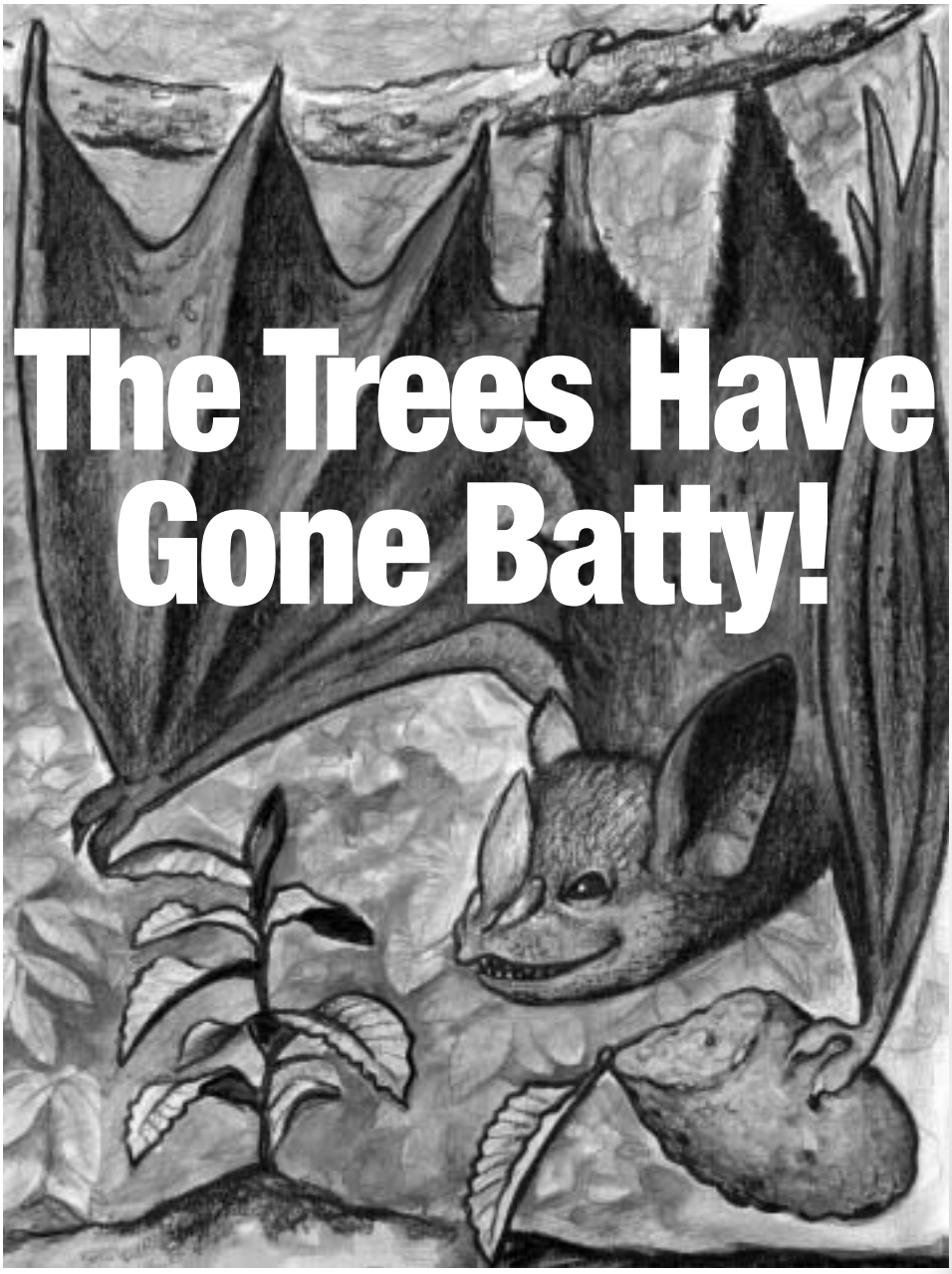


The Trees Have Gone Batty!

How Bat Scat Helped Restore a Tropical Forest

Meet Dr. Parrotta:

I like being a scientist because I get to explore and learn about the natural world. Nature is like a bottomless treasure chest, full of surprises and mysteries. It is fun to try to unravel those mysteries. It is important for humans to find ways to use the gifts of nature without damaging the environment, and also to repair the damage that we have already caused.

Dr. Parrotta

Glossary:

scat (skat): Animal fecal dropping; animal waste.

sample (**sam** p<u>oo</u>l): A part or piece that shows what the whole group or thing is like.

represent (rep r<u>e</u> **zent**): To be an example of.

mine (m<u>i</u>n): To take coal, ores, or other minerals from the Earth by digging a large hole.

natural resources (**na** cha rôl **r<u>e</u>** sôr sez): A supply of something in nature that takes care of a human need, such as oil.

disperse (di **spürs**): To scatter or spread in all directions.

defecate (**def** uh k<u>a</u>t): To get rid of waste matter from the bowels.

infertile (in **fürt** l): Not able to produce crops, fruit, or offspring.

complex (käm **pleks**): Complicated and having many different relationships.

native (**n<u>a</u>** tiv): Naturally occurring in an area.

mammal (**mam** ul): Any warm blooded animal with a backbone and glands to produce milk for feeding their young.

diversity (duh **vür** suh t<u>e</u>): The quality of being different or varied.

germination (jür mi **n<u>a</u>** shun): The act of sprouting or beginning to grow.

Pronunciation Guide

<u>a</u>	as in ape	ô	as in for
ä	as in car	<u>u</u>	as in use
<u>e</u>	as in me	ü	as in fur
<u>i</u>	as in ice	<u>oo</u>	as in tool
<u>o</u>	as in go	*ng*	as in sing

Accented syllables are in **bold**.

Thinking About Science

When scientists want to learn what is happening to a particular piece of land, they usually go out to that place to study what is happening. Because they usually cannot study every inch of a large piece of land, scientists select small areas, or *samples* of land, to study. They assume that the samples *represent* the rest of the land in which they are interested. This same idea is used in most scientific studies. For example, when scientists want to know what the public thinks about something, they cannot ask everyone. They ask a sample of people that the scientists believe can represent everyone. When was the last time you used a sample? When you eat a potato chip from a bag, do you think the rest of the chips in the bag will taste like the first one? Is the first potato chip a sample? Why or why not?

Thinking About the Environment

Humans use land for many things. Sometimes, they want to use land temporarily. In this case, they disturb the land, then they let it grow naturally again. An example of this is when humans *mine* the land for minerals and other *natural resources*. Can you think of other examples of using natural resources that cause a temporary disturbance to the land? Sometimes when the land is disturbed, it cannot restore itself back to its original condition without help from humans and other animals. In this study, the scientists wanted to know whether humans and other animals were helping a tropical forest to restore itself after it had been disturbed by a mining operation.

Jamaican Fruit bat.

Introduction

The scientists in this study were interested in knowing whether humans and other animals can help disturbed areas of land to become healthy ecosystems again. A mining company in Brazil (Figure 1) asked the scientists to restore a tropical forest on their old mining site. The original tropical forest had been cut down to mine the area for

Thinking About Ecology

An ecosystem is made up of all of the plants, animals, bacteria, and nonliving things that occur in a particular environment. When an ecosystem is healthy, the plants, animals, and bacteria depend on each other and on the nonliving environment to live. Some bats, for example, need to eat the fruit of plants to live. When bats eat fruit, they help to *disperse* the seeds of plants. Can you think of how they might do this? When they eat the fruit, they cannot digest the seeds. Because they cannot digest the seeds, they either *defecate* or spit out the seeds. They usually defecate some time after they have eaten the fruit. By that time, they may have flown away from the tree. The seeds fall onto the ground and begin to grow. You can see that the trees help the bats by providing food, and the bats help the trees by dispersing seeds. The bats and the trees depend on each other. They are part of a healthy ecosystem.

bauxite (**bäk** s<u>i</u>t) or aluminum ore. Bauxite is the main compound used in making aluminum.

Mining disturbs the land by removing the trees and the top layer of soil, or topsoil (Figure 2). This causes the land to be *infertile*. Since there are no trees left on the land, there is no source of seeds to help trees grow again. Although the scientists could plant some trees, they would never be able to create the kind of *complex* ecosystem that includes all of the original plants and animals. The scientists wanted to know whether they could set up the conditions so that plants and animals could come in from outside the mined area without further human help. Then, the new plants and animals might help the land to become healthy again.

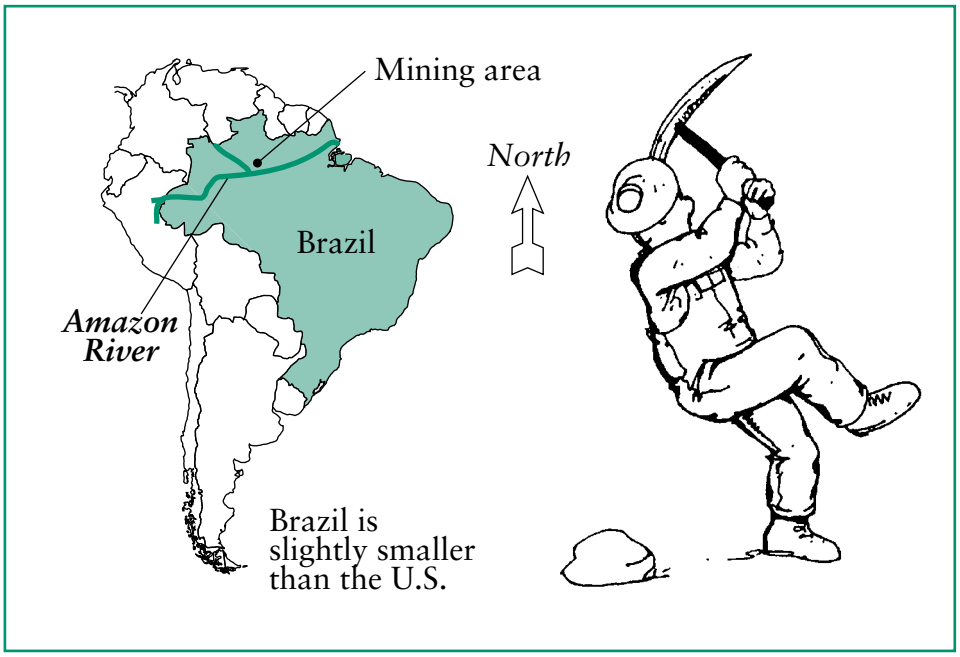


Figure 1. Location of the study area in Brazil.

Figure 2. The mining site.

Reflection Section

- If you were the scientist, what would you tell people you are trying to do through your research on the old mining site?

- Although trees are not mobile, their seeds can spread to new areas and grow. Can you think of two ways that a tree's seeds can move from place to place?

Methods

The scientists covered the bare ground with new topsoil and planted 70 different kinds of *native* trees. Although this seems like a lot of different kinds of trees, it is not a lot for a tropical forest in Brazil. Brazilian tropical forests can have thousands of different kinds of trees! Then, the scientists waited 10 years for the trees to grow. At the end of 10 years, the scientists selected 32 sample areas to study. The areas they studied were circles, each 10 meters in diameter (To find out how many yards this is, multiply 10 times 1.09).

The scientists went into these sample areas and identified the kind of trees growing

in each circle. They also counted how many of each kind of tree was growing. The scientists determined which of the trees were over 10 years old. The scientists then knew that the rest of the trees had grown on their own over the last 10 years. The scientists recorded the number and kind of birds and *mammals* they found within the sample areas. They collected all of this information by observing and carefully recording everything that they saw.

Reflection Section

- Why did the scientists want to identify which trees they had planted 10 years ago and which trees had grown on their own?

- Why do you think that the scientists wanted to know the kind and number of birds and mammals within the sample areas?

Results

The scientists found that the numbers and kinds of new trees growing in the sample areas were different, depending on where the sample area was located. The sample areas that were close to the outer edge of the mined area, near existing tropical forests, had a greater *diversity* of tree species (Figure 3). The scientists counted 125 different kinds of trees. They also had more trees growing in them than the sample areas near the center of the mined area. The scientists found 45 different kinds of birds in the sample areas. Of these, less than half would have been able to successfully disperse seeds. That is because most of the birds ate insects or nectar, or would have been able to digest the seeds. (Think of parrots and parakeets. They eat and digest seeds, so they would not be good at dispersing seeds!)

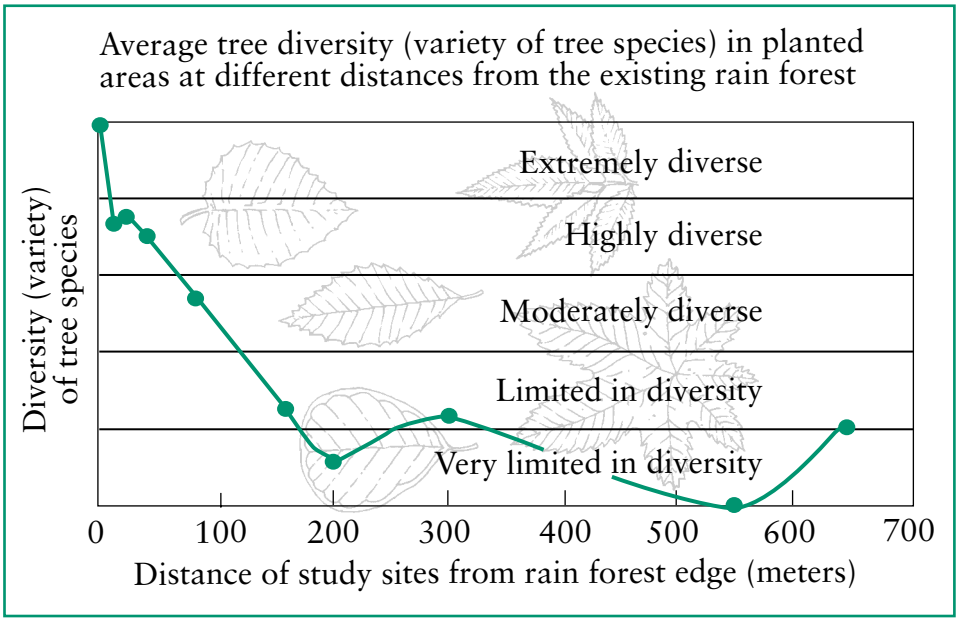


Figure 3. The amount of tree diversity at different distances from the rain forest.

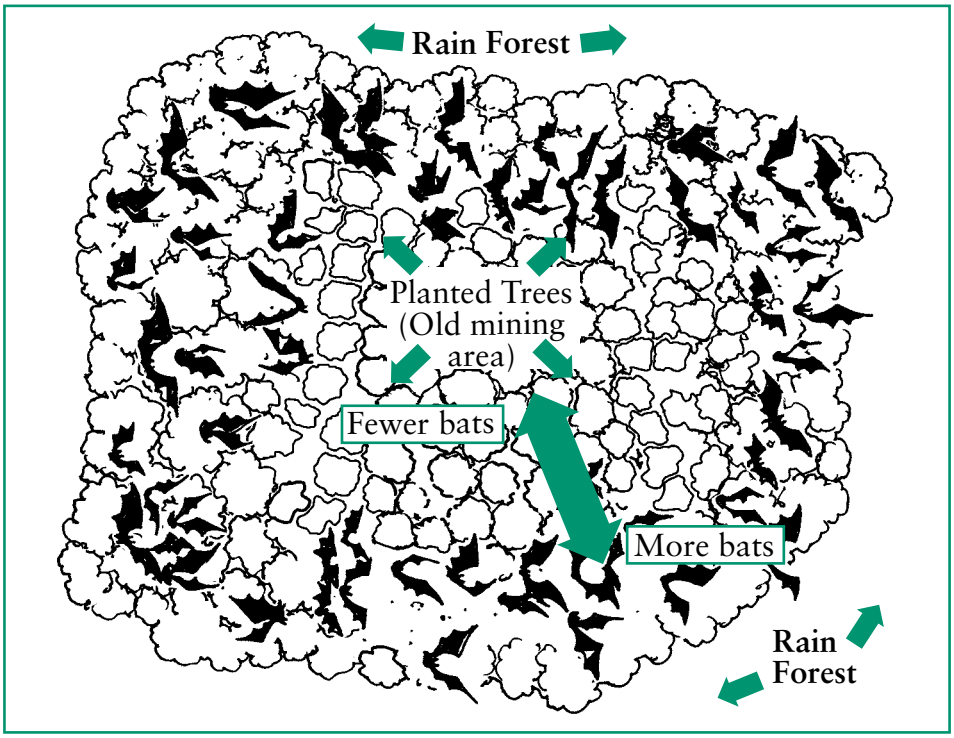


Figure 4. The relationship of the planted forest to the existing rain forest.

The scientists found that a lot of different kinds of mammals lived in the sample areas. The most numerous kind of mammal found in the sample plots was fruit bats. There were more bats in the sample areas closer to the edge of the mined area than in sample areas closer to the center (Figure 4). Although there was not a great diversity of different kinds of bats, there was a large number of fruit bats living in the sample areas. Figures 5 and 6 show how vegetation began growing on the old mining site.

Reflection Section

- Where the scientists found a diversity of new kinds of trees growing, they also found a large number of fruit bats. If you were the scientist, what would you conclude from this information?

- Why do you think that there were more bats and more kinds of new trees near the edges of the old mining area, and fewer bats and fewer kinds of trees near the center?

Figures 5 and 6. The recovering mining site. The roads you can see throughout the area are for transporting soil and seedlings. Eventually, these roads will grow naturally with vegetation and the entire area will become a forest again.

Implications

The scientists concluded that by planting a variety of trees on an old mining site, nature can take over and help the land to become a healthy ecosystem. The scientists believe that by planting the trees, they started a process that might have taken decades or centuries to happen on its own. Once they planted the trees, animals were able to move into the young tropical forest. When bats arrived, they defecated seeds eaten from fruit trees outside of the mined area. The bats helped to make the young tropical forest more diverse, which provided more food for other kinds of animals. After humans have disturbed land, they might have to help restore the environment to a healthy condition. Usually if humans lend a helping hand in the beginning, nature can take over the job.

Reflection Section

- Do you think that it is best to let nature take over the job of restoring an ecosystem to a

healthy condition? Why or why not?

- Can you think of other ways that plants and animals depend on each other in the natural environment? What do trees and other plants provide to animals? What do animals provide to plants?

FACTivity

In this article, you learned how bat scat helped trees to reproduce. For this FACTivity, you will be answering the question: What other benefits does animal scat offer to trees and plants? To do the FACTivity, you will need:

- Four 4-inch plant pots with saucers
- A bucket of soil dug from your school yard—be sure to break up any clumps and remove any grass or plants, including plant roots and rocks or pebbles
- An extra bucket for mixing soil
- A small bag of manure (may be purchased at a garden shop) or a small bag of worm castings (may be purchased at a garden shop)
- A bag of bean seeds (may be purchased at a garden shop)
- A cup or a small shovel
- Masking tape and marker
- Ruler or other type of measuring stick

Before you start, you need to know what manure and worm castings are. Can you guess? Both are animal wastes. Manure is the waste from animals like cows and horses. You should be able to guess which animal produces worm castings!

The method you will use is this: Fill two of the pots with the soil from your school yard to within a few centimeters (or inches) from the top. Be sure to wear rubber gloves when you handle the soil! Label the pots "school yard" with masking tape and the marker. Take a shovelful or cupful of soil from your school yard bucket and place it in the extra bucket. Mix in a shovelful or cupful of manure OR worm castings and mix well with the cup or the shovel. Mix enough schoolyard soil

Table to be completed weekly. You will create four of these, one for each week.

Date:	Height of bean 1	Height of bean 2	Height of bean 3	Average height of the three beans
School yard #1				
School yard #2				
Manure #1				
Manure #2				

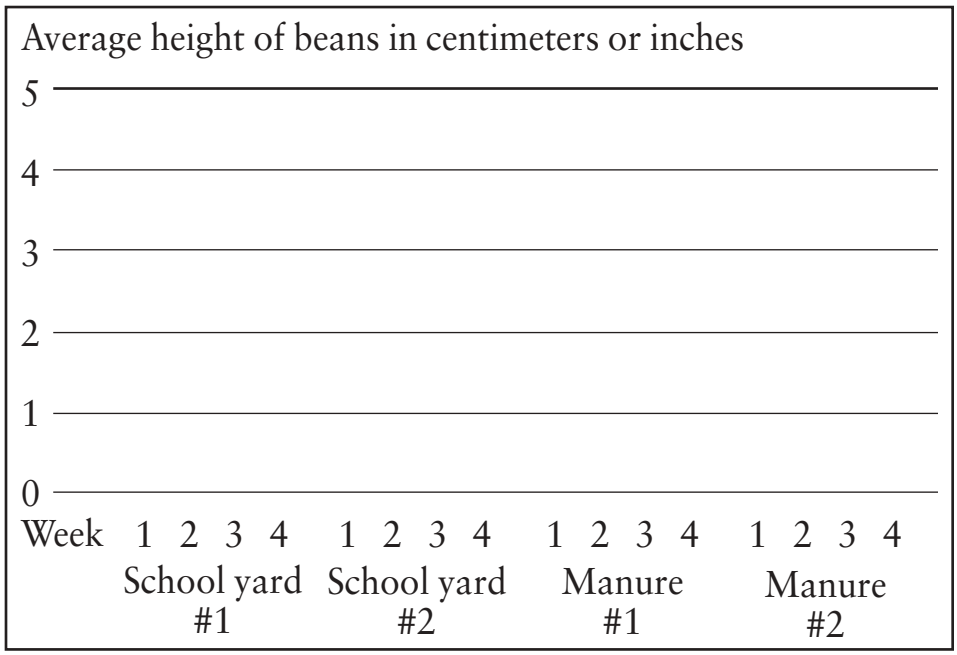
Summary table. Average height of all bean plants over 4 weeks

Date:	Average height of beans Week 1	Average height of beans Week 2	Average height of beans Week 3	Average height of beans Week 4
School yard #1				
School yard #2				
Manure #1				
Manure #2				

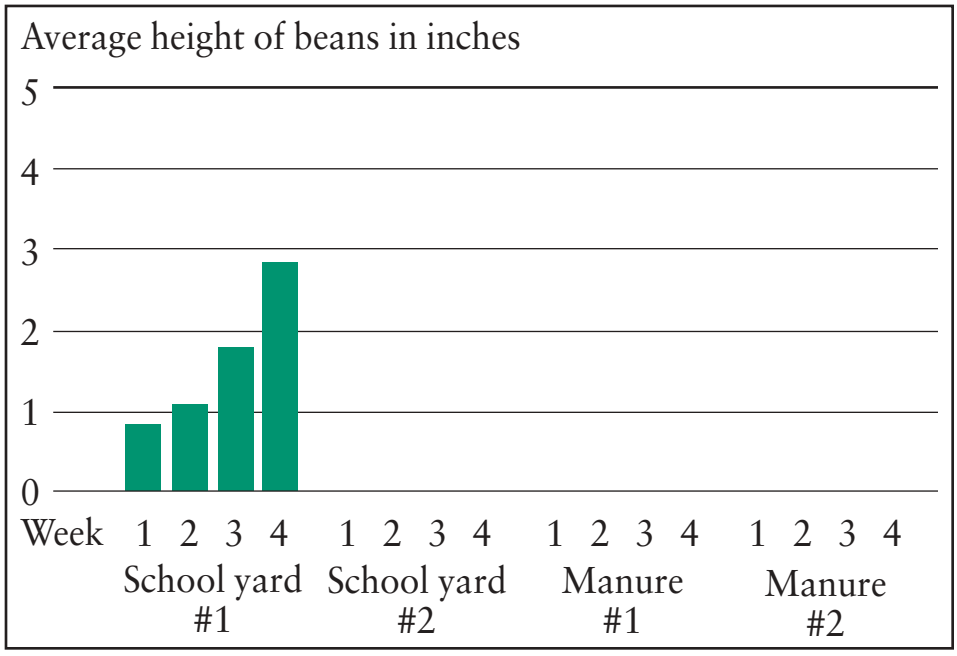
and manure (or worm castings) to fill the next two pots to within a few centimeters (or inches) of the top. Label the pots "manure" or "worm castings" using the masking tape and marker. Make three thumbprints about 2 centimeters deep (or about 1 inch deep) in each pot. Space the thumbprints so that they form a triangle. Place one seed in each thumbprint. Cover the seeds with soil from the pot and gently water.

Put the pots in a sunny window and keep the soil moist. Do not over water! Observe the pots every day for 4 weeks. You can use the chart on the previous page as an example. At the end of each week, measure the growth of the beans. Keep a weekly record of your observations. You will need to calculate the average height of the beans in each pot. To calculate the average, add the height of the three bean plants and divide the total height by three. You can easily compare your data by creating a bar chart (or histogram). To learn how to create a bar chart, see the example at the bottom right. Which kind of soil is best for seed germination and growth? Think about what you learned in this article. Bats helped trees to reproduce by spreading tree seeds through bat scat. What other benefits does animal scat offer to plants? This experiment should help you answer this question.

Sample bar chart: Average height of beans over 4 weeks. (Create this bar chart from the summary table on the previous page. See the example that follows.)



Example bar chart: Average height of beans over 4 weeks.



From Parrotta, John A., Knowles, Oliver Henry, and Wunderle, Joseph M. Jr. (1997). Development of floristic diversity in 10-year-old restoration forests on a bauxite mined site in Amazonia. *Forestry Ecology and Management*. 99: 21-42.