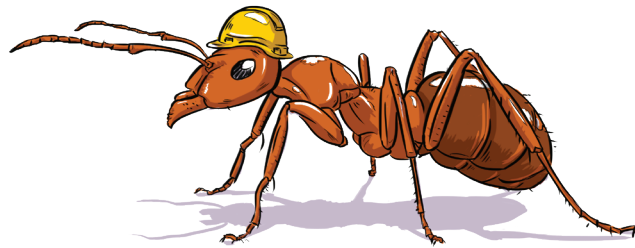


AMAZING ANTS

Simple Sidewalk Science



W. Barkley Butler, Ph.D.

Royal Fireworks Press
Unionville, New York



Copyright © 2017
Royal Fireworks Publishing Co., Inc.
All Rights Reserved.

Royal Fireworks Press
P.O. Box 399
41 First Avenue
Unionville, NY 10988-0399
(845) 726-4444
fax: (845) 726-3824
email: mail@rfwp.com
website: rfwp.com



ISBN: 978-0-89824-589-9

Publisher: Dr. T.M. Kemnitz
Editor: Jennifer Ault
Book designer: Kerri Ann Ruhl
Cover design & illustrations: Christopher Tice

Printed and bound in Unionville, New York, on acid-free paper
using vegetable-based inks at the Royal Fireworks facility. 26ap21

TABLE OF CONTENTS

An Introduction for Students	v
A Warning	vi
Chapter 1: Amazing Ant Facts	1
Chapter 2: The Tools You Need	2
Chapter 3: The Basics of Studying Ants	4
Finding Ants	4
Foraging Ants.....	4
Ant Nests.....	5
Recording Results.....	7
Baiting Ants	10
Types of Baits.....	10
Presenting the Baits.....	12
Locating the Baits.....	12
What to Do Next.....	15
Recording Results: Baiting Ants.....	16
Taste Tests	19
A Simple Question: Can ants taste sugar?.....	19
Simple Two-Choice Taste Test.....	21
A Note About Solutions and Dilutions.....	21
Recording Results: Simple Two-Choice Taste Test.....	24
A Three-Choice Taste Test.....	25
Additional Things to Consider in Designing Taste Tests.....	26
Recording Results: Three-Choice Taste Test.....	27
Identifying Ants	28
Ant Behavior: Really Looking at Ants	31
Chapter 4: Analyzing and Presenting Data	33
Data from an Experiment	33
Graphing	34
Variables.....	34
Graphs.....	35
Averages and Totals, Percentages and Ratios	36
Averages.....	36
Percentages and Ratios.....	37
Warnings about Analyses and Statistics.....	38

Chapter 5: Taking Advantage of Unexpected Results	40
Chapter 6: Experiments and Challenges	44
What Can Ants Taste?	44
Sample Taste Experiment	44
Taste and Other Food Challenges	45
Does Location Matter?	46
Sample Ant Location Experiment	46
Location Challenges	48
What Happens When Ants Meet?	48
Sample Ant Behavior Experiment	48
Behavior Challenges	49
Challenges of Other Types	50
Chapter 7: Communicating Your Results	51
Sample Research Reports	53
Report in the Format of a Paper in a Scientific Journal: Instructions	53
Report in the Format of a Paper in a Scientific Journal: Example	53
Report in the Format of a Poster at a Scientific Meeting: Instructions	63
Report in the Format of a Poster at a Scientific Meeting: Example	64
Chapter 8: In Conclusion: Becoming a Scientist	70
Appendix	73
Ant Identification	73
Books about Ants	74
Websites to Visit	74
General Ant Websites	74
Websites with Taxonomic Keys for Ants	75
Sources for Supplies	76
Keeping Ant Colonies	76
Materials for Keeping and Feeding Ant Colonies	76
Procedures for Keeping and Feeding Ant Colonies	77
Grids to Copy and Use	80
For Instructors	81
Sample Exercises for Classes	84
Ants at a Picnic: Can They “Taste” What We Taste?	84
An Afternoon with Ants	87
A Day with Ants	89
Acknowledgments	94

AN INTRODUCTION FOR STUDENTS

As a boy, I enjoyed playing outside, and I wanted to be a scientist. I read about inventors like Edison and Bell, and I dreamed of following in their footsteps. I collected butterflies. I kept tadpoles and watched them metamorphose into frogs. I borrowed a microscope and studied the protozoa and other microscopic life forms that grew in my aquarium, the puddles in our driveway, and almost everywhere I looked. But I didn't know how to combine my interest in science with my love of nature. I wanted to be a scientist but didn't know how to start. And although I certainly had seen lots of ants, I hadn't really *discovered* them. I didn't realize how much I could learn about ants, and I didn't know how easy it is to study them. If you are reading this book, then I assume that you, too, are interested in both science and nature. This book will help you learn how to get started combining those interests by using ants. It will help you become a scientist, and working with ants can be an interesting and easy way to start.

Unless you live in Antarctica, Greenland, or Iceland (places where there aren't any), you probably have seen ants. But have you really looked at them? Have you ever looked *for* them? Have you thought of studying them? Do you know how fascinating ants are and how much you can learn about them? You can find out a lot about ants using just a few tools—things you can easily find around the house. You don't have to go far, and you don't need expensive or complicated equipment. Whether you live in a city, the suburbs, a village, or out in the country, you should be able to find ants near your home. If the weather is warm—late spring, summer, or early autumn—then you can start your study of ants right now just by going outside. (Sometimes ants come inside, but when they do, people seem to want to kill them rather than study them.)

How should you start? There is no one right way. The purpose of this book is to help you study ants scientifically in ways that are easy and inexpensive. Science isn't really hard. It's just a way of asking questions of nature and finding answers to those questions by doing experiments. As you follow some of the suggestions in this book, you will be doing more than simply learning about the ants that live near you—and there may be more of them than you realized. You will also be learning about how scientists work—how they design experiments, how they collect data, how they analyze data, and how they communicate their results and tell others what they have done and learned. It isn't hard, as you will see, but it does take work, and it is important to keep records.

This book is both an instruction book and a start on a research notebook. Chapter 1 provides some amazing ant facts. Chapter 2 lists the tools you need to get started. Chapter 3 describes some information and skills you need and simple experiments you can do to begin studying ants. Chapter 4 explains some of the ways scientists analyze and present data. Chapter 5 talks about what happens when the results of your experiments surprise you. (Things don't always turn out the way you think they will in scientific research.) Chapter 6 describes several ideas for experiments that build on what you did in Chapter 3. Each experiment is designed to answer a different kind of question. Following each experiment is a list of challenges related to that experiment and ways to address them. Chapter 7 explains how scientists tell other

scientists about their results and includes samples to show you what those methods look like. Finally, Chapter 8 talks about what science is and how it works. That chapter is really just a formal summary of what you will have learned working through the earlier chapters.

Throughout the book you will find pages where you can record your results in an organized way. When you do experiments on your own, you can use those pages as models to create a research notebook that will enable you to record what you learned in comprehensive and effective ways. I hope that the tools and the information in this book will help you begin your development as a scientist.

A WARNING

IF YOU ARE ALLERGIC TO BEE OR WASP STINGS, you should be careful when studying ants. Ants evolved from and are related to wasps. Not all ants sting, but some do. The fire ants of the southeast are particularly notorious for stinging. They can also rapidly swarm all over you if you accidentally step on or disturb a nest, so be careful. If you are allergic to bee stings, talk with your parents and/or your doctor before getting down on the ground with ants.

CHAPTER 1

Amazing Ant Facts

From *Ants of North America: A Guide to the Genera* by Brian L. Fisher and Stefan P. Cover (2007):

- Ant colonies range in size from a few dozen to more than a million ants.
- Most of the ants you see are females, so say “she,” not “he.”
- In North America, there are nearly 1,000 species of ants.
- Ants have been around for more than 100 million years and lived with the dinosaurs.
- Some ants make slaves of other ants.
- Some ants “herd” aphids like we herd cattle and “milk” them for food.
- Some ants “farm” fungus for food.

From *Journey to the Ants: A Story of Scientific Exploration* by Bert Hölldobler & Edward O. Wilson (1995):

- The weight of all of the ants on Earth is about equal to the weight of all of the humans.
- The total number of ants on Earth is probably at least ten thousand billion (10,000,000,000,000).
- A typical worker ant is about one-millionth the size of a human being.
- An entire colony of the smallest ants could live inside the head of a soldier of the largest species.
- Ants conduct “wars” on other ants.

From AntWeb.org (10/17/2016):

- There are currently 16,804 valid species of ants in the world.

CHAPTER 2

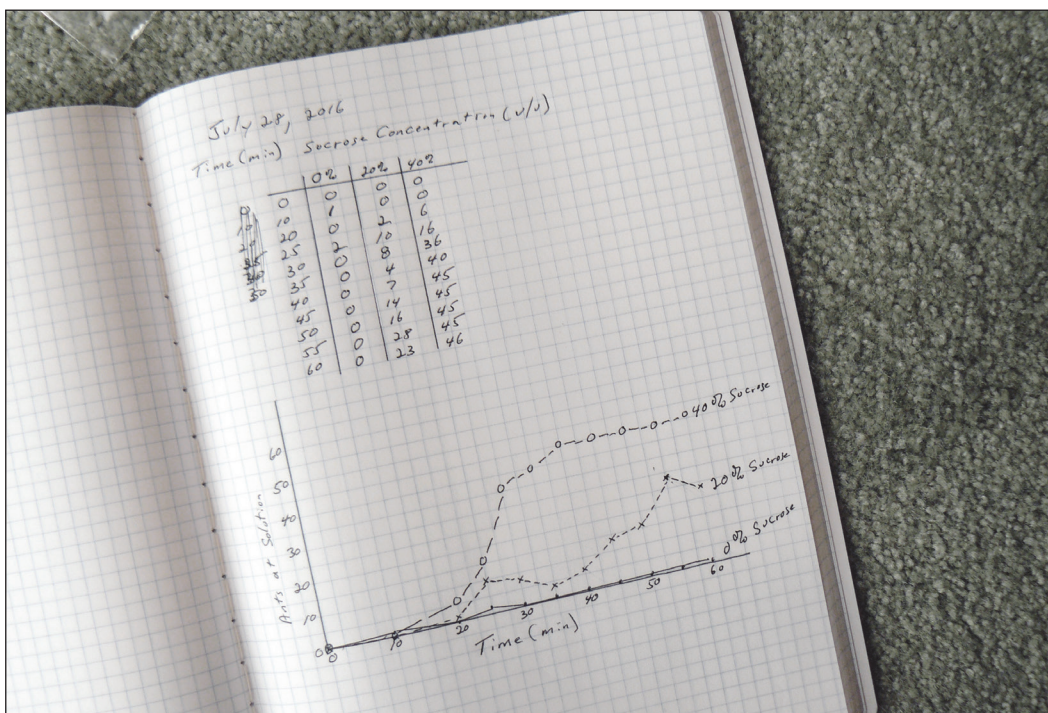
The Tools You Need

All that you really need to get started with your study of ants are your eyes, your interest, and some patience and persistence. (It also helps if you aren't afraid to get down on the ground close to them.) However, a few simple tools may help. As your interest in ants grows, you can add a few other things, but these are more than enough to get you started.

- A good magnifying glass will help you get a better look at these tiny creatures.
- A watch, smartphone, or other timer that will measure time in minutes is essential for many experiments, as you will see.
- Some zip-type storage bags—small clear plastic ones—are good for holding captured ants while you look at them more carefully. They also can be used for sacrificing ants by freezing them for more detailed study or if you want to start a small ant collection. Larger bags will allow you to collect an entire colony of ants to keep and study in captivity. (Procedures for keeping ant colonies are described in the appendix.)
- A small notebook and either a pencil or a pen with waterproof ink will let you keep records of what you do and record the data you collect. Notebooks ruled with grids rather than just lines are particularly useful. The grids help you organize your data and are great for sketching simple graphs.
- A small pair of forceps (tweezers) is useful for catching and handling ants.
- A ruler with a metric scale is useful for measuring things. (Scientists use the metric system of meters, centimeters, millimeters, etc., rather than the English system of feet and inches.)
- A set of measuring spoons and cups is useful for making solutions and dilutions. Many measuring cups have lines for both English units ($\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, $\frac{3}{4}$, and 1 cup) and metric ones (50, 100, 150, 200, and 250 milliliters (ml)). Metric measuring spoons may not be easy to find; however, both the teaspoon and the tablespoon can be used for approximate metric measurements. The teaspoon is 4.9 ml, and the tablespoon is 14.8 ml. Although not exact, these are close enough to use as 5 and 15 ml, respectively.
- Index cards are a good surface on which to set baits.
- Grids are essential. You can make copies of the page of grids in the appendix, cut out the grids, and then laminate them or cover them with tape or plastic wrap. These not only hold wet or liquid baits but are designed to help you estimate the sizes of the ants that come to your baits.
- Flags or other markers can mark the locations of baits or colonies so that you can find them again. These usually can be found in home building supply stores.



Tools for general use



A page from a research notebook

CHAPTER 3

The Basics of Studying Ants

The more you study ants, the more you will learn what works and what doesn't. (And remember, what works for someone else may not be what works for you.) With time, you will develop your own methods for working with them and discover what techniques work best for the question you are trying to answer. So what follows are some suggestions to get you started. If, after you have tried these, you discover approaches that work better for you, use them.

Finding Ants

When scientists do surveys to find out what kinds of ants live in an area, they use a variety of techniques. There are three main approaches: (1) you can look for individual ants out foraging for food, (2) you can search for the nests where ants live in colonies, and (3) you can set out baits to attract ants, as described in the next section of this chapter. Using all three of these approaches, you are likely to find the majority of the ants living and active in the area you are studying.

Most ants don't build anthills—at least, not large ones. If you do know of some anthills in the area you are studying, you can start with those ants. But even if there are anthills near you, there are probably lots of other ants whose homes are less obvious. Some of the smallest ants live in places you might not suspect. So where and how should you look?

Note: How many ants you find will depend on several factors, but one in particular might be a problem. If you are looking in an area that has been treated with pesticides, you may find fewer ants than you would in a similar area that is pesticide-free. (Many lawn service companies use such pesticides.) You might not even find any. There isn't much you can do about it except to go to areas that have not been treated.

Foraging Ants

Foraging ants may be found anywhere. Some will be easy to find, and others may take more time and patience to see. (Remember that patience is an important skill for all scientists. Thomas Edison said, "Genius is one percent inspiration and ninety-nine percent perspiration.")

- Look on the sidewalk. This is the easiest place to spot ants wandering around.
- Look on plants.
 - Look on tree trunks. At first you may not see any ants, but wait and keep looking. After a while you may see more than one kind of ant walking up or down the trunk.
 - If you have big old trees with holes near the roots, look around those. Carpenter ants—large black ants—like to live in hollow tree trunks and often can be seen entering or leaving through holes near the base of the trunk.

- Look on bushes and shrubs, especially deciduous ones. (Deciduous plants are those that lose their leaves in the winter.) You might find ants on evergreen shrubs, but probably not as many.
- Look on other plants, checking their stems and leaves, as well as any buds or flowers. If you have peonies in your garden, you will almost certainly find ants on peony buds before the flowers open.
- Look on the ground.
 - A good way to start is to get down on your hands and knees and crawl slowly across your lawn. Keep your eyes on the ground, and really look. It may help to stop once in a while and just focus on one area for a few minutes. Some of the smallest, slowest, or shyest ants won't be obvious at first, but you may see them if you are patient.
 - If you are looking in an area with litter (not trash, but the collection of leaves and grass and twigs that accumulates in wooded areas), try clearing a space that is two to three feet across and watching it for a few minutes. After a while, ants may come out to explore the newly cleared area.

Ant Nests

Ants nest in many places, and most ants don't build large mounds. Therefore, if you want to find where ants have their homes, you need to look in a variety of habitats. Some of these habitats may not exist where you are looking. For example, well-kept lawns probably have fewer places for ants to live than uncultivated fields, open spaces, and woodlands.

When looking for ant nests, please disturb things as little as possible! If you turn a rock or something else over to look under it, place it gently back when you are finished. The less you disturb the environment, the better.

- Look on the ground, just as you did for individual ants. Look for small holes with ants entering and leaving. You may see some holes surrounded by small mounds of fine dirt. These may be entrances to ant homes, even if ants aren't coming and going at the moment.
- Look under things.
 - Look under rocks or other objects—boards, branches, bark, pavers, etc.—that are lying on the ground. **CAUTION:** Especially if you are in an area that has snakes or scorpions or other small critters that might hurt you, be careful when turning over rocks and other objects lying on the ground. A good approach is to lift the rock or other object carefully from the far side—the side away from you. That way if something is living underneath that darts out when you disturb it, it will be heading away from you rather than toward you. Whenever you are working outside, you should be aware of animals (snakes, scorpions, wasps, spiders, ticks, etc.) or plants (poison ivy, poison oak, etc.) living in that area that might be harmful to you. Know how to recognize and avoid them.
 - Look under dead bark on downed trees or branches.

- Follow foraging ants home.
 - If you see an ant carrying something—an insect part, a seed, or anything else that might be food—then following it should lead you to its home. This might take some time. You will be surprised at how far some ants wander away from their home in search of food.
 - Give ants food to carry home, and watch them. There is more information about baiting ants in the next section. However, if you put out cookie crumbs in various places where you have seen ants, they will probably find them and carry them back to their nests. Light-colored cookie crumbs are generally easier to see.
- Look inside things.
 - Look in hollow twigs or dead plant stems. Some small ants live inside these.
 - Look in old acorns—ones that look as though they have been around not from the previous autumn but from the autumn before that. There are tiny “acorn ants” that live inside acorns and similar-sized plant seeds or growths.

Foraging Ants



Ants on peonies (*Formica incerta*)