Teacher's Packet

ZooScope

OREGON ZOO

Portland, Oregon

AUTHOR/EDITOR: Charis Henrie
DESIGNER: Audrey Johnson

PHOTOGRAPHS BY: Michael Durham
AMUR LEOPARD PHOTOGRAPHS TAKEN BY: Patricia Gayle

PRODUCED BY:
The Education Division
OREGON ZOO
4001 SW Canyon Road
Portland, OR 97221

OREGON ZOO

March 2000
Metro Publication #2000 10318.Zooe

Printed in the United States of America

TABLE OF CONTENTS

COPY PAGE

Notes:

TEACHERS:

This curriculum was created to provide background and activities for teaching inquiry-based science in the classroom and the Zoo. We have created the ZooScope program to provide students with hands-on and minds-on activities that are crucial to taking theoretical learning into the real world. The hope is that as students begin asking about the animals they see, they will want to learn more and will be able to use the skills developed here to create their own research projects. Science becomes real when students are able to make the leap from science in the classroom to activities outside the school building.

The activities in this book are ready-made for upper elementary and middle school students but many of the activities are easily adapted for younger and older students. To assist you in getting the most out of this curriculum we have included:

- background information for teachers
- pre and post visit activities
- on-grounds activities to use at the Zoo
- data sheets and sample graphs
- background information on each of the animals featured in the questions
- a reference section which includes additional sources of information

We hope these materials help you and your students gain a better understanding of the Zoo and the science that occurs here.

Enjoy your visit!

Oregon Zoo Education Team

WHAT IS ZOOSCOPE?

ZooScope is a program to get students involved in inquiry- based learning. Using animals as the focus, ZooScope involves students in the steps of the scientific method in an informal, non-threatening manner. hopefully as students begin watching animals and their behaviors they will begin asking their own questions.

This program was specifically designed to be approachable and "user friendly". Our goal is to make science personal, understandable and usable by all people, not just an activity relegated to professionals in a laboratory.

Why Observe Animal Behavior?

Young people seem to be drawn to animals. ZooScope capitalizes on this natural curiosity to introduce students to the methods of science and behavioral research. ZooScope provides students an opportunity to observe animals and help answer questions that the animal care staff are really asking.

Zoos make it possible to study animals in ways that may not be possible in the wild. In zoos we can monitor each animal's diet, closely observe behaviors, better monitor mother-infant interactions, observe infant development and more. However, zoos cannot recreate all aspects of an animal's wild environment. When we observe animals at the Zoo, we always have to ask ourselves, "Is this what would happen in the wild?" Once scientists identify behaviors in the Zoo, they can look for those same activities in wild populations.

Behavioral observations done at zoos have implications for both captive and wild populations. Here at the Oregon Zoo, researchers detected infrasonic (very low frequency) sounds being emitted from our elephants. Scientists went into the field to see if they could detect the same sounds. It was discovered that elephants (and several other large animals) use very low frequency sounds to communicate over long distances or when visibility is poor (i.e. underwater). This is a good example of how a discovery initially made in a zoo lead to additional discoveries about animals in the wild.

You and your students may or may not discover revolutionary new information. Our goal is to get them to view the scientific process as something in which ANYONE can participate. By using our animals as the hook we hope your students will begin to ask questions about the world around them. Who knows, someday they may make a great discovery, using skills that began with ZooScope.

What is Scientific Inquiry and the Scientific Method?

A discussion about observing animal behavior can lead to the importance of developing good science inquiry skills. When students begin to ask questions about their observations, a logical next step is to develop a process to discover the answers for themselves. The scientific method is a universally accepted process for answering questions about the unknown.

Building Blocks of Scientific Inquiry

Detailed scientific inquiry builds on basic skills. Some of the building blocks for inquiry include:

- **Measuring** (distance, volume, weight, time, frequency, etc.)
- **Observing** (using senses to gather information, sight, hearing etc.)
- **Classifying and Sorting**
- **Organizing Data**
- **Manipulating Data** (counting, adding, subtracting, multiplying, finding ratios, calculating percentages)
- **Controlling Variables**

These skills come in degrees of difficulty. Even the youngest students can graph using picture symbols or add by counting the symbols. If you have a wide range of abilities in your class, each individual or group can conduct the studies using different methods and skill levels.

The Seven Steps in the Scientific Method

1 **Observe**
Make accurate observations of events and objects.

2 **Question**
Identify problems and develop testable questions related to the problem.

3 **Hypothesis (Prediction)**
Use information and questioning skills to generate a statement describing expected results of investigation.

4 **Experiment / Data Collection**
Collect data from an experiment in an accurate and routine manner.

5 **Data Interpretation**
Interpret data by trying to find patterns or meaning in experimental results.

6 **Review your Prediction (Hypothesis)**
How does the data you collected affect your hypothesis?

7 **Report your findings**
Inform others of your findings. Professional scientists usually write papers for professional journals or other scholarly publications. In recent years they may post findings on the world wide web.

Pre-Visit Activities

Writing a Research Question

Writing a good research question is not as easy at it seems. Scientists spend a great amount of time developing clear and concise questions. When writing a research question you should consider four points.

A good scientific question should be:

1 **Interesting to the researcher.** Avoid asking questions that you think would be interesting to someone else. The question should be something you want to know. The most interesting questions are often related to everyday activities or events. For example, "How fast does an apple fall when dropped?"

2 **Simple and Straight Forward.** One of the most difficult tasks of preparing an experiment is asking a good question—one that does not have too many variables. Questions with many variables are difficult to answer in one experiment, because it is difficult to determine which variables are affecting the results.

3 **Answerable (& Practical).** The question needs to be capable of measurement or observation within the limits of time and equipment available. Don't design an experiment to look at the stars unless you have a telescope!

4 **Quantifiable (Measurable).** Most questions asked in science are valuable only if they can be measured. Good scientific questions ask "How much?", "How far?", "How many?", etc. Questions that ask about feelings, motivations, or purposes cannot be directly measured and are not good research questions.

Name

Questions:

Decide which of the following questions are good scientific questions to ask at the Zoo. Why or why not?

1. **What do bears eat?**

2. **What is the effect of visitor numbers on mole rat behavior?**

3. **Why can't penguins fly?**

4. **Why does the zebra have stripes?**

5. **What is the leopard's favorite game?**

6. **Which animals are the most bored / happy in the Zoo?**

7. **Where do the bats hang out most?**

8. **With which parent does the mongoose lemur infant spend the most time?**

9. **How does temperature affect the behavior and food preference of male bats when different numbers of visitors are present?**

Teacher's Answers

1. What do bears eat?
This might be difficult to answer in the Zoo because most people don't get to see the animals eat. Simply asking a keeper or reading a book is not science. This would be a good question to ask if you were studying bears in the wild, and were able to follow them and observe them eating.

2. What is the effect of visitor numbers on mole rat behavior?
This is a good question that is important to the care of zoo animals. Be careful though, just showing a correlation between the number of visitors and mole rat behavior does not prove that the people caused the change in behavior (Could it be the other way around? How could you determine who affects whom?).

3. Why can't penguins fly?
Too difficult of a question to answer in the Zoo! What can you observe/measure that will answer this question?

4. Why does the zebra have stripes?
Again, this is hard to answer in the Zoo. Possiblities include camouflage and confusing predators, but these would be difficult to test in the Zoo.

5. What is the leopard's favorite game?
What is "favorite" and how do you measure it? Try to rephrase it in more measurable terms. You might ask, "With which of the moveable objects in the exhibit does the leopard interact with the most?"

6. Which animals are the most bored / happy in the Zoo?
What does bored/happy mean? How can it be measured? What could you measure that might shed light on your question? You might think about measuring activity, sleep, play behavior, or pacing. Can this question be re-phrased to be a good research question?

7. Where do the bats hang out most?
This is a question about habitat preference. Where do the bats spend the most time and what are the characteristics of this place. This is a good question because it is easily answered and it produces information that might apply to other situations (other bat exhibits).

8. With which parent does the mongoose lemur infant spend the most time?
This is also an easily answered question (as long as you can tell the parents apart). The answer to the question is useful because it helps us to understand what happens as an infant grows up.

9. How does temperature affect the behavior and food preference of male bats when different numbers of visitors are present?
This question might be difficult to answer in a short period of time since it is asking about many variables. It might be best if this was divided into four different questions. Remember—Keep it Simple!

EXTENSION

Have the students turn bad questions into good ones, or try writing some of their own. Have a group or the whole class review them.

Getting ready for your Zoo visit...

A FEW DAYS BEFORE YOUR FIELD TRIP

- ☐ Make copies of the map you received in your teacher packet. Use it as part of a map reading activity to help your students understand the layout of the Zoo.
- ☐ Brainstorm what you think are the rules of the Zoo. Discuss why the Zoo has rules *(most are for the safety of visitors and animals)*. Talk about appropriate behavior around animals.
- ☐ Establish your rules of conduct. Help students decide what are appropriate behaviors and activities for them.
- ☐ Review the principles of the scientific method and data collection.
- ☐ If your students will be working in groups, establish them in advance. Let each student practice their role in the group *(timer, recorder, observer etc...)*. Let the group determine what other animals they would like to study. Have them develop their own research question, or use one of ours.
- ☐ Familiarize students with your schedule for the day. What do they need to bring *(worksheets, pencils, lunch etc...)*? When will you leave school? When will you return? WHEN IS LUNCH? Where will you meet for lunch? *(Please refer to the Planning Checklist you received with your confirmation letter)*

Teacher's Note:
If possible, brief chaperones in advance. Let them know what the students will be doing and the events of the day.

ON THE BUS TO THE ZOO

- ☐ Review expectations one last time. Let them know there might be a slight delay at the gate while you are taking care of paperwork.
- ☐ Make sure everyone knows the schedule for the day. Write it down for the chaperones!
- ☐ Check to see that everyone has brought their supplies to complete their activities *(it might not hurt to have a few extra worksheets and pencils).*
- ☐ Prepare your chaperones in advance. Let them know the students will be working on ZooScope activities. Encourage them to participate by collecting their own data or helping the students. Give them the discussion questions listed on page 11 to help the students focus on each station.
- ☐ Arrive at the Zoo and let the FUN begin.

Activities at the Zoo

While you are on Zoo grounds have your students collect data they can take back to the classroom.

Some ideas that may help your students as they move around the Zoo:

- Have them work in teams to collect data. Appoint a recorder, timekeeper and observer for each team.
- Divide the questions between the groups. Have groups report back to the class about the question they studied when they return to school.
- Prepare your chaperones in advance. Let them know the students will be working on ZooScope questions.
- Encourage chaperones to participate by collecting their own data or helping the students. Give them the discussion questions listed below to help the students focus.

Discussion Questions

While they are at the Zoo students should spend some time observing the animals, collecting data and examining the results of our studies. Some questions to assist in these tasks include:

- Observe the animals. What kinds of behaviors do you see them doing?
- How do they interact with other animals in the exhibit? With the exhibit itself?
- Why did the Zoo choose this animal to study?
- What does the data that has been collected mean?
- What conclusions can be drawn from the data?
- Are there additional questions the Zoo should ask to help clarify the information?
- Do you think we would get the same results studying these animals in the wild?
- What are some of the factors that affect the behavior of animals in zoos compared to those in the wild?

Remember...

The ZooScope questions only cover five animal areas. Encourage your students to view the other animals.

Can they relate the behaviors of the ZooScope animals to some of the others they see?

ZooScope
STATIONS

Teachers Note:

Not all questions may be developmentally appropriate for your students. Use the following pages to determine which questions will allow your students to be successful.

AFRICA SAVANNA

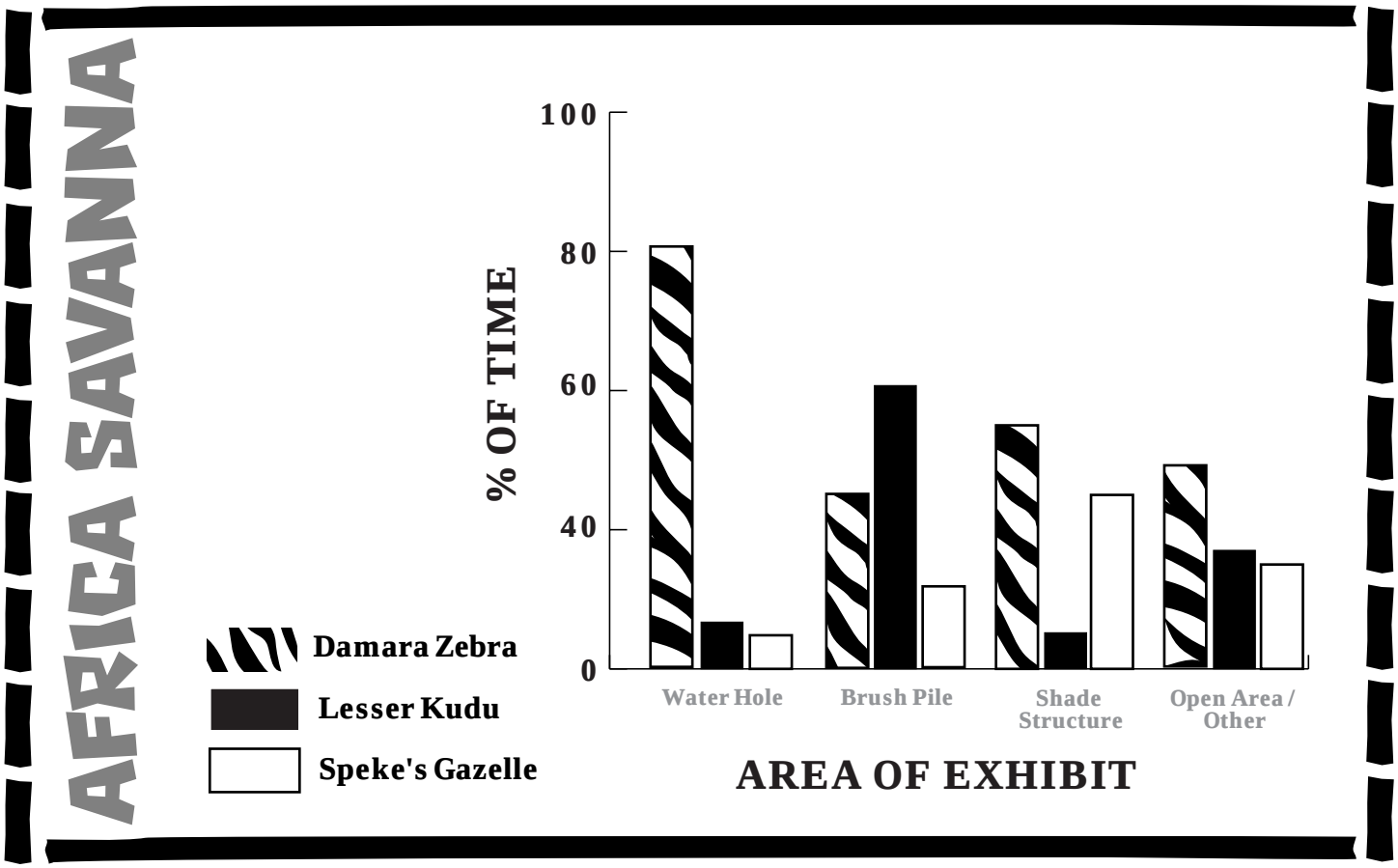
Introduction

The Damara Zebra, Lesser Kudu and Speke's Gazelle are on exhibit together. We would like to know how the different species use the exhibit.

Question?

Which parts of the Savanna exhibit are used by the Damara Zebra, Lesser Kudu and Speke's Gazelle?

SAMPLE GRAPH



What do the Graphs Show?

Which area of the exhibit is used most often?

If you were trying to locate the lesser kudu, where would you look first?

Things to Think About

What might happen if two different species preferred the same area of the exhibit?

Why is it important to build many different features in an animal enclosure?

AFRICA SAVANNA DATA SHEET

QUESTION?

Which parts of the Savanna exhibit are used by the Damara Zebra, Lesser Kudu and Speke's Gazelle?

HOW TO DO AN OBSERVATION

1) Write how many of each animal you see within one body length of each location
2) Animals not near the waterhole, brush pile or shade structure are considered in the open area

Date _____

Time of Day _____

	Water Hole	Brush Pile	Shade Structure	Open Area / Other
Damara Zebra				
Lesser Kudu				
Speke's Gazelle				

AFRICA SAVANNA DATA SHEET

QUESTION?

Which parts of the Savanna exhibit are used by the Damara Zebra, Lesser Kudu and Speke's Gazelle?

HOW TO DO AN OBSERVATION

1) Write how many of each animal you see within one body length of each location
2) Animals not near the waterhole, brush pile or shade structure are considered in the open area

Date _____

Time of Day _____

	Water Hole	Brush Pile	Shade Structure	Open Area / Other
Damara Zebra				
Lesser Kudu				
Speke's Gazelle				

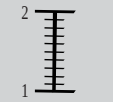
DAMARA ZEBRA

Adaptations / Coloration

- black and white striped with shadow stripes between
- unstriped belly and lower legs
- short bristle-like mane

Behavior

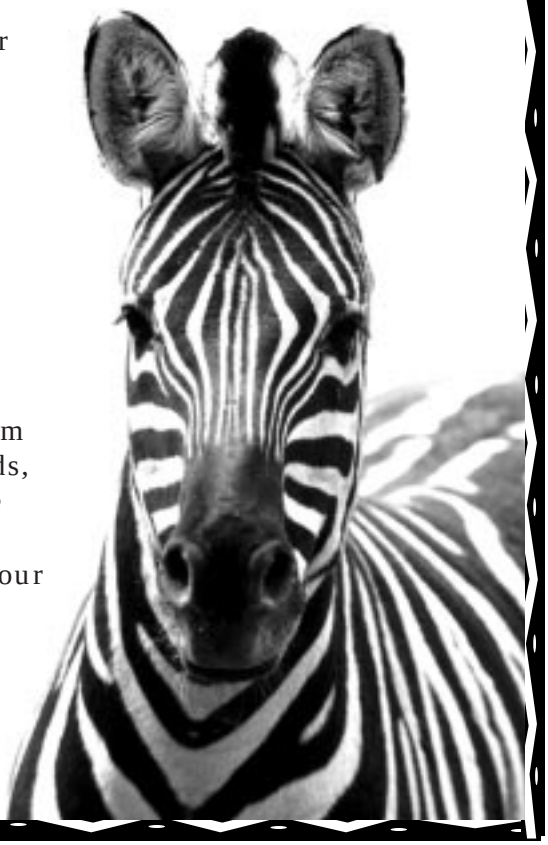
- social group is a harem with one stallion, 2-6 mares and young
- mares associate with one stallion for life
- mares form hierarchy in order of acquisition by stallion
- bachelors live singly or in bachelor herd
- perform social grooming, scrapping and nibbling neck, shoulders and back
- oldest mare leads family with stallion at rear to protect and direct
- herd adjusts pace for sick or crippled members



47”-55” tall from shoulder

Weighs 640-750 lbs.

- associations: gregarious, form large herds in several hundreds, often with wildebeest, antelope and ostriches
- speed: up to 40 miles per hour
- alarm signal: yelping bark



DAMARA ZEBRA

Reproduction / Lifespan

- lifespan: over 20 years
- sexual maturity: 2.5-3 years, males may not form harems until 6 years or older
- stallion steals filly from father's herd, she may be stolen again by another until impregnated
- after birth of first foal, subsequent estrus not as obvious
- mating: only stallions with harems will mate
- pregnancies can occur once a year but usually every 2 or 3 years
- gestation: approximately 370 days
- young: usually one, mother keeps rest of herd away for several days until foal bonds with her

Wild Diet

- savanna grasses, occasionally browse on leaves, bark, roots and stems
- graze singly at night for about one hour at a time
- drink water during day

Zoo Diet

- grass hay, assorted browse

Habitat / Range

- savanna grasslands of eastern Africa
- home range 11-232 square miles
- may cover 10 miles a day

Status

- population stable

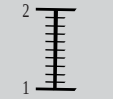
LESSER KUDU

Adaptations / Coloration

- males are deep yellowish gray, two white patches on throat, 11-14 vertical body stripes, horns 20-28 inches long
- mature males are blue-gray and get darker with age
- females are generally smaller, no horns, fawn colored

Behavior

- females live in family groups of 2-3 cows and their off-spring
- during mating season; males join females in herd
- browse in early morning and evening, retreat to brush in heat of day
- young males may live in pairs or small groups
- mature males avoid each other but may have overlapping ranges



64-70 inches long
36-42 inches high at the shoulders

Weighs 123-238 lbs.

LESSER KUDU

Reproduction / Lifespan
- gestation: 7-8 months
- usually single calf
- female leaves herd for birth and keeps calf away from herd for several days
- breeding: bulls fight for females, can lock horns and die

Wild Diet
- browse brush

Zoo Diet
- pellets, alfalfa, assorted browse

Habitat / Range
- thornbrush and arid timber-clad hills of eastern Africa
- found in Ethiopia and Somalia through Kenya to central Tanzania

Status
- not listed

More amazing facts!
- can leap almost 10 yards or clear bush 1.5 yards high and 2 yards in diameter

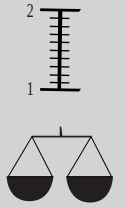
SPEKE'S GAZELLE

Adaptations / Coloration

- light grayish brown with a black flank stripe and a paler band above it
- white buttocks with dark margins
- pale face
- three to five folds of skin in nasal region, inflatable to the size of half a tennis ball, inflated to make an alarm call which sounds like a pistol shot.
- horns with broad band: males 10-12.4" curving backwards in an "S", females 6-10" straighter, steeper and thinner than male

Behavior

- active at dawn and dusk
- gather in family groups up to 20, number depends on amount of vegetation available



1.6-2 feet tall from shoulder
3.1-3.5 feet long

Weighs 33-55 lbs.

SPEKE'S GAZELLE

Reproduction / Lifespan
- gestation: 6-7 months
- single calf
- average birth weight 2.75 lbs.
- wean after 2-3 months
- sexual maturity: female 9 months, males 18 months
- lifespan: 12 years

Wild Diet
- grass, herbs, shrubs and succulents

Zoo Diet
- herbivore pellets, grains, hay

Habitat / Range
- stony brush, grass steppes, semidesert
- current population on horn of Africa, on the Indian Ocean side of Somalia
- former range included eastern Ethiopia

Status
- considered vulnerable

More amazing facts!
- main predators: cheetah, lion, wild dog, leopard, hyena, python
- hunted by humans for food
- habitat modifications have adversely affected populations

Notes:

AFRICAN BIRDS

Introduction

We have recently changed the way we feed birds in the aviary. The foods have been separated with a different mix in each bowl. We would like to know which birds are using each dish to make sure our new method is working properly.

Violet Plantain Eater

Red & Yellow Barbet

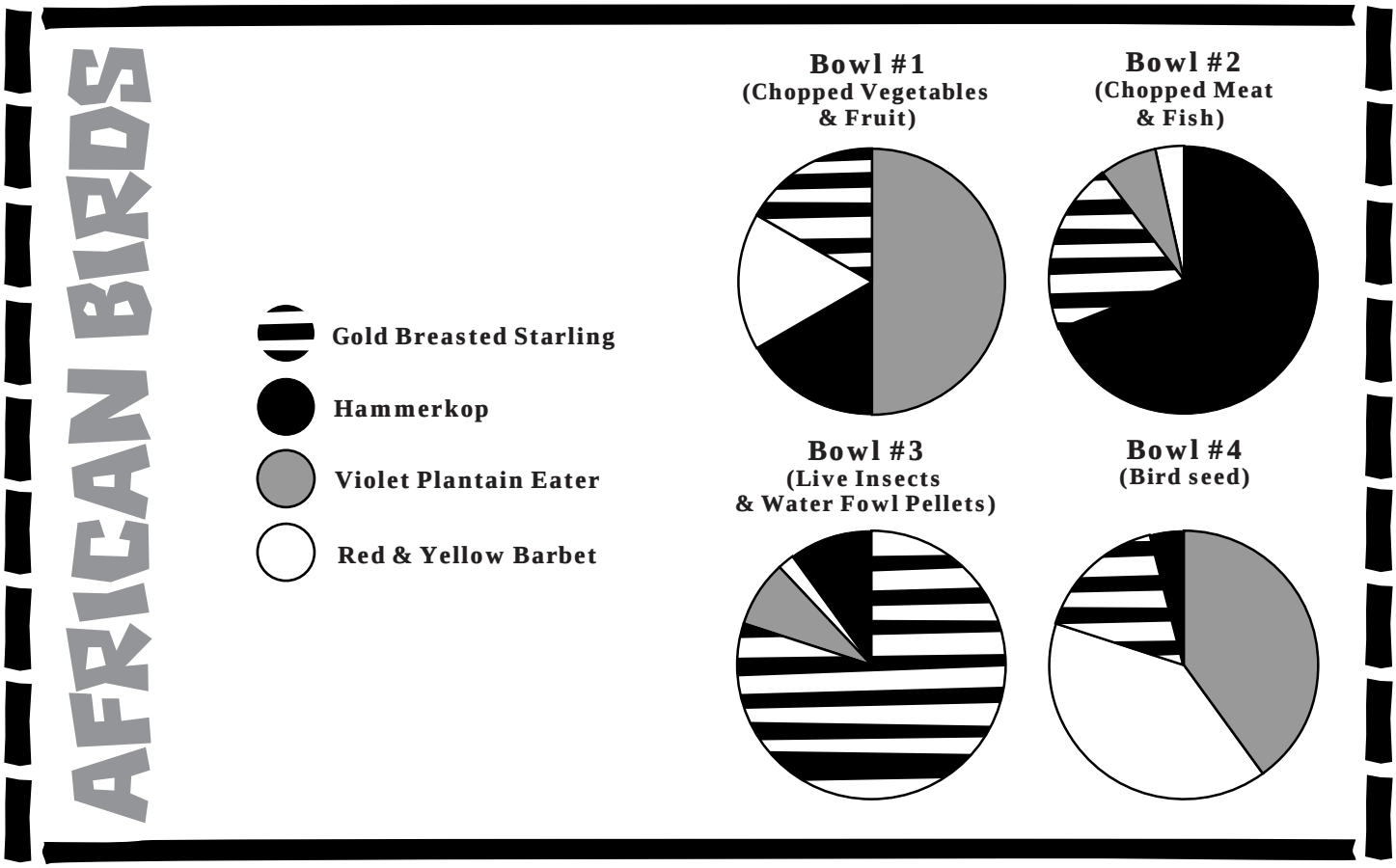
Hammerkop

Gold Breasted Starling

Question?

Which food dish does each African bird prefer?

SAMPLE GRAPH



What do the Graphs Show? Which dish does the hammerkop use most often?

Which bird visits dish #4 most frequently?

Things to Think About Why might different birds prefer different foods?

Why do we put different food mixes in separate dishes?

COPY PAGE

AFRICAN BIRDS DATA SHEET

QUESTION?

Which food dish does each African bird prefer?

HOW TO DO AN OBSERVATION

1) Pick a bowl to observe
2) Identify one (or several) species of bird
3) Count the number of individuals at the bowl
4) Record in the correct box

Date _____

Time of Day _____

	Bowl #1 (chopped vegetables & fruit)	**Bowl #2** (chopped meat & fish)	**Bowl #3** (live insects & waterfowl pellets)	**Bowl #4** (bird seed)
Gold Breasted Starling				
Hammerkop				
Violet Plantain Eater				
Red and Yellow Barbet				

AFRICAN BIRDS DATA SHEET

QUESTION?

Which food dish does each African bird prefer?

HOW TO DO AN OBSERVATION

1) Pick a bowl to observe
2) Identify one (or several) species of bird
3) Count the number of individuals at the bowl
4) Record in the correct box

Date _____

Time of Day _____

	Bowl #1 (chopped vegetables & fruit)	**Bowl #2** (chopped meat & fish)	**Bowl #3** (live insects & waterfowl pellets)	**Bowl #4** (bird seed)
Gold Breasted Starling				
Hammerkop				
Violet Plantain Eater				
Red and Yellow Barbet				

AFRICAN BIRDS

Violet Plantain Eater

- glossy purple feathers cover this 20-inch-tall bird
- other features include a red bill, yellow front, and bare red skin around the eye, with a white stripe

Gold Breasted Starling

- this 14-inch-long bird has a small head with yellow eyes and slender bill
- feathers are glossy green, blue and violet on the head, neck and upper body
- chest is bright golden yellow
- tails are black, long and wedge shaped

Red and Yellow Barbet

- red bill and head
- white ear patches contrast with black and white speckled upper body and neck
- body is bright yellow

Hammerkop

- a large brown body sits on top of long black legs, making this bird 22 inches tall
- a “hammer shaped” crest of backward facing feathers on its head is very noticeable
- long slender black beak

AMUR LEOPARD

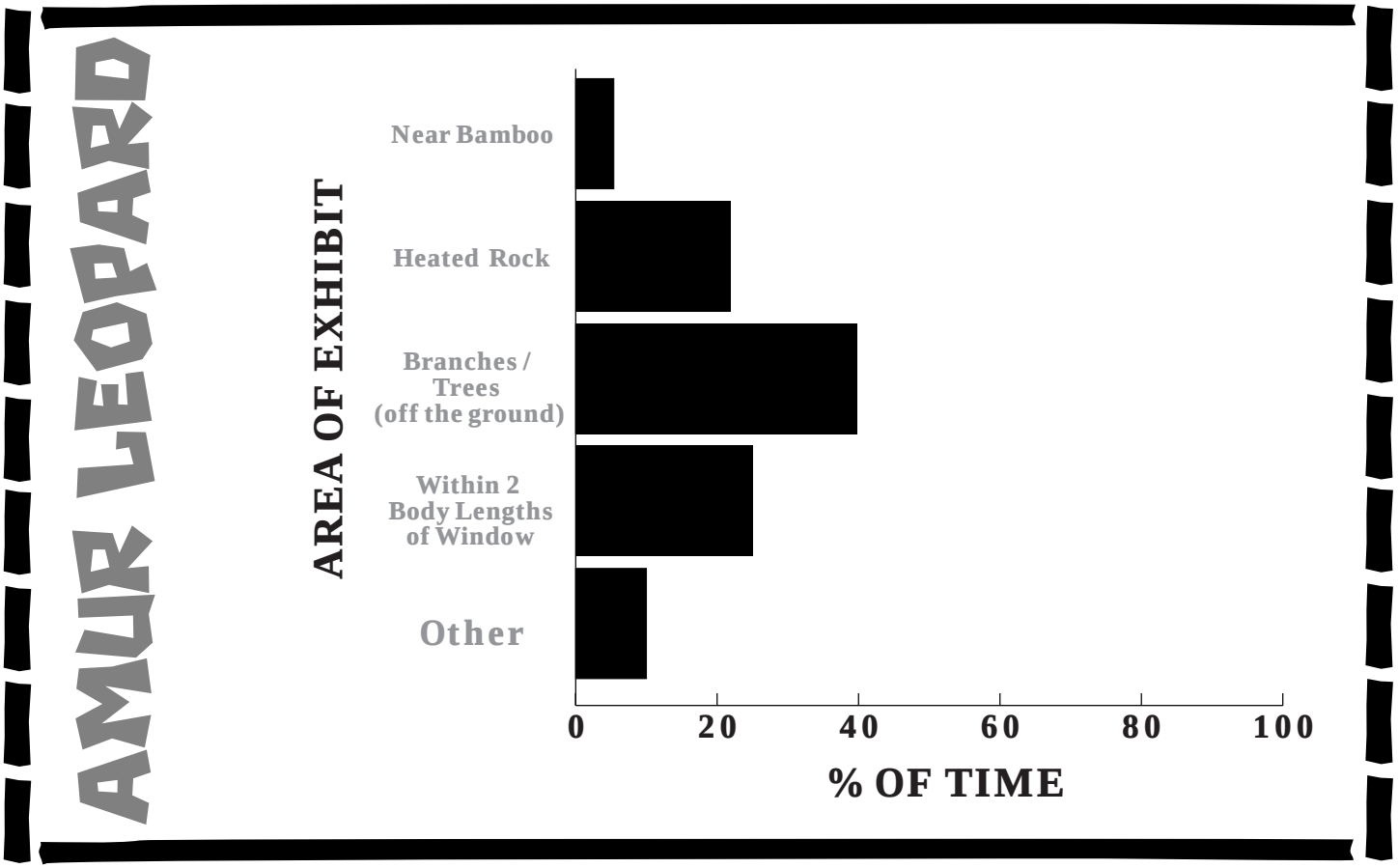
Introduction

Just before the Amur leopards arrived we renovated their exhibit. We would like to know how they are using their new exhibit.

Question?

In which area of the exhibit do the Amur leopards spend the most time?

SAMPLE GRAPH



What do the Graphs Show?

How much time do the leopards spend on branches off the ground?

Do they spend more time near the window or on the heated rock?

Things to Think About

Why are there so many different objects in the leopard exhibit?

Why might the leopards prefer one area more than another? What outside influence might affect their preferences?

AMUR LEOPARD DATA SHEET

QUESTION?

In which area of the exhibit do the Amur Leopards spend the most time?

HOW TO DO AN OBSERVATION

1) Choose a leopard to observe
2) Every 15 seconds, place an "X" in the square that best describes the leopard's location

Date _____

Time of Day _____

	Near Bamboo	On Heated Rock	On Branches / In Trees (off the ground)	Within Two Body Lengths of the Window	Other (please describe)
:00 seconds (start)					
:15 seconds					
:30 seconds					
:45 seconds					
1:00 minute					

AMUR LEOPARD DATA SHEET

QUESTION?

In which area of the exhibit do the Amur Leopards spend the most time?

HOW TO DO AN OBSERVATION

1) Choose a leopard to observe
2) Every 15 seconds, place an "X" in the square that best describes the leopard's location

Date _____

Time of Day _____

	Near Bamboo	On Heated Rock	On Branches / In Trees (off the ground)	Within Two Body Lengths of the Window	Other (please describe)
:00 seconds (start)					
:15 seconds					
:30 seconds					
:45 seconds					
1:00 minute					

AMUR LEOPARD

Adaptations / Coloration

- fur reddish-yellow in summer; lighter in winter
- spots are widely spaced rosettes with thick borders
- long legs and hair help to survive in snowy conditions

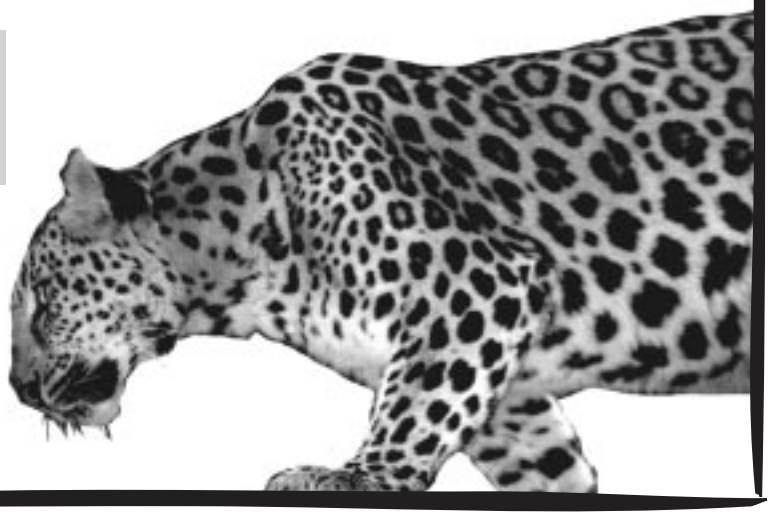
Behavior

- solitary (marks territory with urine)
- nocturnal
- eats alone, will hide food for later
- good climber
- strong swimmer
- great jumper (20' horizontally & 10' vertically)
- territory up to 30 square miles

Reproduction / Lifespan

- lifespan in captivity 23 years; less in the wild
- sexual maturity: approximately 3 years
- breeding season: January-February
- gestation: 90-105 days
- litter size: usually 2-3, but as many as 6
- cubs open their eyes in approximately 10 days
- weaned at approximately 3 months
- leave mother at 18-24 months

MALES 82-198 lbs.
FEMALES 62-132 lbs.



AMUR LEOPARD

Wild Diet
- roe deer, wild boar, sika deer, musk deer and hares

Zoo Diet
- meat, bones, vitamins, enrichment treats

Habitat / Range
- rocky mountain woodlands
- SE Russia, North Korea, Manchuria, Amur River Valley (currently only in a small area on the Russia/China border)
- range overlaps Siberian tiger

Status

CRITICALLY ENDANGERED (less than 50 in the wild) due to habitat loss (major factor) and encroachment of civilization; poaching is also a concern

More fun facts!
- farthest north of all leopard subspecies
- since Amur leopards share the range of Siberian tigers, efforts to save tigers will also protect leopards

Notes:

ASIAN ELEPHANT

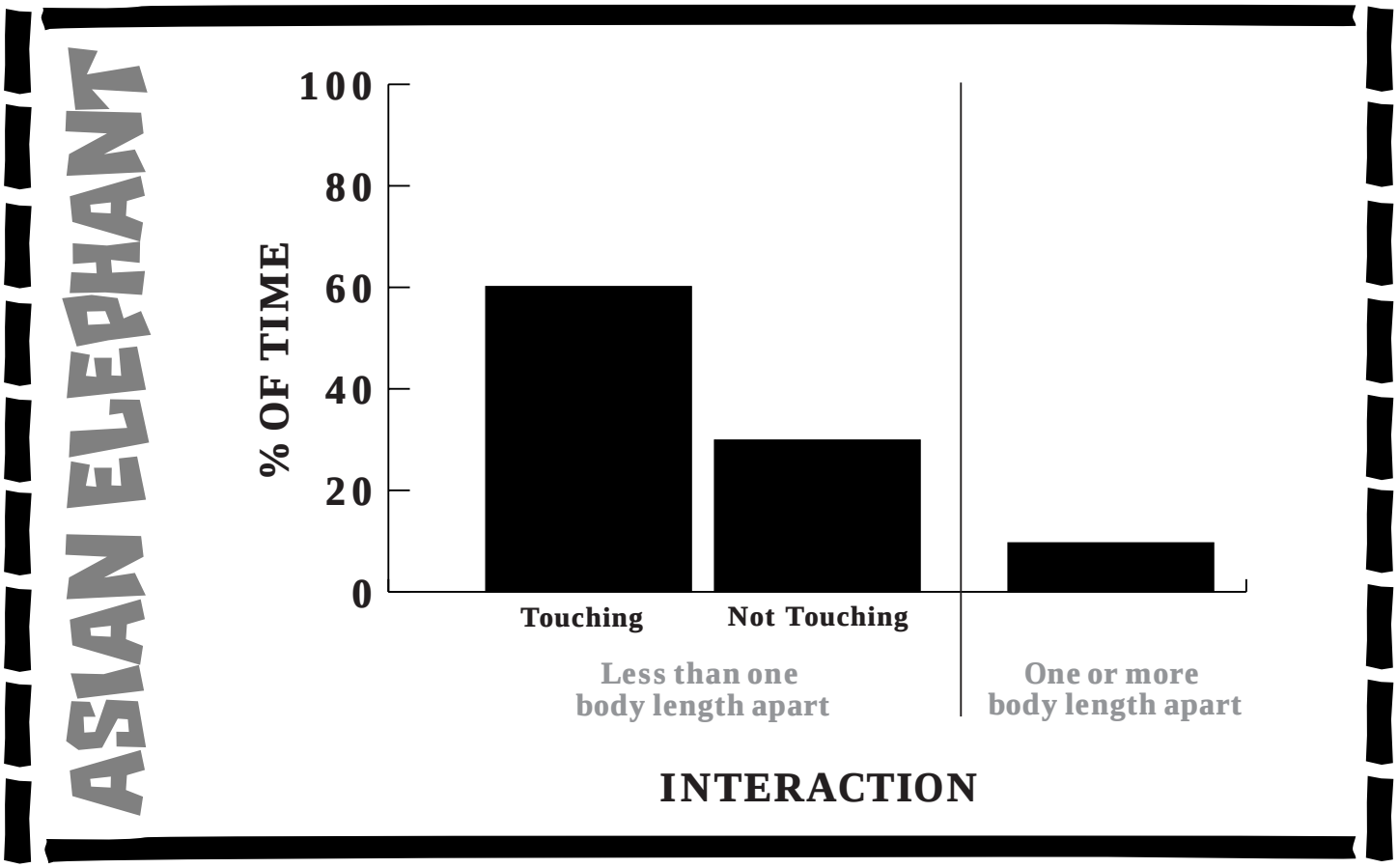
Introduction

Chendra is the youngest elephant in our herd. It is hoped that she and Rose-Tu will spend time interacting with each other. We would like to know how much time they are spending together.

Question?

How often do Rose-Tu and Chendra interact?

SAMPLE GRAPH



What do the Graphs Show? Do Chendra and Rose-Tu spend more than 50% of their time within one body length of each other?

How often do the two young elephants touch?

Things to Think About Do they interact differently than the adults? How?

Do they interact differently **with** the adults? How?

How might their current level of interaction change as they get older?

COPY PAGE

ASIAN ELEPHANT DATA SHEET

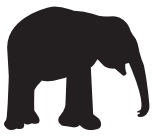
QUESTION?

How often do Rose-Tu and Chendra interact?

HOW TO DO AN OBERVATION

1) Identify Chendra (the smallest) and Rose-Tu (the second smallest)
2) Every 15 seconds place an "X" in the square that best describes how close the young elephants are to each other

Date _____	Less than one body length apart		1 or more body lengths apart
Time of Day _____	Touching	Not Touching	
:00 seconds (start)			
:15 seconds			
:30 seconds			
:45 seconds			
1:00 minute			



ASIAN ELEPHANT DATA SHEET

QUESTION?

How often do Rose-Tu and Chendra interact?

HOW TO DO AN OBERVATION

1) Identify Chendra (the smallest) and Rose-Tu (the second smallest)
2) Every 15 seconds place an "X" in the square that best describes how close the young elephants are to each other

Date _____	Less than one body length apart		1 or more body lengths apart
Time of Day _____	Touching	Not Touching	
:00 seconds (start)			
:15 seconds			
:30 seconds			
:45 seconds			
1:00 minute			

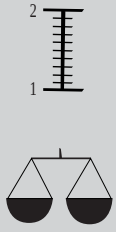
ASIAN ELEPHANT

Adaptations / Coloration

- feet are adapted to support great weight; stand on toes arranged in circle around spongy pad which cushions each step
- teeth: 4 molars (2 upper & 2 lower); well adapted to grinding up branches; each tooth weighs approximately 9 lbs; elephants have 6 sets of teeth in their lifetime
- trunk: amazingly strong & flexible; can lift heavy logs or pluck single leaf from tree
- when completely submerged in water, trunk extends above surface to breathe. Trunks touch, lift, trumpet and are used to drink
- to drink an elephant sucks water part-way into trunk then squirts it into mouth
- tusks: are incisor teeth (up to 5') may weigh up to 40 lbs; only some male Asian elephants have tusks, tusks are constantly growing & wearing down

Behavior

- may spend as much as 18-20 hours each day eating
- lifespan: roughly comparable to human lifespan; 55-65 years (65-70 years is comparatively rare)



9'9" average height

Weighs 7700 lbs. (average) and some males may weigh up to
14,300 lbs!

ASIAN ELEPHANT

Reproduction / Lifespan

- sexual maturity: males 8-12 yrs; females 6-10 yrs; doesn't mean that elephants breed at these ages under wild conditions. In fact, breeding at these ages is highly unlikely
- gestation: 630-660 days
- delivery/birthing: while cow is standing in an upright position
- calves are born rear-end first; height at birth typically 32-36" (grows approximately 1" per month)
- mother accompanied by other adult females ("aunties") that protect young
- Infant: 200-250 lbs at birth
- gains 2.5-30 lbs daily
- nurses up to 5 years

Wild Diet

- bamboo, fruits, grasses, leaves, reeds, shoots, 50 gallons of water daily

Zoo Diet

- vary with animal, its age, etc; typically adult cow might eat in 1 day: 1 bale (100 lbs.) timothy hay, 20-80 lbs. produce (dependent upon availability), 1 gallon of rolled oats, 1.5 gallons of specially-formulated pelleted feed, 30-50 gallons of water, & various vitamin & mineral supplements
- keepers also dispense 2-6 cases of "treats" each day (apples, yams, bananas, sugar cane)
- bulls consume somewhat greater quantities of hay & grain

Habitat / Range

- thick rain forests to open grassy plains
- Burma, Ceylon, India, Malaysia & as far east as Vietnam

Status

Endangered

More Amazing Facts!

Asian Elephants situation is much more precarious than their African counterparts; endangered primarily because of habitat loss due to expansion of human populations; generally not killed for sport or profit

Notes:

BLACK HOWLER MONKEY

Introduction

Black Howler Monkeys and White-faced Sakis share the same exhibit. We would like to know if the howler monkeys' activity level changes when the two species are combined.

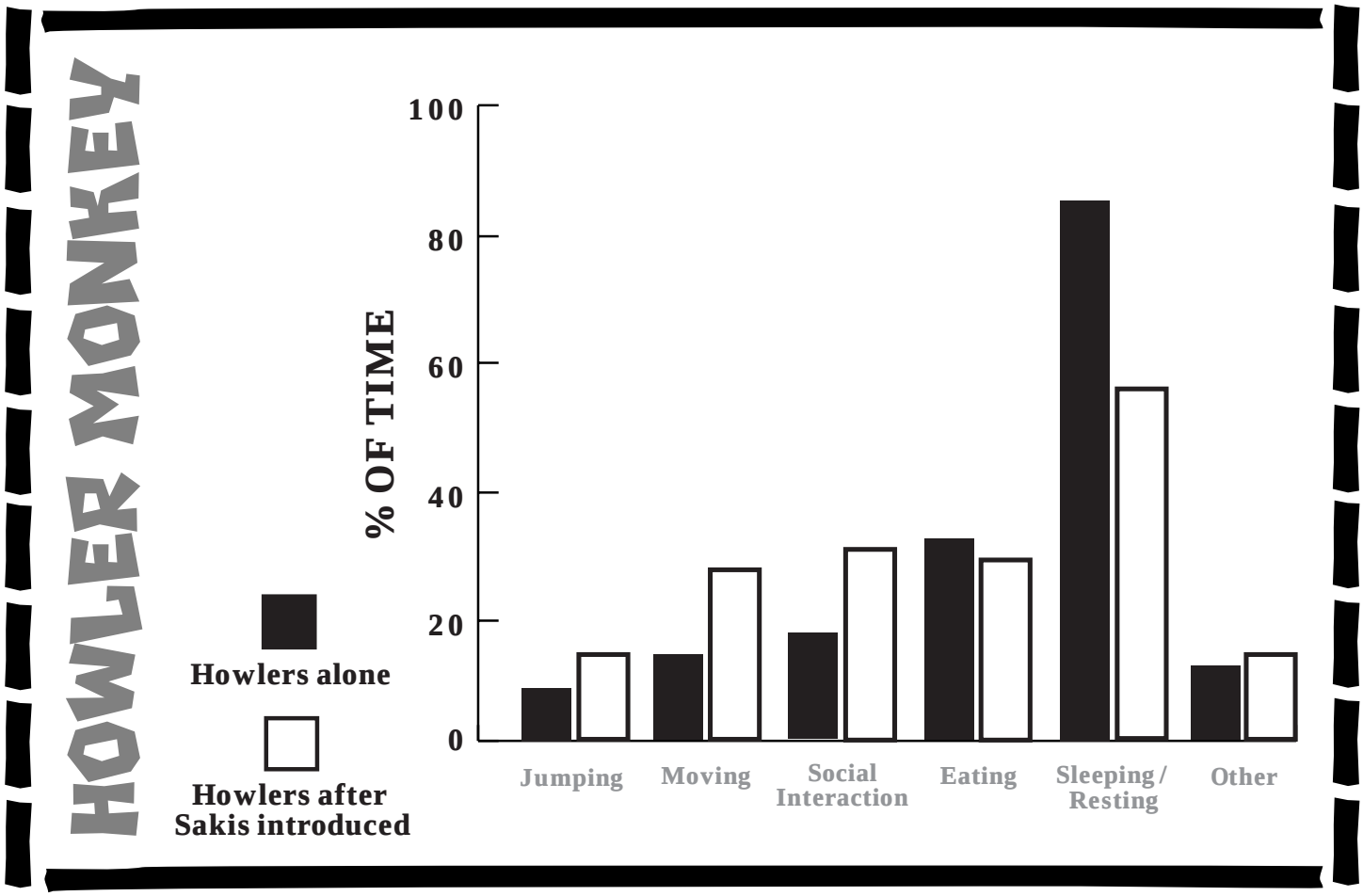
Female

Male

Question?

Does the Howler Monkey's activity level increase when the white-faced sakis are in the exhibit?

SAMPLE GRAPH



What do the Graphs Show?

How much time did the howler monkeys spend sleeping when they were by themselves?

Do the howlers spend more or less time moving after the sakis monkeys were intoduced?

Things to Think About

Why might having the two species together make them behave differently?

What should the Zoo think about when they introduce two species together?

In the wild, with what other animals might the monkeys interact?

BLACK HOWLER MONKEY DATA SHEET

QUESTION?

Does the howler monkeys' activity level increase after the white-faced sakis are introduced to the exhibit?

HOW TO DO AN OBSERVATION

1) Place an "X" in the box describing which species are on exhibit
2) Every 20 seconds place an "X" in the box that best describes each howler monkey's activity

☐ **Howler Monkeys only** ☐ **Howler and Saki Monkeys together**

Date _____

Time of Day _____

	Jumping	Moving (climbing, walking)	Social Interaction (touching)	Eating	Sleeping or Resting	Other (please describe)
(start)						
:20 seconds						
:40 seconds						
1:00 minute						
1:20 minutes						
1:40 minutes						

BLACK HOWLER MONKEY DATA SHEET

QUESTION?

Does the howler monkeys' activity level increase after the white-faced sakis are introduced to the exhibit?

HOW TO DO AN OBSERVATION

1) Place an "X" in the box describing which species are on exhibit
2) Every 20 seconds place an "X" in the box that best describes each howler monkey's activity

☐ Howler Monkeys only ☐ Howler and Saki Monkeys together

Date _____

Time of Day _____

	Jumping	Moving (climbing, walking)	Social Interaction (touching)	Eating	Sleeping or Resting	Other (please describe)
(start)						
:20 seconds						
:40 seconds						
1:00 minute						
1:20 minutes						
1:40 minutes						

BLACK HOWLER MONKEY

Adaptations / Coloration

- color: long coarse hair. Male black, female and juveniles yellow-brown
- face: bare and darkly pigmented
- lower jaw and neck: large swelling under chin; outlined by beard in male
- head: low on shoulders giving a hunched look
- arms and legs: long in proportion to body
- tail: prehensile, (can grip) naked on the underside
- hand: prehensile thumb and opposable big toe

Behavior

- diurnal (active during the day)
- primarily arboreal (lives in trees), occasionally spend short periods on ground
- movement: slow four-footed gait with prehensile tail ready to give support or for grasping
- hangs by arms or tail alone when feeding on slender branches
- avoid leaps but will leap 3-4 yards after much hesitation
- able to swim if necessary
- territory: will defend the territory of current use by howling, accompanied by shaking and breaking of branches
- vocalization: loud and persistent; deep howls or growls
- troop size: 3-19 with 1-3 adult males and 2-7 adult females plus young

Male 18.1-25 in
Female 19.1-27.3 in
(80 % females are the size of males)

Male weighs 16 lbs
Female 12.5 lbs

BLACK HOWLER MONKEY

Reproduction / Lifespan

- lifespan: 16-20 years in wild; 23 years in captivity
- breed throughout year
- gestation: 180-194 days
- single births, occasionally twins
- young will cling to mother for 1 year
- interbirth interval: 7-15 months
- sexual maturity: male 5 years; female 3-4 years

Wild Diet

- primarily a leaf eater; also buds, flowers and fruit, particularly figs. Feed in smaller branches of emergent trees

Zoo Diet

- monkey chow, vegetables, fruit, browse

Habitat / Range

- tropical rain forest and mixed deciduous forest
- upper and middle canopy
- eastern Bolivia, southern Brazil, Paraguay, northern Argentina

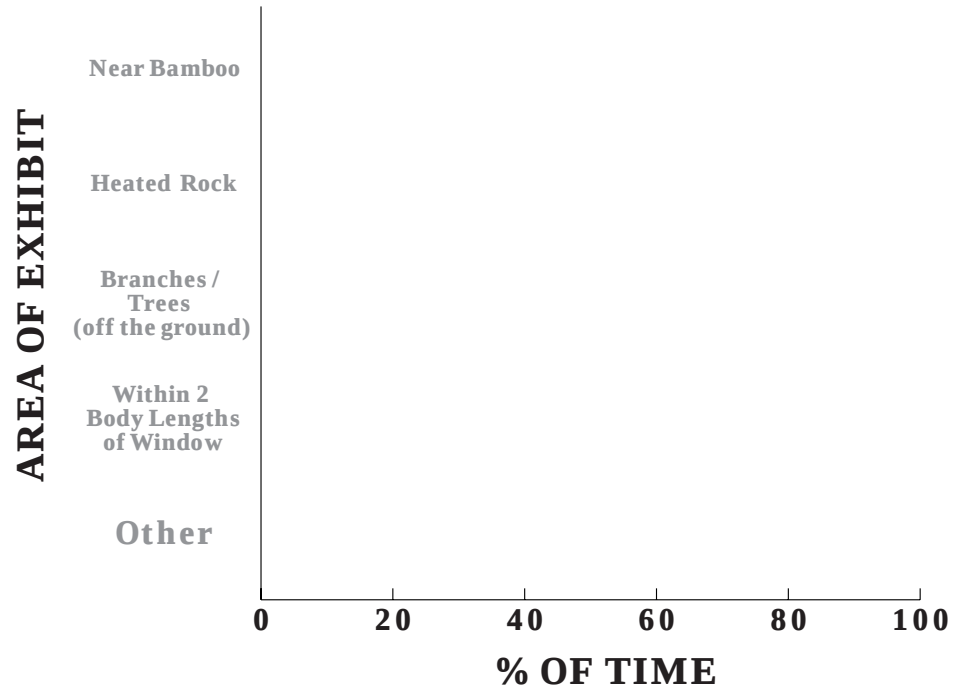
Status

- population stable

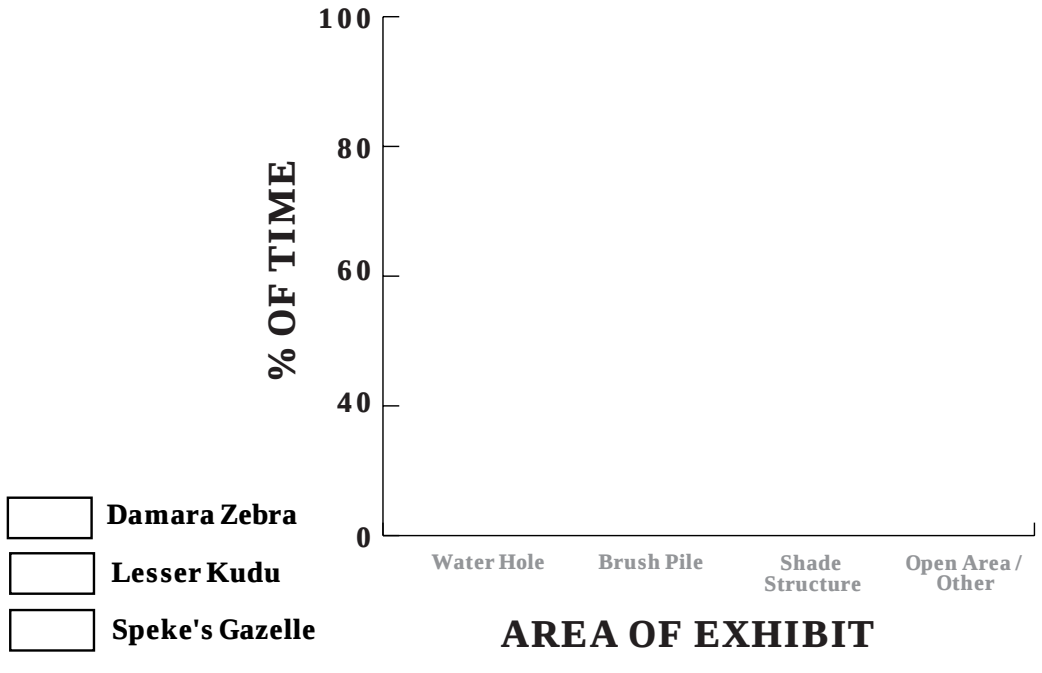
More amazing facts!

- hunted for food and captured for export

AMUR LEOPARD



AFRICA SAVANNA



AFRICAN BIRDS

- Gold Breasted Starling
- Hammerkop
- Violet Plantain Eater
- Red & Yellow Barbet

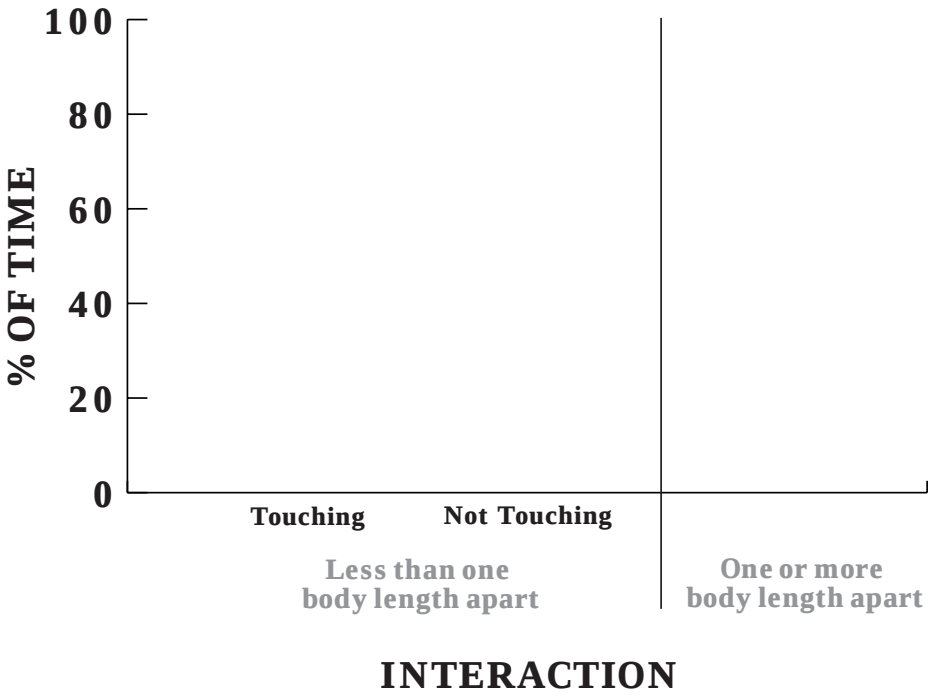
Bowl #1
(Chopped Vegetables & Fruit)

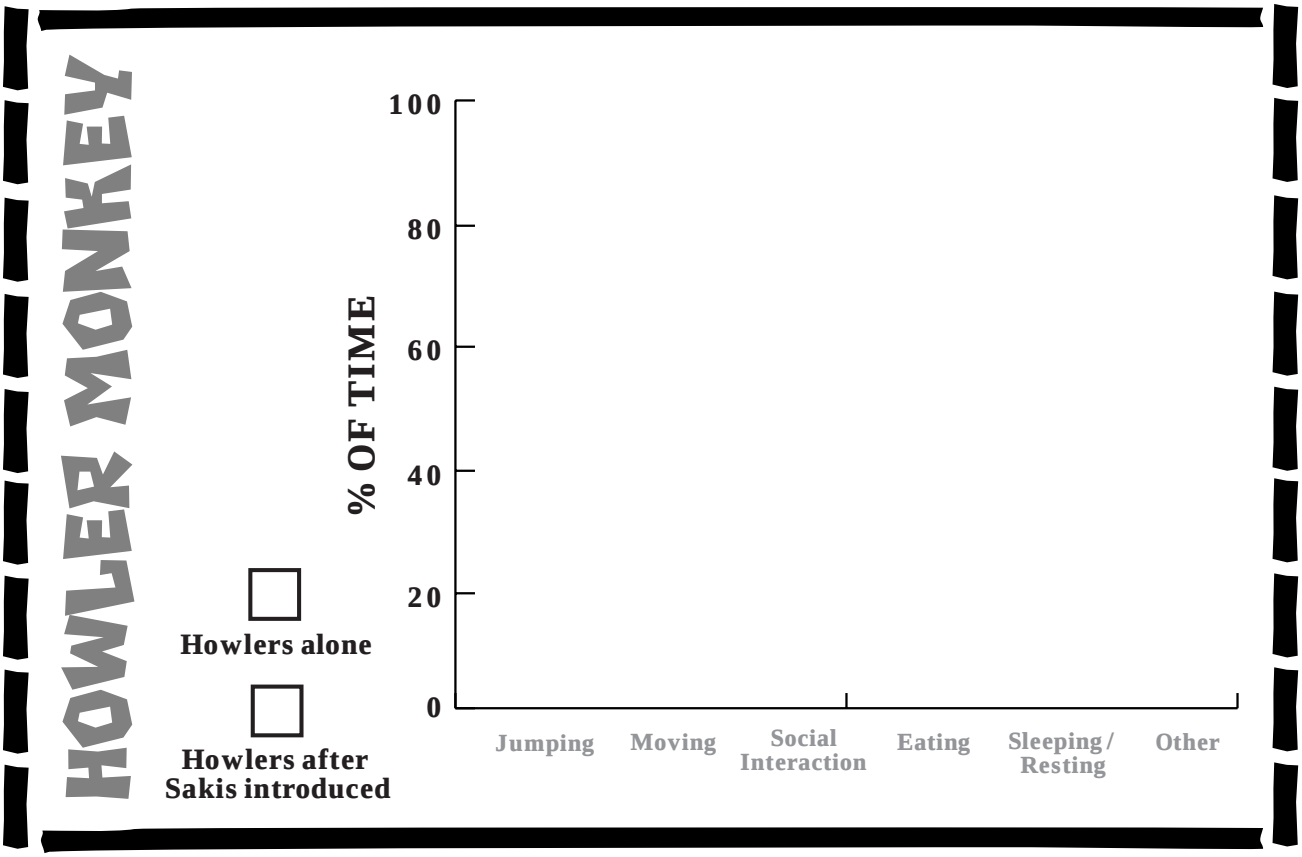
Bowl #2
(Chopped Meat & Fish)

Bowl #3
(Live Insects & Water Fowl Pellets)

Bowl #4
(Bird seed)

ASIAN ELEPHANT




HOWLER MONKEY
% OF TIME
100
80
60
40
20
0
Howlers alone
Howlers after Sakis introduced
Jumping
Moving
Social Interaction
Eating
Sleeping / Resting
Other

Immediately After Your Visit

Take some time to discuss with your students what they observed at each exhibit. This will provide a good summary of the visit to the zoo, before they move on to the next task—data analysis.

Data Analysis

There are several ways students can analyze their data:

1. Begin by building a class data pool (if everyone went to the same stations).

2. Have the students graph their results. This can involve higher math skills. You might want to have them work with percentages or fractions, by turning their information into a portion of all the observations made by the class or by a fraction of the time the animals were observed doing a single behavior. Younger students could create a graph by pasting pictures on a drawing of the exhibit.

   After the students have had an opportunity to examine their results, the next step is data interpretation.

Data Interpretation

There are several questions students should ask themselves about the data they collected. These are the same questions professional scientists would ask themselves after the conclusion of a research project. In science, things are seldom black and white/yes or no. In reality, interpreting the meaning of scientific data is a process that involves creative and critical thinking.

Some things to ask when interpreting data include:

- Is it "good" information? Has it been taken accurately? Is the sample size large enough? (the larger the sample the more reliable your conclusion)
- Does the data help you answer the research question?
- Are there factors beyond your control that might be affecting the results?
- How might this information affect how the Zoo cares for these animals?
- Could this information be used in other zoos? In the wild? How?
- Did this study create additional questions that might lead to another study? What are those questions?

Honesty and objectivity are your goals when interpreting data. It is preferable to be able to explain the reasons why your results may not answer your question than to make claims that are not supported by the data.

If further questions have arisen, can you use your existing information to answer them? Other questions may become the focus of additional studies. It is not uncommon for a study to generate more questions than it answers. This on-going creation of questions challenges scientists to keep learning and expanding their knowledge.

Presentations

In order to expand the body of knowledge, individual scientists must share their findings with others. Presentations can take many forms. Scientists make oral presentations, write reports, create "posters" or, in recent times, post their findings on the Internet. Here are some ideas to help your students with their presentations.

The first step in preparing any presentation is to organize your thoughts. A scientific presentation has five basic parts:

1. **The Question** What did the study ask? What were you hoping to find out?
2. **Data Collection Methods** How did you gather information? What techniques did you use? What equipment did you use?
3. **Plan** How was your study conducted?
4. **Results** What does the data show (also known as data analysis)?
5. **Discussion** What do you think the data means? What may lead to incorrect assumptions?

Poster Session

Formal posters are one technique scientists use to present their findings. Posters vary in size but are usually about 3' x 4'. Some are free-standing on a table top. Others are placed on an easel or hung on a wall. The purpose of a poster is to present a visual summary of your research. You may be on hand to explain questions, or leave the display to speak for itself. The poster should include text, pictures and graphs in a logical layout. Artifacts or props can be displayed if space allows.

The creation of a poster allows students a fun hands-on way to collect their thoughts and summarize their projects. It also allows a chance to integrate art and language arts into the project.

Formal Report

Have your students create a traditional written report. It should include sections that show:

Abstract (a.k.a. summary)
Background (why are you doing the study?)
Methods
Results
Discussion
Graphs and **tables** as well as a **list of references** should also be included.

The creation of formal reports can be intimidating if tackled all at once. Have your students work on one section at a time. These reports can be bound and displayed for others to see.

After the Presentations

Discussion and debate is an essential element of the scientific process. Sometimes not everyone agrees with a conclusion. Challenge your students to use their critical thinking skills to examine their conclusions and those of their classmates. Are there other conclusions that can be drawn? Is one conclusion right and the other wrong? What could be done to clarify the issue?

Beyond ZooScope

The process you and your students have just completed is only the beginning. The ZooScope program is a first taste of the scientific method and science inquiry. We provided the questions and the data collection techniques and even helped with the graphing and data analysis. Now that you have followed the steps, you and your students can create your own inquiry-based research project.

Your students can use these skills to create additional science experiments, develop a plan for what items to stock in the student store, or even create a proposal to determine which playground equipment to purchase. Scientific process skills are not just for scientists—they work for everyone.

Famous animal behaviorists include **Jane Goodall** who worked with Chimpanzees and **Diane Fossey** who worked with Mountain Gorillas. Many researchers are currently working in Africa and other parts of the world.
Can your students find people on the cutting edge of animal behavior?

Where do Scientists Work?

Brainstorm a list of where scientists work. What are their working conditions? Do they work year-round? What kind of special skills might they need? Where might they live?

Example: A Marine Biologist would work in the ocean, but also on shore in a laboratory. They probably have a field season when they are out in nature gathering information, but spend many months inside analyzing what they gathered. They might need to know how to scuba drive, or pilot a boat. They would need to live near the ocean—there aren't too many marine biologists in Kansas. A physicist might have completely different working conditions.

What do Scientists Do?

Your students could pick different types of scientists and research what their job might be like. They could try to find famous people in each field and what they discovered. When were these discoveries made? Are some types of science newer than others? Some possible areas of science include:

Biology
Physics
Geology
Chemistry
Meteorology
Paleontology
Astronomy
Archaelogy
Computer Science
Botany
Ecology

Appendix 1

An Inquiry-based Classroom Study

The Secret Life of Pill Bugs

In this activity, your class can develop a research question which can be answered in the classroom, then shared with others. You and your students have the opportunity to use science process skills to develop your own mini-research study in the classroom. This activity looks at an animal that can be found right around your school—pill bugs—also known as rolypolies, sow bugs, bibble bugs, tiggy hogs or potato bugs. Pill bugs are isopods, a sub-group (Class) of the larger group (Phylum) called Arthropoda, which includes insects, spiders and crustaceans. There are many different species commonly called pill bugs. Some live in the ocean or fresh water, others in forests, some even live in deserts.

REFERENCE
Animals in the Classroom: Selection Care and Observation
David C. Kramer

Please remind your class that pill bugs are living animals. Take this opportunity to review the requirements of animals and what precautions should be taken when working with them. Emphasize to your students that they are much larger and stronger than pill bugs and they should be very careful not to harm them. Make sure to return the bugs to the outside environment after you have completed your observations.

Collecting Your Pill Bugs

Pill bugs are very common in Oregon and Washington. They prefer shady moist places. Under bushes or near the foundation of your school are good places to look. If you can't immediately find them, place a piece of plywood or cardboard on the ground for a few days. If the weather has been dry, lightly sprinkle the ground with a watering can first. Check in a few days, you should be able to find several pill bugs. Take the pill bugs back to your classroom in a container of moist soil. If possible, include some leaves or wood for them to hide under. Be careful when you are carrying them, they are not accustomed to traveling.

Teacher's Note:

This activity also works well with crickets (available from many pet stores) or any other small animals (mice, hamsters, guinea pigs, lizards, snakes etc.) that you can safely bring into your classroom.

In the Classroom

Create a "research journal" for each student (or group).
Review the scientific method with your class. Discuss the process.

1. Have students begin to make observations. You might want to have a list on the bulletin board for students to write down what they see (students can work individually, in groups or as an entire class).

2. After making their own observations students will begin to ask questions. Have a brainstorm session. Help your students phrase the questions so they would make good research questions (see earlier activity)

3. Just in case you have difficulties developing some research questions, here are some examples to get you started.

   Do pill bugs prefer light or dark places?

   How do pill bugs react to being touched?

   How long does it take for a rolled up pill bug to unroll?

   What types of food do pill bugs prefer?

   At what temperature are pill bugs most active?

   How steep an incline can pill bugs climb?

   How fast can a pill bug go?

   Can a pill bug dig?

   Can a pill bug go through a maze?

4. Have each individual or group choose a question they would like to pursue and note it in their journal.

5. Allow students to make predictions based on their previous observations. For example:

   Pill bugs prefer the dark.
   It takes 10 seconds for a rolled up pill bug to uncurl.
   Pill bugs prefer apples over lettuce.

6 Ask students to develop ways to test their questions. How would they design a study? What data would they collect? How would they collect it? What tools/equipment will they need? Will they need a magnifying glass for close-up observations?

Creating a data collection table may help students organize the information as they gather it.

7 Keeping variables constant is a challenge for scientists. Students usually understand the concept of being fair. The analogy of a group of people playing the same game by different rules often illustrates the importance to students. All the conditions of an experiment should be the same for the animals being observed (same amount of light, constant temperature etc...). Once you have a constant environment, THEN you can begin changing individual factors. Make one area of the cage dark (or light), warm one area of the enclosure, etc... This will give you reliable information. Your results will be based on the one variable you are studying, not other outside influences.

8 Allow time for students to plan and conduct their research project. They could keep a research journal of all their ideas and plans. Students could also use their journal to record the data they collect and document the process.

9 When your students have finished their observations and data collection, have them organize the information they have gathered. Using their math skills, they can make graphs or charts illustrating the pill bugs' activities. They can show the pill bug behaviors as percentages or fractions. They can use pencil and paper, calculators or even computers to analyze their findings.

10 When they have completed their analysis, have the students present their findings to the class or another group. Make sure they describe for the audience their research question, the methods they used for their observations, what information they collected and what they think the information means. Students may wish to create visual aids for their presentations.

11 Your students have just completed the same process that is used by scientists all over the world! Science is something that can be done anywhere by anyone. This process for answering questions has applications outside of the world of science. You could use these same techniques in marketing, business, manufacturing... the applications are limitless.

After the Study

Return the pill bugs to where you found them. Make sure the area is out of direct sunlight and the soil is damp. Your pill bugs have just had a big adventure. They may need some time to rest before returning to their normal activities.

Appendix 2

Additional Resources

Resources for Students

PreK-1 (early readers)

BUG WATCHING
Rebel William
The Wright Group, Bothell, WA 1990

WHY?
Miriam Frost
The Wright Group, Bothell, WA 1993

TRACKS
Rebel Williams
The Wright Group, Bothell, WA 1993

WHAT DO SCIENTIST DO?
Marcie Bovetz
The Wright Group, Bothell, WA 1993

UNDER GROUND
Rebel Williams
The Wright Group, Bothell, WA 1990

Upper Elementary

THE SCIENTIFIC METHOD (Video)
National Geographic,
Washington D.C. 1993

ROLYPOLYOLOGY; SNAILOLOGY; WORMOLOGY; CRIKETOLOGY; LADYBUGOLOGY; CATERPIL-LAROLOGY (A SERIES)
Michael Elsohn Ross
Carolrhoda Books Inc., Minneapolis, MN 1996

Web Sources:

The Albatross Project
Wake Forest University
www.wfu.edu / albatross

Jason Project
www.jasonproject.org

Whale Net
www.whale.wheeluck.edu

Resources for Teachers

Animals in the Classroom: Selection, Care and Observation
David C. Kramer
Addison Wesley Longham Inc. Menlo Park CA 1989

Bottle Biology
Kendall/Hunt Publishing Co., Dubuque IA 1993

The Pillbug Project: A guide to investigation
Robin Burnett
National Science Teachers Association,
Washington D.C. 1992

Explorations in Backyard Biology: Drawing on Nature in the Classrooms, Grades 4-6
R. Gary Raham
Teacher Ideas Press, Englewood CO 1996

Bug Wise
Pamela M. Hickman
Addison-Wesley Publishing Co., Reading MA 1990

Creepy Crawlers and the Scientific Method: Over 100 Hards-on Science Experiments for Children and **Classroom Critters and the Scientific Method**
Sally Stenhouse Kneidel
Fulcrum Publishing, Golden CO 1993

Chameleon Condos: Critters & Critical Thinking
Craig Berg
Chameleon Publishing, Shorewood WI 1994

Beyond the Science Kit: Inquiry in Action
Wendy Saul and Jeanne Reardon
Heinemann, Portsmouth NH 1996

Science for All Children: A Guide to Improving Elementary Science Education in Your School District
National Science Resources Center
National Academy Press, Washington D.C.

If you live, work and play in the metropolitan area, Metro regional services matter to you and your family. That's because Metro is working to help ensure that you have:

access to nature
·
clean air and water
·
the ability to get around the region
·
safe and stable neighborhoods
·
a strong regional economy
·
resources for future generations

Metro manages regional parks and green spaces and the OREGON ZOO. It also oversees operation of the Oregon Convention Center, Civic Stadium, the Portland Center for the Performing Arts and the Expo Center, all managed by the Metropolitan-Exposition-Recreation Commission.

Metro serves 1.3 million people who live in Clackamas, Multnomah, and Washington Counties and the 24 cities in the Portland Metropolitan area. Metro provides transportation and land-use planning services and oversees regional garbage disposal and recycling and waste reduction programs.