classroom alternative, students could watch nature videos on wild species of felids and canids and observe behaviors shown in the videos.

Materials: "Cat and Dog 'Body Language' Observation Worksheet" (included), clipboards, pencils, timer or clock **Related careers:** zookeeper, field biologist/wildlife scientist

- Provide each student with two behavior observation worksheets (one for recording observations of a cat, one for recording observations of a dog). These worksheets can be completed as a group or individually. Students should observe at least one cat and one dog for a total of about 12 minutes each (split into six consecutive two-minute increments).
- For this observation study, students may want to choose to observe an active animal, as opposed to one that is sleeping. Students may also want to observe the same animal for more than one 12-minute period at different times of day or on different days to see if they observe different behaviors.
- Read the following instructions to your students:

"Cats and dogs use their 'body language' to communicate with others of their species. By observing dogs and cats closely in different situations, you might be able to understand what they are communicating!

Observe a cat or a dog for about 12 minutes. Before you begin timing, on a blank piece of paper, write or draw a description of the setting and what is happening around you and the animal. Use this same piece of paper to note down or sketch any events or changes in setting during the 12-minute observation time (such as a loud noise, another person or animal entering the room, or the animal moving to a different location). Use a wristwatch, a timer, or the help of an adult to keep time. Using the observation worksheet, at the end of every two minutes, check the box under each category by the phrase that best describes what you observe the animal doing at that very moment. As a researcher, it is important that you limit your interaction with the animal during the observation period."

• When their observations have been completed, lead a discussion with the students about the different behaviors they have observed. How might the setting and happenings be affecting the body language of the animal? Which behaviors are specific to dogs? Which behaviors are specific to cats? Which behaviors do both dogs and cats exhibit? Why would certain behaviors differ between dogs and cats? (This might tie back to the hunting and other natural behaviors necessary for the daily survival of wild felid and canid species.)





CAT AND DOG "BODY LANGUAGE" OBSERVATION WORKSHEET: CAT DOG (CIRCLE ONE)

TIME PERIOD #I

(end of 2 minutes):

EYES:

- Open
- Closed
- Blinking

TAIL:

- 🛛 Up
- Down
- □ Straight Out
- □ Curled around body
- □ Wagging/Moving

Ears:

- 🛛 Up
- Down or back/Flat against head
- □ One up/one down
- □ Moving

Sounds:

- D Purr
- □ Meow
- Bark
- Growl
- Hiss

WHISKERS:

- □ Straight out from face
- □ Flat against face
- □ Moving

Моитн:

- Open (teeth showing)
- Open (teeth not showing)
- Closed

TIME PERIOD #2

(end of 4 minutes):

EYES:

- Open
- $\Box Closed$
- Blinking

TAIL:

- 🛛 Up
- Down
- □ Straight Out
- □ Curled around body
- □ Wagging/Moving

Ears:

- 🛛 Up
- Down or back/Flat against head
- \Box One up/one down
- □ Moving

Sounds:

- D Purr
- □ Meow
- Bark
- Growl
- **D** Hiss

WHISKERS:

- □ Straight out from face
- □ Flat against face
- □ Moving

Моитн:

- Open (teeth showing)
- □ Open (teeth not showing)
- □ Closed

TIME PERIOD #3

(end of 6 minutes):

Eyes:

- Open
- Closed
- Blinking

TAIL:

- 🛛 Up
- Down
- □ Straight Out
- □ Curled around body
- □ Wagging/Moving

Ears:

- 🛛 Up
- Down or back/Flat against head
- □ One up/one down
- □ Moving

Sounds:

- D Purr
- □ Meow
- Bark
- Growl
- **D** Hiss

WHISKERS:

- □ Straight out from face
- □ Flat against face
- □ Moving

Моитн:

- □ Open (teeth showing)
- □ Open (teeth not showing)
- □ Closed

TIME PERIOD #4

(end of 8 minutes):

EYES:

- Open
- □ Closed
- Blinking

TAIL:

- 🛛 Up
- Down
- **Given Straight Out**
- □ Curled around body
- □ Wagging/Moving

Ears:

- 🛛 Up
- Down or back/Flat against head
- □ One up/one down
- □ Moving

Sounds:

- D Purr
- □ Meow
- Bark
- Growl
- Hiss

WHISKERS:

- □ Straight out from face
- □ Flat against face
- □ Moving

Моитн:

- □ Open (teeth showing)
- Open (teeth not showing)
- □ Closed

TIME PERIOD #5

(end of 10 minutes):

EYES:

- Open
- Closed
- Blinking

TAIL:

- 🛛 Up
- Down
- □ Straight Out
- □ Curled around body
- □ Wagging/Moving

Ears:

- 🛛 Up
- Down or back/Flat against head
- $\hfill\square$ One up/one down
- □ Moving

Sounds:

- D Purr
- □ Meow
- Bark
- Growl
- Hiss

WHISKERS:

- □ Straight out from face
- □ Flat against face
- □ Moving

Моитн:

- □ Open (teeth showing)
- Open (teeth not showing)
- □ Closed

TIME PERIOD #6

(end of 12 minutes):

Eyes:

- □ Open
- □ Closed
- □ Blinking

TAIL:

- 🛛 Up
- Down
- □ Straight Out
- □ Curled around body
- □ Wagging/Moving

Ears:

- 🛛 Up
- Down or back/Flat against head
- □ One up/one down
- □ Moving

Sounds:

- D Purr
- □ Meow
- 🛛 Bark
- Growl
- **D** Hiss

WHISKERS:

- □ Straight out from face
- □ Flat against face
- □ Moving

Моитн:

- □ Open (teeth showing)
- Open (teeth not showing)
- Closed

WHO HAS THE SKILLS?

Grades 3-5; C, W

Materials: "Who Has the Skills?" worksheet (included) Related careers: multiple

- Direct your students to choose three to four skills from the list on the student worksheet that would be most valuable for each of the zoo job positions listed. Write the letters of the skills next to the title of the job.
- For each of the job positions, have your students write a short paragraph or explain orally to the class why he/she feels that those skills would be valuable for that job.

Answer Key: Answers may vary. Have your students explain why they feel each skill is important to the job to check for understanding.

- 1) Zoo Class Instructor: b, f, i, n
- 2) Zoo Accountant: c, g, h, l, n
- 3) Zookeeper: a, d, e, h, m, n
- 4) Zoo Graphic Arts Designer: c, g, k, n
- 5) Zoo Security Officer: a, b, e, d, i, n
- 6) Zoo Horticulturist (Gardener): d, e, j, n



Who Has the Skills? STUDENT WORKSHEET

Choose three to four skills from the list below that would be most valuable for each of the job positions listed. For each job position, write a short paragraph or be prepared to explain to the class why you feel that those skills would be valuable for that job.

SKILLS:

- a) observation skills
- b) public speaking/communication skills
- c) writing skills
- d) good physical condition
- e) ability to work out of doors
- f) ability to work with children
- g) computer skills
- h) mathematical skills
- i) First Aid certification
- j) botany knowledge
- k) artistic sensibility
- l) good organization skills
- m) animal care knowledge
- n) ability to work effectively as a part of a team
- 1) Zoo Class Instructor:



2) Zoo Accountant:

3) Zookeeper:

4) Zoo Graphic Arts Designer:

5) Zoo Security Officer:

3) Zoo Horticulturist (Gardener):



Animal Observations

Grades 6-12; S

In this activity, students will hone their observation and data collection skills by conducting research at the zoo. By researching the behavior and enclosure use of animals, zoo staff gains valuable information about the animals that contributes to keeping the animals healthy and conserving wild populations of their species. If your class is unable to complete these observations at a zoo, students can observe wildlife near the schoolyard or their backyards, such as squirrels and robins or other common birds, or students can observe pets at home or in the neighborhood. **Materials:** "Animal Behavior Observations and Research" activity sheets included in this packet (one of each per student for each animal he/she will observe while at the zoo), pencils, zoo map*, clipboard (or stiff cardboard with a binder clip), stopwatches or wristwatches **Related careers:** zookeeper, field biologist/wildlife scientist

- In the classroom: In preparation for the zoo visit, separate students into small groups. (Keep in mind that at the zoo, you are required to have one chaperone for every six students. Chaperones must accompany students at all times while on zoo grounds.) Have each group of students pick one to three species to observe when the class goes to the zoo. Encourage students to consider observing animals such as arthropods, reptiles, or amphibians in addition to mammals and birds. Students may want to gather some background information on their animals, such as habitat and diet, before going to the zoo. (The zoo's Web site, www.zoo.org, contains fact sheets on many of the species found at the zoo.)
- At the zoo: Give each group of students one to two hours to conduct observations on the animal species they have selected and researched. Because the groups must stay together, the groups will observe the same animals, but each person should record their own data on the data collection sheets. Have each person complete one "Animal Behavior Observations and Research" sheet and one "Animal Use of Enclosure Observations and Research" sheet for each animal he/she observes. After the first sheets are completed, the group can decide whether they wish to continue collecting more data on the first species or whether they would like to move on to another species during the time allotted. Each group may observe up to three species (and complete up to three of each of the data collection sheets).
- **Back in the classroom:** Ask your students to pretend that they are a team of animal behavior scientists. Using any background information gathered and the results of their observations, have each student write down three questions about the animal(s) they observed for the "Observations and Research" sheets. The questions should be ones that the students could potentially answer by conducting long-term observations of the animals in the zoo or in the wild (Science 2.1). The questions should be simple enough to be answered through observation, measurable (for example, "How much time do the penguins spend in the water?" as opposed to "Do the penguins like being in the water more than being on the rocks?"), and interesting to the students. If they wish, students can share their questions with the class and describe how they might conduct observations in order to answer the questions.

Extension:

In addition to recording data, students can practice sketching their observations of animal behavior and/or locations in the enclosures. (Arts 4.5)

Extension for grades 10-12:

Back in their groups, have each group of students formulate a hypothesis based on one of the questions that arose from their observations at the zoo. On a second field trip, or on their own, students can return to the zoo to collect more data on the animals through observation. Each group can prepare and present a poster for the rest of the class that outlines their hypothesis, methods of observation, results and conclusions.

*Included in this packet and available at zoo gates.

Animal Behavior Observations and Research

Researcher's Name		
Date	Time	Location
Species Name		Number of animals
Description of Animal		
Description of Habitat (exhibi	it)	

Behavior Chart: Watch the animal(s) for several minutes. During each minute, put a mark under the behavior you observe. You can make comments at the bottom of the page.

Minutes	Sleeping	Inactive/ Awake	Eating	Grooming (licking/touching)	Caring for young	Active/	Other
				(·······	, , , , , , , , , , , , , , , , , , , 	F-#J	ļ
1							
2							
3							
4							
5							

Behavior Notes: If you see any behaviors you think are interesting or noteworthy, write them down.

Animal Use of Enclosure Observations and Research

Researcher's Name		
Date	Time	Location
Species Name		Number of animals
Description of Animal		
Description of Habitat (exhibi	t)	

Animal use of enclosure: Choose one animal to watch for a short period of time. Watch the animal for 10 minutes (or 10 equal time intervals). During the last couple of seconds of each minute (or time interval), put a mark (or number corresponding to the minute) on the map on the back of this page indicating the animal's location in the exhibit.

Behavior Notes: If you see any behaviors you think are interesting or noteworthy, write them down.

Animal Use of Enclosure: Watch the animal for 10 minutes (or 10 equal time intervals). During the last couple of seconds of each minute (or time interval), put a mark (or number corresponding to the minute or time interval) on the map below indicating the animal's location in the exhibit.

Location:



Note: If the animal is able to move through different vertical levels of the exhibit (e.g. move into trees, move on ground, swim through water or fly through air), also mark the animal's vertical location on the map below at the end of each minute (or time interval).

Vertical Location:



Example Animal Behavior Observations and Research

Researcher's N	Name Zoo Staff				
Date7/20/0)7	_Time2:	00 p.m.	Location	Bug" World
Species Name	Flamboyant Flo	wer Beetle		Number of anima	ls <u>10+ (observed one at a time)</u>
Description of	Animal <u>Scarab</u>	beetles, app	roximately one inch	long with metallic	green and white markings. Males
have forked "	horns" extending	g from the fr	cont of the head, fem	ales lack horns. O	bserved a female.
Description of	Habitat (exhibit)	<u>Glass tank</u>	k, compost and bark	substrate, several	branches propped up around exhibit,
tray with fruits	s and vegetables	near back oj	f tank.		
Behavior Char observe. You c	rt: Watch the anim	nal(s) for se nts at the bo	veral minutes. Durin ottom of the page.	ng each minute, pu	It a mark under the behavior you

	Minutes	Sleeping	Inactive/ awake	Eating	Grooming (licking/ touching)	Caring for young	Active/play (walking)	Other Interacting
1							*	
2							*	
3								*
4								*
5								*

Behavior Notes: If you see any behaviors you think are interesting or noteworthy, write them down.

Flying. Interacted with both males and females

Example Animal Use of Enclosure Observations and Research

Resea	rcher's Name_Zoo Stay	f				
Date_	7/20/07	Time_	2:00 p.m.	Location	"Bug" World	
Specie	es Name <u>Flamboyant</u> F	lower Bee	tle			
Descr	iption of Animal Scara	b beetles,	approximately or	ne inch long with mete	allic green and white marking	s. Males
have .	forked "horns" extend	ing from th	ne front of the hee	ad, females lack horns	s. Observed a male and then a	ı female.
Descr	iption of Habitat (exhib	oit) <u>Glass</u>	tank, compost an	ed bark substrate, seve	eral branches propped up aro	und exhibit,

tray with fruits and vegetables near back of tank.

Animal use of enclosure: Choose one animal to watch for a short period of time. Watch the animal for 10 minutes (or 10 equal time intervals). During the last couple of seconds of each minute (or time interval), put a mark (or number corresponding to the minute) on the map on the back of this page indicating the animal's location in the exhibit.

Behavior Notes: If you see any behaviors you think are interesting or noteworthy, write them down.

1,2 etc. = *Male* (*first observation*). *Was chasing females that came into his area.*

1,2 etc.= *Female* (second observation). Interacted with the male from the first observation when she went

into his area.

Question that arose from observations: Do males and females use the exhibit space differently?

Animal use of enclosure: Watch the animal for 10 minutes (or 10 equal time intervals). During the last couple of seconds of each minute (or time interval), put a mark (or number corresponding to the minute or time interval) on the map below indicating the animal's location in the exhibit.

Location:



Note: If the animal is able to move through different vertical levels of the exhibit (e.g. move into trees, move on ground, swim through water or fly through air), also mark the animal's vertical location on the map below at the end of each minute (or time interval).

Vertical Location:

Quadrant I Top left 1/4	Quadrant II Top right 1/4
3, 4, 5, 6, 7, 8, 9, 10	
3, 4, 5,6, 7, 8, 9, 10	
2 1	
Quadrant III	Quadrant IV
Bottom left 1/4	Bottom right 1/4

Exhibit Statistics

Grades 6-12; M

In designing and maintaining exhibits, zoo staff members, such as keepers, maintenance workers and horticulture staff, rely on mathematical calculations to make important decisions. The following activity gives students practice in real-life work situations where mathematical calculations provide valuable information.

Materials: paper, pencil, calculators (optional)

Related careers: zookeeper, zoo curator, horticulturist, maintenance worker, zoo exhibit designer

• Students can use the following statistics about zoo exhibits to calculate the answers to the questions about each exhibit (Math 5.3).

Hippo Pool

- 3" diameter fire hose
- Pool contains approximately 75,000 gallons
- Approximately 40 minutes to fill
- Pool is drained and refilled every odd day

Questions: 1. How much water is used for the hippo pool each month? Each year?

- 2. How much water does the hose emit per minute?
- 3. What does it cost to keep water in this pool weekly? Monthly? Yearly? (Contact your local utilities department for cost of water per gallon.)

Penguin Pool

- Two hoses are used to fill the pool. One 4" diameter fire hose and one 1 1/2" diameter fire hose
- Pool contains approximately 115,000 gallons
- Approximately 2 hours to fill
- Pool is drained and refilled one time per week
- A new filter has been installed in the penguin pool. Once that filter is up and running, the pool will only need to be emptied and refilled six to seven times per year.

Questions: 1. How much water is used for the penguin pool each month? Each year?

- 2. How much water do the two hoses emit per minute?
- 3. What does it cost to keep water in this pool weekly? Monthly? Yearly? (Contact your local utilities department for cost of water per gallon.)
- 4. Once the new filter is up and running, how much water will be used in the penguin pool each year? How much water will be saved each year? How much money will be saved each year?

"Bug" World

- 11 tanks 12" x 24" with 4" deep substrate (potting soil)
- 1 bag potting soil (1 1/2 cubic feet) costs \$3.99
- Tanks are changed completely every other week
- Questions: 1. How much substrate is used each month? Each year? 2. How much does it cost to change the substrate in these tanks each month? Each year?

Zoo Doo

- 100 herbivorous (plant eating) animals, representing more than 25 species contribute to Zoo Doo
- 600 tons of manure and bedding materials are converted to approximately 1,000 cubic yards of finished compost
- Solid waste dumping fees (as of February 2007): \$82.50/ton
- Zoo Doo is sold for \$10.95 for a 2-gallon bucket or in bulk for \$35.00 for a small truck load (1 cubic yard). (One cubic yard = 201.98 gallons)

Questions: 1. How much money would be spent on disposal fees each year if the manure and bedding were sent to landfills instead of being composted?

- 2. What are the benefits to the zoo from this recycling? (Savings on landfill fees, zoo uses Zoo Doo for own compost needs, so brings in revenue from sale of Zoo Doo)
- 3. What are the benefits to others if the manure and bedding is recycled? (*reduced amount of material that goes to the landfill, Zoo Doo available for gardening*)
- 4. How much can the zoo make selling Zoo Doo in 2-gallon buckets? By the truck load?

Cost of Feeding Animals

Grades 6-12; M

Because zoos are often working under tight budgets, it is important for zoo staff members, such as keepers and curators, to calculate the costs of feeding the animals to create their budget requests and to work within those budgets. Zoo commissary workers must use math to keep the commissary stocked, predict when and how much food to reorder, and to deliver the proper amount of food to each area of the zoo.

Materials: "Cost of Feeding Animals Information Sheet" and "Diet Price Sheet" (included in this packet), paper, pencils, calculators (optional)

Related careers: zookeeper, zoo curator, commissary worker, accountant

- Students can use the following information to figure out how much it costs to feed each of the listed animals daily, monthly and yearly.
- Students may use the included "Diet Price Sheet" or can go to the store and price the produce, fish and other priceable items. *Note:* There are other feeding costs such as vitamins that are not included in these figures.



COST OF FEEDING ANIMALS INFORMATION SHEET Information current as of June 2000

DAY EXHIBIT:

Dumeril's Boa - 1 rat/week/animal

NIGHT EXHIBIT:

Coendu (prehensile tailed-porcupine) –	
each animal one time/day	
12 omnivore biscuits	6 leaf eater biscuits
1/2 yam	1-2 leaves of lettuce
1 sm. carrot	1/2 apple
1/4 tomato	1 slice of banana, 2" thick
RAPTORS:	
Great Horned Owl (per week)	
5 rats	3 mice
1 1/2 quail	
Kestrel (small falcon) (per week)	
2 mice	1/2 quail
20 regular meal worms or wax worms	
Female Bald Eagle (per week)	
12 trout	10 quail
1/3 salmon	

ELEPHANTS (four female elephants) (daily)

4-6 lbs. herbivore diet per elephant5 apples divided among all four (used as treats)1 box lettuce divided among all four (used as treats)

2 bales hay (100 lbs./bale) divided among all four 3 bananas divided among all four (used as treats) 50 lbs. carrots divided among all four

TRAIL OF ADAPTATIONS:

Tiger, male (daily) 5 lbs. meat *

*Could be horse meat, chicken, etc. For this problem use the horse meat prices in the price list or get prices for chicken at the grocery store.

Penguins (26 individuals)

1-2 lbs. smelt per day per penguin five days per week Two days per week 220 live trout are put into the pool

GORILLA DAILY DIETS Current June 2000

MORNING SPREAD

	PETE'S GROUP	VIP'S GROUP
Carrots	1 1/2 lbs.	2 lbs.
Yams	0	1 lb. 4 oz.
Cucumber	3 each	0
Romaine	4 heads	4 heads
Celery	4 heads	4 heads
Spinach	3 bunches	1/2 bunch
Kale	1 lb.	1 1/2 lbs.

EVENING SPREAD

Adults: PE=Pete NI=Nina AL=Alafia VI=Vip AM=Amanda JU=Jumoke Juveniles: NA=Nadiri NG=Ngozi MO=Monifa

	PE	NI	AL	NA	VI	AM	JU	NG	MO
Cooked Carrot	10 oz.	3 oz.	3 oz.	2 oz.	10 oz.	5 oz.	5 oz.	2 oz.	2 oz.
Cooked Yams	10 oz.	3 oz.	3 oz.	2 oz.	7 oz.	4 oz.	4 oz.	2 oz.	2 oz.
Oranges	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Bananas	1	1/2	1/2	1/2	1	1	1	1/3	1/3
Romaine	1	1	3/4	1/4	1	1	1		
Celery (head)	1	1	3/4	1/4	1	1	1		
Spinach (bunch)	1	1	3/4	1/4	1/2	1/4	1/4		
Broccoli (bunch)	1/2	1/8	1/8	1/8	1/2	1/4	1/4		
Chow	1 qt	1/3 qt	1/3 qt	1/3 qt	1 qt	1 qt	1/2 qt	9 ea	9 ea

MIDDAY SNACK

	PETE'S GROUP	VIP'S GROUP
Carrots	1/2 lbs. (whole)	1 1/2 lbs. (whole)
Yams	1 lb. raw whole	0
	NI & AM4 oz., PE-8 oz.	
	plus 4 oz. cooked for Nadiri	
Cucumbers	0	3 (whole)
Apples	5 (1 for PE, 1 for mistakes)	3 3/4(3/4 cut in 6 pieces)
Celery sticks	12	9
Kale	1 1/2 lb.	18 leaves
Peanuts	27 (PE-12, NI-5, AL-7)	24 (AM-7, VI-7, JU-7)

GORILLA DAILY DIETS (CONTINUED) Nonfat Yogurt

Fill yogurt to lines on nine individual cups. Should use about 1 1/3 quarts. Note: Nadiri gets more yogurt than the others.

	PE	NI	AL	AM	JU	VI	NG	MO	NA
Banana (mashed)	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Mulitvitamin	2	2	2	2	2	2	0	0	1/2
Vitamin C		1000 mg							500 mg
Vitamin E		800 IU							

MORNING BOWLS

	PE	NI	AL	NA	VI	AM	JU	NG	MO
Cooked Potatoes	10 oz.	3 oz.	0 oz.	3 oz.	7 oz.	5 oz.	5 oz.	3 oz.	3 oz.
Oranges	1	1/2	1/2	1/2	1	1/2	1/2	1/2	1/2
Grapes	6	4	6	4	6	6	6	5	5
Peanuts	10	4	4	4	4	4	4	2	2
Chow (In yogurt carton)	1/2 qt			1/2 qt	4 ea	1 qt			



MORNING YOGURT	CONTAINERS	(to be prepared	the day before)

<u>Melati</u>	<u>Chinta</u>	<u>Heran</u>	<u>Towan</u>	<u>Belawan</u>
1 apple	3/4 apple	1 apple	1 apple	1 apple
1/2 orange	1/2 orange	1/2 orange	1/2 orange	1/2 orange
1/2 banana	1/2 banana	1/2 banana	1/2 banana	1/2 banana
				6 grapes

TREAT OF THE DAY FOR YOGURT CONTAINERS

Sunday: 1/2 small yam Monday: 1 tomato Tuesday: 1 cluster grapes Wednesday: 1 egg Thursday: 1 section melon Friday: 1/2 onion Saturday: 1 rice cake

MORNING GREENS

broccoli and kale spread indoors romaine, celery, and broccoli cut in quarters spinach and kale left uncut

For outdoor east exhibit:

- 1 1/2 bunches broccoli
- 1 bunch kale
- 2 heads celery
- 2 heads romaine
- 1 1/2 bunch spinach

For outdoor west exhibit:

- 1 1/2 bunches broccoli 1 bunch kale
- 2 heads celery
- 2 heads celery 2 heads romaine
- 1 1/2 bunch spinach

Orangutan Daily Diets (continued)

1ST SNACK - 1:30 PM

4 heads romaine - cut in quarters. 6 Oranges: 5 cut in 1/2, 1 cut in 1/8

2ND SNACK - 3:30 PM

4 heads Celery 1 bunch Kale

AFTERNOON

Cut into 1/4-1/2' inch thick slices:

2 apples, 6 carrots For outdoor east exhibit: Cut in quarters: 1 1/2 heads romaine 1 1/2 bunches broccoli

Uncut:

1 bunch spinach 1 bunch kale For outdoor west exhibit: Cut in quarters: 1 1/2 heads romaine 1 1/2 bunches broccoli

Uncut: 1 bunch spinach



DIET PRICE SHEET Prices as of January 2000

GRAINS		
ТҮРЕ	QUANTITY	PRICE PER QTY
Herbivore diet (grain pellets)	50 lb	\$ 7.75
_Dog chow	50 lb	\$ 18.00
Monkey/leaf eater biscuit	50 lb	\$ 22.00
Omnivore biscuit	50 lb	\$ 16.75
Scratch (primarily corn for birds)	50 lb	\$ 8.00
Oyster shell	50 lb	\$ 3.50
Gamebird feed	50 lb	\$ 9.00
Omolene horse feed (sweet feed)	50 lb	\$ 28.25
Wild bird seed	40 lb	\$ 40.00
Ratite diet (ostrich, emu etc.)	50 lb	\$ 16.00
Grass hay	1 ton	\$200.00 (1 bale=\$10)

MEATS

ТҮРЕ	QUANTITY	PRICE PER QTY
Herrings	1 lb	\$.70
Smelt	1 lb	\$.40
Trout	each	\$ 1.10
Quail	each	\$ 1.10
Mice	each	\$.25
Rats	each	\$.75
Horse meat	1 lb	\$.48
Salmon	1 lb	FREE DONATION

PRODUCE

ТҮРЕ	QUANTITY	PRICE PER QTY
Yogurt (not produce)	1 qt	\$ 1.49
Beans, green	1 lb	\$ 1.19
Apples, red	40 lbs	\$ 11.40
Yams	40 lbs	\$ 13.20
Kale	24 heads	\$ 9.60
Spinach	26 bunches	\$ 9.60
Celery	30 heads	\$ 23.90
Broccoli	14 heads	\$ 9.90
Bananas	40 lb	\$ 13.45
Papayas	8/box	\$ 16.85
Grapes, red seedless	18 lb	\$ 18.95
Cabbage	23 heads	\$ 7.95
Cucumbers	24/box	\$ 9.95
Lettuce, romaine	24 heads	\$ 10.85
Tomato	1 lb	\$ 1.09
Carrots	25 lb	\$ 7.85

INVERTEBRATES

Each week the zo	pays \$350 total for:
55,000	Regular Mealworms
12,000	Giant Mealworms
2,000	Super Mealworms
8,000	Wax Worms (250/carton)

Salaries and Cost of Living

Grades 6-12; M

Materials: "Salaries and Cost of Living" chart (page 15 in this packet), calculators (optional), computer with graphing program (optional) **Related careers:** multiple

• Using the "Salaries and Cost of Living" chart included in this packet, have each student organize the information in such a way that the jobs, salaries and cost of living can be easily compared. Students will have to standardize the salary information (i.e. calculate all salaries weekly, monthly or annually). Students may wish to construct bar graphs or other visual tools to display the information.

Are You the Best Person for the Job?

Grades 9-12; R, W, C

Materials: "Zoo Jobs and Internships Lists" (included) Related careers: multiple

- Have your students read through "List I" of job and internship announcements for zoo and other wildlife positions. Have each student choose the job or internship that they think would best suit them and write a paragraph or prepare an oral presentation about the strengths and skills they have that make them well suited for the job. *Note:* The jobs in the first list were chosen because they are jobs or internships that are appropriate for high school students or recent high school graduates.
- Next, have students look over "List II" of jobs and choose a job that they feel they might be suited for in the future. Have each student write a paragraph or prepare an oral presentation about the strengths and skills they currently have that would make them well suited for the job, and the strengths, skills and training or education that think they would need to acquire in order to be considered for the job.
- If necessary, students may use a dictionary to define unfamiliar words used in the job description.



ZOO JOBS AND INTERNSHIPS LIST All names of institutions have been changed. Although these are real job announcements, they are listed here to provide examples only.

All job announcements appeared in the February 2007 Association of Zoos & Aquariums' Connect. Available at http://www.aza.org/JobListings

List I

"Education Intern: Education interns learn to do guided tours making use of 15 passenger vans and jeeps. They also work with school and scout groups in a variety of learning activities. They present short lessons on chemical capture techniques, radio telemetry methods, poisonous arthropods, natural dyes and inks, fossils, and much more. The wide variety of teaching opportunities and educational training provide the education intern with an exciting array of new skills and experiences. Training is provided by the education staff. Housing and stipend are available."

"Head Camp Counselor. State Zoo is looking for a creative, enthusiastic, responsible and hardworking individual interested in Environmental and Conservation Education and being outside working with children throughout the summer. The head counselor takes a leading role in all aspects of our program participants' experience, teaching diverse audiences from preschoolers to teenagers in the Zoo's summer camps. Through live animal presentations, games, crafts and Zoo hikes, the head counselor will provide a link between people and nature in a complex and changing world, inspiring positive actions that further the Zoo's conservation efforts. This job will vary from 30-40 hours a week, including evenings, weekends and overnights. It also includes extensive walking, spending time outside in all weather and working with children on a daily basis. Some heavy lifting and extended time standing may be required. Qualifications: Experience and/or strong interest in working with children including preschoolers on a daily basis; Coursework in environmental education, biology or related field; strong communication skills; Willingness to learn to work with a variety of animals including reptiles and invertebrates; successful completion of a background check and first aid and CPR training required."

"Elephant Care Intern: Requirements/competencies: Must be at least 18 years of age. Availability to work 40 hours/ week, holidays, weekends and some evenings. Must be team oriented. Public speaking experience preferred. Ability to lift 50lbs. Excellent communication skills. Bachelor degree or working towards a degree in any of the life sciences preferred. Prior animal experience or training experience with animals preferred. Housing not provided.

Primary responsibilities: Daily elephant care including but not limited to feeding, stall cleaning, foot and skin care and training of 1.1 African Elephants within a protected Contact Management System. Prepares and provides recommended diets and fresh water to all animals daily. Observes animals for changes in behavior and any signs of injury or illness. Assists veterinarian with animal treatment and administers medications as prescribed. Follows guidelines on safe handling, restraint. Keeps accurate daily records. Reports all safety concerns and issues immediately. Provides necessary animal **enrichment**. Light construction and maintenance related to elephant care. Performs daily educational demonstrations."

"Train/Rides Attendant: Job Purpose: To assist in the safe and efficient operation of the Zoo's rides and attractions. Responsibilities: assist guests with rock climbing activities, operate the Zoo's carousel and train rides, may assist with ticket taking, may involve some cashiering. Knowledge/Skills/Abilities: excellent customer service skills, must be friendly, outgoing and courteous, must be able to work some evening hours if/when required. Required Qualifications: must have a high school diploma or equivalent, must be 18 years of age, must have a valid Drivers License, must provide a (3) year MVR prior to employment, must be able to work in inclement weather."

"Apprentice Zookeeper. Entry level position that rotates keeper work to most areas of the zoo. Eligible for promotion to Keeper I after 1 year paid exotic animal experience. Requires valid driver's license; able to push, pull, lift 50lbs and pass physical exam; work weekends and holidays - 2 weekdays off; animal experience, degree preferred."

List II

"Web Developer: Work with Museum staff or internal team to develop new web pages and update current website. Program web tools on the intranet and on the website (including surveys, forms and other programmatic needs) and help support our more senior developers in the maintenance of web applications. Help generate reports, web pages and sub-sites as needed. Qualifications summary: 1 to 3 years of experience. Strong web technology skills, including HTML, CSS, Photoshop or Fireworks, as well as one or more programming languages such as PHP or JSP. Strong web abilities to create web pages that are standards compliant and appealing. Ability to work with numerous Museum departments and manage ongoing needs for home website and intranet development."

"Gardener: A Gardener is needed to perform a variety of tasks related to the planting, cultivating, and caring for ornamental plants and shrubs used to beautify the Zoo grounds. A Gardener assumes primary responsibility for flower and shrub planting and maintenance of a specified area. Minimum requirements are an Associate degree in conservation, plant science, biology or related field preferred, one-year experience in the care of plants, flowers, shrubs, trees, and lawns and a valid Texas driver's license."

"Security Officer: Ensure physical security & safety of Town Zoo's customers, staff, properties by being alert for potential threats & responding to situations appropriately & within Town Zoo guidelines. Patrol assigned areas throughout Town Zoo's buildings, garage, grounds to ensure safety & security of the Zoo & its staff & visitors. Be on alert for threats to safety/security, taking appropriate action within Town Zoo guidelines. Assist in efficient building evacuation in emergencies. Serve on Bomb Threat Search Team. Assist drivers w/ information. Direct individuals w/ disabilities to designated areas. Respond to customer/staff needs & concerns in timely, courteous manner. Maintain confidence & trust; protect confidential information. Prepare required routine & emergency reports, including entries in daily log, in accurate & timely manner. Safeguard equipment & property. Maintain professional appearance while on duty."

"Director of Development: The South Zoo seeks an enthusiastic, self-motivated individual to join our team as Director of Development. This position is responsible for directing and coordinating fund raising efforts for both operational and capital support. This person also cultivates current and prospective donors, along with providing stewardship. This includes grant writing, reporting and seeking new sources for funding and paid sponsorships. Qualification Requirements: Bachelors or Masters Degree with at least 7 years experience in fund raising or equivalent combination of education/experience. Good communication skills, both written and oral. Flexibility and the ability to handle multiple projects simultaneously and meet frequent deadlines. Willingness to be a team player. Passionate about the South Zoo mission and direction. The capacity to project the unique aims and values of the institution to donors and prospective donors. Be active in civic organizations."

"Zoo Keeper: The Main Zoo currently has a need for a Zoo Keeper in our Reptile department. Duties include food preparation, feeding, exhibit and public area cleaning, care of exhibit reptiles, and related maintenance responsibilities in the reptile buildings and various outdoor exhibits. Zoo Keepers observe, evaluate, and report animal behavior and condition to their supervisor on a daily basis. They assist in treating Zoo animals in accordance with instructions from their supervisor or veterinarian. Minimum qualifications include ability to work weekends, holidays, and occasional after-hours assignments; valid driver's license; associate degree in wildlife management, zoology, biology, or related field preferred; one-year zoo keeping experience; and venomous experience preferred."

"Head of Education: We seek a proven leader of public education programs whose background includes a successful track record of innovation and growth. Ideally this person would have experience creating and implementing programs ranging from K-12, to college level adult education. The use of collections (museums, botanic gardens, zoos and science centers) as a central medium for designing educational experiences is highly desired. The qualified candidate will be able to demonstrate a solid knowledge of and ability to develop professional dynamic relationships with teachers, faculty, administration and others in the public school sector. At the higher education level, the successful candidate would participate in the coordination of certificate and degree-oriented program strategies. Experience in the expansion of innovative adult education programs is also desired. This person must have at least

five years of management-level responsibility, large program budgetary accountability, external relations, and must have worked with committees of board of directors or program advisory groups. A bachelor's degree from an accredited college or university is required; an academic degree at the masters or doctorate level is highly preferred."

"Veterinarian: Duties: Under limited supervision is responsible for administering preventative medicine for animals within the zoo including such areas as quarantine protocols, vaccination, nutrition, necropsies, parasite programs medical record maintenance, etc. Provides individual care for zoo animals. Diagnosis and treats illness and injuries in zoo animals; determines the nature of the illness or injury and treats animals surgically or medically. Keeps abreast of veterinary practices and procedures through research and reading. Prepares various records and reports and ensures compliance with all regulatory agencies. On call 24 hours a day 7 days a week. Qualifications: Doctorate of Veterinary Medicine from an accredited university with at least on year of post graduate training, at least one year of veterinary experience within a zoological institution, plus one or two years of supervisory experience; or any equivalent combination of training and experience which provides the required knowledge, skills and abilities. Must possess a valid State Veterinary license by time of appointment, driver's license and must obtain a valid DEA license. Must be able to meet the physical demands of the job including but not limited to lifting 50 lbs and working in all weather conditions."



Tropical Rainforest staff

Reporting Scientific Findings

Grades 11-12; R, W

Reading and summarizing scientific journal articles will familiarize students with the formats that scientists use to report their findings. The articles will also provide students with first-person, up-to-date information on research in the fields of biology and conservation.

Materials: Science journals such as *Nature, Science, Conservation Biology, Zoo Biology, Journal of Wildlife Management,* and *American Journal of Primatology.* Some of these journals are available for use in the library at Woodland Park Zoo's Education Center.

Related careers: zoologist, field biologist/wildlife scientist, botanist, zookeeper, zoo horticulturist, zoo curator, zoo research coordinator

- Have students read scientific journal articles that relate to a topic of their choice. The topic could be an animal, a region of the world, a type of habitat or a conservation issue (Reading 3.4).
- Each student should write a short summary of the scientific article, including an explanation of the conclusions the authors came to as a result of their research. Journal article summaries could also be presented orally to the rest of the class.

Graphing Trends – Bear Weights

Grades 3-9; M, S

Zookeepers and veterinary staff track weights of animals to keep an eye on their health. Graphing these weights can help zoo staff to track trends and notice changes in the animals' health. Some animals, such as grizzly bears, exhibit seasonal changes in weight. In this activity, students will graph the weights of Woodland Park Zoo's grizzly bears over a period of four years and will interpret seasonal trends as well as changes in weight as the bears grew from juveniles into adults.

Materials: graph paper, pencils, "Woodland Park Zoo – Grizzly Bear Weights" chart (included in this packet) **Related careers:** zookeeper, veterinarian

- Using the weights given in the chart, have your students graph the bears' weights over the whole time period given. Students can choose the type of graph they feel is most suitable to illustrate the data (line, bar or column).
- How do the bears' weights compare during the first year of data and the last year of data? *Note:* The data used in this activity was collected on two male grizzly bears at Woodland Park Zoo between February 1996 and March 2001. These grizzly bears were born in January 1994, so the data represents the bears' weights from 2-7 years of age.
- What trends do you notice in the bears' weights between August and January of each year? What trends do you notice in the bears' weights between February and July of each year? How might these trends relate to the seasonal behaviors of grizzly bears? Would the weight trends of Woodland Park Zoo's grizzly bears differ from weight trends in wild grizzly bears? (*Grizzly bears sleep through the winter, but do not go into a deep state of hibernation like other animals, such as marmots, do. Wild grizzly bears can be active and may search for food during the winter, especially if there are periods of mild weather, but spend most of the time sleeping. In general, Woodland Park Zoo's grizzly bears more active during the winter months than wild grizzly bears might be. The weight trends of the zoo's grizzly bears might differ somewhat from those of wild grizzly bears because at the zoo the bears are fed throughout the winter, although their diet is reduced during the winter months. In the wild, grizzly bears weigh the least in the spring and early summer, after the long period of rest, and weigh the most during the late fall and early winter, after the period of intense foraging.)*
- How do Denali's weight trends compare to Keema's weight trends? Are the trends the same or different?

WOODLAND PARK ZOO GRIZZLY BEAR WEIGHTS (in pounds)

Month weighed	ID # 940353 Keema	ID #940352 Denali	Month weighed	ID # 940353 Keema	ID #940352 Denali	Month weighed	ID # 940353 Keema	ID #940352 Denali
Feb '96	510	520	Jan '99	822	794	Dec '01	934	940
Mar '96	488	504	Feb '99	808	778	Jan '02	922	946
Apr '96	496	496	Mar '99	796	756	Feb '02	918	916
May '96	500	496	Apr '99	766	724	Mar '02	902	866
Jun '96	512	510	May '99	774	712	Apr '02	884	848
Jul '96	516	510	Jun '99	702	672	May '02	808	788
Aug '96	524	516	Jul '99	708	692	Jun '02	734	750
Sept '96	600	592	Aug '99	750	714	Jul '02	708	746
Oct '96	640	622	Sep '99	816	770	Aug '02	714	778
Nov '96	640	626	Oct '99	830	788	Sep '02	722	794
Dec '96	672	670	Nov '99	882	852	Oct '02	750	748
Jan '97	660	666	Dec '99	880	858	Nov '02	846	902
Feb '97	668	670	Jan '00	878	854	Dec '02	806	850
Mar '97	642	632	Feb '00	882	856	Jan '03	754	808
Apr '97	608	612	Mar '00	864	844	Feb '03	886	898
May '97	602	584	Apr '00	836	812	Mar '03	862	850
Jun '97	592	576	May '00	862	816	Apr '03	874	836
Jul '97	596	586	Jun '00	732	690	May '03	812	780
Aug '97	630	620	Jul '00	706	690	Jun '03	716	722
Sep '97	682	648	Aug '00	732	718	Jul '03	656	676
Oct '97	744	718	Sep '00	783	771	Aug '03	688	718
Nov '97	752	736	Oct '00	856	846	Sep '03	748	792
Dec '97	746	734	Nov '00	880	870	Oct '03	820	870
Jan '98	746	740	Dec '00	908	896	Nov '03	878	908
Feb '98	736	724	Jan '01	886	878	Dec '03	904	912
Mar '98	728	706	Feb '01	894	870	Jan '04	904	892
Apr '98	710	672	Mar '01	906	870			
May '98	698	632	Apr '01	902	862			
Jun '98	668	630	May '01	858	818			
Jul '98	670	648	Jun '01	754	752			
Aug '98	704	654	Jul '01	704	724			
Sep '98	768	732	Aug '01	728	744			
Oct '98	828	778	Sep '01	764	762			
Nov '98	838	790	Oct '01	788	802			
Dec '98	832	796	Nov '01	890	888			

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Share Your Knowledge #I

Grades 3-12; R, C

Zoo employees, including keepers, administrators and curators in addition to education staff, are often called upon to give presentations to zoo visitors, community groups, school groups and other public groups about the zoo, the animals, the plants and/or the habitats. It is important for those in zoo and wildlife careers to be comfortable and experienced in presenting natural history information to individuals and groups of people. **Materials:** books, magazines and Internet access to find information about animals, plants, and/or habitats **Related careers:** zookeeper, zoo education staff, zoo administrator, zoo curator, naturalist, teacher/instructor

- Have each student prepare an educational presentation for the rest of the class about a zoo animal, plant or habitat (Communication 4.4). These presentations can be given orally, with or without visual aids, either in the classroom or at the zoo. If presenting in the classroom, students may wish to prepare diagrams, maps, audio recordings, slides or PowerPoint presentations to add audio/visual interest to their presentations (Communication 2.5). To gather information for the presentations, students can use books, magazines and the Internet (Reading 1.5 and 3.1).
- When developing presentations, have each student create an outline that clearly illustrates an objective or message that his/her presentation will communicate and the elements of the presentation that will convey this message (Communication 2.2). The message or objective could be related to conservation or a better understanding of and appreciation for some part of the natural world.

Share Your Knowledge #2

Grades 5-12; R, C

Zoo education staff members are often called upon to develop creative ways of teaching the public about ecological or biological concepts. For example, how would you demonstrate the effectiveness of body fat as an insulator against cold (many animals that live in cold climates have thick layers of body fat to keep them warm)? How about putting a small plastic bag filled with vegetable shortening (fat) over a tray of ice? Feel the ice with one hand directly on the ice and the other hand on the bag of shortening on the ice. Does the fat provide insulation? This is one way to teach about this adaptation to the cold. In this activity, students are challenged to develop their own simple games or activities for teaching ecological and/or biological concepts.

Materials: will depend on each group's needs Related careers: zoo education staff, teacher/instructor

- Divide your class into pairs or small groups, or have each student work individually. Have each student or group of students choose an ecological or biological concept related to a topic the class has recently been studying. Some examples are: adaptations that improve hearing (owls, bats, etc.); leaf shapes how leaves are adapted for different climates; the effects of forest clearing on erosion patterns; adaptations for running fast; adaptations for climbing trees; how energy moves through trophic levels in an ecosystem; etc.
- Have each student, or group of students, develop a simple game or activity that illustrates the ecological or biological concept. The game or activity should use inexpensive, readily-available materials and take no more than 10 minutes to demonstrate.
- As time is available, have each student, or group of students, test out their activity or game with the class. The student(s) may want to write revisions to their activity or game depending on how the trial run with the class goes.



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Designing A Zoo Exhibit

Grades 5-12; A, W

In this three-part activity, students will integrate natural history information, visual arts skills and writing skills to design a zoo exhibit, build a model of the exhibit and then develop a marketing campaign for the new exhibit. Parts 1 and 2 of this activity could be completed without Part 3, or Part 3 could be completed on its own if time doesn't allow for all three parts to be completed.

Materials: materials for drawing and/or painting, cardboard, cardstock, modeling clay, craft sticks and other materials to build models, graphic design/layout software

Related careers: many careers in zoos

Part I – Design a Zoo Exhibit

- Individually or in groups, have students choose an animal for which to design a new zoo exhibit. Students should begin by researching the natural history of the animal, including information about its habitat, physical needs, current status (threatened, endangered or otherwise listed), diet, social structure, reproduction/life cycle, etc. In planning their exhibit design, students should also keep in mind areas for keepers to work in, keeper safety, spaces to hold animals when they are not on exhibit, viewing areas for visitors and other needs related to a zoo exhibit.
- Have students make preliminary illustrations of their exhibit designs using drawings and written descriptions.
- With their exhibit design, have students fill out a chart describing the elements of their exhibit and why each element is included. For example:

Exhibit includes:	Why we included this:
Deep moat on all sides	Prevent animals from escaping

• From the list of jobs at Woodland Park Zoo (pages 10-11) and other information provided in this packet have students choose five job positions that would be involved in some aspect of their new exhibit. For each job position, have students write a short paragraph about the job and how the job relates to the new exhibit.

Part 2 – Build a Model of the Exhibit

- Have each student or group of students create a three-dimensional model of their zoo exhibit using materials such as cardboard, cardstock, modeling clay, craft sticks, etc.
- Students should pay special attention to scale and accuracy in building their models.

Part 3 – Develop Signs and/or Marketing Materials for the Exhibit

- Have each student or group of students design a poster or brochure or signs that illustrate the zoo exhibit that they have developed (Arts 4.5). The poster or brochure could be an advertisement to encourage people to come to the zoo to see the new exhibit. The signs could provide educational and inspirational information for visitors viewing the new exhibit. In an eye-catching yet informative way, using both graphic elements and text elements, the poster, brochure or signs should communicate to zoo visitors:
 - Why the visitor should come to the zoo to see the new exhibit (i.e., something that will excite the visitor to come see the exhibit)
 - Which animals, plants, and/or habitats are displayed in the exhibit
 - The importance of these animals, plants, and/or habitats in the natural world
 - How the zoo is involved in conservation of the animals, plants and/or habitats displayed in the exhibit
 - How the visitor can participate in conservation of the animals, plants and/or habitats displayed in the exhibit

Horticulture – Seed Germination

Grades 5-12; S

Germinating plants from seeds is a common undertaking for horticulturists and other botanists. Sometimes seed germination is simple and straightforward. Sometimes germinating seeds can be very challenging and can require a good deal of experimentation. As is true for adult plants, seed germination requires the right combination of soil, water and light – but "the right combination" varies from species to species. In this activity students will experiment to determine which germinating conditions work best for two different species of plants.

Materials: seeds (two different kinds of plants, any common seeds, such as peas, will do – check the planting directions and make sure the two types of seeds require somewhat different conditions for germination), sterilized seed-starting medium (can be purchased at garden stores), egg cartons, spray bottles **Related careers:** horticulturist, botanist, landscape

designer, plant nursery staff

- Give students (working individually, in pairs or in groups) seeds of each of the two plants, but do not include any directions for planting. Provide each group with egg cartons and sterilized seed-starting medium in which to plant the seeds.
- Have students brainstorm different conditions in which to plant the seeds, varying aspects such as

depth in soil, soil temperature, amount of water, amount of light. Out of their brainstorms, have each group design an experiment that examines only one variable (amount of water, temperature, depth in soil, amount of light, etc.) and keeps the others constant. Each group should try to germinate seeds from each of the two plant species so that they can compare the results. (See Diagram 1 below.)

- Students can use egg cartons as containers for planting their seeds and the spray bottles will come in handy for watering the seeds. Students should punch small holes in the bottom of the egg cartons to allow for drainage.
- Each student should keep a daily journal in which he/ she records observations of his/her seed germination experiments. Once the plants have germinated, students should record their observations of growth for several weeks. A final journal entry should compare and contrast the germination and growth of the two different types of seeds under the different growing conditions.
- Provide students with an opportunity to compare and contrast their results with those of other students. Under which conditions did the seeds germinate the quickest and produce the healthiest plants? Can any conclusions be drawn from the results of everyone's experiments taken together?



Diagram I: Example of germination experiment

Horticulture – Plant propagation

Grades 5-12; S

Propagating, or reproducing, plants through leaf cuttings, stem cuttings, simple layering, air layering or tissue culture is a skill employed by horticulturists to increase their plant stock in an inexpensive, timeefficient manner. By propagating plants, horticulturists can also obtain plants genetically identical to plants that have desirable characteristics. In this activity, students can try the first four of these five methods of plant propagation – and have a houseplant to take home! Due to the laboratory and other specialized equipment required, tissue culture is not included in this activity. Materials: diagrams (included in activity descriptions), "parent" plants (see below), propagation medium*, small plant pots (peat pots, plastic nursery pots, clay pots, etc. - three per student), rooting hormone (one that includes fungicide), sphagnum moss, plastic wrap, and potting soil. (These materials can be obtained at most garden or home improvement stores.)

Related careers: horticulturist, botanist, landscape designer, plant nursery staff

*Propagation medium: You and/or your students can make several types of propagation media. Students should all use the same mix (unless they control all other variables and test the propagation mix itself).

Propagation Mix #1: equal parts sand (coarse, construction-grade) and peat moss

- Propagation Mix #2: equal parts sand (coarse, construction-grade) and vermiculite (horticultural grade, No. 2)
- Propagation Mix #3: vermiculite only (horticultural grade, No. 2)

Propagation Mix #4: equal parts perlite and peat moss Propagation Mix #5: equal parts perlite and vermiculite

• During these propagation activities, students should keep a laboratory journal in which they make detailed records including the method of propagation, the steps involved in the propagation procedure, details about water and light conditions, and the success (or failure) of the plant.

I) Leaf cutting:

Parent plant: Snake plant (Sansevieria)

- Cut a leaf into 2-inch sections, keeping track of "which end is down."
- Fill a small pot with well-moistened propagation medium. Insert each cutting in the propagation medium with the correct orientation (the cutting will

not develop roots if it is placed upside-down). Insert the cutting deep enough so that it is able to sit upright securely.

• Maintain high humidity while the cutting is developing roots. This can be accomplished through misting with a spray bottle or enclosing the cutting in a "dome" made from a clear, 2-liter plastic bottle with the top cut off (be sure to keep the cutting out of direct sunlight to avoid excessive heat).



• Roots should develop within two weeks, but could take longer. Once roots have developed the plant can be delicately planted in potting soil.

2) Stem cuttings:

Parent plant: Chinese Evergreen (Aglaonema)

- Cut 4-inch lengths from the tips of the stems of the parent plant.
- The end of the stem may be dipped in rooting hormone to encourage root growth.
- Insert the cutting into the medium (insert approximately two-thirds of the stem – so that the cutting will stand upright) and then water thoroughly.
- To reduce water loss while the roots are developing, remove the lowest leaves on the steam or cut off the outer half of each of the leaves.
- Maintain high humidity while the cutting is developing roots. This can be accomplished through misting with a spray bottle or enclosing the cutting in a "dome" made from a clear, 2-liter plastic bottle with the top cut off (be sure to keep the cutting out of direct sunlight to avoid excessive heat).
- Roots should develop within two weeks, but could take longer. Once roots have developed the plant can be delicately planted in potting soil.

3) Simple Layering:

Parent plant: Pothos ivy (*Epipremnum aureum*)
Arch a stem from the plant down to the ground (or CADEEDS + (5))

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to a second pot filled with moist propagation medium) and hold the stem in place (wires bent into U-shapes will work to hold the stem down). Leave six to 12 inches of the tip



- of the stem above the soil.
- Make a small notch or some grooves in the lower part of the bend in the stem. The notch or grooves can be dusted with rooting hormone.
- Push the bottom of the bend into the propagation medium. Then cover the bend of the stem with propagation medium.
- Roots should form at the notched area within several weeks.
- The stem with new roots can be cut away from the parent plant and planted in potting soil.

4) Air layering (see Diagrams 1-6):

Parent plant: Rubber plant (*Ficus elastica*), Diffenbachia (dumb cane), Schefflera or umbrella tree (*Schleffera* or *Brassia actinophylla*). You may want to try this as a class instead of having students try it individually due to the expense of the parent plant.

- Prepare a few handfuls of sphagnum moss by soaking the moss in water until saturated.
- Use a mature, healthy parent plant and choose a sturdy stem, thicker than a pencil, to air layer.
- With a sharp knife, make an upward cut on the stem, almost to the center of the stem (see Diagram 1). The cut should be approximately 1-1/2 to 2 inches long. It may be necessary to support the plant stem with a splint so that the stem doesn't bend and break at the site of the cut.
- Insert a sliver of wood or a toothpick into the cut to keep it slightly open (see Diagram 1).
- The wound can be dusted with a commercial rooting hormone. For the plants listed here, a low power rooting hormone will work, such as a mix of IBA and NAA (two naturally-occurring types of rooting hormone) with a fungicide to prevent rotting.
- Make a ball around the wound with a handful or two of the damp sphagnum moss. Squeeze excess water out of the moss before using, so it is moist but not sodden. The ball should be about the size of an orange. You can use string to wrap around the moss and tie it in place (see Diagram 2).

- Wrap the sphagnum ball completely in plastic wrap, securing the top and bottom ends with electrical tape, making sure that the tape secures the edge of the plastic wrap to the stem of the plant so that no moisture can escape (see Diagrams 3 and 4).
- Watch the sphagnum ball for roots growing from the wound site (see Diagram 5). Once you can see roots growing on all sides, the newly rooted plant can be removed.
- To remove the new plant, prune the stem just below the moss ball and new roots (see Diagram 6).
- Remove the plastic wrap, but not the moss, being careful not to disturb the roots. Plant the new plant in a pot with good potting soil.
- To help the new plant establish a good root system, keep the plant away from direct sunlight and keep the plant very moist by misting it several times daily with a spray bottle for about a week.



Making Matches: Species Survival Plan (SSP) Coordination

Grades 8-12; S, M

When coordinating Species Survival Plans, SSP coordinators and their committees work together to carefully match animals according to their genetic ancestry. SSP coordinators are usually zookeepers or curators who take on this responsibility as a part of their jobs. In order to sustain genetically sound captive populations, SSP coordinators make suggestions as to which animals should be bred together. In this activity, students will deduce from tables which animals are least closely related in order to determine which animals should be bred together to ensure a healthy captive population. Refer to the background information in this packet for a further discussion of Species Survival Plans. Materials: pencils, paper

Related careers: zookeeper, zoo curator, conservation biologist, and geneticist

• If necessary, in order to become familiar with drawing family trees to determine genetic relatedness, proceed through Problem #1 step-by-step with your students. Then have your students complete Problem #2 on their own.

PROBLEM I:

- Step #1: From the Generation #1 table write the father/ mother pairs across the top of the page. Draw squares around the males and circles around the females. Connect the pairs that mated and produced offspring with a single line.
- **Step #2:** Draw straight lines down from the lines connecting the pairs and write the ID number(s) of the resulting offspring (from the first column of Generation #1 table) at the end of the line, drawing the appropriate symbol around the ID number to indicate the gender.
- **Step #3:** From the Generation #2 table, determine which pairs of penguins already on your chart mated and produced offspring. Draw lines connecting the pairs that mated.
- **Step #4:** From the lines connecting the new pairs, draw lines straight down and write the ID number(s) of the resulting offspring (from the first column of Generation #2 table) at the end of the line, drawing the appropriate symbol around the ID number to indicate the gender of the penguin.
- **Step #5:** Analyze the connections you have made. Which pair of male and female penguins from the first column of the Generation #2 table would be the ideal pair to mate because they share no common genes?

GENERATION #1:

ID # and Gender of Penguin	ID # of Father	ID # of Mother
3F	1M	2F
6F	4M	5F
9M	7M	8F
12M	10M	11F

GENERATION #2:

ID # and Gender of Penguin	ID # of Father	ID # of Mother
13M	9M	3F
14F	9M	6F
15M	12M	8F
16F	4M	3F

TEACHER KEY – FAMILY TREE

Penguins #15M and #16F would be the ideal pair to mate. Penguin #13M has the same mother as penguin #16F and the same father as penguin #14F. Penguin #14F is the granddaughter of penguin #8F and penguin #15M is the son of penguin #8F.



PROBLEM 2:

Using information from the following tables, have students work individually to determine which two of the five tigers in the first column of the Generation #2 table should be bred together to produce the most genetically diverse offspring.

Hints:

- Individuals may breed with more than one other individual.
- Assume that each tiger in the table has only desirable (no deleterious, or harmful) genes.
- There are two possible correct combinations.

GENERATION #1:

ID # of Gender of Tiger	ID # of Sire (father)	ID # of Dam (mother)
564F	228M	135F
537F	312M	316F
496M	234M	227F
495M	234M	227F

GENERATION #2:

ID # of Gender of Tiger	ID # of Sire (father)	ID # of Dam (mother)
756M	312M	564F
757F	312M	564F
771F	496M	537F
T9101F	495M	728F
T9102M	495M	728F

Information from: Brady, Gerald L., AZA Sumatran Tiger Coordinator, ed. Sumatran Tiger Studbook 1996.

TEACHER KEY – FAMILY TREE

There are two possible correct combinations – #757F + #T9102M and #756M + #T9101F.



Extension:

Through role-playing, have your students explore the issues involved when the Species Survival Plan coordinator recommends that animals be moved from one zoo to another for breeding purposes. Use the following scenario as a basis for the role-play:

The tiger SSP coordinator has recommended that tiger #757 be moved from Zoo A to Zoo B so that it can breed with tiger #T9101. The other two tigers at Zoo A will remain at Zoo A. Tiger #757 was born and raised at Zoo A and both the staff and visitors at Zoo A feel significant ties to the tiger. At Zoo B, tiger #T9101 has reached the age where she can begin breeding, but Zoo B does not currently have an appropriate match for her. The staff at Zoo B feel that the matching of tiger #757 with tiger #T9101 will produce great benefits for the captive population of Sumatran tigers.

Designate students to play the roles of: Director of Zoo A, tiger keeper at Zoo A, community members who visit Zoo A, the Tiger SSP Coordinator, the Director of Zoo B, tiger keeper at Zoo B, and community members who visit Zoo B.

Can the students, through role playing, come to any conclusions about what should be done? What are the arguments for the move? What are the arguments against the move? What are some alternative actions that could be taken?

Wild Wise Activities: Field Marks and Mapping



Raptor presentation

Grades 5-7; S, M

The following three activities are a part of Woodland Park Zoo's Wild Wise curriculum. Wild Wise is an outreach program offered for 5-7th grade students throughout Washington state. Wild Wise uses multimedia technology coupled with outdoor experiences to introduce students to wildlife observation, wildlife field identification and mapping skills. These skills are important to wildlife biologists and other scientists who work with wildlife or in conservation. Note: For more information on the Wild Wise outreach program call (206) 615-1020 or see the Wild Wise section of Woodland Park Zoo's Web site at www.zoo.org/wildwise.

Lesson One — Field Marks

Materials: Overhead transparency of barn owl image. Overhead transparency of barn owl field marks. Related careers: field research, biologist

Instructions:

Ask students the following questions:

- How are biologists able to identify plants and animals with certainty in the field?
- What do biologists look for when identifying plants and animals?
- What if, when viewing wildlife, conditions aren't ideal? (For example, lighting is poor or an animal only shows itself for a brief moment.)

Based on the answers from the students, address the following points:

• Biologists use <u>field marks</u>. Field marks are the distinguishing features that make an animal stand out from every other animal. The concept behind field marks is that an individual does not need to get a

"perfect" view of an animal to be able to identify it with certainty. Biologists typically look for and record important characteristics upon seeing an animal or plant and refer to resources like field guides at a later time to confirm their identification.

Show the students the image of the barn owl on the overhead projector.

Ask the students to record any unusual features that they see. Check for understanding by showing the image with the field marks for the barn owl: white heart-shaped face, dark eyes and pale body color.

Extend the activity to all plants and animals by asking students the following:

• What should the observer key in on? Key field marks typically consist of color, shape and pattern. Behavior can also be a key field mark. Questions biologists may ask themselves include: What was the color of the animal's body or parts of its body? Were there spots, stripes, solid patterns? How large was the animal? Was there anything unusual about the way the animal moved? Did the animal make a noise or call? The same questions regarding color, shape and pattern can be asked of plants as well.

Extension:

• Consult a reference like Peterson Field Guides as an example of field marks on a variety of different wildlife. These guides highlight field marks with arrows pointing to distinguishing characteristics.

Lesson Two — Mapping

Materials: Overhead transparency of map with latitude and longitude markings.

Related careers: field research, biologist

Instructions:

Have a brief discussion with the students incorporating the following points:

- Latitude and longitude are imaginary lines created by mapmakers. They are the key elements of mapping and allow us to pinpoint any place on a map with a high degree of accuracy.
- Latitude lines run east/west.
- Longitude lines run north/south.
- Whether reading latitude or longitude, the number may contain up to seven digits. For example, 121° 20' 00". That is interpreted as

121 degrees, 20 minutes, 00 seconds.

- Sixty seconds is equal to one minute, 60 minutes is equal to one degree.
- Mapping is a tool for safety and science. For safety, the ability to read a map can be the difference between a quick walk back to your house or hours lost in the wilderness. For science, it's a key tool for directing others to specific locations where observations were recorded.

Show the students the overhead of the provided map. Given the precision of the map, find the latitude and longitude of Bridge Creek Campground. Check for understanding by reviewing Bridge Creek Campground's latitude and longitude.

Bridge Creek Campground latitude:
48 degrees, 26 minutes and 00 seconds.
Bridge Creek Campground longitude:
120 degrees, 52 minutes and 00 seconds.

Extension:

• If students have prior experience with mapping, work with maps that require a higher level of precision (with seconds for example) and plot latitude and longitude accordingly.

Lesson Three — Mapping

Overview: This lesson is intended to incorporate real world applications for mathematics by showing how the x and y axes can be used to describe important information about the natural world. Precision and the concept of data collection are described in this lesson.

Background: A small population of ferruginous hawks nest in southeastern Washington. An ongoing field study is examining where the birds go in the winter and why their numbers are declining.

Materials: A computer with Internet access

Investigation:

- On your computer, via the Internet, go to the Web site www.zoo.org/wildwise.
- Click on the Student Projects button.
- Click on the Mapping icon.
- Review resources: a) Animal Facts: ferruginous hawk
 - b) Ferruginous hawk slide show
 - c) Ferruginous hawk field study
- Complete a report, incorporating the two points listed under objectives.

Extensions:

• Map the latitude and longitude of the three other hawks in the study and draw some preliminary conclusions regarding where ferruginous hawks are spending their time and why their numbers might be declining.



White, heartshaped face

WILDLIFE CAREER PROFILE

Activity from World Wildlife Fund's Windows on the Wild: Wildlife for Sale – used with permission.

14 Calculate Your Wildlife Career Profile

SUBJECTS

social studies, language arts

SKILLS

gathering (reading comprehension, listening, simulating), analyzing (identifying patterns, comparing and contrasting, discussing), interpreting (generalizing, inferring), applying (decision making), presenting (writing)

VOCABULARY

bushmeat, ecotourism, epidemiology, forensics, innovation, lobbyist, morphology, nonprofit organization, Peace Corps Volunteer, reflection

TIME

one or two sessions with the possibility of a homework assignment

MATERIALS

copies of the "Career Cards" (optional), "Career Descriptions" (optional), "What's Your Preference?," "Career Profile Scoring Sheet," "Wildlife Career Profiles Descriptions," and "On the Job" (pages 221–237)

TA AT

AT A GLANCE

Determine your personal career profile and learn about wildlife-related jobs that might match your skills and interests.

OBJECTIVES

Identify several wildlife-related careers and understand how these careers deal with wildlife trade and environmental issues.

our students may have always dreamed of a career working with wildlife. Or they may have been inspired by the activities in this module to try to help stop illegal wildlife trade. In this activity, your students will learn more about their work preferences—and the field of wildlife conservation—by calculating their career profiles and investigating some wildliferelated jobs that might be suited to their interests.

Of course, this activity isn't meant to suggest that each one of your students should aspire to work on wildlife issues. But it should empower them to know that plenty of jobs exist for people with their skills. The activity may also help the students feel better about some of the problems associated with wildlife trade if they know constructive ways that people can help. As with any activity that looks toward the future, sometimes imagining a positive outcome goes a long way toward making it happen.

Note: "What's Your Preference" is not a scientifically valid survey, but it can be used as a general indicator of some factors that may affect individuals' preferences for certain wildlife-related careers. While the questionnaire is a good way to gauge where students' interests lie, it's important to let them know that the results reflect their current preferences. Those preferences are neither predictions nor predeterminations. Rather, they're intended to stimulate thinking and reflection.

Before You Begin

For Part I (optional), make one copy of "Career Cards" and "Career Descriptions" (pages 221–224). (This section provides enough cards for up to 54 students to participate in the activity. If necessary, you can adjust the number of cards to fit the number of students in your group.)

For Part II, make one copy per student of the "What's Your Preference?" (pages 226–227, "Career Profile Scoring Sheet," (page 228) and "Wildlife Career Profiles" (pages 229–230). Make one copy of "On the Job" (pages 231–237) for each group of students.

What to Do • Part I

(Optional)

Begin with this activity to get your students thinking about the variety of wildlife-related careers that exist. First, divide the class into two groups. To one group, hand out the "Career Cards" that list professions (e.g., wildlife inspector, field biologist, nature photographer); give one to each student. To the other group, hand out the "Career Descriptions" cards, which explain what people in certain wildlife-related careers do. Give the students 5 minutes to find their "partner," or the person in the class who has the card that matches his or her profession or description. The answers are on page 225.

Once the partners have found each other, they should discuss how their particular career might help wildlife or the environment in general. The pairs can then report on "their" career as they read their cards to the group. Now explain to students that they will have a chance to find out more about these careers.

> "If we're going to rise to a future in harmony with our environment, we need everyone's skills. We need artists. We need musicians. We need cooks. We need journalists. Whatever people do, whatever our roles in life are, we can make a difference."

-Jane Goodall, conservationist

There are currently over 18,000 wildlife management professionals nationwide—and this number is expected to grow in the coming years. Jobs in the wildlife field include botanists, data management specialists, endangered species biologists, environmental educators, marine biologists, professors, wildlife managers, and research scientists.

1. Distribute the survey.

Explain that the purpose of the "What's Your Preference?" survey is to help the students discover more about their personality and interests as they relate to different types of careers. Tell them that they should answer the questions on the survey honestly. Explain that there are no wrong or right answers and that one preference isn't better than another. Ask them to complete the surveys individually.

2. Hand out copies of the "Career Profile Scoring Sheet."

After the students have completed the survey, explain that the questions they answered were designed to reflect their current career profile preferences. In other words, their answers provide some indication of the kinds of jobs the students might enjoy. Students should use the "Career Profile Scoring Sheet" to help determine their dominant trait in each of the three general categories. (See categories listed below.)

For these three categories, each student's responses will probably fall more heavily on one side than the other. Have the students write their three dominant traits at the bottom of their worksheets (for example, individual–action–process or group–reflection–innovation).

3. Distribute one copy per student of "Wildlife Career Profiles."

Have students read and react to the nine descriptions of career profiles. Explain that the specific careers will be discussed later. After each one, you might pause to ask who matched which profile. Ask students whether they feel the profile accurately summed up their interests. Why or why not? Remind them that the profiles may not be completely accurate because a simple questionnaire can't draw out all the details that would provide a well-rounded picture of each individual's preferences and strengths.

After you discuss the profiles, have the students focus on the job descriptions. Explain that these descriptions were purposely written to be very specific so they can provide the students with as vivid an example of real-world jobs as possible. But what else do the students notice about the jobs? (The students should notice the environmental focus.) If you had your students complete the matching activity in Part I, explain that the general jobs they learned about in the matching activity can be applied to a wide variety of fields. However, the jobs listed in the careers profiles specifically have an environmental or wildlife trade focus.

On the description sheet, students should circle the jobs that appeal most to them. If the jobs still don't seem to quite fit, students can adapt the closest job description to make it more appropriate for their interests and skills. For example, "administrative assistant at a zoo or park" could become "administrative assistant at a recording studio" (or at a television station, *Sports Illustrated* magazine, or some other place). "Wildlife inspector" could become "customs inspector" or "security guard." Emphasize to your students that the most satisfying jobs tend to combine the skills that a person has with the subjects that a person finds most interesting or important.

4. Distribute one copy of "On the Job" to each student.

Have students form groups of seven and ask each member to read one biography. Can they figure out which profile best matches the biography they read? Each group member should share their biography and identify the matching profile. When all the groups have sorted the seven biographies according to profile, have the groups compare their answers. (There is no "right" or "wrong" sorting.)

5. Assign a futures writing activity.

Based on the options presented below, have students choose a career to focus on in this creative writing activity. Once students have chosen jobs they'd like to explore, have them imagine themselves working in that profession 20 years from now. How might their job affect the status of wildlife in the country or the world? If there's enough time, the students can work on these assignments in class. If not, have them complete the assignment as homework. They can use the wildlife career biographies as models for their essays.

Option #1: Ask each student to choose a wildliferelated job that interests them. (Students do not have to choose a job that matched their career profile.)

Option #2: Ask students to think about a career they have previously been interested in. Then have them imagine how their work in that kind of career could be geared toward environmental or wildlife-related work.

Organizations with Information on Wildlife Careers

The American Zoo and Aquarium Association provides information about zoo and aquarium-related careers on its Web site at <www.aza.org/publications>.

National Wildlife Federation's Earth Tomorrow is an environmental education and leadership program for educators and students from urban high schools. It involves students and educators in environmental projects at the community level and provides an introduction to environmental careers. Web site: <www.nwf.org/earthtomorrow>.

The Nature Conservancy of Hawaii distributes a "Careers in Conservation" portfolio, which includes a student handbook that provides information about environmental job opportunities, job characteristics, work settings, skills needed, and average salaries of several conservation careers. The portfolio also includes an educator's guide to lesson plans that exposes students to conservation careers and professional profiles of conservation workers. Complimentary copies are available from The Nature Conservancy of Hawaii, P.O. Box 971665, Waipahu, HI 96797. (808) 537-5408. E-mail: <npak@tnc.org>.

Student Conservation Association (SCA)—Conservation Career Development Program (CCDP) offers a one-year program in conservation education, community service activities, and career services for minority students who are in urban high schools. Web site: <www.sca-inc.org>.

WRAPPING IT UP

Assessment

Read the following paragraph to your students: "An anonymous person has just written a letter to a small local newspaper in southern Arizona saying that a major smuggling ring is operating on both sides of the U.S.-Mexico border. The smugglers are taking mountain lions, bighorn sheep, roadrunners, and rare cacti and are delivering them to collectors in the United States and Europe." Tell your students that the tip immediately stirs people into action. Then have each student make a list of the kinds of professionals who might become involved in such a case and describe the specific role each might play.

Unsatisfactory—The student either cannot name more than two or three professions relevant to this topic or cannot clearly describe the roles they might play.

Satisfactory—The student makes a list of at least four professions and clearly explains their relevance to the story described.

Excellent—The student identifies a varied list of at least five to eight professions relevant to the story and demonstrates originality in describing their specific roles.

Portfolio

Have students include the futures writing assignments in their portfolios.

Extension

Have students interview someone who is in a wildlife-related profession that interests them. Interview questions might include the following: How did the person arrive at that job? What schooling or training did the person have? What are the most and least appealing aspects of the job? Afterward, let students share the results of their interviews and discuss any new insights they have learned about the profession.

Resources

100 Jobs in the Environment by Debra Quintana (IDG Books Worldwide, 1997).

Aldo Leopold: American Ecologist by Peter Anderson (First Books-American Conservationist Series, 1995).

Careers for Animal Lovers by Russell Shorto (The Millbrook Press, 1992).

The Complete Guide to Environmental Careers in the 21st Century by Environmental Careers Organization (Island Press, 1999).

Preparing for a Career in the Environment by J. C. Ferguson (Ferguson Publishing Company, 1998).

Working with Wildlife: A Guide to Careers in the Animal World by Thane Maynard and Jane Goodall (Franklin Watts Incorporated, 1999).

For more information on personality typing, see *Introduction to Type: A Guide to Understanding Your Results on the Myers-Briggs Type Indicator* by Isabel Briggs Myers (Center for Applications of Psychological Type, 1993).

CAREER CARDS

14 Calculate Your Wildlife Career Profile

CAREER CARDS (Cont'd.)

14 Calculate Your Wildlife Career Profile

CAREER DESCRIPTIONS

14 Calculate Your Wildlife Career Profile

CAREER DESCRIPTIONS (Cont'd.) 4 Calculate Your Wildlife Career Profile

Answers-Career Match

administrative assistant: A person who assists others with the everyday operations of an organization. Duties may include keeping track of the budget, maintaining records, and filing or organizing information.

advertising executive: A person who works to develop creative ways and marketing strategies to sell products and services.

animal trainer: Someone who modifies an animal's behavior, usually through a specific set of techniques. This career may include working with captive animals to sharpen their survival skills so that they can be released into the wild and preparing injured wild animals for use in educational programs.

aquarist: A person who takes care of marine plants and animals at a zoo or aquarium. This career includes cleaning and maintaining the aquarium; researching marine wildlife species, including their natural history and care in captivity; and collecting wildlife for public displays.

artist: A person who creates artwork (such as paintings, photographs, sculptures, pottery, or drawings).

campaign organizer: Someone who works with lobbyists and politicians to create change or to help citizens take action on certain issues.

clothing designer: A person who creates new "looks" in clothing by using different textures, fabrics, and cuts.

computer programmer: Someone who creates software for computers.

educator: Someone who facilitates learning, either in a school or another setting.

field biologist: A scientist who conducts research outdoors on living things. This research might include population studies on a species of animal or studies of the species' habitat preferences.

filmmaker: Someone who creates, directs, or produces motion pictures (such as television shows, documentaries, and films).

fund raiser: A person who obtains money for projects through a variety of methods, including holding fundraising events and writing grants to get support from foundations, companies, and other donors.

lawyer: Someone who supports individuals, organizations, and governments in court cases and other legal matters.

librarian: Someone who works in a library, is knowledgeable about library resources, and can help others with research.

lobbyist: A person who tries to influence legislators to pass certain laws.

park ranger: Someone who patrols a park area to provide information to visitors, make sure people are following the regulations, and ensure protection of the park's natural resources and ecosystems.

Peace Corps Volunteer: A person who works for an agency of the U.S. government that places individuals in countries around the world to work in many different professions, such as teaching English, working with communities on resource management, and providing training for business management.

photographer: Someone who takes pictures for magazines, books, calendars, and other uses.

politician: Someone who holds a public office and who is actively involved in politics.

professor: A person who teaches at the college level.

project manager: A person who has good organizational skills and who oversees the running of specific programs or projects.

researcher: A person who designs experiments and projects to learn more about a topic and answer specific questions.

salesperson: A person who sells products and services.

tour guide: Someone who leads trips for and provides information to vacationers.

veterinarian: An animal doctor.

wildlife inspector: An agent of the U.S. Fish and Wildlife Service who inspects declared wildlife shipments for illegal wildlife or wildlife products hidden among legal imports.

writer: A person who writes books, newspaper articles, film scripts, speeches, magazine features, or other pieces.

zoo director: Someone who is responsible for the overall direction and long-term vision of a zoo.

WHAT'S YOUR PREFERENCE?

14 Calculate Your Wildlife Career Profile

Please answer the following questions, indicating which option applies most to you. Try to answer honestly on the basis of what you would most likely do or what sounds most appealing. There are no right or wrong answers. Just go with your "gut feeling," and choose the answer that you feel comfortable with most of the time.

1. Which would you rather do?

- a. Watch other people play a sport.
- b. Play the sport yourself.

2. Which sounds like more fun?

- **a.** Going to a big party and seeing lots of people.
- b. Hanging out with a few close friends.

3. Which statement do you agree with more?

- **a.** I prefer working on graded assignments by myself.
- **b.** I prefer working on graded assignments with a group of people.

4. Imagine you've just spent a month studying volcanoes in your science class. Which of the following two assignments would you prefer?

- Answer 10 questions about volcanoes, and turn them in to the teacher in 3 days.
- **b.** Come up with your own volcano project showing what you have learned, and turn it in within the next month.

5. Given the choice, which would you rather do for an afternoon?

- a. Write a poem, story, or article about trees, then watch a movie on the giant redwoods.
- **b.** Plant trees and make a sculpture from tree limbs.

6. Which do you think you would rather do?

- a. Start and run your own company.
- b. Work for an existing company.

7. Which do you think would be more exciting?

- a. Winning a team Olympic gold medal in basketball or gymnastics.
- **b.** Winning an individual Olympic gold medal in figure skating or track.

8. Which more accurately describes you?

- a. I'm always dreaming up new ideas and new ways of doing things.
- b. I'm a good organizer and a good planner.

WHAT'S YOUR PREFERENCE? (Cont'd.) Calculate Your Wildlife Career Profile

9. If you spent a week with friends at a beach house, which would you prefer?

- a. Being where the action is all of the time.
- b. Having some time to yourself.

10. As a way to get a sense of a foreign city, which would you rather do?

- a. Play a pickup game of soccer with some local teenagers.
- b. Visit a local museum or "people watch" in a café.

11. If you're getting gifts for your friends and family, which would you rather do?

- a. Buy unique gifts at a store.
- b. Make the gifts yourself.

12. Which statement better describes how you interact with your friends?

- a. I'm usually the one who comes up with ideas for what we should do together.
- b. I tend to follow along with other people's ideas.

13. On most days, which do you wish you had more of?

- a. Time to yourself.
- **b.** More time with other people.

14. Which two classes do you prefer?

- a. Physical education and studio art.
- b. English and mathematics.

15. On a rainy day, which would you prefer to do?

- a. Read a book.
- b. Go to a video arcade or an indoor basketball court.

WILDLIFE CAREER PROFILES

14 Calculate Your Wildlife Career Profile

Individual-Action-Innovation

You're a creative individualist who could produce amazing products or research. You'll be happiest if you can pursue your wild ideas away from schedules and big businesses. Career possibilities include the following:

- Wildlife photographer for a nature or an environmental magazine
- · Field biologist who studies lions in Africa
- Nature artist who uses recycled materials to make collages
- Designer of eco-friendly clothing

Individual-Action-Process

You have the right skills to do important hands-on work. Best of all, you can be counted on to get the job done without a lot of supervision or support. Perhaps you'd like to be one of the following:

- Park ranger who monitors backcountry trails at a national park
- Wildlife inspector who monitors the U.S.-Mexico border
- Animal trainer who works with a captive breeding and release program for the California condor or some other endangered species
- Veterinarian who works at the a zoo and specializes in primate research
- Zoo keeper or aquarium staff member who feeds and works with manatees

Individual-Reflection-Innovation

For you, the perfect job puts you in some quiet, secluded setting where you're free to contemplate the world and to come up with creative ideas for making it a better place. Possible jobs include the following:

- Science or nature writer who does stories for an environmental magazine
- · Environmental history or science professor
- Environmental filmmaker who makes documentaries on the temperate rain forests of the Pacific Northwest

Individual-Reflection-Process

Your skills make you a great asset to many projects. You think clearly, keep a close eye on details, and help people turn ideas into action. Possible jobs include the following:

- Scientific researcher who studies the effects of toxic chemicals on beluga whales
- Librarian who works for an environmental organization
- Administrative assistant at a zoo or park
- Computer programmer who writes programs that monitor the population levels of endangered species

beluga whale

WILDLIFE CAREER PROFILES (Cont'd.)

14 Calculate Your Wildlife Career Profile

Group-Action-Innovation

You're skilled at guiding other people, motivating them to work and think hard, and making real improvements in the world. You might consider working as one of the following:

- Peace Corps Volunteer who works on environmental education projects in Africa
- · Director of a large internationally renowned zoo
- · Environmental educator at an urban nature center

Group-Action-Process

You like to be where the action is—talking and working with people on a regular basis. You have the right combination of energy and gregariousness to be one of the following:

- Environmental lobbyist who works on legislation related to endangered species
- Ecotourism guide who leads groups through the rain forest
- Salesperson who works at a store that sells environmentally friendly products and organic foods

Group-Reflection-Innovation

You have the makings of a true leader—someone who is a good thinker and knows how to motivate other people into action. You might consider being one of the following:

- Politician who works to create stricter environmental laws
- Project manager at a nonprofit organization that works to protect marine species
- Advertising executive who develops environmental public service campaigns

You're skilled at applying your mental sharpness to interesting problems and you enjoy working with a team whose members are as capable as you are. You have the makings of one of the following:

- Environmental lawyer who works with the National Park Service on developing and enforcing laws to protect biodiversity in parks
- Fund raiser for an environmental nonprofit organization
- Campaign organizer for environmentally related legislation

Worldwide, over \$400 billion is spent each year protecting the environment. That's enough to support hundreds of thousands of jobs!

ON THE JOB

THERE'S NO Place like home

Ramaz Gokhelashvili, Researcher and Conservation Center Director

When asked how many children he has, Ramaz Gokhelashvili answers, "Two. One is my 14-year-old daughter, and the other is my 7-year-old conservation organization." Ramaz is a trained ecologist and wildlife biologist, works as a lobbyist, and is the executive director of the Georgian Center for the Conservation of Wildlife (GCCW).

A native of Georgia (a country in the Caucasus region of central Europe), Ramaz became interested in biology through classes in junior high and high school. Camping and hiking were among his favorite things to do. At college, he continued to study biology and wildlife ecology, and he went on to teach science at the high school and college levels for several years. Through his studies and experiences, Ramaz became concerned about environmental issues in Georgia and decided the most important thing he could do was work to protect the biodiversity of his country—an area that is filled with an incredible variety of animals, plants, and ecoregions.

In 1993, Ramaz teamed up with other local and international conservationists to start the GCCW, a feat that he considers his greatest achievement. "The organization is helping to protect Georgia's environment through education, lobbying, and research," Ramaz explains. One of GCCW's major accomplishments was its lobbying work that helped persuade the parliament of Georgia to sign on to CITES, the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Today, Ramaz's organization continues to educate the public and to support CITES by producing guidebooks and materials for customs officers and for companies involved in wildlife trade. The organization also produces television programs that introduce CITES and wildlife trade-related issues to the public.

Conservation work in Georgia isn't without its difficulties, though. According to Ramaz, "The low level of public environmental awareness and the economic problems in my country are the main challenges to our work." Because of these problems, GCCW's latest focus has been on public education projects and on sustainable development initiatives. By helping Georgian citizens to better understand and appreciate the uniqueness of their country's biodiversity and the incredible natural resources that are available, Ramaz hopes that the public will become more motivated to take part in activities and programs to address environmental challenges.

Ramaz sees a future in which both wildlife and humans prosper: He hopes to continue working to maintain Earth's balance and, in turn, to help enrich people's lives. By collaborating with colleagues in other nongovernmental organizations (NGOs) as well as with government officials and scientists from around the world, Ramaz hopes to contribute to a brighter future for the world's biodiversity. For others who are interested in protecting endangered wildlife, Ramaz's advice is this: "Learn as much as possible about the field in which you want to work, but, more importantly, you should love what you're doing."

PANDAS AND TIGERS AND WHALES, OH MY!

Ginette Hemley, Vice President, Species Conservation, World Wildlife Fund

If you think it's important to protect endangered species such as giant pandas, tigers, elephants, whales, and rhinos, you'll be glad to know that Ginette Hemley is on the job. She works every day to save these and other species, and the places where they live, which are quickly disappearing. As a biologist, her idea of a healthy planet is one in which there is a diversity of species and habitats, and where people and other species live in harmony.

Ginette is the vice president of species conservation at World Wildlife Fund (WWF), one of the largest international conservation organizations in the world. As a vice president, Ginette manages WWF's international endangered species programs, which include initiatives to save rhinos, tigers, elephants, pandas, and whales—WWF's flagship species. Another important aspect of Ginette's job is her work to strengthen global policies and programs for endangered species, particularly those threatened by overexploitation and trade. In this controversial arena, Ginette advocates stronger legislation to protect at-risk species and to control illegal wildlife commerce. She also works to ensure that policy decisions are based on sound science. Ginette coordinates the projects that focus on WWF's flagship species and that are part of WWF's network-wide initiative that works to "leave our children a living planet."

Dealing with a controversial and difficult topic such as how best to protect endangered species and the habitats where they live can take its toll, but when asked about how she keeps a positive attitude, Ginette responds, "Despite the obstacles, we've seen progress, and any progress is encouraging. Sometimes you must measure it in small steps." Also, Ginette finds her job incredibly challenging, which keeps it interesting. "There's always something new cropping up, so I'm constantly stimulated."

How did Ginette end up with a career protecting endangered species? Her geologist father piqued her interest in science from a young age and she went on to study biology in college. With that background, Ginette came to Washington, D.C., to work as an intern at a conservation group. She then went to work with the enforcement division of the U.S. Fish and Wildlife Service. Ginette has been at WWF since 1984, and her experiences in working for the government as well as for nongovernmental conservation groups have helped her to discover the best and most effective ways to protect species at risk.

Ginette's advice to people interested in her line of work is to study or learn about ecology and the links between people and wildlife. She also recommends learning a second (or even a third!) language—half of WWF's staff is fluent in a second language.

It's not surprising that Ginette's life goals are tied to endangered species work, partly because her career is so stimulating and critical. Ginette says her idea of perfect happiness is "to always have enough challenging work to do-but not too much-and to be centered and focused on core values in my personal life as well as my professional life."

WALK WITH THE ANIMALS, TALK WITH THE ANIMALS Sharon Deem, Wildlife Veterinarian

Working as a field veterinarian for the Wildlife Conservation Society, based at the Bronx Zoo, Sharon Deem travels around the world in the name of conservation. When ecotourism and other human activities encroached on the gorilla habitat in central Africa, Sharon established a health-monitoring program for those animals. When an outbreak of disease occurred

among gazelles and brocket deer in Africa, Sharon studied the health of nearby domestic animals (such as cattle, sheep, and goats) to figure out if and how the diseases had spread between domestic and wild animals. When authorities in developing countries confiscate illegally caught animals such as macaws destined for the pet trade, Sharon works with rehabilitation centers that reintroduce those animals to the wild. She focuses on how to minimize the spread of disease from captive animals to their wild relatives.

Sharon often works in remote regions of the world, where trekking can be tough and communicating with people of different cultures and languages is challenging. One time, she was trying to ask an Izoceno-Guarani Indian in Bolivia to remove a sedated peccary from its hiding place in a log. Tugging on her earlobes, she tried to indicate that she wanted the man to pull the peccary out by its ears. But the man didn't understand began to mimic her gesture, pulling on his own ears. Eventually, they worked together to get the peccary out of the log. Throughout the rest of Sharon's stay, pulling on one's earlobes became a symbol signifying that one person didn't understand the other. Sharon says, however, that having cultural experiences like this one only add interest to her international work.

Sharon loved animals, ecology, and medicine from an early age, so working toward a veterinary career seemed like the natural thing to do. Sharon studied biology in college, went on to veterinary school, and then continued her academic training by getting a Ph.D. in veterinary epidemiology (the study of amimal diseases). Through all of this education, Sharon remained committed to her goal of working as a wildlife vet. In fact, she says that the best thing you can do if you're interested in a career like hers is to "keep an open mind to the larger picture of conservation even if little obstacles and defeats come across your path. Be committed to your interests and learn the issues through reading, observing, and doing."

It makes Sharon proud to feel that her work has made a difference in the long-term survival of species. Much of Sharon's work relates indirectly to wildlife trade issues because the organization she works for deals with the monitoring of poaching, the legal harvesting of wildlife, and the trading of bushmeat (selling wild animal species for human consumption). Sharon also advises people on the proper way to handle confiscated live animals.

Where does Sharon see herself in the future? "Working in the area of animal health and conservationin other words, doing pretty much what I'm doing now."

COMMUNITY CONSERVATIONIST

Al Liu, Regional Enterprise Development Specialist, Peace Corps Volunteer

What do corporate management, butterflies, and ecotourism have in common? All are part of Al Liu's job as a Peace Corps Volunteer in Amboro National Park, located in the tropical lowlands of eastern Bolivia.

Al works with community members and other Peace Corps Volunteers to develop ecotourism projects that help preserve Amboro, one of the most diverse natural areas in the Western Hemisphere. Although the biodiversity in Amboro is vast, the park also faces numerous threats. One of the greatest threats

is the hunting and collecting of endangered species. By working with local communities to start small ecotourism projects, AI and his team help create new business opportunities that promote conservation.

One of the most exciting projects that AI is involved with is starting a butterfly farm in one of Amboro's surrounding communities. The farm will supply chrysalises (butterfly pupae) to museums and exhibits in other countries that display live butterflies from tropical countries. The exhibits, known as butterfly houses, are becoming popular in North America and Europe because people love to see the beautiful, exotic butterflies and the brightly colored flowers that are displayed in these greenhouse-type settings.

Working as a Peace Corps Volunteer, AI has had the opportunity to explore many aspects of living in another country, and he says that learning how to communicate in another language has been exciting and difficult at the same time. Peace Corps Volunteers, who come from many different professions, work in positions that include teaching English, advising local business owners, educating students and government employees about the environment, and even training people as beekeepers. And AI's position is the perfect way for him to use his environmental knowledge, conservation training, and business savvy.

Al finds his work in international conservation very challenging and satisfying. He has degrees in international politics and corporate environmental management, which give him a strong background for his community business projects. But breaking into the international conservation field isn't easy. If you're interested in a job like his, Al's advice is to "get field experience, preferably in another country." He says, "You can learn a lot in school and also from a job, but it's often difficult to fully understand the challenges of conservation unless you're actually 'in the field'. Becoming a Peace Corps Volunteer is one great way to get overseas and have the opportunity to start your own conservation project and work with a community."

CRIME BUSTER

Bonnie Yates, Wildlife Forensic Morphologist, U.S. Fish and Wildlife Service

If you "do the crime"—smuggling or poaching wildlife, that is—Bonnie Yates will do her best to see you "do the time." Bonnie is a wildlife forensic morphologist at the U.S. Fish and Wildlife Service lab in Oregon. Wildlife forensic morphology is the study of form and function in the identifiable features of animals—like bones, fur, and feathers—in order to testify in court about wildlife law enforcement cases. So when law enforcement officials seize suspected illegal animal parts are beneficial.

illegal animal parts or products, it's Bonnie's job to figure out what animal was killed and how its body parts were used by the people who benefited from its death.

A typical day starts with Bonnie picking up a sealed evidence container and taking it to her lab to begin her analysis. But Bonnie never knows what may be inside the container. It might be a complete zebra hide, a fang hanging on a necklace, a few broken leg bones from a kill site, or a single hair taken from the suspect's dryer lint. Depending on the type of evidence, its size and color, and its completeness or fragmentation, Bonnie can immediately eliminate what it isn't. But to figure out what it is, she has to make comparisons with known items in her collection (such as different animal skulls or zebra skins from each of the endangered subspecies of zebra). Bonnie spends the rest of her day photographing the evidence, completing her notes, logging the data in a special computer program that tracks the cases, and writing up her report.

Bonnie has always been interested in animals, but she never imagined that she would end up in a lab solving wildlife crimes. In fact, she started out thinking she would become a veterinarian. When she was growing up, the only vet school in her home state did not admit women, so Bonnie shared her love of nature with others by becoming a teacher. Later, while working on her graduate degree, she started working in the lab of an anthropologist who analyzed animal bones from archeological sites. Bonnie was hooked on bones immediately! After working for many years as a zooarchaeologist—studying artifacts from archeological sites to identify which animals lived in particular areas, which animals were hunted by people, and how people hunted and used animals—it was natural for Bonnie to apply her wealth of knowledge to the work of the crime lab.

Bonnie realizes that her job is very unusual. Her unique lab is the only one of its kind in the country, and she is one of only three morphologists at the lab. But she notes that many states have departments in their crime labs that are devoted to wildlife crime. Bonnie says that other aspects of forensics besides morphology are just waiting for new specialists, including pathology, toxicology, molecular biology, and ballistics. Her advice? Find a mentor. "Natural teachers are just waiting for an interested student to knock on their doors or volunteer in their labs." Who knows? Maybe someday you'll be putting wildlife criminals behind bars, too!

Technology and Wildlife Conservation

Grades 10-12; R, S

The following article and the discussion questions will help students to explore how research scientists in different fields have collaborated in efforts to conserve wildlife.

Materials: copies of the following article, "Saving wild elephants through DNA research"

Related careers: field biologist/wildlife scientists, research scientist, molecular biologist, geneticist, conservation biologist, veterinarian

- Have students read the following article about the application of **DNA** research to elephant conservation (Science 3.2). As a class, research and/or discuss the following topics:
- 1. What are the main threats to the survival of elephants in the wild? Are the threats the same in Africa and in Asia?

- 2. What are the effects of poaching on elephants and their social systems? (It may be necessary to research elephant social systems in order to discuss this question.)
- 3. How would developing a system to determine the origin of ivory help to protect elephants?
- 4. Would the tracking of ivory be possible without the aid of DNA research?
- 5. List the scientists who collaborated on or were involved with this project and their respective organizations or agencies. How do you think these scientists came to work together? Do you think they could have achieved the same results without collaborating? What are some of the benefits of scientific collaboration?

Saving wild elephants through DNA research

BY WARREN KING, SEATTLE TIMES MEDICAL REPORTER Copyright © 2000 The Seattle Times Company Used with permission. Health & Science: Tuesday, August 22, 2000

In the heart of Seattle, research scientists are doing their part to save some of the earth's most magnificent beasts: the wild elephants of Africa. Researchers at the University of Washington and the Fred Hutchinson Cancer Research Center are developing a system of DNA fingerprinting to identify ivory poached from the forests and savannas of Africa. "There is incredible pressure on elephants all over. ... It is vital to track the consequences of the ivory trade," says Dr. Sam Wasser, the UW scientist who is director of the project and a veteran researcher of animal behavior in Africa. Wasser and Dr. Kenine Comstock, a Hutchinson Center molecular biologist, are confident their system will be able to pinpoint the specific geographic origin of any piece of ivory. They hope the project will help curb the illegal ivory hunting that has increased in recent years and help scientists learn more about the migration of elephant herds.

Wasser had the idea for the project when he saw firsthand the devastation of elephants in Tanzania, where he worked for 27 years as a researcher. He still visits every year. Small groups of females wander through savannas and forests without a herd, their social system destroyed by the killing of tusk-bearing matriarchs. Herds have learned they must forage in less-preferred habitats to avoid hunters. Many juvenile elephants die young from inadequate nourishment. Tuskless males and females are increasing in number as poachers have killed off the animals that carry the ivoryproducing genes. "There are some herds with as many as 40 percent of the adults without tusks," says Wasser, who has studied the longterm effects of elephant poaching. Ivory hunting has long been a plague on elephants. In the 1980s, it reached devastating proportions as the United States and Asian ivory markets took off. From 1979 to 1986, the African elephant population had plummeted from 1.3 million to 600,000. In 1989, the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), a United Nations-sanctioned group, prohibited all international sales of ivory, and governments backed the ban. Conservationists rejoiced, but a false sense of security led to a significant reduction of enforcement within a few years. And poaching continued: The wars of central Africa made guns more available and increased logging in Zaire, the Congo, the Central African Republic and other areas thinned the forest canopy, exposing elephants more to poachers. In 1998, CITES granted a request from the governments of Namibia, Botswana and Zimbabwe to allow a one-day sale of stockpiled ivory from elephants that died of natural causes. The governments said they

needed the money to finance culling of some of their overpopulated elephant herds. The animals were suffering from food shortages and sometimes raiding farms and villages. Wildlife officials killed hundreds of the animals, mainly from helicopters with automatic rifles. The rumor on the street and in the bush was that the ivory trade ban was lifted everywhere. Poachers became more active. And even when they learned the truth, they hunted anyway, hoping another sale would be allowed. Requests to CITES for another sale, expanded to include South Africa, were withdrawn last spring when it was apparent other countries didn't support the move.

As conservationists' concerns about poaching increased, Wasser, the veteran wildlife scientist, secured matching grants from the Woodland Park Zoo's Center for Wildlife Conservation and the U.S. Fish and Wildlife Service for a total of \$168,000. Then he enlisted Comstock to help develop the ivory- identification system. Comstock works in the Hutchinson Center lab of Dr. Elaine Ostrander, a cancer researcher who also has an interest in wildlife conservation. Ostrander, head of the geneticsgenomics program at the center, is playing a significant role in the project with her technical expertise in genetics. "There have been so many exciting advances

in technology due to the humangenome project that I guess my lab feels it's sort of our personal responsibility to make sure those advances get passed on to the many places where they can do good," says Ostrander. "Compared to cancer research, conservation biology is relatively poorly funded. If we can spend a bit of our own time and energy to help ... I guess that's important to us."

Comstock and Wasser are building a map to show the origin of specific elephant DNA fingerprints. These are composed of panels of "markers" - or patterns in the DNA - that are highly variable among elephants and help pinpoint their geographic origins. "We're basically using the same technology that is used in human forensics - the technology similar to what was used in the O.J. Simpson trial," says Comstock. The scientists are using as a base for their map about 700 elephant DNA samples collected by Dr. Nick Georgiadis, director of the Mpala Research Center in Nanuki, Kenya. Georgiadis accumulated the DNA as he studied differences between forest and savanna elephants. The DNA samples are from countries that contain about 80 percent of Africa's elephants and represent a substantial number of herds. Wasser and Comstock will also use DNA from fecal samples to build the map. For example, there is no DNA in the Georgiadis collection from Zambia or Mozambique. Dr. Ben Mutayoba, a scientist at Sokoine University in Tanzania, who trained with Wasser at the UW, will extract the DNA from feces collected by

park rangers in different countries. The goal is to have more than 90 percent representation of all African elephant herds. "We need to convince governments that what we have is accurate," says Wasser.

A major obstacle in the project was finding a way to extract DNA from all parts of a tusk, from the base to the tip, a technique that had eluded other scientists. The researchers learned of a method developed by Dr. David Sweet, a forensic scientist for the government of British Columbia, to take DNA from human teeth for use in criminal investigations. They were eager to take ivory samples to Sweet's lab in Vancouver, but U.S. Fish and Wildlife Service officials prohibited the transport of ivory across the border. Sweet instead brought equipment from his lab to the Hutchinson center. Then Comstock adapted his technique to remove ivory DNA. Another hurdle was learning how to pulverize pieces of ivory so the DNA could be extracted. Using a saw to create ivory dust for analysis didn't work because the heat generated by friction destroyed the DNA. The researchers used equipment from Sweet and the U.S. Fish and Wildlife Service that submerges pieces in liquid nitrogen, keeping the ivory cold, brittle and easy to pulverize.

Once Wasser and Comstock complete their DNA map, they will test its accuracy with ivory from known locations in Africa. They hope they will have the system up and running within about a year. The system will be limited by the

fact that a number of elephant herds wander back and forth across national borders. Thus, if another sale is allowed, a piece of ivory could mistakenly be identified as poached, says Dr. Richard Ruggiero, program officer for the U.S. Fish and Wildlife Service's African Elephant Conservation Fund in Washington, D.C. Wasser says the system still will be able to pinpoint the geographic origin of most African ivory. And he predicts the identification system will expand to Asia, where about 5 percent of the world's elephants live and where they are even more threatened than in Africa. Ruggiero also has great confidence in the system's ability to help stem poaching of elephants. "It has the potential to be the most useful tool available to us, in terms of technological advancements in conservation," says Ruggiero.

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