

LEAF CUTTING ANTS

Fungus Farmers

TEACHER



Activity Overview

Leaf cutting ants carry away leaf pieces that are up to 30 times their weight. They sometimes carry these pieces 100-200 meters (about 2 football fields). It can take a whole day for one trip. Once they return to their nest, ants chew the leaves but they don't eat them. They use them as nutrients for growing fungi. It is the fungi that the young ants actually eat.

It is important to learn about the leaf cutting activities of these "fungus farmers." In Central America, for example, they help limit the spread of water hyacinths so that they don't grow uncontrollably in waterways. However, in the southeastern United States water hyacinths grow uncontrollably and have become a real pest, blocking rivers and streams. Their expansion is not limited by leaf cutting ants.

In this activity, students will use the TI-73 Explorer™ to become familiar with a technique for measuring the amount of leaves Leaf Cutter Ants chew. This technique could be used to assist scientists in determining whether or not Leaf Cutter Ants may limit the growth of water hyacinths. Students will use a piece of construction paper to simulate a leaf and a hole punch to simulate Leaf Cutter Ants.

Conclusion: Students will make a graph of mass and area of squares of different sizes cut out of construction paper. They will discover that they can use the graph to determine the area of any shape made out of the same material, such as a cut out of a leaf chewed by ants.

Activity at a Glance

Grade: 4-9
Subject: Science
Category: Life Science
Topic: Living Things, Fungi, Plants, Animals

Time Required

- Two 45-minute periods

Level of Complexity

- Medium

Materials*

- T-73 Explorer™
- Metric Ruler
- Squares of various sizes made of construction paper
- Hole punch
- Balance with accuracy to at least 0.1 gram
- Large leaf



TI-73 Explorer™

* This activity has been written for the TI-73 Explorer™ but you can easily substitute the TI-83 or TI-83 Plus.



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Concept Background

- Some arthropods live in the canopy of a rainforest while others can be found in the soil and decaying leaf litter of the forest floor. Arthropods such as ants fill many roles in the tropical rainforest ecosystem. They are consumers of leaves and are consumed by other animals. They also break down leafy debris and recycle other animals' wastes.
- Arthropods outnumber every other living thing on Earth and have been around for at least 350 million years. There could be as many as 30 million arthropod species living in tropical rainforests around the world.
- The worker leaf-cutter ants climb the trees of the rainforest and cut pieces of leaves from the canopy. They carry these leaf bits on their backs to their underground colony.
- A bit of leaf may weigh 30 times more than the ant carrying it. An ant's journey home can take a whole day.
- Ants chew leaves and place them in a pile that becomes a fungus garden. Fungus grows on the chewed leaves and the ants use the fungus for food.
- The ants depend on the fungus for food, and the fungus depends on the ants to transplant it to new nests.
- Leaf-cutter ants are important to the rainforest ecosystem because they prune the trees and stimulate forest growth. In agricultural settings such as farms, leaf-cutter ants can be pests that cause serious crop damage.

Preparation and Classroom Management Tips

- Use construction paper to cut out 6 squares. The lengths of the sides in cm are: 4, 8, 12, 16, 20, and 24. You may consider having the students cut out the squares.
- In Procedure, Steps 1 – 6, students will use all the squares except the one that has a side length of 16 cm.
- In Procedure, Step 7, students will use the square that has a side length of 16 cm.
- In Procedure, Step 7, you may use the Table function on the TI-73 Explorer™ to find the area of the square knowing its mass. To do that replace Step 7 with the following:
 - a. Press **2nd** [TABLE]. Column X represents **Area** in centimeters square (cm²). Column Y represents **Mass** in grams (g).
 - b. Press **↓** and then use **↓** to scroll down to the value closest to the measured mass of the square.
 - c. Read the corresponding value for the area of the square in Column X.

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National Education Standards

Science Standard A: Science as Inquiry
Students design and conduct a scientific investigation. They use appropriate tools and techniques to gather, analyze, and interpret data. Students communicate scientific procedures and explanations.

Science Standard C: Life Science
Students should develop an understanding about the structure and function of living systems, reproduction and heredity, regulation and behavior, populations and ecosystems, and the diversity and adaptations of organisms.

Math Standard: Numbers and Operations
Students should develop an understanding of numbers: ways to represent and manipulate them and the relationships among different numbers and between number systems. Students should develop and implement strategies to estimate results and judge reasonableness of their results.

Math Standard: Data Analysis and Probability
Students should develop an understanding about how to collect, organize, display, and interpret data. Students should also be able to apply the basic concepts of probability.

Geography Standard 4: Places and Regions
Students should understand the physical and human characteristics of places.

Geography Standard 8: Physical Systems
Students should understand the characteristics and spatial distribution of ecosystems on the Earth's surface.

English Language Arts Standard 8
Students use informational resources to gather, synthesize, and communicate information.



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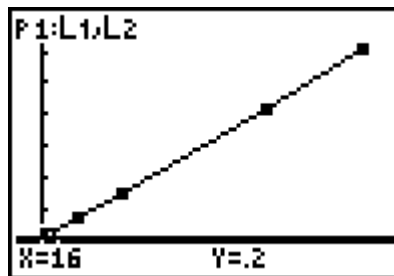
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- In Procedure, Step 8, you may want to consider preparing leaf cutouts for the students.
- In Procedure, Step 9, make sure that many holes are cut on the leaf so that the weight of the cut leaf is considerably smaller and can be measured by the balance.
- Encourage students to answer the questions in Data Analysis in their journal.
- Create your own student questions for use on your students' TI graphing devices using the Texas Instruments StudyCard applications.

Data Analysis

Table 1

Length of a side (cm)	Area (cm ²)	Mass (g)
4	16	0.2
8	64	0.7
12	144	1.5
20	400	4.2
24	576	6.1



Note: The values for mass in Table 1 depend on the type of construction paper used.

Area of unknown square = 256 cm² (Procedure, Step 7)

Student answers for **Area of chewed leaf**, **Area of whole leaf**, and **Area of left over leaf** will vary depending on the size of the leaf and the number of holes punched (Procedure, Steps 8 and 9).

- 1 Q. Why was it important to use a best fit line to find the area of the leaf? (Hint: Would you need a best fit line if the mass of your leaf was exactly the same as the mass of one of the squares on your graph?)
 - A. *If the mass of the leaf was exactly the same as the mass of one of the squares, then the area of the leaf would be the same as the area of the square. Therefore, students would not have to use the graph. A best fit line helps students estimate the area of the leaf that falls between points on the graph.*
- 2 Q. Your graph can help you find the area of any shape cut out of the same construction paper. Use your graph to find the area of a circle that weighs 3 g. The circle is made out of construction paper.
 - A. *Answers will vary. Using the sample data shown in Table 1 and the graph, the area of a circle is 281.5 cm².*

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Vocabulary

Arthropod An animal with a hard outer skeleton (exoskeleton) and jointed legs.

Biodiversity A measure of the number and variety of species within a region.

Brown food web A food web that starts with bacteria and fungi breaking down dead leaves, animal carcasses, and waste products. This kind of food web also includes microbivores that eat the bacteria and fungi, as well as the animals that prey upon the microbivores.

Canopy The layer of a forest made up of the tops of tall, leafy trees. Rainforest canopies usually reach heights of 18 to 30 meters (approximately 60 to 100 feet).

Consumer An organism that eats other organisms to get its food.

Decomposer A bacterium or fungus that feeds on and breaks down dead plant or animal matter, making nutrients available to the ecosystem.

Endemic Living only in a certain region.

Entomologist A scientist who studies insects and other arthropods.

Epiphyte A plant that gets its moisture and nutrients from the air and rain and usually grows on another plant.

Exoskeleton The hard outer covering of an arthropod.

Frass Solid insect waste products.

Green food web A food web made up of species that feed on plants or prey upon species that feed on plants.



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- 3** Q. Describe how you would use the mathematical model developed in this activity to find the mass of a leaf with a known area.
- A. *Draw a vertical line from the X coordinate (known area) to the best fit line. The Y coordinate at that point is the mass of the leaf.*
- 4** Q. Use your graph to find the mass of a construction paper leaf that has an area of 200 cm².
- A. *Answers will vary. Using the sample data shown in Table 1 and the graph, the area of the leaf is 2.1 g.*
- 5** Q. What is the mass of a leaf chewed by 10 ants in one day?
- A. *Answers will vary.*
- 6** Q. If 10 ants chewed leaves for 10 days, what would be the total mass of the leaves chewed?
- A. *Answers will vary.*
- 7** Q. If 10,000 ants chewed leaves for one day, what would be the area chewed?
- A. *Answers will vary.*
- Area of leaves chewed by 10,000 ants in one day = Area of chewed leaf (from Step 9) x 1,000**
- 8** Q. What would be the area of leaves chewed by 10,000 ants in one week?
- A. *Answers will vary.*
- Area of leaves chewed by 10,000 ants in one week = Area of chewed leaf (from Step 9) x 1,000 x 7**

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Vocabulary continued

Herbivore An animal that feeds on plants.

Herbivory Consumption of plants by animals, including insects.

Microbivore An animal that feeds on decomposers (bacteria and fungi) at the base of the brown food web.

Mutualistic relationship A relationship between different species in which each organism benefits from its association with the other.

Photosynthesis The process by which plants use sunlight, carbon dioxide, and water to make their own food (sugar). Oxygen is a by-product.

Producer An organism that makes its own food.

Species A group of individuals that share many physical characteristics and can interbreed.

Taxonomist A scientist who specializes in classification. Taxonomists classify different organisms into ordered groups related through evolution.

