Garden Mosaics

science
people
cultures
action

by MARIANNE KRASNY

PROGRAM MANUAL
Garden Mosaics
Program Manual

Written by
Marianne Krasny, Ithaca, NY

with
Rebekah Doyle and Keith Tidball, Ithaca, NY

and help from
the Garden Mosaics Leadership Team Members and Cooperators

Alan Berkowitz, Middletown, NY
Stephen Brown, San Antonio, TX
Mary Cox, Baltimore, MD
Glenda Daniel, Chicago, IL
Antonio DiTommaso, Ithaca, NY
Gillian Dorfman, Shelburne, VT
Gretchen Ferenz, NYC
Deborah Hoard, Ithaca, NY
Sharon Kahkonen, Ithaca, NY
Ann Marie Kennedy, Sacramento CA
Lenny Librizzi, NYC, NY
Leigh MacDonald, Ithaca, NY
Rosalyn McMullen, Bronx, NY
Noah Najarian, NYC, NY
Julie Samuel, Chicago, IL
Michael Simsik, NYC, NY
Ellen Smoak, Greensboro, NC
Doris Stahl, Philadelphia PA
Emelie Swackhamer, Allentown PA
Stephanie Thompson, Ithaca, NY
Caroline Tse, NYC, NY
Anna Wasescha, St Paul, MN
Jo Ann Whitehead, Boston, MA
Robert Williamson, Greensboro, NC

Illustrations by: Gillian Dorfman
Design/layout by: Diana Bryant and Gillian Dorfman
Table of Contents

Sections

Section I: Garden Mosaics Overview
Section II: Garden Mosaics, Plant-based Learning, and Community Gardens
Section III: Garden Mosaics in Youth Groups and Classrooms
Section IV: i·m·science
Section V: Science Pages
Section VI: Action Projects
Section VII: Resources, Permission Forms, and Photo Guidelines
Garden Mosaics Program Manual
Table of Contents: Sections and Chapters

Section I. Garden Mosaics Overview............................................................... 1
  Garden Mosaics in a Nutshell ................................................................. 2
  Welcome to Garden Mosaics! ................................................................. 2
  Garden Mosaics Mission ....................................................................... 3
  Our Name .............................................................................................. 3
  Our Core Values .................................................................................... 3
  Our Goals .............................................................................................. 3
  What Do Garden Mosaics Participants Do? .......................................... 3
  Achieving Your Goals through Garden Mosaics .................................... 5
  What We Are NOT ............................................................................... 6
  What Is Unique about Garden Mosaics? .............................................. 6
  Garden Mosaics Resources .................................................................. 8

Section II. Garden Mosaics, Plant-based Learning, and Community
  Gardens ................................................................................................ 9
  Overview ............................................................................................... 9
  Chapter 1. Why Garden Mosaics? ....................................................... 10
  Chapter 2. Why Plant-based Learning? .............................................. 14
  Chapter 3. Why Community Gardens? .............................................. 15

Section III. Garden Mosaics in Youth Programs and Schools ................ 17
  Overview .............................................................................................. 17
  Chapter 1. Goals and Objectives ......................................................... 18
  Chapter 2. What Do Youth and Adults In Garden Mosaics Do? .......... 19
  Chapter 3. Planning Your Garden Mosaics Program ......................... 22
  Chapter 4: Evaluation .......................................................................... 26
  Chapter 5. Assessment Activities ....................................................... 28
  Chapter 6. Ice-Breaker Activities ......................................................... 36
  Chapter 7. Hands-On Gardening Activities ....................................... 38
  Chapter 8. Inquiry Activities ............................................................... 39
  Chapter 9. Checklist for Conducting Garden Mosaics Program .......... 41
  Program Planning Form ...................................................................... 43

Section IV. i-m-science ............................................................................ 51
  Overview .............................................................................................. 51
  Chapter 1. Gardener Story .................................................................. 53
  Chapter 2. Community Garden Inventory ........................................ 69
  Chapter 3. Neighborhood Exploration .............................................. 91
  Chapter 4. Weed Watch ..................................................................... 109

Section V. Science Pages ......................................................................... 133
  Overview .............................................................................................. 133
  Science Pages – Black and White Versions – ................................. 135
Section I.

Garden Mosaics

Overview

Read this Section for an overview, or “Executive Summary,” of the Garden Mosaics program.
Garden Mosaics in a Nutshell


When? How? of Garden Mosaics...

Who? Anyone interested in gardening, cultural traditions, or enhancing communities, including youth, gardeners, educators, volunteers, and the general public.

What?
• Youth Program. A science education program that combines intergenerational mentoring, community action, and understanding different cultures. Youth learn from elder community members, who share their gardening practices, cultural backgrounds, and wisdom about their community. Youth also learn from the Garden Mosaics educational resources and activities.
• i-m-science investigations. International online databases focusing on community gardens, gardeners, neighborhoods, and urban weeds. Anyone can contribute to the i-m-science databases.
• Educational Resources. Free online Science Pages and stories about gardens, gardeners, and communities. Also available in print form.

Why? Garden Mosaics addresses issues related to science education, youth and adult well-being, cultural understanding, and sustainable communities and agriculture.

Where? Activities take place in community gardens, neighborhoods, home and school gardens, and indoors. Youth participants are from community centers, camps, home schools, classrooms, and science enrichment, job skills training, intergenerational, service-learning, and environmental education programs. Any adult or youth can participate in the i-m-science investigations and use the online resources.

When? Activities vary in length. Spend a few minutes viewing a Science Page, or a few hours conducting an i-m-science investigation. Or lead a group of youth in a longer-term project combining many activities.

How? Educators and volunteers use the Program Manual, Science Pages, i-m-science databases, Interactive DVD, and other print and web resources to conduct youth and classroom programs. Educators also may attend regional workshops. Any interested individual can use the online Science Pages and conduct the i-m-science investigations using the online instructions.

A final note. Garden Mosaics is flexible—feel free to use our resources and adapt them for youth, adult, and intergenerational programs, and for your own learning. Or help others learn about gardening and communities, and publicize your own activities, by contributing to the i-m-science databases.

Garden Mosaics
Department of Natural Resources
Cornell University
Ithaca, NY 14853-3001
gardenmosaics@cornell.edu
607-254-5479
www.gardenmosaics.org
Welcome to Garden Mosaics!
Welcome to the Garden Mosaics Program Manual. The bad news is the Program Manual is long. The good news is you don’t need to read it all to learn about Garden Mosaics. Read this Overview for an introduction to our program, and then go to the Sections and Chapters that are most useful to you.

Garden Mosaics welcomes participants from all countries throughout the world. Some of our resources are available in Spanish, and we currently are translating parts of this manual into Arabic and Russian. If you speak limited English and would like to inquire about participation in Garden Mosaics, please contact us at gardenmosaics@cornell.edu. We can respond to inquiries in Spanish, French, Arabic, Russian, German, and other languages.

Garden Mosaics Mission
Connecting youth and elders …
- to investigate the mosaic of plants, people, and cultures in gardens,
- to learn about science,
- and to act together to enhance their community.

Our Name
Garden Mosaics refers to two beautiful mosaics found in community gardens. First are the gardeners, who represent a mosaic of cultures from around the world. Second are the mosaics of plantings that these gardeners create.

Our Core Values
Garden Mosaics is:
- **Science**… asking questions, observing, interviewing, recording data, and using the Internet to learn about science.
- **People**… elder gardeners sharing their knowledge with youth and youth helping elders.
- **Cultures**… learning about the connections between plants, planting practices, and cultures from all over the world.
- **Action**… enhancing gardens and the neighborhood.

As an educator or interested individual, you are welcome to conduct a long-term Garden Mosaics program or to use individual resources and activities to meet your needs. Regardless of how you use our resources, keep in mind these four Garden Mosaics core values.

Our Goals
Garden Mosaics seeks to:
- Create a set of resources and activities that combine science learning, intergenerational mentoring, cultural understanding, and community action, and that can be used flexibly by educators, youth, and individuals.
- Develop a model educational program that integrates the “local knowledge” of gardeners with the scientific knowledge of researchers, and that combines civic and science education.

What Do Garden Mosaics Participants Do?
Garden Mosaics can be conducted as a youth or gardening program or as an individual activity. Youth programs can choose from the entire suite of resources and activities, whereas gardening programs and individuals will find the *i-m-science investigations* and Science Pages most useful.
**i-m-science investigations**

*i-m-science investigations* entail using interviews and observations to collect data, and reporting your findings to our online *i-m-science databases*.

Why the name “*i m science*?”

*i-m-science* means *I Am Science*. Youth and community members can contribute to science in important ways.

*i-m-science* means *Information Mosaics* science. The small “i” has become a universal symbol for information. The “m” refers to the mosaics of plants, planting practices, people, and cultures in community and other gardens.

Finally, *i-m-science* means *International Mosaics* science. We invite youth, gardeners, and volunteers from all over the world to share their knowledge of plants and growing practices, and of the role gardens play in their communities.

Through sharing the results and photos of your *i-m-science investigations* using the online databases, you are helping to create a beautiful website that is used for education and research. You also can work with Garden Mosaics to post the database reports from your city or region on your own website.

Through conducting *i-m-science investigations* with elder gardeners, youth form positive relations with local role models. They also develop interviewing, observation, and data recording skills, and make important contributions to their community.

The four *i-m-science investigations* are Gardener Story, Community Garden Inventory, Neighborhood Exploration, and Weed Watch.

**Gardener Story**

Participants develop an oral history and take photographs illustrating a gardener’s planting practices and “planting tips,” and the connections between those practices and the gardener’s culture. The gardener can be from a community, home, or school garden. The Gardener Stories provide a rich educational resource for visitors to our website.

**Community Garden Inventory**

Participants take a walk through a community garden with an experienced gardener. They ask the gardener questions and make their own observations about the plants, structures, and activities in the garden. They can use our online Community Garden Inventory Form to catalog a single garden or all the gardens in their city. This *i-m-science investigation* also can be conducted in school gardens that include community involvement.

**Neighborhood Exploration**

Participants use aerial photographs, maps, and a walk to explore their neighborhood. They learn where besides the garden people can find fresh food and places for talking with friends, relaxing, enjoying nature, and cultural and educational events. They then produce a neighborhood collage using photos and maps, and share their results online using the Neighborhood Exploration Form.

**Weed Watch**

Participants survey weeds in urban home, community, or school gardens, and catalog the methods gardeners use to control weeds. Cornell scientist Antonio DiTommaso is using the Weed Watch data to develop an environmentally-sound weed control program for urban vegetable gardens.
Science Pages
While interviewing elders in the gardens, you may encounter unfamiliar plants and growing practices. You can use the online or print versions of Science Pages to learn more yourself and for teaching purposes. For example, you can use the Science Pages to help participants understand the concepts behind what they see in the garden, either during “teachable moments” in the garden, or before or after the *i-m-science investigations*. Alternatively, you can use the Science Pages to reinforce important topics in classroom teaching or environmental education programs. Or you can laminate the pages and post them in a garden. English and Spanish versions are available in color and downloadable black and white format on the website. Check the Garden Mosaics website for new pages and information, including how to obtain color print Science Pages, and translations into additional languages.

Action Projects
Youth conduct an Action Project to help the gardens and their community. Action Projects can be related to Art in the Garden, Food Systems, Garden Design, Garden Enhancement, Garden Research, Land Use, or Nutrition and Health. Youth submit the online Action Project Form to share their accomplishments with others. Action Projects often serve as the culmination of a longer-term Garden Mosaics program, but they can also be conducted as stand-alone projects.

Short Activities
Garden Mosaics includes a number of short activities that can be used alone or incorporated into longer-term programs. These activities take place inside or in the garden.
- *Ice-Breakers* help the youth get to know each other.
- *Hands-on Gardening* gives youth a chance to get “their hands dirty.”
- *Inquiry Activities* help youth learn about plants and ecosystems.
- *Assessment Activities* provide fun ways to discover what youth are learning.

Achieving Your Goals through Garden Mosaics
Garden Mosaics is designed to be used in different ways by different people.

If you **work with youth in community settings**, you can conduct a Garden Mosaics *youth program* using our online, print, and electronic resources. Youth can start their program by conducting several Ice-Breaker, Hands-On Gardening, or Inquiry activities. Next they can conduct *i-m-science investigations* and contribute to the *i-m-science databases*. To enhance what they learn from elders and from observations during the *i-m-science investigations*, youth read about plants and science concepts, and conduct the short activities described on the Science Pages. The Action Projects give youth a chance to apply everything they have learned to help their community. You can also use the Action Projects to motivate youth who are not interested in science to participate in the more “sciency” parts of the program. **Start by going to Section III: Garden Mosaics in Youth Programs and Schools, in this manual.**
If you are a **teacher**, you can use the Science Pages and *i-m-science databases* to enhance *classroom learning*. If you have more time, you can conduct Inquiry Activities, *i-m-science investigations*, and Action Projects. Note that we have included inquiry and content learning objectives, and assessment suggestions, for each *i-m-science investigation*. Start by going to Section III: Garden Mosaics in Youth Programs and Schools.

If you are a **gardener or other adult or youth interested in promoting environmentally-sound agriculture and sustainable communities**, you can participate in the *i-m-science investigations*. You will collect data from gardeners and other community members, and contribute your findings to online databases. The information you collect will be used to help researchers and community activists, and as an educational resource for others. Go to Section IV: *i-m-science*.

If you **run a gardening education program** such as Master Gardeners, you can use the Science Pages to help your audiences learn about plants and planting practices. Or have your gardeners contribute to the *i-m-science databases*. Alternatively you may have volunteers who want to conduct Garden Mosaics programs with youth. Go to: Section VI: Science Pages, Section IV: *i-m-science*, or Section III: Garden Mosaics in Youth Programs and Schools.

If you are **traveling to another country or region**, consider talking with a gardener or small-farmer and sharing their “Gardener Story” online. Or describe a community garden using the online “Community Garden Inventory.” Go to Section IV, Chapter 1: Gardener Story, or Chapter 2: Community Garden Inventory.

If you simply **want to learn about plants, gardeners, cultures, and the environment**, browse through our online Science Pages and *i-m-science databases*. Go to Section VI: Science Pages. Or go to [www.gardenmosiacs.org](http://www.gardenmosiacs.org) and click on Science Pages. Also click on *i-m-science* to learn about interesting gardeners and gardens.

If you are a **program developer or researcher**, or are simply **curious about the background and outcomes of our program**, you can read about our program philosophy and research. Finish reading this Section and then go to the overviews for various Sections and Chapters. Also, go to [www.gardenmosiacs.org](http://www.gardenmosiacs.org), click on About Us, Research and Evaluation. Contact Garden Mosaics if you have questions or are interested in collaborating with us.

**What We Are NOT**

Garden Mosaics is **NOT** a how-to gardening program. Our activities work best for youth and others who already have some interest and experience with gardening, or as part of a hands-on gardening program. For educators working with youth who have had no exposure to gardening, we have provided several short, hands-on gardening activities in Section III, and gardening education resources in Section VII.

**What Is Unique about Garden Mosaics?**

**Science, People, Cultures, Action.**

Garden Mosaics integrates science education with intergenerational mentoring, cultural understanding, and community action.

**An Educational Program … an Educational Website.** Garden Mosaics provides education at two levels. On the one hand, youth and adults learn through conducting the Inquiry Activities, *i-m-science investigations*, and Action Projects. At the same time, the stories and data they contribute to the website become important educational tools for others.

**Flexible/Free.** Garden Mosaics provides a set of resources that can be used in any number of ways—from year-long youth programs to “free-choice learning” by youth or adults in their home. Many of the resources are available for free online.
Local Role Models. Youth participating in Garden Mosaics learn from and form partnerships with elders in their own community. These elders serve as positive local role models. The youth also help the elders through their Action Projects.

Integrating Local and Scientific Knowledge: i-m-science and Science Pages. Garden Mosaics is unique as an educational program in that it integrates the local knowledge of elders and scientific knowledge. For example, if you go to our i-m-science databases, you will see Gardener Stories that document the local knowledge of elders. These gardeners have a wealth of knowledge not otherwise available to youth and the general public. While reading the Gardener Stories, you will notice some underlined names of plants and planting practices. When you click on the underlined text, you link directly to a Garden Mosaics Science Page that describes what scientists know about the plant or practice.

New Approaches to Citizen Science. Citizen Science refers to research projects that use data collected by lay persons. The Cornell Laboratory of Ornithology is a pioneer in the Citizen Science movement. Its scientists have used observations collected by thousands of volunteer birdwatchers to help us understand how to conserve birds. Garden Mosaics has added several new dimensions to Citizen Science through our i-m-science investigations. First, i-m-science is unique in that we not only collect observational data about gardens and plants, but also information from people—i.e., the gardeners and other members of the community.

Furthermore, our i-m-science investigations are designed not just with scientists in mind. For example, the Community Garden Inventory is a collaborative effort with the American Community Gardening Association, which plans to use the data to document the benefits provided by community gardens. The Gardener Story and Neighborhood Exploration are designed primarily to collect information that can be used in educational programs, and by gardeners and other interested adults. The Weed Watch data will be used by scientist Dr. Antonio DiTommaso to help him design environmentally-sound means of urban weed control. In addition to these uses, all the i-m-science databases are posted online where they become an integral part of the Garden Mosaics educational website.

Participatory. Garden Mosaics invites you to participate at many levels. When you contribute to the i-m-science databases, you are helping to create the unique educational Garden Mosaics website. In return, we can help you to post the Gardener Stories and other i-m-science database reports from your city or region on your own website. Feel free to contact us to suggest new topics for Science Pages or i-m-science investigations.
Garden Mosaics Resources

**Website.** The Garden Mosaics website is designed as a free educational resource. Includes over 35 Science Pages in English and Spanish and the complete text of the *Program Manual*. Also includes instructions, forms for posting data, and results of the *i-m-science investigations* and Action Projects.

The resources listed below are available for sale or for free. Check the Garden Mosaics website for ordering information.

**Program Manual.** The illustrated *Garden Mosaics Program Manual* includes instructions and forms for a variety of activities, *i-m-science investigations*, and Action Projects. Black and white Science Pages, and information useful for community educators, teachers, and individuals conducting Garden Mosaics in different settings also included.

**Promotional DVD or Video.** An 11-minute inspirational film that captures the essence of what Garden Mosaics youth programs are all about. Available in DVD or video format.

**Interactive DVD.** An interactive DVD with live footage of educators conducting the *i-m-science investigations* and other activities with youth. Also includes the Program Manual text, forms, and many other resources.

**Science Pages.** Attractive, illustrated fact and activity sheets about plants, planting practices, and other science topics. Color Science Pages can be viewed online or purchased. Black and white versions with additional information and activities available online and in the *Program Manual*, or can be printed off the website. Available in English and Spanish. A subset of Science Pages available in Arabic.

**Posters, Signs, Brochures.** Posters suitable for hanging on walls of schools, community centers, homes, and offices. Signs for posting in gardens. Brochures to publicize your Garden Mosaics programs.

**Illustrations.** If you are an educator working at an organization with limited funds, we may be able to help you to produce educational materials. For example, you are an international NGO and produce educational materials but don't have enough money to hire an illustrator. Contact us and we may be able to share some of our illustrations free for educational use.

For more information on how to access these resources, contact:

Garden Mosaics  
Department of Natural Resources  
Cornell University  
Ithaca, NY 14853-3001  
gardenmosaics@cornell.edu  
607-254-5479  
www.gardenmosaics.org
Section II.

Garden Mosaics, Plant-based Learning, and Community Gardens

Overview

Garden Mosaics is an educational program for youth and adults. It uses plant-based learning to address issues related to science education, youth and adult well-being, multi-cultural understanding, and sustainable communities / sustainable agriculture. Whereas most Garden Mosaics activities can be conducted in any garden, several of the im-science investigations and many of the Action Projects focus on urban community gardens in particular.

In this section, we answer three questions:

• Why Garden Mosaics?
• Why plant-based learning?
• Why community gardens?

Garden Mosaics is also a research program, focusing on plants, gardens, gardeners, and the role of gardens in the community. The rationale for the specific research projects is included in the chapters on the four im-science investigations (Section IV). In addition, Garden Mosaics includes research on the impact of the learning activities on educators, youth, and other participants. Results of this research are published in journals and books, which are listed in References and Resources (Section VII). We also have links to articles under Research and Evaluation on the Garden Mosaics website (www.gardenmosaics.org).
Chapter 1. Why Garden Mosaics?

Garden Mosaics addresses issues related to science education, youth and adult well-being, multicultural understanding, and sustainable agriculture / sustainable communities. Although the rationale for Garden Mosaics was developed within the US context, other countries face many of the same issues.

Science Education

Issue

It is the paradox of our time. In an economy driven by knowledge, the United States leads the world in innovation and discovery but lags in K-12 science and mathematics. The strain of this dichotomy is already becoming apparent to businesses dependent on an educated workforce, policy-makers weighing complex technical issues, and parents concerned about their children's opportunities.

Rita Colwell, former Director of the National Science Foundation, is one of many scientists, educators, and politicians concerned about the alarming lack of science understanding among the nation's youth. International tests confirm that science knowledge among US students ranks well below that of other developed and many poorer countries.

Policy makers are concerned about the state of science education for a number of reasons. They want our nation to be a world leader in innovation and discovery, and to reap the economic benefits of science and technology. They realize that a strong background in science makes for better citizens—individuals who can evaluate the arguments set forth by politicians, corporations, and non-profit groups about the environment, health, and other important local and global issues. Furthermore, they want to provide opportunities for our children, and feel that science offers rewarding careers as well as the lifelong enjoyment that comes with discovery.

Solution

The National Science Education Standards provide a framework for science learning. They suggest that science learning should focus not only on content, but also on inquiry, i.e., providing youth with opportunities to ask questions and to conduct research to answer their questions.

The Garden Mosaics im-science investigations, Action Projects, Inquiry Activities, and “Try This” activities on the Science Pages provide youth with an opportunity to ask questions and conduct research. The Science Pages also serve as a source for science content, or information about specific topics. Furthermore, the study of plants provides many opportunities to address learning standards in science and other subjects.

Garden Mosaics goes further than many school-based inquiry programs by incorporating learning from neighborhood elders as well as from materials developed by scientists. Incorporating the “local knowledge” of elders with learning from scientifically-rigorous curricula provides a powerful model for urban, multicultural science education. Furthermore, Garden Mosaics embeds many of its science learning activities into a community Action Project. Knowing that the results of their im-science investigations will be used to design an Action Project to benefit their community can motivate youth to learn science.

1 Colwell and Kelly 1999
2 NRC 1998
3 Lewis 2004
4 George 2001
Youth and Adult Well-being

Issue
At least 25 percent of US adolescents are at serious risk of substance abuse, adolescent pregnancy, school failure, and committing crimes.

Solution
Settings that promote positive youth development share a number of characteristics. For example, they provide structure, supportive relationships, and opportunities to belong, build skills, and integrate family, school, and community. Youth who are developing positively demonstrate a number of personal and social characteristics, including critical thinking, reasoning, and decision-making skills; confidence in their ability to make a difference; good relationships with parents, peers, and other adults; and commitment to civic engagement.

Garden Mosaics emphasizes many of the characteristics of programs that promote youth well-being. Fundamental to the Garden Mosaics program is connecting youth with positive adult role models in their community. Through working alongside and learning from elders in their community, youth demonstrate their abilities and realize that caring and knowledgeable adults surround them.

Civic engagement, such as occurs through the Garden Mosaics Action Projects, also helps youth develop self-esteem and feelings of self-efficacy. It can help youth improve their school work, and develop skills that carry over into science inquiry learning (e.g., the ability to identify, research, and analyze a problem, work collaboratively, write reports, and give public presentations).

Intergenerational programs have a deeper impact on youth if seniors, instead of just telling youth about what they know, learn and act alongside youth. Seniors in turn become more committed to participate and form more meaningful relationships with youth.

By conducting research and engaging in community action, youth and adults involved in Garden Mosaics also learn skills important for citizens in a democracy. They develop the ability to find out new information, and to apply that information to help their community. And they learn that science involves cooperating with peers and community members.

---

5 Eccles and Gootman 2002
6 NRC 1998
7 Center for Intergenerational Learning 2004
Multicultural Understanding

Issue
Increasingly in the future, US scientists and engineers must be able to operate in teams composed not only of people from many disciplines, but also from different nations and cultural backgrounds⁸.

Young people need to develop skills, such as critical thinking and relating their own experiences and knowledge to wider issues, in order to participate fully in this global society⁹.

Solution
As science educators, we value the contributions and uniqueness of youth from all backgrounds¹⁰. Many of the Garden Mosaics activities take place in urban neighborhoods whose residents represent a diversity of immigrant and US cultures. Youth conducting the activities learn about the diversity of plants, planting practices, and cultures. Recently, Garden Mosaics has taken an obvious next step—extending our model for multicultural education to encompass learning about science within a global context.

Through learning about science within a multicultural and global context, youth can appreciate the relevance of science to their own lives. This in turn can make science more interesting and inspire youth to higher achievements. Learning about science from a broader perspective may also help youth develop informed opinions and take appropriate action about science within a global society, or even choose a career in science that contributes to positive social change⁸.

Below are five global science understandings important for youth and adults.

- Scientists all around the world are making discoveries. For the scientist, making discoveries is exciting and rewarding. Scientists’ discoveries help us to understand the natural world and to solve global problems.
- Discoveries often are made by international teams of scientists, rather than by individuals. Being part of a scientist team may involve travel to foreign countries and working with people whose language and culture differ from one’s own.
- Scientists can learn from the accumulated knowledge of farmers, foresters, and other people who have experience with the system the scientists are studying.
- Scientists have an ethical responsibility to the communities in which they work.
- Politics, history, and culture all impact science, and science also can have a powerful impact on our society.

---

⁸ NSF 2002
⁹ Brownlie et al 2003
¹⁰ NSTA http://www.nsta.org/positionstatement&psid=21
Sustainable Communities/Sustainable Agriculture

Issue
The act of turning a litter-strewn median into a lush patch of collard greens and geraniums was a public act of hope and faith, a quiet statement that at least some residents believed the neighborhood could be more than it was. Everything that happened afterward rippled from that single act\textsuperscript{11}.

Solution
Community gardens are not only sites for growing food. They also provide a wealth of benefits to the surrounding community, including places for relaxation, meeting with friends, and cultural events. These benefits often are sorely lacking in the high density, low-income neighborhoods where many community gardens are located. In some neighborhoods, community gardens also serve as sites for job training and generating income.

Many gardeners have developed environmentally-sound ways to grow vegetables and flowers. In North America and Europe, community gardeners often are immigrants from developing countries or poorer areas within their own country. In some cases, they may not have been able to afford commercial fertilizers and pesticides. Instead, they depended on more sustainable ways of adding nutrients (e.g., composting and intercropping), conserving water (e.g., mulching, mounds and furrows), and controlling pests (e.g., use of marigolds to repel nematodes, use of soap solutions in place of commercial pesticides).

Similarly, rural gardeners may have retained traditional practices that were developed prior to large-scale agriculture.

Thus community gardens can help build sustainable communities and facilitate more sustainable ways of growing food. Many Garden Mosaics activities take place in community gardens and surrounding urban neighborhoods. Garden Mosaics participants contribute toward sustainable communities and sustainable agriculture in a number of ways. For example, they:

- Conduct Action Projects to benefit the community and gardens.
- Contribute to databases about gardeners and their traditions, community gardens, neighborhoods, and environmentally-sound gardening practices. These databases are used for education and research purposes.
- Develop education programs in community gardens, thus demonstrating the value of these sites to local elected officials, education policy makers, and community members.

The reflections of Harvard Professor Felton Earls, the author of a 10-year study of urban crime, can serve as inspiration for Garden Mosaics youth and other participants.

What made it work ... is the underlying capacity of a few residents to take action and to sustain it... The assumption might be that you need 95 percent of the community involved. But in most cases it's a small percentage taking action. Often, the threshold for change can be a very, very small number\textsuperscript{11}.

\textsuperscript{11} Ryan 2004
Chapter 2.
Why Plant-based Learning?

One of the most challenging tasks an educator faces is how to make science relevant and exciting to youth. Plants have always been a major part of people’s lives—providing food, medicines, fiber for clothing, and shelter. Thus, educators can help young people to see the connections between studying plants and solving local, national, and global problems. For example, understanding plant growth can help us develop environmentally-sound ways of feeding an ever increasing human population.

Plants and gardens also bring to life important scientific principles. Youth begin to understand life cycles when they plant a seed and watch a seedling grow. They can observe insects eating plants and birds eating insects, and relate their observations to the concept of food webs. When they pull weeds and place them in a compost pile, they can begin to understand the decomposition process. Or they may have a chance to watch bees pollinate flowers, or ants feeding on flower nectar fight off other insects—real life examples of symbiotic relationships. Through conducting soil tests or watching the path of the sun, youth also begin to understand the physical sciences. Thus, plants and gardens may be used not only to teach biology, but also ecology, chemistry, physics, and environmental science.

In many urban areas, gardens may be the only sites where youth and adults can observe these natural processes. Parks and other natural areas may be distant from where the youth live. Or youth and their parents may not feel safe in natural areas that provide hiding places for unfamiliar people or animals. In contrast, gardens may be found nearly anywhere, from small roof tops or balconies to large city lots. And they always include people engaged in positive activities.

Community gardens generally include a “mosaic” of people of different ages, ethnicities, and backgrounds. Thus, they offer an opportunity to teach science in a multicultural and intergenerational context. Furthermore, because people in community gardens often have immigrated from different countries or regions, they offer an opportunity to place science in a broader, global context, as well as to integrate social sciences into science education programs. Youth working in community gardens have the opportunity to meet older members of their community who have a wealth of gardening experience, and to learn about the rich cultural backgrounds that shape the elders’ gardening practices.

In short, it is no wonder that increasing attention is being paid to the role of plants and gardens in science education. But plants offer more than a tool for learning about science principles—they help build wholesome people and communities. Planting seeds can be an expression of optimism that something beautiful and useful will grow—of hope for the future. Caring for seedlings and plants, protecting and nurturing them, can be an investment in self and society. Gardens, especially gardens where people work together to grow food and create community, can be sites for healing wounds between ethnic groups, and for helping youth to grow up in an environment where they learn, experience nature, and create dreams for their future.
Chapter 3.
Why Community Gardens?

Community gardens are places where people share land to grow vegetables, herbs, and flowers in individual plots and in common areas; where people exchange resources and trade stories; and ultimately where people cultivate a sense of community. You can find community gardens on formerly vacant lots, in parks, at retirement communities, apartment complexes, and schools, and on the grounds of faith-based organizations. They are often spaces where a "mosaic" of gardeners from different backgrounds and ethnicities cultivate a "mosaic" of plants.

Urban community gardening is a growing movement in the US. Although no one knows the exact number of gardens, it is estimated that over 1,000,000 individuals are involved in more than 15,000 organized community gardens. The urban community gardening movement is spreading to smaller cities across the US. Similarly, community gardens are a growing movement in France, Spain, and other European countries, as well as in Africa, the Middle East, and possibly other regions of the world.

Some community gardens have become symbolic of the struggle for self-reliance and building communities. For example, the Soweto Mountain of Hope Garden in South Africa is a symbol of the struggle against violence and AIDS, and of hope for the future. It is a living demonstration of how poor, oppressed people can come together and create a beautiful, safe, and productive space where people share plants, music, food, dance, and dreams for the future.

Similar to the Soweto Mountain of Hope, many community gardens in the US are created when local residents grow tired of vacant land, trash, and crime in their neighborhood. They seize control of the vacant lots and transform them into community green spaces with vegetables, flowers, benches, and play areas for children.

Thus, community gardens are designed and maintained by the local residents to address the unique needs of their neighborhood. They provide an alternative for residents who cannot afford to travel or feel unsafe in parks. They also provide a source of fresh food in neighborhoods that may lack grocery stores.

Because community gardens are important sites for growing food, sharing knowledge about gardening, meeting neighbors from different backgrounds, and building healthy communities, they are ideal for addressing the Garden Mosaics core values—science, people, cultures, and action. Community gardens also provide unique sites for realizing the Garden Mosaics mission:

Connecting youth and elders ... to investigate the mosaic of plants, people, and cultures in gardens, to learn about science, and to act together to enhance their community.

---

Bicho 1996, Malakoff 1995
Section III.

Garden Mosaics in Youth Programs and Schools

Overview
This Section provides an introduction to conducting Garden Mosaics as a youth program and in school classrooms. Additional resources for conducting Garden Mosaics with youth can be found in *i-m-science* (Section IV), Science Pages (Section V), and Action Projects (Section VI).

If you will be conducting *i-m-science investigations* or using the Science Pages on your own, you may want to skim this section and go to *i-m-science* (Section IV) or Science Pages (Section V). Alternatively, you can go to *i-m-science* and the Science Pages on the Garden Mosaics website (www.gardenmosaics.org).
Chapter 1. Goals and Objectives

Garden Mosaics combines science learning, intergenerational mentoring, multicultural understanding, and community action. Below are learning and behavioral objectives for youth related to each of these themes.

Science Learning

• Inquiry. Develop interview, observation, data recording, reporting, and presentation skills, and apply these skills in the i-m-science investigations and Action Projects.
• Content. Understand science concepts related to plants, insects, soils, maps and air photos, planting practices, and gardens as ecosystems.
• Online Networks. Participate in an international network of youth, gardeners, educators, and scientists contributing to i-m-science databases.

Intergenerational Mentoring

• Learning. Learn from elders about planting practices and the connections of those practices to the gardeners’ cultural traditions.
• Sharing. Share with elders what they have learned about the garden and community.
• Positive Relationships. Form positive relationships with adult gardeners and other community members.

Multicultural Understanding

• Diversity. Demonstrate an appreciation for the diversity of cultural traditions in the garden and community.
• Plants and Cultures. Describe the relationship of gardeners’ plants and planting practices to their cultural heritage.
• Global Science Understanding. Learn about science within a global context, and how scientists from different cultures and countries work collaboratively to solve important problems.

Community Action

• Civic Engagement. Plan and conduct an Action Project to benefit the garden and community.
• Online Networks. Participate in an international community of youth and adults contributing to the Action Projects databases.
Chapter 2. What Do Youth and Adults In Garden Mosaics Do? 
Overview
As an informal educator or teacher, you can use one or more Science Pages in your youth program or classroom, or choose individual activities, *im-science investigations*, or Action Projects. Or you can conduct a long-term youth program combining multiple aspects of the Garden Mosaics program. Science Pages are available in Section V and on the Garden Mosaics website. Short activities can be found in several places, including the “Try This” section of the Science Pages, and in Chapters 5-8 of this Section. *im-science investigations* are found in Section IV and Action Projects are in Section VI. In this chapter, we provide guidelines for combining the various activities and Science Pages into a long-term youth program or classroom project.

In a long-term program, youth can begin with several short activities, including Ice-Breakers and Hands-On Gardening. Next youth conduct the *im-science investigations*, through which they learn about gardeners, gardens, and the neighborhood, and work with gardeners to decide on an Action Project. Action Projects result in a benefit to the garden and neighborhood. Throughout all the activities, youth learn about science content and processes using the Science Pages. Youth also can conduct Inquiry Activities to reinforce their understanding of science concepts. To complete your project, make sure to report results from your *im-science investigations* and Action Projects to the Garden Mosaics website. Guidelines for assessing student learning in a long-term Garden Mosaics program are found in Chapter 5 of this Section; ideas for assessing student learning in individual *im-science investigations* are found in the chapters for each investigation.

Short Activities
Garden Mosaics includes a number of short activities that can be used alone or incorporated into longer-term programs. These activities take place inside or in the garden.
- Ice-Breakers help the youth get to know each other.
- Hands-On Gardening gives youth a chance to get “their hands dirty.”
- Inquiry Activities help youth learn about plants and ecosystems,
- Assessment Activities provide fun ways for you to find out what youth are learning.

Use the Ice-Breakers and Hands-On Gardening activities to start off a longer-term program. The youth should get acquainted with each other so that they can work together effectively during their Garden Mosaics *im-science investigations* and Action Projects. Before the youth can ask good questions of the elder gardeners, they need to have some familiarity with gardening.

*im-science investigations*
Youth and gardeners engage in four *im-science investigations* to answer the following general questions:

Who are the gardeners?
What’s happening in the garden?
What’s happening in the neighborhood?
How are gardeners controlling weeds?

To answer the first question, “Who are the gardeners?” the youth create a *Gardener Story*, detailing the gardener’s planting practices, how he or she learned the practices, and any planting tips the gardener may suggest. Because many gardeners are elderly, their unique practices are in danger of being lost if they are not recorded. Youth use the *Gardener Story Form* to contribute to an international database on ethnic and sustainable planting practices.
To answer the second question, “What’s happening in the garden?” youth conduct a **Community Garden Inventory**. They take a walk through the garden with a knowledgeable gardener. During the walk, the youth interview the gardener and make observations about what is growing, what structures are present, and what activities take place in the garden. In addition to learning about the garden, the youth collect information that is important to community garden advocates in countries throughout the world. Youth use the *Community Garden Inventory Form* to share the results of this *i-m-science investigation*.

To answer the third question, “What’s happening in the neighborhood?” youth conduct a **Neighborhood Exploration**. They use aerial photographs, maps, and a walk through their neighborhood to see where besides the garden people can find fresh food and places for talking with friends, relaxing, enjoying nature, and cultural and educational events. They then produce a neighborhood collage using photos and maps, and share their results online using the *Neighborhood Exploration Form*.

To answer the last question, “How are gardeners controlling weeds?” youth survey weeds in the garden and interview gardeners about methods they use to suppress weeds. They use the online *Weed Watch Forms* to report their data. The data the youth collect through Weed Watch are being used by Cornell scientist Dr. Antonio DiTommaso to develop an environmentally-sound urban weed control program for vegetable gardens.

Each of the *i-m-science investigations* entails gathering information through interviews with gardeners or other community members, and through observations in the garden and neighborhood. Youth enter the information onto data forms, which are posted on the Garden Mosaics website. The data and photographs youth collect become an important educational resource for other youth and adults, and may be used for research purposes.

### Action Projects

Most Garden Mosaics youth want to do more than simply learn about the gardeners, garden, and neighborhood. They want to do something meaningful for the gardeners, to create something beautiful for the garden, and to answer questions about gardening that come up during the *i-m-science investigations*. The Garden Mosaics Action Projects provide such opportunities.

The Action Projects are carried out in cooperation with the gardeners, and where possible, draw from their cultures and planting practices. For example, the youth may carry out experiments or contact scientists to answer questions of concern to gardeners, and share their findings with the gardeners.

Youth choose an Action Project related to **Art in the Garden, Food Systems, Garden Design, Garden Research, Land Use, or Nutrition and Health**. They then fill out the *Action Project Form* to share their accomplishments with other youth and adults around the world. Action Projects often serve as the culmination of a longer-term Garden Mosaics program, but they also can be conducted as stand-alone projects.
Science Pages

Through conducting the *i-m-science investigations* and Action Projects, youth gain inquiry skills, including interviewing, observation, and recording information. You can also use “teachable moments” during the *i-m-science investigations* and Action Projects, as well as the Garden Mosaics Science Pages, to help youth understand the science concepts underlying what they discover in the garden. Some Science Pages explain the science behind planting practices, whereas others describe plants that the youth are likely to find in the gardens. For example, if the youth learn from the gardeners about liming soil, they can turn to the *pH* Science Page. If they find an unusual plant such as papalo or alache, they can read about the plant on the appropriate Science Page. In addition to explanations, Science Pages include short activities to help youth understand concepts, and a spotlight on interesting research. Science Pages are available in color web and color print format (English and Spanish) and downloadable black and white version (English only). Many Science Pages also include Teaching Tips for educators.

A Final Note: Local Actions, Global Connections

Whereas the Action Projects provide opportunities for youth to contribute to their local community, reporting their results to the online Garden Mosaics databases allows youth to see the importance of their work at the national and global level. Completing the Gardener Story, Community Garden Inventory, Neighborhood Exploration, Weed Watch, and Action Project online forms enables the youth and gardeners to collaborate with scientists, greening activists, youth, and other Garden Mosaics participants around the world.
Chapter 3. Planning Your Garden Mosaics Program

Following are some guidelines for planning your Garden Mosaics program. You also may want to refer to the Checklist for Conducting a Garden Mosaics Program (Chapter 9 of this section), Garden Mosaics Program Planning Form (end of this section), and updates on the Garden Mosaics website (www.gardenmosaics.org).

Youth

Garden Mosaics is designed for upper elementary through high school youth ages 10-18. The youth are drawn from community centers, camps, science enrichment programs, school age childcare, after school, home school, 4-H, summer employment, and similar programs. The activities also may be conducted in school classrooms. In some cases, youth start their involvement during the summer and continue in classrooms during the school year. Or they may start with an activity during the school year and continue with im-science investigations and Action Projects over the summer.

Depending on their age and background, youth will need different amounts of preparation before conducting the activities with gardeners. For example, some youth may need practice in learning how to greet the gardeners appropriately (shake hands, introduce themselves, make eye contact). Other youth may need to learn more about garden science so that they are able to ask the gardeners interesting questions during the Community Garden Inventory and Gardener Story. You may want to have youth read and conduct the activities on relevant Science Pages prior to conducting the im-science investigations.

You also will need to adapt how you introduce the program to youth differing in age and interests. For example, younger youth are curious, love learning about science, and become readily engaged in the im-science investigations. Thus, 10-12 year olds may be perfectly happy to conduct the im-science investigations and then decide on an Action Project. In contrast, youth 13 years and older may insist on knowing why they are doing the im-science investigations. They want to feel as if they are doing something meaningful beyond just learning about the garden and gardeners. Thus, for older youth, start by suggesting an Action Project that captures their interest, such as painting a mural or putting up interpretive signs in the garden. Then explain that they will use the im-science investigations to gather information that will help them plan the Action Project. For example, they can incorporate the plants and planting practices they learn about from elders into the mural and interpretive signs.

Structuring the Garden Mosaics im-science investigations and other activities around the Action Projects is one way to engage youth. Other strategies to motivate older youth who may hold negative attitudes toward science learning include linking the Garden Mosaics activities to skills youth want to learn, such as job, computer, or communication skills. Because many of the activities take place outdoors, often during the hot summer months, youth should be prepared to work under challenging conditions. Ideally, youth should have an interest in gardening or the outdoors, or in developing science, communication, and career skills. Make sure the youth know what to expect (for example, that they will be walking and working with elders outdoors).
**Gardeners and Garden Site**

Although Garden Mosaics was designed with community gardens in mind, you can conduct the program at any garden where youth have the opportunity to interact with elder gardeners. Community gardens include gardens on formerly vacant lots, allotment gardens, and gardens at retirement communities, public housing, community centers, and churches, mosques, temples, and synagogues. Many school gardens also invite community involvement and thus are ideal places to conduct Garden Mosaics. If possible, choose a site that is close to where the youth normally meet, and where the gardeners will welcome the youth.

If you are working in a school or other garden where there are no elder gardeners, you can invite a gardener to your site to conduct the Gardener Story. Alternatively, youth can conduct the Gardener Story and many other activities with elders in their home gardens. The Community Garden Inventory must be conducted at a site that has community involvement. The Neighborhood Exploration is designed for an urban neighborhood surrounding a community garden, but can be adapted to any site where it is safe for youth to walk. Weed Watch can be conducted at any garden, but if you are going to share your results over the website, the investigation must take place in an urban vegetable garden.

Try to choose gardeners who use interesting ethnic, traditional, or environmentally-sound practices. Also be sure to select a gardener who is enthusiastic about working with the youth. Gardeners who know how to engage youth are a real asset to any Garden Mosaics program. We have found that most gardeners are very willing and even eager to share their knowledge with youth. Often this is because they are concerned about youth losing interest in gardening. Older gardeners also may fear the loss of their culture and related plants and planting practices. Garden Mosaics provides an opportunity for gardeners to see youth engaged in healthy activities and carrying on cultural traditions.

Take the time to establish a positive relationship with the gardeners before the first time they meet the youth. Explain the program and what to expect. Work with the gardeners to plan a program that takes into account their time, and any communication and language issues.

In some instances, the gardeners may speak limited English. You may have a young person or volunteer who shares a common language with the gardeners and can translate for the rest of the group. Finding a bi-lingual summer assistant (for example, a college intern) is another possibility.

**Educators**

You may be conducting Garden Mosaics by yourself or in cooperation with other educators. Garden Mosaics educators can be college interns, Master Gardener or 4-H volunteers, teachers, and professionals or volunteers working in non-formal educational settings (for example, community centers, non-profit greening organizations). The educators should have experience working with youth from varying backgrounds, skill in facilitating inquiry-based learning, and enthusiasm. They also should be able to organize the activities with the youth and gardeners, incorporate science learning into the activities, and keep the youth motivated through hot summer weather. Some Garden Mosaics sites have put together a team of volunteers, college students, and other professionals to cover all the knowledge and skills needed.
Partner Organizations
Many Garden Mosaics programs partner with a community organization (for example, community center, summer camp, or summer employment program). It is important to work with the partner organization to develop common goals and agreements on responsibilities for each staff member and volunteer. Be sure that the partner organization fully understands and supports the involvement of their youth in Garden Mosaics. Also be sure their summer program is well organized (for example, includes structured activities for youth, does not allow youth to wander in and out).

Program Length
Although Garden Mosaics is designed with summer youth programs in mind, it can be extended into the school year. (Sites with very hot climates conduct the program during the cooler months.)

Each of the *im-science investigations* can be conducted in one morning or afternoon, followed by an indoor session to discuss and collate the results, and enter them onto the website. Action Projects vary greatly in length. Whereas an Art in the Garden Action Project may be conducted in one session, some Garden Research projects may last through the growing season or longer. The youth’s backgrounds also will affect the amount of time spent on Garden Mosaics. If you are working with youth who lack gardening, interviewing, and other relevant experience, you will need extra time.

You can add to the length of your program by having youth read, discuss, and do the activities on the Science Pages. Or you can pick and choose parts of the curriculum if you wish to do a shorter program. For example, some groups may just want to do the Gardener Story and write up the results for the Garden Mosaics website.

Supplies
You will need aerial photographs and maps in the Neighborhood Exploration. Directions for obtaining airphotos and maps of your site and related curriculum materials are included in the Neighborhood Exploration *im-science investigation*.

You will need to obtain several supplies, including journals and clipboards for youth, newsprint, and markers. You also will need a camera and film, and you may want to buy disposable cameras for the youth to use during the Neighborhood Exploration. Additional supplies for individual activities are included with the activity. All the supplies are low cost and readily available.
Curriculum Resources

**Website.** The Garden Mosaics website is designed as a free educational resource. Includes over 35 Science Pages in English and Spanish and the complete text of the Program Manual. Also includes instructions, forms for posting data, and results of the *im-science investigations* and Action Projects.

The resources listed below are available for sale or for free. Check the Garden Mosaics website for ordering information.

**Program Manual.** The illustrated Garden Mosaics Program Manual includes instructions and forms for a variety of activities, *im-science investigations*, and Action Projects. Black and white Science Pages, and information useful for community educators, teachers, and individuals conducting Garden Mosaics in different settings also included.

**Promotional DVD or Video.** An 11-minute inspirational film that captures the essence of what Garden Mosaics youth programs are all about. Available in DVD or video format.

**Interactive DVD.** An interactive DVD with live footage of educators conducting the *im-science investigations* and other activities with youth. Also includes the Program Manual text, forms, and many other resources.

**Science Pages.** Attractive, illustrated fact and activity sheets about plants, planting practices, and other science topics. Color Science Pages can be viewed online or purchased. Black and white versions with additional information and activities available online and in the Program Manual, or can be printed off the website. Available in English and Spanish. A subset of Science Pages available in Arabic.

**Posters, Signs, Brochures.** Posters suitable for hanging on walls of schools, community centers, homes, and offices. Signs for posting in gardens. Brochures to publicize your Garden Mosaics programs.

**Illustrations.** If you are an educator working at an organization with limited funds, we may be able to help you to produce educational materials. For example, you are an international NGO and produce educational materials but don’t have enough money to hire an illustrator. Contact us and we may be able to share some of our illustrations free for educational use.
Chapter 4. Evaluation

Introduction

Although some educators and youth dread evaluation, assessing what youth learn can actually be fun for you and the youth. The evaluation tools we have included, such as youth producing a scrap book or taking family members on a garden tour, can be enjoyable learning experiences. In many cases, they are part of the Garden Mosaics activities, or provide additional learning experiences. So youth won’t even feel as if they are being evaluated!

Why Evaluate?

Educators and organizations increasingly are being asked to show accountability. How are taxpayer and foundation dollars being spent? What are the impacts of their programs?

It is important to think about how the assessment data you collect will be used. For example, you may want results that you can show a funding agency, or share with elected officials. Politicians and funders often expect test scores for assessing classroom learning. In contrast, for community-based education programs the most convincing evidence may be hearing presentations from youth and gardeners; seeing examples of the youth’s journals, artworks, or reports posted to the web; or learning how the program enabled your organization to partner with scientists and community groups. Many of the assessment activities included in this manual result in posters or other products that you can share with funders.

Evaluation in Community Education Settings

In general, there are two ways to assess science learning: tests and actual performance. Although tests are usually easier to implement, they generally are not the best measure of inquiry-based learning. In addition, tests may not be appropriate for the community settings where most Garden Mosaics projects take place. We also have found that the literacy skills of youth involved in Garden Mosaics vary widely, thus making written tests or surveys extremely difficult to interpret.

Many educators think about evaluation in terms of comparing knowledge or skills before and after youth participate in a program. It is important to know something about your participants’ level of understanding before the project so that you can gear the activities to their level. However, you can collect this information informally, through youth drawings or interacting with the youth, rather than through a formal survey or assessment. We advocate this approach for several reasons. First, it may be embarrassing to the youth to answer a series of questions at the beginning of the program for which they cannot be expected to know the answers. Second, it requires a great deal of skill on the part of the evaluator to be able to design and interpret pre- and post-surveys or tests, especially when working with youth ranging in age and ability, and in some cases, number of sessions attended. (In community settings, attendance may be more erratic than at school, and youth may vary in age.)
For these reasons we advocate assessing youth’s actual “performance” in a community-based program such as Garden Mosaics. Examples of performance include giving presentations or tours, or producing journals or scrapbooks. More specific assessment tools are included in Chapter 6 of this Section and in the individual *i-m-science* investigations.

**Tips for Evaluating Your own Program**

---

**Decide on what to assess before the program begins**

This way you may be able to embed the assessment into other youth activities. It also helps to ensure that you will have information that is useful to you, and that is needed by your administration and funders.

---

**Keep an Educator’s Journal**

This can be as simple as a small notebook in which you record the date an activity was conducted, along with your thoughts and observations on youth participation and learning. Such information can be invaluable when it comes time to write program reports. It also can be helpful in planning future programs by providing a record of what worked well and what failed. You can expand on the journal idea by including photos of the activities and products, or anything else you think will help you create an informative summary of the program.

---

**Tailor your Evaluation to the Needs of Your Program**

If you try to evaluate every aspect of the program, you may find yourself overwhelmed or unable to figure out what all the information you’ve collected actually means. Be specific. What do you want to know about youth learning and participation in the program? Be selective. What tools and methods will you use to obtain that information? The tools offered in Chapter 6 are a starting point, but you also may want to devise some simple tools that will address the specific needs of your program. Pick and choose a few tools that will be most useful to your program.

---

**Talk to the Youth**

Make discussion and sharing ideas a regular part of your program. At the end of each activity, talk about what was learned, what was the best or worst part, and what was different, interesting, or funny. Not only do these discussions encourage youth to reflect on the day’s events and thus help reinforce new concepts, they also provide feedback on what youth are learning and material for the educator’s journal.

---

**The *i-m-science* and Action Project Database Entries are also Outcomes**

When youth engage in an Action Project, they use what they learned from the *i-m-science investigations* to inform their project. Be sure to document both the Action Project process and the final product. Also, you can use *i-m-science* and Action Project database entries as evidence of youth learning.
Chapter 5.
Assessment Activities

Overview
Assessment activities can be fun for you and the youth. The assessment activities in this chapter build on the *i-m-science investigations* and other Garden Mosaics learning activities. Products, such as posters, art, journals, maps, collages, and *i-m-science* and Action Project completed data forms and website entries, also can serve as evidence of learning. You can share these products with your administration and funders.

The assessment activities in this section are designed for Garden Mosaics programs that include several activities conducted over a period of time. Assessment ideas for individual *i-m-science investigations* can be found in Section IV: *i-m-science*.

---

14 The evaluation tool kit and much of the information on assessment in this manual were contributed by Stephanie Thompson, Seavoss Associates.
### Assessment Activities Overview

<table>
<thead>
<tr>
<th>Activity</th>
<th>What</th>
<th>When</th>
<th>What Measured</th>
<th>Time</th>
<th>Materials</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garden Scrapbook or Journal</td>
<td>Youth compile photos, reports, and other evidence of their learning.</td>
<td>Throughout the program</td>
<td>Youth experiences and learning throughout program</td>
<td>Variable</td>
<td>Binders, Paper, Camera, Art supplies</td>
<td>Scrapbook or journal, List of what youth learned</td>
</tr>
<tr>
<td>Garden Tour</td>
<td>Youth describe to visitors the garden, plants, planting practices, and the role of the garden in the community.</td>
<td>Any time after completion of the Gardener Story or Community Garden Inventory</td>
<td>Youth learning about plants, planting practices, gardeners, and the garden</td>
<td>Planning: 1 hour or more, Tour: 30 minutes or more</td>
<td>Pencils and paper for planning, Camera or VCR for recording the tour</td>
<td>Photo or video recording of garden tour, Number of visitors participating in tour</td>
</tr>
<tr>
<td>Draw-a-Garden</td>
<td>Youth draw a garden.</td>
<td>One or more times throughout the program</td>
<td>Youth perception of garden and its elements</td>
<td>15 to 20 minutes per drawing</td>
<td>Paper, Crayons, markers, or pencils, Place to store drawings</td>
<td>Youth drawings from before and after program, Educator’s notes about youth comments on the drawings</td>
</tr>
<tr>
<td>Garden Puzzle</td>
<td>Youth create a diagram showing what’s in the garden, and garden inputs and outputs to the community.</td>
<td>One or more times throughout the program</td>
<td>Youth perception of garden and how it fits into the community</td>
<td>Initial puzzle: 30-60 minutes, Revisions: 15-20 minutes per session</td>
<td>Poster board or butcher paper, Colored paper/ Post-its®, Glue, Crayons, markers, or pencils, Scissors</td>
<td>Youth diagrams of garden and what it contributes to neighborhood from before and after the program</td>
</tr>
</tbody>
</table>
Garden Scrapbook

Introduction
Youth compile a journal or scrapbook highlighting their experiences in the program. Contents can include written reflections, photographs, artwork, newspaper clippings, pressed leaves and flowers, recipes, etc. The scrapbook can be a group or individual project; you even may want to involve the gardeners in creating the scrapbook with the youth. It provides a means of documenting youth participation in the program, and allows youth (and gardeners) to share the knowledge they gain through the activities, as well as their opinions and reflections.

When
Throughout the program. Provide frequent opportunities for youth and gardeners to add to the scrapbook.

Time Required
- Introduce the scrapbook and make initial entries: 60 minutes
- Make additional entries: 10-60 minutes each

Materials
- Binder, photo album, or notebook
- Paper, pencils, markers
- Glue sticks
- Scissors
- Camera
- Copies of black and white Science Pages
- Photos, maps, dried flowers, or anything else youth might like to include in the book

Procedure
1. **Introduce the scrapbook or journal.** Explain the purpose of the scrapbook, and invite youth to share ideas for what to include.
2. **Make a cover page.** Ask youth to design a cover page and make a few initial entries. This might include artwork created by youth, or photos of program participants or the garden.
3. **Make regular entries.** Ideally, youth will have frequent opportunities to reflect on their participation and add to the scrapbook. Try to balance written and non-written entries. Keep the written entries fairly short for youth who don’t want to feel like they are doing homework.

Possible Scrapbook Contents
- Photographs
- Maps
- Artwork such as drawings of plants, insects, garden, etc.
- Newspaper or magazine articles
- Copies of completed data forms and narratives
- Copies of completed Science Pages
- Seeds, pressed leaves and flowers
- Recipes

Ideas for Written Entries, Drawings, and Photographs
- One thing I learned today about the neighborhood/garden/gardeners/soils/etc. was...
- The most interesting thing about the gardeners we interviewed was...
- One way to help the gardeners is...
- The gardener I interviewed grew up in...
- The best thing about today was...
- The worst thing about today was...
- My favorite vegetable is...
- My favorite plant in the garden is...
- One vegetable in the garden that I’ve never eaten before is...
- Something I saw/did today for the first time in my life...
- How I feel when I’m in the garden
- If I had a garden of my own, I’d grow...
- Sounds I hear in the garden
- Things I smell in the garden

Products
- Album that documents what participants did, what they thought, and what they learned.
- If you ask youth to write “one thing I learned today” following each activity, by the end of the summer you should have a long list of concepts that you can use to document youth learning.
- Try asking youth to answer the same question at different points in the program and see how their answers change.
Garden Tour

Introduction
Youth lead guests through the garden, describing the plants, planting practices, and role of the garden in the community. The ability of youth to plan the tour and share what they have learned is evidence of their accomplishments.

When
Any time after the conducting the Gardener Story and/or Community Garden Inventory in-science investigations.

Time Required
- Planning the tour: 60 minutes or more
- Conducting the tour: 30 minutes or more

Materials
- Pencil and paper
- 3x5 cards
- Camera or VCR

Procedure
1. Use the Garden Tour Checklist to help plan the tour. The checklist includes the same steps as in the procedure below.
2. Invite guests to the garden. Potential guests include family and friends of the youth and gardeners, neighbors, and community leaders. It is important for the visitors to be “real”—otherwise, the youth may view the activity as a test rather than a tour.
3. Brainstorm. Explain that visitors will be coming to the garden, and that the youth will be asked to show them around. What do the youth think the visitors would like to see? What would they like to tell the visitors about the garden? What are the important features a visitor should know about? How will the visitors interact with the gardeners? How long should the tour last?
4. Create a plan. Have the youth create a tour plan. They may wish to divide up responsibilities. For example, one youth might provide an introduction and a bit of garden history, while another points out different types of plants around the garden. Discuss how the youth will handle questions from the visitors. Emphasize that it is OK to say, “I don’t know.” It is even better to say, “I don’t know but I could find out the answer by...” The youth may want to write important information on index cards that they can refer to during the tour.
5. Practice (optional). The youth can practice giving tours to one another or to the educator(s).
6. Call to confirm the day, time, and place of the tour with the guests and gardeners.
7. Conduct the tour. If there is more than one visitor, you may choose to divide the youth into small groups, each one showing a visitor around the garden.
8. Take brief notes and photos of the tour as it proceeds through the garden.
9. If needed, compile these notes and the other products (see below) into a report.

Products
- X (number of) youth led a tour of Y (number of) community members through the garden
- Brainstorming notes
- Written tour plan
- Index cards or other notes used during the tour
- Photos or video of youth conducting the tour
- Garden Scrapbook entries
- Educator’s notes on what youth said and did during the tour
- Comments from visitors

Variations
- Work with the gardeners to plan an “open house” for the neighborhood. Invite community members to drop in any time on a designated day. Youth can give tours to individuals and small groups as they arrive.
- Have youth make a video tour of the garden. Allow the youth to plan and then record brief segments about the plants, planting practices, gardeners, and the role of the garden in the community. The video can be shown to families and friends, gardeners, community leaders, and funders.
- Invite one of the guests to videotape the tour. Youth are sometimes more willing to share what they know when they are being filmed.
Garden Tour Checklist

- Identify potential garden visitors and schedule a tour.

<table>
<thead>
<tr>
<th>Name</th>
<th>Relationship to garden</th>
<th>Phone number</th>
<th>Will attend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Date and time of tour: _________________

Number of guests expected: _________________

- Brainstorming session with youth.

- Develop tour plan.

- Place reminder call to visitors.

- Document tour: take notes and photographs.

- Record number of tour participants.
  
  # of youth: ____________
  
  # of visitors: ____________

- Keep brainstorming notes, tour plan, photos, and videotapes.

- Compile a report about the activity using the photos, notes, and other information.
Draw-a-Garden Overview

Introduction
Drawing a garden may be a good activity for younger participants. The youth's drawings can help to illustrate youth understanding of plants and what is important in the garden. Collecting drawings at the beginning and end of the program allows you to look for changes in the youth's perception of plants and other aspects of the garden.

When
Twice, once at the beginning and once near the end of the program

Time Required
About 20 minutes per drawing

Materials
• Paper
• Markers or crayons

Procedure
At the beginning of the program...
1. Have the youth write their first name, age, and the date on the paper.
2. Ask the youth to draw a picture of a garden. What might be in the garden? What might the garden look like? Don’t make specific suggestions about what to include; the goal is to see what youth include on their own.
3. Talk to the youth as they draw. As the youth work on their pictures, walk around and look at the drawings. Ask non-judgmental questions. Talking to the youth about their drawings can help clarify what certain objects are, and also can help you understand the youth’s perception of what a garden is.
4. Jot down notes about your conversations with the youth while they were drawing.

At the end of the program...
5. Collect the drawings and examine them. What plants did the youth include? Are they realistically represented? Youth who have limited experience with gardens may draw, for example, individual ears of shucked corn laying in rows on the ground, bunches of bananas growing in rows on top of the soil, or potatoes growing on plants above ground. Did the youth include water sources, compost piles, garden tools, and other features in the drawing?
6. Summarize your notes and observations about the drawings.
7. Store the drawings in a safe place.

When
Before/After.

Procedure
At the beginning of the program...
1. Have the youth write their first name, age, and the date on the paper.
2. Ask the youth to draw a picture of a garden. What might be in the garden? What might the garden look like? Don’t make specific suggestions about what to include; the goal is to see what youth include on their own.
3. Talk to the youth as they draw. As the youth work on their pictures, walk around and look at the drawings. Ask non-judgmental questions. Talking to the youth about their drawings can help clarify what certain objects are, and also can help you understand the youth’s perception of what a garden is.
4. Jot down notes about your conversations with the youth while they were drawing.

At the end of the program...
5. Collect the drawings and examine them. What plants did the youth include? Are they realistically represented? Youth who have limited experience with gardens may draw, for example, individual ears of shucked corn laying in rows on the ground, bunches of bananas growing in rows on top of the soil, or potatoes growing on plants above ground. Did the youth include water sources, compost piles, garden tools, and other features in the drawing?
6. Summarize your notes and observations about the drawings.
7. Store the drawings in a safe place.
8. Repeats steps 1-7.
9. Compare the drawings. Are the later drawings more realistic? Do they include features that youth learned about during the program (for example, water barrels, raised beds, specific vegetables)? In what other ways are the later drawings different?
10. Summarize your observations. You can summarize your observations in a report that includes examples of before and after youth drawings.

Products
A report, poster, or slide show (using scanned images) of youth’s drawings before and after the program, comments the youth made while drawing, and your assessment of what the activity showed about youth learning.

Variations
• Draw-a-Plant. Have youth draw a particular plant that they will encounter in the garden. Ask them to label the parts of the plant. At the end of the program, are the drawings more realistic? Are the youth able to label more parts than they were previously? This variation may help you to better understand youth learning about plants.
• Before/After. Instead of having the youth create a new drawing at the end of the program, give back their first drawing and ask them what they would like to change or add. Then let them create a new drawing. This allows youth to reflect on their earlier perceptions.
Introduction
Youth create a poster or diagram illustrating garden components, inputs, and outputs. The diagram provides evidence of youth learning about the flow of resources into and out of the garden.

When
Twice, once at the beginning and once near the end of the program. Or conduct this activity periodically throughout the program.

Time Required
- First diagram. 30-60 minutes
- Each additional diagram: 15-20 minutes

Materials
- Construction paper or Post-It© notes in 3 different colors. Cut out circles in one color, triangles in two colors. The pieces should be 3-4" in size.
- Markers
- Tape or poster putty
- Newsprint or butcher paper

Procedure
At the beginning of the program...
1. Draw a large circle in the center of a piece of newsprint. This circle represents the garden.
2. Tell the youth they are going to make a puzzle of what's in the garden, what it gives to the neighborhood, and what the neighborhood gives to it. You can call these three things garden components, inputs, and outputs. You can explain what these terms mean by giving an example of a car. Some of the components of a car are tires, seats, engine, and steering wheel. Can the youth think of others? Some of the inputs that a car needs are fuel, oil, and a person to drive it. Can the youth think of additional inputs? Some of the outputs that a car might provide are transportation, noise, fumes, and independence. Can the youth list additional outputs?
3. Ask the youth about the important components in the garden. What is in the garden? Have them write each component on a colored circle. Try not to provide too many examples; let the youth come up with ideas on their own.
4. Ask the youth to write down garden inputs. What does the garden need in order to be successful? Have them write each input on a colored triangle. Again, let the youth answer on their own.
5. Ask the youth to name garden outputs. What does the garden produce for the community? Have them write each output on triangles having a different color than the input triangles.
6. Attach the circles and triangles to the paper. Place the components within the garden boundary and the inputs and outputs around it with arrows pointing in or out.
7. Encourage youth to discuss why they are including certain components, inputs, and outputs.
8. Take notes about what the youth are saying.
Periodically throughout the program (optional)...

9. If you are conducting the puzzle as an ongoing activity, post the diagram where youth can see it.

10. Take a photo of the diagram to document what was included on it.

11. Keep some blank circles and triangles on hand.

12. Allow the youth to add new components, inputs, and outputs throughout the program. They should use a different color marker for different dates (and make a legend of marker colors and dates) so you can tell which items are from the original diagram and which are new. Have them discuss what they are adding or changing.

13. During or after each session, jot down notes about what the youth are saying.

At the end of the program...

14. Have the youth add any new components, inputs, and outputs they can think of. They should use a different color marker so you can tell which items are from the original diagram and which are new. Have them discuss what they are adding. What new things did they add? Would they like to take anything away?

15. Take notes about what the youth are saying.

16. Compare the diagrams. Were the later diagrams more realistic or complete? How might they reflect what the youth experienced in the program?

17. Summarize your observations. You can summarize your observations in a report that includes photos and examples of youth diagrams.

Products
A report, poster, or slide show (using scanned images) of diagrams youth make before and after the program, comments the youth made while diagramming, number of new elements added, and your assessment of what the activity showed about youth learning.
Chapter 6. Ice-Breaker Activities

Overview
You can use the Ice-Breaker Activities with a group of youth who have not worked together previously. You may want to include the gardeners in some of the activities.

If I Were a Plant...
**Time Required**
5-10 minutes

**Materials**
None

**Procedure**
Ask participants to sit or stand in a circle. Explain that each participant will select a plant (you may want to narrow this to a flower or a vegetable) that they would want to be and explain why. As the group leader, start off the exercise. For example, “If I were a plant, I would be a sunflower because they turn to face the sun.”

Picking Flowers

**Materials**
Flowers with petals (such as daisies, calendulas, cosmos, nasturtiums, or tulips). Provide enough flowers for each person in your group. For flowers that have more than 10 petals, take some of the petals off. Ideally there should be some flowers with a few petals, some with 5-7, and several with around 10.

**Time Required**
20-30 minutes

**Procedure**
Ask participants to select a flower. Once everyone has their flower, sit or stand in a circle. Explain that each person has to say something about themselves for each petal. For example, if you have a cosmos with 6 petals you would pick off the petals, one at a time, saying something about yourself with each petal.

Edible Mosaic

**Time Required**
- 60 minutes to prepare cookie dough beforehand.
- 60 minutes to conduct activity with youth.

**Materials**
- Sugar cookie dough (instant or homemade)
- Apple or pear butter or icing
- Fresh or dried fruit (e.g., sliced bananas, blueberries, raspberries, dried cranberries)
- Nuts and seeds (e.g., sunflower seeds, almonds)
- Candy (e.g., chocolate chips)
- Cookie sheet

**Procedure**
Before the activity, divide cookie dough into individual cookies. Place cookies on cookie sheet close enough for them to flow together when baked. Cookie dough should bake such that it fills the entire cookie sheet and provides a solid rectangular surface large enough for up to eight youth to work on. If you have a larger group, use more cookie dough and cookie sheets as needed.

Provide the group with the mosaic making materials (fruit, nuts, etc.) and instruct them to spread the fruit butter or icing on the cooked dough. This will hold the materials to the sugar cookie. Give them about 30 minutes to make a design with the fruit, nuts, and candy. Then, have the groups explain their design, take a picture, cut up their mosaic, and enjoy!

Garden Quiz

**Time Required**
15-20 minutes plus preparation time.

**Materials**
- 1 large poster board taped to wall
- 3 x 5 cards
- 16 small business envelopes
- Markers

---

16 Rosalyn McMullin, Cornell Cooperative Extension-NewYork City, contributed this activity.
**Procedure**

Similar to a TV game show, participants select a category and value and are asked a question. If the participant answers the question correctly s/he receives an index card that indicates the points. If you have a large group, divide them into two teams. The teams select a captain who gives the answers for the team. They play until all of the questions have been answered. At the end of the game, participants tally the points on their index cards.

We have presented some example questions, but you may want to develop your own questions based on the level of your youth. List categories such as “History of Food” or “Plant Products” on the poster board. Use the marker to write monetary values on the envelopes and tape them to the poster board. Also write the monetary value of the envelopes on the 3x5 cards and place them in the envelopes. Develop questions for each category for each monetary value or use the questions below.

**Poster Board with Envelopes**

<table>
<thead>
<tr>
<th>History of Food</th>
<th>Plant Products</th>
<th>Food Culture</th>
<th>Vegetables and Fruits</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
</tbody>
</table>

**Questions and Answers**

**History of Food**

- 10 - Which African-American scientist came up with many uses for the peanut? Answer: George Washington Carver.
- 20 - This vegetable has been grown for more than 4,000 years. It grows almost anywhere and you can buy it by the head. What is it? Answer: Lettuce.
- 30 - What common food is eaten by many people every day, has been around since the days of ancient Egypt, Babylon, and Greece, and is made from grain? Answer: Bread.
- 40 - We are called the Three Sisters. We are planted together and are traditional foods of Native Americans. What are we? Answer: Corn, beans, and squash.

**Plant Products**

- 10 - What part of the cacao (kah KOW) tree does chocolate come from? Answer: The seed (more specifically, the ground up seeds).
- 20 - One of these plants is used in baby powder and disposable diapers: corn, wheat, or rice. Answer: Corn (corn starch).
- 30 - Other than food, what products come from plants? Name two. Possible answers: Medicines, cloth, rope, paper, wood, dyes, and inks.
- 40 - The slimy sap I ooze helps heal your wounds. What plant am I? Answer: Aloe vera

**Food Culture**

- 10 - This vegetable is spicy and very popular in hot climates. Answer: Chili pepper.
- 20 - What vegetable is sauerkraut made from? Answer: Cabbage.
- 30 - What food is eaten by more people in the world than any other? Answer: Rice.
- 40 - What is the main ingredient in guacamole? Answer: Avocado.

**Vegetables and Fruits**

- 10 - Name a small, sweet fruit that grows along the ground. Answer: Strawberry.
- 20 - What common vegetable is really a fruit? Answer: Tomato (could also be cucumber and other “vegetables” with seeds).
- 30 - Name a vegetable that is a flower and is green. Answer: Broccoli.
- 40 - This fruit is sometimes called a zipper-skin fruit because it is so easy to peel. Answer: Tangerine.
Chapter 7.
Hands-On Gardening Activities

Overview
Although the focus of the Garden Mosaics activities is not on hands-on gardening, youth should have some gardening experience in order to conduct the *i-m-science investigations* and Action Projects. Here are some possibilities for youth who do not have previous gardening experience.

Painting Pots, Planting Seeds

*Time Required*
25-30 minutes

*Materials*
- Clay or plastic pots (5" or 8"), one for each youth
- Various art supplies (e.g., acrylic paints, glue, glitter, paint brushes, sponges)
- Seeds (Mint and chamomile grow well in pots and do not need much care.)
- Potting soil
- Small plastic containers for scooping soil into pots (e.g., small yogurt containers)

*Procedure*
Have each youth decorate his/her pot and pick out the plant s/he would like to grow. Next have the youth add potting soil and plant their seeds. Explain to them how to care for their seedlings.

From Paper to Pots to Plants

By using a “paper pot maker,” youth can recycle newspaper into small pots for starting seedlings. The newspaper is biodegradable and can be planted directly into the ground when the seedlings are ready for transplanting.

*Time Required*
30-60 minutes

*Materials*
- Labels
- Newspaper
- Paper pot maker (available from http://www.seedsofchange.com. Enter “paper pot maker” under search to find the product. It costs about $15.)
- Permanent marker for labeling
- Plastic containers for scooping soil into pots (e.g., small yogurt container)
- Scissors
- Seeds (Beans and flower seeds work well)
- Tablespoons
- Tray for seedlings (e.g., reused aluminum pie plates)
- Water
- Compost, peat, vermiculite
- 5-gallon bucket (for mixing potting soil)

*Procedure*
1. **Make potting soil** by adding vermiculite, peat, and compost (roughly two parts compost to one part peat and one part vermiculite) in bucket. Add water, stir well, and let sit.
2. Follow instructions on pot maker and use strips of newspaper to create seedling pots.
3. Allow youth to decide what seeds they would like to plant. Review how long each seed will take to grow, care, and transplanting needs.
4. Place pots on small trays for youth to take home. Have youth fill each of their pots nearly to the top with potting soil using small plastic containers and tablespoons.
5. Add seeds to pots.
6. Take home, care for the plants, and enjoy!

Gardening with the Gardeners

Arrange a time for youth to meet a gardener(s) and help in their garden.

Garden Plot

Arrange for youth to plant and tend their own plot in a school, home, or community garden. Refer to Resources and Links on the Garden Mosaics website (www.gardenmosaics.org) for more information on involving youth in gardening.
Chapter 8.
Inquiry Activities

Overview
Inquiry activities engage youth in asking questions and seeking answers. A good source of inquiry activities is the “Try This” section of Garden Mosaics Science Pages. (All the Science Pages except those focusing on plants have a “Try This” section.) The Garden Puzzle in Chapter 5 of this section also can be used as an inquiry activity. We have included two additional inquiry activities in this chapter.

Garden Ecosystem
Introduction
Youth work collaboratively to create a poster showing the different ecosystem components in a garden.

Time Required
60 minutes

Materials
• Markers
• Tape
• Newsprint or butcher paper
• Pictures or photos of items in gardens, glue (optional)

Procedure
1. Introduce youth to the idea of an ecosystem. The garden ecosystem includes the living and non-living parts of the garden. In this activity, they will be asking questions about how the living and non-living parts of the garden interact with each other.

2. Have the youth brainstorm different living and non-living things in the garden. The youth may suggest soils, plants, structures, wildlife, and people.

3. Assign youth to different groups, including plants, soils, animals, people, and structures. Give each group a large piece of paper (e.g., newsprint or butcher paper) and markers.

4. Have each group list examples of the plants, soil types, animals, etc. that are found in the garden. For example, the soils group might list soils in raised beds, fertilizers, compost, and mulch. The structures group might list shed, fence, casita, and tall building bordering garden. People may include gardeners, garden manager, children, and visitors. The youth can also draw pictures or cut out photographs of the different things in the garden and paste them on their sheets.

5. Once they have listed the examples, have the youth come back together and tape their sheets of paper together so they overlap slightly on a wall or on a central place on the floor.

6. Have each group explain what they came up with and add other examples that the larger group of youth suggests.

7. Introduce the concept of interactions among parts of an ecosystem. Ask the youth if they can think of an example of a living or non-living thing affecting something else in the garden. For example, shade from a building might affect how fast plants grow. Insect pollinators make it possible for some plants to form seeds or fruits. Mulch may keep down weeds and allow vegetables to grow. People eat vegetables.

8. Ask each youth to draw one arrow between two different parts of the ecosystem, and explain how the different parts interact with each other. Does an increase in one part result in a decrease (negative feedback) or increase (positive feedback) in the other part?

9. Engage the youth in a discussion of how different parts of the garden ecosystem interact, and of positive and negative feedback.17

17 For a more indepth activity on feedback loops in gardens, refer to: http://www.actionbioscience.org/biodiversity/rinker2.html#educatorresources
Asking Elders\textsuperscript{18}

\textbf{Introduction}
Youth use a drawing or photograph of a specific plant to start a conversation with knowledgeable gardeners in their community.

\textbf{Time Required}
- Find drawings or photos and copy them: 30 minutes
- Introduce activity to youth: 20 minutes
- Time for youth to talk to elders on their own
- Discuss youth’s findings: 45 minutes

\textbf{Materials}
- Copies of drawings or photos of plants
- Newsprint and marker
- Paper and pencils

\textbf{Procedure}
1. \textbf{Choose one or more plants that the elders in the youth’s community might be knowledgeable about.} If you are working in a community where there are immigrants, you might choose a plant that is grown in the countries from which the immigrants came. You can also choose a common plant so that youth are more likely to find someone who knows about it. Or perhaps there is a plant that the youth encountered in the garden and are curious about.

2. \textbf{Ask the youth to brainstorm a list of questions about the plant.} For example, what varieties are grown? What methods are used to grow the plant? Where can you get seeds to grow the plant? If the plant is a weed, what methods are used to control it? Is it also eaten? How is it prepared? Write the questions on the board or on newsprint.

3. \textbf{Have each youth write down the questions they will ask on a sheet of paper.}

4. \textbf{Have the youth identify someone who they think will be knowledgeable about their plant.}

5. \textbf{Have each youth interview an elder gardener or other knowledgeable person.} The youth should ask their questions and record the answers.

6. \textbf{When the youth come back together, have them share their findings with each other.} They may want to compile what they learned about the plant(s) into a report.

\textsuperscript{18} This activity was contributed by Roger Ellis, EcoPort South Africa.
Chapter 9.
Checklist for Conducting Garden Mosaics Program

1. Use the Program Planning Form at the end of this section to help you plan your project.

2. Decide on the focus of your program. You may want to focus broadly on gardening science with elders. Alternatively you may want to choose a particular Action Project beforehand, and organize the activities so they build up to the Action Project.

3. Obtain permission for the youth to be in the program, and if appropriate, to have their photos and first names only posted on the Garden Mosaics website. We have provided sample Youth Permission Forms for parents or guardians in English and Spanish (Section VII).

4. Contact gardeners and explain the program. Obtain permission from the gardeners to participate in the program. In particular, if you think you may be posting a Gardener Story or photograph to the Garden Mosaics website, be sure to have the gardener sign the Gardener Permission Form (Section VII).

5. Decide on how you will assess the program, including how the assessment results will be used and what assessment activities you will include at different points in the program. If appropriate, conduct a pre-program assessment activity with youth.

6. Conduct one or more Ice-Breaker Activities with the youth.

7. If the youth in your program do not have any gardening experience, you will need to involve them in hands-on gardening. This can be a simple activity, such as potting plants or applying compost to soils. Or it can be a longer-term effort, such as growing vegetables in a garden plot reserved for the youth, or helping the elder gardeners. At least one hands-on gardening activity should be conducted prior to the i-m-science investigations. Hands-on gardening also can be conducted along with the other Garden Mosaics activities throughout the growing season.

8. Depending on the experience of your youth, you may want to conduct several activities to prepare youth for the i-m-science investigations. For example, you may want to go over interviewing skills or complete some of the activities on the Science Pages.

9. Have youth carry out the four i-m-science investigations to learn about gardeners and garden science and to help them decide on an Action Project. Explain to the youth that they will be conducting i-m-science investigations to learn about the gardeners, garden, and neighborhood. They will use what they learn from these activities to decide on an Action Project that will help the gardeners and garden. (For example, the gardeners might have questions about a particular vegetable variety and the youth can conduct with research on the Internet to find the answer. Or the youth can teach the gardeners how to conduct research on the Internet.) Use the Science Pages to help youth learn more about what they find in the garden.
10. Have the youth fill out the Gardener Story Form (all sites), Community Garden Inventory Form (community garden sites only), Neighborhood Exploration Form (all sites), and Weed Watch Forms (urban sites only) and submit them to the Garden Mosaics website. Remember to submit photos for the Garden Mosaics website, following the Photo Guidelines (Section VII).

11. Have the youth decide on an Action Project. If you have already decided that they will be limited to one particular project (for example, an art project), the youth can make decisions about what kind of art they will create and how they will involve the gardeners. They can learn what other groups have done through the Action Projects online database.

12. Have the youth conduct the Action Project.

13. Have the youth fill out the Action Project Form and submit it to the Garden Mosaics website.

14. Make sure that the youth write thank you notes to the gardeners.

15. Conduct a final banquet or other event with gardeners and parents or guardians. Some programs have celebrated with cooking a meal using produce from the garden. Others have conducted educational events where the youth shared what they learned with gardeners and community members at the garden, or at county and state fair. A closing ceremony is a good time to recognize the youth and gardeners with a certificate for their participation.

16. Recognize and reward youth for their participation. Present youth with certificates or other rewards for their participation and special contributions or accomplishments.

17. Explore possibilities for youth to continue their projects over the academic year. Contact their teachers to tell them about the program and suggest how the youth might continue their Garden Mosaics activities.
Program Planning Form

Your Name

Name of your Program

Your Organization

1. Youth
Organization sponsoring youth program, if different from your organization

Days/hours youth are available to conduct Garden Mosaics activities

Particular interest, motivation, or benefit for youth participating in this program

Special considerations for working with this audience (e.g., motivation, literacy, disabilities, translation needs)

How will parents, other family members, or guardians be involved?
Program Planning Form (cont'd)

2. Garden and Gardeners

Name of Garden

Location (street address and neighborhood)

Name and phone/address of gardener contacts (e.g., garden manager)

Days/hours gardeners are available

Particular interest, motivation, or benefit for gardeners participating in this project

Special considerations for working in this garden (e.g., translation needs)

How will other community members be involved?
Program Planning Form (cont’d)

3. Educators and Volunteers
Names and contact information of other educators and volunteers

For each person, what is their role or responsibility in implementing Garden Mosaics activities with youth?
Program Planning Form (cont'd)

4. Goals, Objectives, and Strategies
Overall program goal (What do you or your organization hope to achieve?)

Learning objectives (What would you like to see the youth learn or do? You can refer to the Garden Mosaics science learning, intergenerational mentoring, multicultural understanding, and community action objectives in Chapter 1 of this section.)

What strategies will you use to motivate the youth to achieve your objectives?

How will you recognize and reward the youth?

How will you involve youth in planning the Action Project?

How will you evaluate whether you meet your program goal and learning objectives for youth?
5. **Schedule of Activities**
For each activity, include date, Science Pages you will use, Materials and Supplies, and any other relevant details.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Date/Time</th>
<th>Science Pages/ Other Resources</th>
<th>Materials/Supplies</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Short Activities</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ice-Breakers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hands-On Gardening</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inquiry Activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assessment Activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. Schedule of Activities (cont’d)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Date/Time</th>
<th>Science Pages/Other Resources</th>
<th>Materials/Supplies</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>i-n-science investigations</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gardener Story</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community Garden Inventory</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neighborhood Exploration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weed Watch</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. Schedule of Activities (cont’d)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Date/Time</th>
<th>Science Pages/ Other Resources</th>
<th>Materials/Supplies</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Action Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(indicate which type: Art in the Garden, Food Systems, Garden Design, Garden Enhancement, Garden Research, Land Use, or Nutrition and Health)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. Notes
Section IV.

*i.m.*science

Overview

This Section provides guidelines for conducting *i-m-science* investigations and reporting the results to the online *i-m-science* databases. For educators conducting *i-m-science* investigations with youth, we have provided information about science learning and assessment, as well as detailed instructions for conducting the investigations. If you will be conducting *i-m-science* projects on your own, read this Overview, and then go to the investigations that interest you. For each investigation, read the chapter overview and illustrated short version, and then go to the *i-m-science* forms at the end of the chapter and online.

If you are unable to complete the forms in English, please contact Garden Mosaics. We can work with you to arrange for translations of the forms into other languages. We will post your data in the original language and translated into English.
What is i\-m\-science?

*i\-m\-science investigations* entail using interviews and observations to collect data, and reporting your findings to our online *i\-m\-science databases*. The databases are used for education and research.

Why the name *i\-m\-science*?

*i\-m\-science* means *I Am Science*. Youth and community members can contribute to science in important ways.

*i\-m\-science* means *Information Mosaics* science. The small “i” has become a universal symbol for information. The “m” refers to the mosaics of plants, planting practices, people, and cultures in community and other gardens.

Finally, *i\-m\-science* means *International Mosaics* science. We invite youth, gardeners, and volunteers from all over the world to share their knowledge of plants and growing practices, and of the role gardens play in their communities.

Why participate in *i\-m\-science*?

*i\-m\-science investigations* can be conducted for two purposes: to add to the online databases and as educational activities for youth and adults.

*i\-m\-science databases*. Through sharing the results and photos of your *i\-m\-science investigations* using the online databases, you are helping to create a beautiful website that is used for education and research. You also can contact Garden Mosaics about posting the database reports from your city or region on your own website, so that they will help spread the word about your own programs.

*i\-m\-science youth programs*. Through conducting *i\-m\-science investigations* with elder gardeners, youth form positive relationships with local role models. They also develop interviewing, observation, and data recording skills, and make important contributions to their community.

*i\-m\-science investigations*

The four *i\-m\-science investigations* are Gardener Story, Community Garden Inventory, Neighborhood Exploration, and Weed Watch.

**Gardener Story**

Participants develop an oral history and take photographs illustrating a gardener’s planting practices and “planting tips,” and the connections between those practices and the gardener’s culture. The gardener can be from a community, home, or school garden. The Gardener Stories provide a rich educational resource for visitors to our website.

**Community Garden Inventory**

Participants take a walk through a community garden with an experienced gardener. They ask the gardener questions and make their own observations about the plants, structures, and activities in the garden. You can use our online *Community Garden Inventory Form* to catalog all the gardens in your city. This *i\-m\-science investigation* also can be conducted in school gardens that include community involvement.

**Neighborhood Exploration**

Participants use aerial photographs, maps, and a walk through their neighborhood to see where besides the garden people can find fresh food and places for talking with friends, relaxing, enjoying nature, and cultural and educational events. They then produce a neighborhood collage using photos and maps, and share their results online using the *Neighborhood Exploration Form*.

**Weed Watch**

Participants survey weeds in urban home, community, or school vegetable gardens, and catalog the methods gardeners use to control weeds. They enter their data into the three *Weed Watch Forms* and submit their forms online. Cornell scientist Antonio DiTommaso is using the data to develop environmentally-sound methods for controlling urban weeds.
Chapter 1.
Gardener Story

Overview

The Gardener Story is an “oral history” of a gardener. You ask questions about the gardener’s planting practices and the connection of those practices to the gardener’s background and culture. You also take photographs of the gardener and his or her plants. Then you write a short Gardener Story and share it through the Garden Mosaics website.

Gardeners love to share their stories and knowledge with interested listeners—young and old alike. The Gardener Story is an opportunity for you to learn from gardeners and for the gardeners to pass down their traditions to new generations.

By conducting the Gardener Story, you will be contributing to an international database of gardeners, their planting practices, and their cultural heritage. Many of these practices will be lost if not recorded by you and other i-m-science participants. Each Gardener Story is posted online so that anyone can learn about the unique stories of gardeners and their cultural traditions.

Some of the Gardener Story questions ask about where the gardener grew up and the connection of the gardener’s culture to his or her gardening practices. Nearly all gardeners grow plants and use practices that reflect their cultural heritage. Community gardeners often come from other countries or more rural areas in their own country, and bring with them practices that reflect their particular cultures. Feel free to conduct the Gardener Story with any interesting gardener—young or old, working in a home or community garden.

Garden Mosaics is very interested in Gardener Stories from other countries besides the US. If you prefer to create a Gardener Story in a language other than English, please contact us at gardenmosaics@cornell.edu (we can respond to inquiries in Spanish, French, Arabic, Russian, German, and other languages). We will work with you to translate the Gardener Story questions into your language, and to post your Gardener Stories in the original language and in English.

Although most participants write up their Gardener Stories, you may be able to submit an audio/slide show version. We have included general guidelines for this method.

Anyone Can Submit a Gardener Story...

If you wish to conduct the Gardener Story on your own or with a group of adults, you can go directly to the short, illustrated version of the Gardener Story following this overview, and then to the guiding questions and Gardener Story forms online or at the end of this chapter. You also may want to read more about the research objectives of the Gardener Story, and the instructions for conducting the audio/slide version. The rest of the information in this chapter is primarily for conducting the Gardener Story with a group of youth or students.

Conducting the Gardener Story with Youth

We have included in this chapter the following information for conducting the Gardener Story with youth: inquiry and content learning objectives, assessment ideas, and comprehensive instructions.

You can conduct the Gardener Story in a variety of settings, including gardening education programs, a social studies class studying immigration, a service-learning project, or an intergenerational program. If you are not able to travel to a garden, you can invite a gardener to your school or other setting for the interview.
WHAT IS A GARDENER STORY?
A Gardener Story is an "oral history" about a gardener.
You will interview the gardener, and create a story about what he grows and how he got interested in gardening.

I wonder what plants he grows.

Does he have any planting tips that are good for the environment?

How does he use the plants?

How does he grow the plants?

Are there any other questions you think are important?

WHY THE GARDENER STORY?
Every gardener has some interesting way to plant vegetables or flowers.

Often these practices are carried on from parents and grandparents. Because many gardeners are elderly, their unique practices are in danger of being lost if they are not recorded.

When I was young, my grandmother taught me how to garden.

WHAT WILL YOU NEED?
✔ copy of Gardener Story Form
✔ copy of the Gardener Story Guiding Questions
3x5 inch cards or paper
pencils
clipboards
cameras and film
drinks and snacks

If you have a tape recorder, you could tape your interview.

WHAT TO DO...BEFORE GOING TO THE GARDEN
Background Research
✔ Read some Gardener Stories on the Garden Mosaics website. What makes a good Gardener Story?
✔ Talk to your group leader before you start, or read the Garden Mosaics Program Manual about gardener permission forms.

Who will introduce us to the gardener, and explain what we want to do?

Who will take photos?

Who would like to take notes?

Who should we interview?

We've got to remember to thank the gardener for letting us interview him.

Generate Questions
✔ Brainstorm a list of questions that you think are important to ask the gardener.
✔ Look at the online Gardener Story Guiding Questions. Make sure to include the questions on your list that you need answered to complete the Gardener Story. Write down your questions on 3x5 cards or paper to take to the garden.

Generate Questions
✔ Brainstorm a list of questions that you think are important to ask the gardener.

Practice Interviewing
✔ Review the interviewing skills on the website. Practice interviewing with your friends.
✔ Decide what everyone is going to do at the interview.

Does any one have a tape recorder to tape the interview?

Maybe someone should make sure all our questions are answered.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
WHAT TO DO...AT THE GARDEN

Make introductions
✔ Introduce yourselves to the gardener.
✔ Explain that you would like to hear his story.

Ask questions
✔ Ask questions from your list.
✔ Also ask questions about things that seem to be important to the gardener. Your Gardener Story will be more interesting if you can capture things that the gardener is excited about.
✔ Don’t be afraid to ask questions about things you don’t understand or want to learn more about.

Collect information
✔ Before the interview ends, make sure you have answered all of the questions on your list and on the Gardener Story Guiding Questions.
✔ If it’s OK with the gardener, take photos to illustrate the information.
✔ Thank the gardener and share your drinks and snacks.

I’m growing the same vegetables my family grew for generations in the Dominican Republic.

WHAT TO DO...AFTER YOU LEAVE THE GARDEN

Review findings
✔ Discuss the interview.
✔ Write down the answer to each question on the Gardener Story Guiding Questions Form.
✔ Discuss what information and photos you want to include in the Gardener Story that you submit online.

Share online
✔ Decide who will write the story.
✔ Write up the story and submit it online with your photos to the Garden Mosaics website. If you taped the story, you can also create a slide show with audio quotes from the gardener.

Learn more
✔ Check out the online Science Pages. Click on any pages that might help you to understand more about what you learned.
Gardener Story Research

Research Objective
To compile information about planting practices of immigrant, minority, and other gardeners, and about how these practices are tied to gardeners’ cultural heritage.

Research Questions
• What plants does the gardener grow?
• How does s/he use the plants?
• What planting practices does s/he use to grow the plants?
• How does the gardener’s ethnic or cultural heritage influence his/her gardening?
• Does the gardener use any practices that are good for the environment?

Why Is Gardener Story Research Important?
Every avid gardener has some interesting practice or planting tip that other gardeners and even scientists would be interested in. Because many community and other gardeners are elderly, their unique practices are in danger of being lost if they are not recorded.

Practices that reflect a particular culture or a unique way to conserve resources are especially important to preserve. Many community gardeners are immigrants from poor countries or regions within their country. They sometimes hold on to practices from their native region, which were taught to them by elders. Because they may not have had access to chemical pesticides and fertilizers or large-scale irrigation, they may have developed environmentally-sound ways to manage insects, weeds, soils, and water. Similarly, rural gardeners sometimes keep practices that reflect their ancestry, such as planting heritage varieties. Garden Mosaics participants can play an invaluable role in preserving our knowledge of these unique practices for future generations.

Gardener Story Science Learning

The Gardener Story is a great opportunity for youth to learn about two aspects of science:
• Inquiry, or “doing science,” and
• Content, which includes facts and concepts.

Inquiry
If you follow the instructions for conducting the Gardener Story investigation, youth will learn the following inquiry skills.

Inquiry Learning Objectives
Youth will:
• Define questions to ask the gardener.
• Apply interview skills to learn about the gardeners and their gardening practices.
• Synthesize information they gather into a narrative.
• Submit their narrative and photographs online.

Content
You can use the Garden Mosaics Science Pages to help the youth learn more about the plants and practices they encounter in the garden. For example, a gardener might mention that she plants marigolds with her tomatoes to keep pests away. You could use the Interplanting for Pest Control Science Page to explain this practice to the youth. If you anticipate youth will encounter unfamiliar concepts or plants during the interviews, you can have the youth read the relevant Science Pages before conducting the Gardener Story investigation.

You can also use “teachable moments” in the garden to encourage the gardener to explain unfamiliar concepts to the youth. For example, if the gardener talks about planting kalaloo, encourage the youth to ask what this plant is used for and where it is grown. If the gardener points out a water collection system, encourage the youth to ask how the system works and how the gardener waters the plants.

With your guidance and using the Science Pages, you can expect youth conducting the Gardener Story to learn the following content.
**Content Learning Objectives**
Youth will learn about:
- Plants, planting practices, and uses of plants.
- Physical, biological, and ecological science concepts related to the plants and planting practices.
- How plants and planting practices relate to the gardener’s cultural heritage.

**Additional Assessment Tools**

**Participation**
To generate a summary of what youth and other participants did, record number of:
- youth participants,
- gardeners who participate and name of garden,
- educators or volunteers and their affiliation.

Also save the list of interview questions, notes from the story, and a copy of the completed narrative.

**Gardener Story Assessment**

<table>
<thead>
<tr>
<th>Inquiry Learning Objectives</th>
<th>Evidence of Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Youth will:</td>
<td></td>
</tr>
<tr>
<td>• Define questions to ask the gardener.</td>
<td>The list of interview questions that youth create and notes from the interview planning discussion are evidence of youth ability to define questions.</td>
</tr>
<tr>
<td>• Apply interview skills to learn about the gardeners and their gardening practices.</td>
<td>Written notes from the interview and the completed narrative are evidence that youth were able to apply their interview skills and synthesize the information gathered.</td>
</tr>
<tr>
<td>• Synthesize information they gather into a narrative.</td>
<td></td>
</tr>
<tr>
<td>• Submit their narrative and photographs online.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Content Learning Objectives</th>
<th>Evidence of Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Youth will learn about:</td>
<td></td>
</tr>
<tr>
<td>• Plants, planting practices, and uses of plants.</td>
<td>The initial discussion should give you an idea of youth knowledge about these concepts prior to conducting the Gardener Story.</td>
</tr>
<tr>
<td>• How plants and planting practices relate to the gardener’s cultural heritage.</td>
<td>The completed narrative provides evidence of youth understanding of the relationship between plants and planting practices and cultural heritage, and of related science concepts.</td>
</tr>
<tr>
<td>• Physical, biological, and ecological science concepts related to the plants and planting practices.</td>
<td>The puzzles and other activities on the Science Pages help to assess youth learning about specific concepts.</td>
</tr>
</tbody>
</table>
**Notes and photos**
Use notes and photos to help you remember important learning moments during the Gardener Story "i-m-science investigation."

- During the interview(s), **notice the youths' interview skills and interactions with the gardeners.** Are they able to obtain the information needed to complete the Gardener Story? Do they ask follow-up questions? Do they ask new questions based on their own interest in the gardener's history?
- **Use a camera** to document youth participation in the interviews. You may already be using a camera to take photos of the gardener and plants in the garden, but you can also take pictures of the youth as they conduct the activity.

**Discuss differences among gardeners**
If the youth interview more than one gardener, have them discuss some of the differences among the gardeners in planting practices, uses of the plants, where they are from, and reasons for gardening. For example, if several gardeners grow the same plant, the youth might make a master list of all the uses mentioned for the plant. These comparisons help youth understand gardeners' choices of plants and planting practices; a comparison chart or list of different uses of a particular plant is concrete evidence of their learning.

**Share learning**
Have the youth compile planting tips from the gardeners they interviewed. They can post the planting tips in the garden for other gardeners to see or add them to their scrapbook. Or have the youth ask the gardeners for a recipe that reflects the cultural use of a plant they grow. They can write up the recipe along with a description of the plant and the role it plays in the gardener's culture. Make photocopies of the recipe for the youth to take home and share with their families.

<table>
<thead>
<tr>
<th>Plant</th>
<th>How used by Gardener 1</th>
<th>How used by Gardener 2</th>
<th>How used by Gardener 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basil</td>
<td>Makes pesto to freeze for winter</td>
<td>Companion plant for tomatoes; eats fresh in salads</td>
<td>Doesn't grow basil.</td>
</tr>
<tr>
<td>Collards</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zucchini</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lemongrass</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tomatoes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Conducting the Gardener Story with Youth

Time Required
- Preparing the youth for the Gardener Story: 1-2 hrs
- Conducting the Gardener Story: 1-2 hrs
- Discussing and summarizing the interview into a narrative, choosing photographs, and posting them on the website: 2-3 hrs

Product
Youth will compile their results into a Gardener Story that they share over the Garden Mosaics website.

Materials
For each youth:
- Clipboard, paper, and pencil
- Copy of the short, illustrated version of the Gardener Story
- Copies of Garden Mosaics Science Pages as needed, available at <www.gardenmosiacs.org>
- Copy of the Gardener Story Guiding Questions
- Copy of Gardener Story Form
- 3x5 inch cards (optional)

For entire group:
- Camera and film, or digital camera
- Tape recorder and tape (optional)
- Copies of Gardener Permission Form (Section VII)
- Photo Guidelines (Section VII)
- Computer with Internet
- Drinks and snacks for the activities in the garden

Procedure
Before Meeting with Youth
1. **Choose gardeners who are dynamic and whose stories about gardening and their past will readily engage the youth.** Seek out gardeners who have interesting practices that reflect their culture and heritage, and consider including gardeners who use sustainable or environmentally-sound practices. The gardener does not need to be the garden manager or particularly knowledgeable about the whole garden.

2. **The ratio of youth to gardeners should be no greater than 6:1.** This allows all the youth to have an important role asking questions and taking notes, and ensures that everyone can hear the gardener. If you have more than six youth, you may want to divide into groups, each group interviewing a different gardener.

3. **Contact the gardeners to arrange the visit.** Discuss the Garden Mosaics project with them. Be sure to describe your group and explain your purpose for coming to the garden. Arrange a time for the youth to conduct the Gardener Story.

4. **You may need to arrange for a translator** if the gardener speaks another language. If some of the youth in your group share a language with the gardener they may be able to translate.

5. **Ask for permission to interview and photograph the gardener and garden.** Also ask for permission to use the photos on the Garden Mosaics website. Have the gardener sign the Gardener Permission Form (Section VII).

6. **Decide which concepts the youth need to go over before conducting the Community Garden Inventory.** If the youth are familiar with gardening, they should have enough background to ask good questions and make careful observations. Some youth may need to read the Science Pages and conduct some of the learning activities on the back of these pages before conducting the Gardener Story.
Preparing Youth for the Gardener Story

1. **Hold a discussion with the youth about learning through the stories of others.** Ask the youth:
   - Can you remember a story told to you by an older relative?
   - What was it like hearing these stories?
   - Why might it be important to listen to the stories of people who are older?

2. **Have the youth access the Gardener Story database on the Garden Mosaics website and read over some of the existing descriptions of gardens.** Ask them: What makes a good Gardener Story?

3. **Remind the youth about the Action Project**, which will involve taking an action to benefit the garden and gardeners. Let the youth know the stories they collect during the Gardener Story will be used for two purposes. The first is to collect and preserve information about the gardener’s unique planting practices. The second is to help the youth learn about the gardeners’ interests and concerns so that they can plan their Action Project. If you or your group has already decided on a focus for the Action Project, discuss with the youth what questions they might ask to help plan the project.

4. **Have the youth read the relevant Science Pages** and conduct the learning activities on the back as appropriate.

5. **Hand out the short illustrated version of the Gardener Story** for the youth to refer to.

6. **Guide the youth through a brainstorming session to develop a checklist of questions to ask the gardeners.** The questions should cover those items in the Gardener Story Guiding Questions as well as other items the youth are curious about. For example, although not part of the Guiding Questions, youth may be curious about why the gardener likes gardening. Responses to such more personal questions can be inspirational for the youth. Also be sure the youth include questions about the gardeners’ concerns to help them plan their Action Project.

   Questions youth will need to answer to write the Gardener Story include:

   **Gardener’s background**
   - Where is the gardener from?
   - How did he or she get started gardening?

   **Plants**
   - What plants does the gardener grow?
   - How does the gardener use the plants (for example, medicines, food)?
   - How many people eat the produce grown in the garden?
   - How much money does the gardener save by not having to buy the produce s/he grows?

   **Planting Practices**
   - How does the gardener control insect pests?
   - How does the gardener control weeds?
   - What practices does the gardener use to enhance the soil?
   - What watering practices does the gardener use?
   - If the gardener has limited space, what practices does s/he use to save space?
   - How might some of the gardeners’ practices be good for the environment?

   **Planting Tips**
   - What planting tips might the gardener offer to other gardeners?

   **Culture and Gardening**
   - How does the gardener’s ethnic or cultural heritage influence his/her gardening?
7. Review interviewing skills with the youth. These skills include politeness (for example, shaking hands, eye contact), question asking, note taking, and listening.

8. If needed, have the youth practice their interview skills. Divide the youth into pairs (try to place youth together who do not know each other well). Explain that the purpose of this activity is to practice interviewing skills—including polite and respectful behavior, asking questions, listening, and summarizing and presenting what you learn. You may want to suggest a set of topics that the youth are familiar with for a practice interview (for example, place of birth, favorite activities, the best time they ever had) or allow the youth to brainstorm the questions. Have them write down their questions before the interview. Remind them to take notes, as they will present what they learned about their interview partner to the group. After they present the results of their interviews, have a discussion. Ask the youth:
   1. Do you feel ready to interview a gardener?
   2. What might be different about interviewing a gardener compared to interviewing someone your own age?

9. Help the group plan how they want to carry out the interview. To keep the youth involved, it is important for each youth to be responsible for a particular task throughout the activity (this may mean that some youth have more than one role). Help the youth decide:
   • Who will introduce the group and the activity to the gardeners?
   • Who will be the note takers?
   • How will they make sure that all the questions that they have brainstormed are answered?

   • Who will help keep the conversation focused? (Should they let the gardener talk about other things? Why might it be important to let the gardener talk freely? How much should they interrupt to get back to their questions?)
   • How should they end the interview?

10. Before conducting the interview, the youth should write all the interview questions on 3x5 inch cards or other paper so that they don’t forget any questions. Encourage the youth to ask questions in addition to those on the list, especially if they don’t understand something or are curious to learn more about what the gardener is saying.

11. The day before the scheduled interview, remember to call the gardener(s) to confirm.

12. If possible, distribute cameras for the group to use during their Gardener Story. The youth can take photos for submission to the Garden Mosaics website following the Photo Guidelines (Section VII).

13. You also may want to have the youth tape the interview. Although they won’t transcribe the whole tape, they can refer back to parts of it if they have questions about what they heard. Have a youth volunteer to handle the tape recorder.

Conducting the Gardener Story

1. Prompt the youth who volunteered to introduce the group.

2. Prompt the youth who volunteered to take photos and to tape record. Make sure the recorder is close enough to the gardener to capture the conversation.

3. Encourage the youth to begin asking questions.

4. Be prepared to jump in as needed to keep the questions flowing, to clarify and ask follow up questions when you notice the youth do not understand something, and to keep the conversation focused.
5. As the gardener talks about plants and planting practices, use any “teachable moments” to explain to the youth science concepts related to what they are seeing.

6. As the interview draws to a close, summarize the main points discussed and ask for clarification as needed. Ask the youth to make sure that all the questions on their checklist have been answered.

7. Have the youth thank the gardener before they leave and later with a follow-up note.

After the Gardener Story
1. Discuss the gardener interview with the youth. Ask the youth:
   • What did you learn about the gardener?
   • What did you learn that you would like to follow up on?
   • What did you not understand?

2. It is best to go over everyone’s notes as a group shortly following the interview. Hand out copies of the Gardener Story Guiding Questions. Based on their notes, the group should write down the answer to each question in the Guiding Questions.

3. Use the relevant Science Pages to help the youth learn more about what they saw and heard in the garden.

4. Help the youth decide as a group how they will share the task of converting the Guiding Questions into a narrative about the gardener. The narrative should cover the questions on the Gardener Story Form. It should be no longer than two typed, single-spaced pages, which is equal to about 1,000 words or six paragraphs. The youth may want to divide into smaller groups, each writing a section.

5. Although the Gardener Story should be the youth’s summary of their interview with the gardener, you may need to assist the youth with reviewing and revising their draft(s) of the narrative so it is acceptable for sharing with a broader audience. Make sure the youth spell check the story if they are using a computer.

6. Ask the group to review the photographs they took and select photos of the gardener and garden that help illustrate the story. Have them write brief captions for each photo.

7. If possible, contact the gardener and share the story for his/her approval before submitting it to the Garden Mosaics website.

8. Have the youth submit the story and photos to the Gardener Mosaics website using the Gardener Story Form.

9. Send the gardener a final copy of the story and photos with a thank you note to further emphasize your appreciation of the time s/he spent with the group.

Audio/Slide Version
Audio submissions may be submitted on CD or on tape. Our preference is for audio submissions in digital format, edited to clips of about 30 seconds each, corresponding to the gardener’s response to each interview question. But we can also accept unedited tapes, clearly organized by interview question. Check the Garden Mosaics website (www.gardenmosaics.org) for future updates on the audio/slide version.

1. When preparing to conduct the Gardener Story, let the students know that they will also be recording a few of the questions for an audio/slide show, in addition to their written Gardener Story. In preparation, ask them to select four questions from the Gardener Story Guiding Questions that they will use for the audio/slide show.

2. When contacting the gardeners, ask if it would be OK to briefly audio tape them for an audio/slide show. If they agree, please modify the permission form to reflect use of their name and images for the audio/slide show component.

---

18 The audio/slide version of the Gardener Story was contributed by Caroline Tse, Cornell Cooperative Extension-New York City, and Noah Najarian, Najarian Web Design.
3. **Locate an audio tape player and external microphone.** (Without an external microphone, the recording quality will be too low and the recording will be unusable.) Ask the youth to prepare for the audio/slide show by testing out the audio tape player in advance, checking volume, and seeing how close a speaker needs to be to the microphone in order to get the clearest sound. When selecting a site to conduct the Gardener Story, try to locate an area with the least amount of background noise.

4. **Conduct the Gardener Story as usual.** Mention to the gardener that you will ask him or her to repeat some of his answers at the end of the interview, so you can tape them. When the Gardener Story is completed, ask the students to re-ask the four questions they identified for the audio/slide show. With the tape player set to a relatively high volume, record the gardener’s responses. Ask the gardener to begin with, “My name is __ and I am a gardener at the __ garden in __ (city).” Please ask the gardener to speak conversationally and not too quickly. Feel free to re-record responses. Please limit each response to a few minutes.

5. **At the end of the taping, ask youth to take some photographs (horizontal only) relating to the gardener’s responses.** (Please take at least one portrait of the gardener in the garden setting, for the first slide.) For example, in response to “list the plants that the gardeners grow,” the gardener may mention tomatoes, cucumbers, and basil. The youth could take a picture of the gardener with those plants, and close-up photos of the vegetables. Please provide at least 3 to 4 photos related to each response, and take them at varying distances so that some show more of the background, some the gardener in action (and/or teaching youth), and some close-up of the vegetables. Having a variety of images from which to choose will create a more interesting slide show (see Photo Guidelines, Section VII).
Gardener Story Guiding Questions

Write down all your notes related to each question below. You will use these notes to write your Gardener Story for the Garden Mosaics website.

1. Where is the gardener from originally? If the gardener grew up in your area, where were his or her parents or grandparents from?

2. How did the gardener get started gardening?

3. List plants that the gardener grows. For each plant, tell how the gardener uses it.

4. How many people eat the produce the gardener grows?

5. How much money does the gardener save by not having to buy the produce that he or she grows in the garden?

6. Describe how the gardener controls insect pests.
7. Describe how the gardener controls weeds.

8. Describe any practices the gardener uses to enhance the soil.

9. Describe where the gardener gets water and how he or she waters the plants.

10. Describe any practices the gardener uses to make the best use of space in the garden.

11. Describe any practices the gardener uses that are good for the environment.

12. What planting tips might the gardener offer to other gardeners?

13. How does the gardener’s ethnic or cultural heritage influence his or her gardening?
Gardener Story Form

Garden Name _____________________________________________________________

Garden Address _________________________________________________________
(include street and number if available, or nearest cross streets if number not known).

City ________________________________________________________________

State ___________________________ Zip Code/Postal Code ___________________

Country ________________________

Name of Youth Program _______________________________________________

Name of Adult Contact ________________________________________________

Email address of Adult Contact __________________________________________

☐ Check here if you do NOT want your contact name and email address posted with your
Gardener Story on our website.

Name of Gardener interviewed:

_____________________________________________________________________

Date of Interview

Month _____________ Day _____________ Year ______________

Number of participants involved in Gardener Story

_____ Youth

_____ Adult Educators/Volunteers

Write a Gardener Story covering the information below. The completed story should be no
more than two pages single-spaced.

1) Gardener’s Background (1 paragraph)
   • Where is the gardener from?
   • How did he or she get started gardening?

2) Plants (1-2 paragraphs)
   • What plants does the gardener grow?
   • How does the gardener use the plants? (for example, for medicine or food)
   • How many people eat the produce the gardener grows?
   • How much money does the gardener save by not having to buy the produce s/he grows?
3) **Planting Practices** (1-3 paragraphs)
- How does the gardener control insect pests?
- How does the gardener control weeds?
- What practices does the gardener use to enhance the soil?
- What watering practices does the gardener use?
- If the gardener has limited space, what practices does he or she use to save space?
- How might any of the gardener’s practices be good for the environment?

4) **Planting Tips** (1 paragraph or a bulleted list)
- What planting tips might the gardener offer to other gardeners?

5) **Culture and Gardening** (1 paragraph)
- How does the gardener’s ethnic or cultural heritage influence his or her gardening?

**Photographs**
Please send us several photos for display on the website with your Gardener Story. You can send us digital or print photos (see *Photo Guidelines*, Section VII).

**Submission Methods**
1) **Online. We prefer this method!**
Visit our website—www.gardenmosaics.org—and go to *i-m-scienc*e. Click on Gardener Stories, then Submit Your Form. Complete the online *Gardener Story Form*, attach any digital photos, and submit.

OR

2) **Mail**
Complete this *Gardener Story Form* and mail it along with any print photos, or digital photos on disk or CD, to:
Garden Mosaics
Department of Natural Resources
Fernow Hall
Cornell University
Ithaca, NY 14853

If you have any questions, please contact us at:
gardenmosaics@cornell.edu
Chapter 2.
Community Garden Inventory

Overview

In the Community Garden Inventory, you interview gardeners and make observations as you walk through the garden. Through this “garden hike,” you learn about what plants are growing, what structures are present, and what activities take place in the garden. Then you share your findings on the Garden Mosaics website.

The Community Garden Inventory is an important database for the future of community gardens. It provides information on the locations, uses, and benefits of community gardens in neighborhoods throughout the world. Students, researchers, community planners, and organizations working to support community gardens will be able to use the information. Each Community Garden Inventory Form is posted online, thus making the information available to anyone who wants to learn more about these unique gardens.

Garden Mosaics is very interested in Community Garden Inventories from other countries besides the US. If you prefer to submit a Community Garden Inventory Form in a language other than English, please contact us at gardenmosaics@cornell.edu (we can respond to inquiries in Spanish, French, Arabic, Russian, German, and other languages). We will work with you to translate the questions into your language, and to post your Community Garden Inventory in the original language and in English.

Anyone Can Contribute to the Community Garden Inventory...

If you wish to contribute to the Community Garden Inventory on your own or with a group of adults, go directly to the short, illustrated version of the Community Garden Inventory (called Garden Hike) following this overview, and then to the Community Garden Inventory forms on the Garden Mosaics website or at the end of this chapter. You may also want to read more about the research objectives of the Community Garden Inventory in this chapter. The rest of the information in this chapter is primarily for conducting the Community Garden Inventory with a group of youth.

Conducting the Community Garden Inventory with Youth

We have included in this chapter the following information for conducting the Community Garden Inventory with youth: inquiry and content learning objectives, assessment ideas, and comprehensive instructions. Note that for conducting this activity with youth, we sometimes use the name “Garden Hike” rather than Community Garden Inventory.

If you want to contribute data to the online Community Garden Inventory database, you will need to conduct this i-m-science investigation in a community garden. Community gardens are common in many large cities, and small cities often have one or more community gardens. You also may find a community garden at an apartment complex, retirement home, or church, synagogue, temple, or mosque. Some school gardens involve neighborhood adults and thus can be considered community gardens. School and home gardening and other youth programs may want to conduct the Community Garden Inventory as a one-time field trip to a community garden.

If you do not plan to contribute to the Community Garden Inventory, feel free to conduct this i-m-science investigation in any garden with a willing, knowledgeable, and enthusiastic gardener. In home gardens, the focus may be more on the plants and less on the structures and activities that take place in the garden.
GARDEN HIKE

WHAT IS THE GARDEN HIKE?
The Garden Hike is a "mobile interview." You will interview gardeners as you walk through the garden.

During the Garden Hike, you will ask questions about things that interest you in the garden.

WHAT TO DO...BEFORE GOING TO THE GARDEN

Background Research
✔ Read about community gardens on the Garden Mosaics website. Also go to the Community Garden Inventory Database on the Garden Mosaics website and read about some other gardens.
✔ Discuss with your friends why you think community gardens are important.

Generate Questions
✔ Brainstorm a list of questions that you think are important to ask gardeners.
✔ Look at the online Community Garden Inventory Form. Make sure to include the questions you need answered to fill in the form on your list.

WHAT WILL YOU NEED?
✔ copy of Community Garden Inventory Form
✔ 3x5 inch cards or paper to write your questions on
✔ pencils
✔ clipboards
✔ cameras (optional)

WHAT WILL YOU NEED?

Practice Interviewing
✔ Review interviewing skills on the website and practice interviewing with your friends.
✔ Decide what everyone is going to do during the interview in the garden.

WHY THE GARDEN HIKE?
You will join people all over North America gathering information for the online Community Garden Inventory. Together you can help us understand why community gardens are important to people.

WHAT WILL YOU NEED?

We could write our questions on 3x5 cards so each person has their own questions to ask.

During the Garden Hike, you will ask questions about things that interest you in the garden.

Don't forget drinks and snacks!

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
WHAT TO DO...AT THE GARDEN
✔ Introduce yourselves and the activity to the gardeners.
✔ Tell them about the Garden Hike.
✔ Begin at one end of the garden and walk through the garden with the gardeners. Ask questions from your checklist.
✔ Also ask questions about what you see and about things that seem to be important to the gardeners.
✔ Don’t be afraid to ask questions about things you don’t understand or want to learn more about. The gardeners will be excited to know that you are interested in what they do!
✔ Observe things, take photos, and jot down notes about what you see.
✔ Before you leave, make sure you have answered all of the questions on your checklist and on the Community Garden Inventory Form.
✔ Thank the gardeners before you leave.

WHAT TO DO...AFTER YOU LEAVE THE GARDEN
Review findings
✔ Discuss the visit to the community garden. Talk about what you learned about the community garden.

What did we learn about the people and plants in the garden?
What did you not understand?

What might you want to learn more about?

Why might these gardens be important to neighborhoods?

Share online
✔ Write down the answer to each question on the Community Garden Inventory Form. Then enter your data onto the online form.

Learn more
✔ Check out the online Science Pages. Click on any pages that might help you to understand more about what you learned.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
Community Garden Inventory Research

Research Objective
To compile baseline information about community gardens from around the world that will be shared through the online Community Garden Inventory.

Research Questions
- What types of plants are growing in the community garden?
- What structures (for example, casitas, compost bins) are present in the garden?
- What activities take place in the garden?

Why is the Community Garden Inventory Research Important?
Community gardens are important places for people and their communities. People grow food, meet and talk with friends, play games, relax, enjoy nature, exercise, and watch concerts and other cultural events in community gardens. Many gardens host educational tours and workshops. People who help plan and manage the gardens often gain valuable skills in community organizing. In many urban neighborhoods, these may be the only sites where people are able to enjoy these activities and learn these skills.

Community gardens are on land that is owned by a public or private landowner. In some cases, the landowner has to weigh the benefits of preserving the garden versus building more housing or stores, or other land uses. The more information we have about the role gardens serve in communities, the better decisions we can make about preserving them.

Baseline information about gardens also is useful to scientists who conduct research on urban gardens. Researchers from an array of disciplines work in community gardens, including sociologists, anthropologists, nutritionists, soil scientists, and agricultural scientists. Their research interests are varied and include food security, urban migration, and soil contamination.

Community Garden Inventory Science Learning

The Community Garden Inventory is a great opportunity for youth to learn about two aspects of science:
- Inquiry, or “doing science,” and
- Content, which includes facts and concepts.

Inquiry
If you follow the instructions for conducting the Community Garden Inventory im-science investigation, youth will learn the following inquiry skills.

Inquiry Learning Objectives
Youth will:
- Define questions to ask the gardener.
- Apply interview skills to learn about the garden.
- Apply observational skills to learn about the garden.
- Synthesize information they gather onto a data form.
- Submit their data electronically.

Content
You can use the Garden Mosaics Science Pages to help the youth learn more about the plants and concepts they encounter in the garden. For example, if the youth find gardeners growing collards and want to know more about them, you can refer to the Collards Science Page. If you anticipate unfamiliar concepts or terms will come up during the Community Garden Inventory, you can have the youth read and conduct the activities on the relevant Science Pages before going to the garden.

You can also use “teachable moments” in the garden to explain unfamiliar concepts to the youth. For example, if the gardener talks about a compost pile, you may need to explain what compost is. Also encourage the youth to ask follow-up questions about what they see. For example, the gardeners may point out a water collection system. Encourage the youth to ask the gardeners to explain how the system works and how they water the plants.

With your guidance and using the Science Pages, you can expect youth conducting the Community Garden Inventory to learn the following content.
**Content Learning Objectives**
Youth will learn about:
- Plants, structures, and activities that take place in the garden.
- Physical, biological, and ecological science concepts related to the plants.

## Community Garden Inventory Assessment

<table>
<thead>
<tr>
<th>Inquiry Learning Objectives</th>
<th>Evidence of Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Youth will:</td>
<td></td>
</tr>
<tr>
<td>• Define questions to ask the gardener.</td>
<td>The list of interview questions that youth create and notes from the interview planning discussion are evidence of youth’s ability to define questions.</td>
</tr>
<tr>
<td>• Apply interview skills to learn about the garden.</td>
<td><strong>Written notes and the completed Community Garden Inventory form</strong> are evidence that youth were able to apply their interview skills and synthesize the information gathered.</td>
</tr>
<tr>
<td>• Apply observational skills to learn about the garden.</td>
<td></td>
</tr>
<tr>
<td>• Synthesize information they gather onto a data form.</td>
<td></td>
</tr>
<tr>
<td>• Submit their data form electronically.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Content Learning Objectives</th>
<th>Evidence of Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Youth will learn about:</td>
<td></td>
</tr>
<tr>
<td>• Plants, structures, and activities that take place in the garden.</td>
<td>The <strong>initial discussion about community gardens</strong> should give you an idea of what youth know about community gardens prior to the Community Garden Inventory.</td>
</tr>
<tr>
<td>• Physical, biological, and ecological science concepts related to the plants.</td>
<td>The <strong>completed Community Garden Inventory form and photos</strong> taken by youth provide a summary of the information youth collected about garden plants, structures, and activities. The <strong>puzzles and other activities on the Science Pages</strong> help to assess youth learning about specific concepts.</td>
</tr>
</tbody>
</table>
Additional Assessment Tools

**Participation**
To generate a summary of what youth and other participants did, **record number of:**
- youth participants,
- gardeners who participate and name of garden,
- educators or volunteers who participate and their affiliation.

Also save the **list of interview questions,** **notes from the hike,** and a copy of the **completed Community Garden Inventory form.**

**Notes and photos**
This will help you remember important learning moments during the activity.
- During the hike and interviews, **notice the youths' interview skills and interactions with the gardeners.** Are they able to obtain the information needed to complete the inventory form? Do they ask follow-up questions? Do they ask new questions based on their own interest in a particular aspect of the garden?
- **Use a camera** to document the hike and interview(s). You may already be using a camera to take photos of plants and structures in the garden, but you can also take pictures of the youth as they conduct the activity.

**Garden calendar**
Youth can use the information collected during the Community Garden Inventory to create a calendar of events taking place in the garden. They can include dates of planting and harvest for different crops, and social, cultural, recreational, and educational activities. A completed calendar provides evidence of the youths' ability to synthesize the information gained from the activity, as well as learning about the activities that take place in the garden.

**Garden map**
Have youth use what they learn to make a map of the garden. They can show the gardeners' plots, what's growing, watering systems, compost piles, tool sheds, casitas, picnic tables, and so on. The completed map provides evidence of learning about plants, planting practices, and the community aspects of the garden. The map can be laminated and posted in the garden or community center, or added to a scrapbook.
Conducting the Community Garden Inventory (Garden Hike) with Youth

**Time Required**
- Before meeting with youth: 1-2 hrs
- Preparing the youth for the Community Garden Inventory: 1-2 hrs
- Conducting the Community Garden Inventory: 2 hrs
- Discussing and entering the data: 2 hrs

**Product**
Youth will compile their results and contribute them to the online Community Garden Inventory database.

**Materials**
For each youth
- Clipboards, paper, and pencils
- Copy of *History of Community Gardens* Science Page
- Copy of *Community Garden Inventory Form*
- 3x5 inch cards (optional)

For entire group
- Camera and film, or digital camera
- Computer with Internet
- Copies of *Gardener Permission Form* (Section VII)
- *Photo Guidelines* (Section VII)
- Drinks and snacks

**Procedure**

**Before Meeting with Youth**

1. **Conduct this science investigation** with gardeners who are dynamic and knowledgeable and who enjoy interacting with youth. The garden manager is often the best person for this activity.

2. **The ratio of youth to gardeners should be no greater than 6:1.** This allows all the youth to have an important role asking questions and taking notes, and ensures that everyone can hear the gardener. If you have more than six youth, you may want to divide into groups, each group interviewing a different gardener.

3. **Contact the garden manager or other knowledgeable gardeners to arrange the visit.** Discuss the Garden Mosaics project with them. Be sure to describe your group and explain your purpose for coming to the garden. Arrange a time for the youth to conduct the Community Garden Inventory.

4. **You may need to arrange for a translator** if the gardener speaks another language. Some of the youth or a volunteer in your group may share a language with the gardeners and be able to translate.

5. **Ask for permission to photograph the gardeners** and garden. Also ask for permission to use the photos on the Garden Mosaics website. Have the gardeners sign the *Gardener Permission Form* (Section VII).

6. **Decide which concepts the youth need to go over before conducting the Community Garden Inventory.** If the youth are familiar with gardening, they should have enough background to ask good questions and make good observations. Some youth may need to read the Science Pages and conduct some of the learning activities on the back of these pages before conducting the Community Garden Inventory.
Preparing Youth for the Community Garden Inventory

1. **Lead a discussion on community gardens.** Ask the youth:
   - Have you ever visited or seen a community garden?
   - What are community gardens?
   - What are the differences and similarities between a home garden and a community garden?

2. **Have the youth do some background reading and discuss what they read.**
   Below are some suggested readings along with some discussion questions.
   - *Community Spirit Makes Garden Magic*
     - What activities take place in community gardens?
     - Why might community gardens be important to gardeners?
     - Why might these gardens be important to the community?
   - *History of Community Gardens*
     - Science Page
     - How has the purpose of community gardens changed over time?
     - What are some of the main differences between early community gardens and ones created in the last 20-30 years?

3. **Have the youth access the Community Garden Inventory i-m-science database** on the Garden Mosaics website and read over some of the existing descriptions of gardens.

4. **Remind the youth about the Action Project,** which will involve doing a project to benefit the gardeners and the neighborhood. Let the youth know the information they collect during the Community Garden Inventory will be used for two purposes. The first is to provide data on community gardens for the online Community Garden Inventory database. The second is to help them learn about the gardeners’ interests and concerns so that they can plan their Action Project. If you or your group has already decided on a focus for the Action Project, discuss with the youth what questions they might ask the gardeners to help plan the project.

5. **Guide the youth through a brainstorming session to develop a checklist of questions to ask the gardeners.** The questions should cover the items on the Community Garden Inventory Form as well as other items the youth are curious about. Share the data form with the youth and make sure that all the questions on the form are on their list. Remind the youth that the information they collect during the Community Garden Inventory will be used to help plan their Action Project, so they want to include questions about the gardeners’ concerns.
Questions the youth will need to answer to fill in the online Community Garden Inventory Form include:

- What is the name of the garden?
- What is the address of the garden?
- What type of community garden is it? (community center, neighborhood, public housing, senior center or housing complex, school, church, other)?
- Who owns the garden? (city, private, land trust, other non-profit, other)?
- How many members does the garden have?
- Who founded the garden (city agency, Cooperative Extension, non-profit, residents, other)?
- When was the garden started?
- What was on the site before it was turned into a garden (abandoned building, park, vacant lot, yard, other)?
- What types of plants are present (flowers, fruits, herbs, shrubs, trees, vegetables, other)? (Submitting a list of garden plants is optional.)
- What structures are present in the garden (bench, casita, compost pile or bin, fence, mural, notice board for community events, picnic table, play equipment, shed, water collection system, water access, other)?
- What activities take place in the garden (social and cultural, educational, community organizing)?
- What cultures and ethnic groups are present in the garden?
- What languages are spoken in the garden?

6. Before conducting the interview, the youth should write all the interview questions on 3x5 inch cards or other paper so that they don’t forget any questions. Encourage the youth to ask questions in addition to those on the list, especially if they don’t understand something or are curious to learn more about what the gardener is saying.

7. Review interviewing skills with the youth. These skills include interview politeness (for example, shaking hands, eye contact), question asking, note taking, and listening.
8. **If needed, have the youth practice their interview skills.** Divide the youth into pairs (try to place youth together who do not know each other well). Explain that the purpose of this activity is to practice interviewing skills—including polite and respectful behavior, asking questions, listening, and summarizing and presenting what you learn. You may want to suggest a set of topics that the youth are familiar with for a practice interview (for example, place of birth, favorite activities, the best time they ever had) or allow the youth to brainstorm the questions. Have them write down their questions before the interview. Remind them to take notes, as they will present what they learned about their interview partner to the group. After they present the results of their interviews, have a discussion. Ask the youth:
   - Do you feel ready to interview a gardener?
   - What might be different about interviewing a gardener compared to interviewing someone your own age?

9. **Help the group plan how they want to carry out the interview.** To keep the youth involved, it is important for each youth to be responsible for a particular task throughout the activity (this may mean that some youth have more than one role). Help the youth decide:
   - Who will introduce the group and the activity to the gardeners?
   - Who will be the note takers?
   - How will they make sure that all the questions that they have brainstormed are answered?
   - Who will help keep the conversation focused? (Should they let the gardener talk about other things? Why might it be important to let the gardener talk freely? How much should they interrupt to get back to their questions?)
   - How should they end the interview?

10. **Lead the group in a discussion of the importance of observations.** Ask them to brainstorm a list of things they want to look for. Have them decide on how they will take notes on their observations.

11. **The day before the scheduled interview, remember to call the gardener(s) to confirm.**

12. If possible, **distribute cameras** for the group to use during their Community Garden Inventory. They should take photos for submission to the Garden Mosaics website following the *Photo Guidelines* (Section VII).

---

**Conducting the Community Garden Inventory**

1. **Begin the Community Garden Inventory at one end of the garden and walk through the garden with the gardeners.**

2. **As they walk with the gardeners, the youth should ask questions from their checklist.** They also should ask questions about what interests them and about things that seem to be of particular importance to the gardeners.
3. You may need to encourage the youth to ask follow-up questions. In some cases, you will have to follow up on what the gardeners say or what you observe yourself. For example, a rain barrel or spigot may lead to questions about watering. Seeing a gardener using fertilizer can lead to questions about soils. A fence may bring up issues of vandalism, whereas a mural or ornamental tree can lead to a discussion of the garden as a beautiful spot. And a casita or other building can lead to questions about what sorts of activities occur in the garden. Also encourage the youth to use the Community Garden Inventory as an opportunity to ask questions about any concerns the gardeners might have, such as soil contamination or insect pests.

4. As the gardeners talk about their plants and planting practices, use any “teachable moments” to explain to the youth science concepts related to what they are seeing. For example, seeing beans growing next to amaranth may prompt a discussion of how some plants add nitrogen to the soil, possibly helping other plants to grow. Seeing shade from nearby multi-storied buildings may prompt a discussion of the importance of light to plants. Having the gardeners talk about adding lime to the soil provides an opportunity to talk about pH.

5. Encourage the youth also to take photos, make observations, and jot down notes about what they see.

6. When your group has finished touring the garden with the gardeners, make sure they have answered all of the questions on the Community Garden Inventory Form before they leave the garden.

7. Have the youth thank the gardeners before they leave and later with a follow-up note.

After the Community Garden Inventory

1. Compile your results and enter them online. Review each question on the Community Garden Inventory Form with the youth. Based on their notes, the group should write down the answer to each question. If they have access to the Internet, the group can fill out the online Community Garden Inventory Form on the Garden Mosaics website. If your group cannot directly enter their data onto the website, have them use a paper or electronic file copy of the form, and email or send it to the address on the form. If it is not feasible for the youth to fill out the form, please fill it out yourself.

2. Discuss the visit to the community garden with the youth. Ask the youth:
   • What did they learn about the community garden?
   • What activities take place in the garden?
   • What plants are growing?
   • How are the plants grown?
   • Why might these gardens be important to neighborhoods?
   • What did they learn on the visit that they would like to follow up on?
   • What did they not understand?

3. Use the relevant Science Pages to help the youth understand or learn more about what they saw in the garden.

4. Discuss the interviews and observations. Ask the youth:
   • What did they think of interviewing?
   • What would help them to do another interview?
   • What other questions might they ask?
   • What kinds of observations did they make?
   • What else might they want to observe during a future visit to the garden?
Community Garden Inventory Form

Garden Name

Garden Address
(include street and number if available, or nearest cross streets if number not known).

City

State Zip Code/Postal Code

Country

Name of Youth Program

Name of Adult Contact

Email address of Adult Contact

☐ Check here if you do NOT want your contact name and email address posted with your Community Garden Inventory form on our website.

Name(s) of Gardener(s) interviewed

Date of Interview
Month Day Year

Number of participants involved in Community Garden Inventory

_____ Youth

_____ Gardeners

_____ Adult Educators/Volunteers

1) Type of Community Garden

Check one box

☐ Church, Synagogue, Temple, or Mosque

☐ Senior Center/Senior Housing Complex

☐ Community Center

☐ School

☐ Neighborhood

☐ Other (please describe)

☐ Information not available
2) Who owns the garden?

Check one box

☐ City ☐ Other (please describe)
☐ Private (for example, apartment or individual home owner) ______________________________
☐ Land Trust ☐ Information not available
☐ Other Non-profit Organization (please give name of organization) ______________________________

3) Number of people

3a) How many gardeners are active in the garden during the growing season?

Check one box

☐ 2-10 ☐ 26-50 ☐ 101-150 ☐ Over 200
☐ 11-25 ☐ 51-100 ☐ 151-200 ☐ Other (please note)
☐ Information not available ______________________________

3b) About how many people visit the garden each year?

Check one box

☐ 1-50 ☐ 100-200 ☐ 500-1000 ☐ No visitors
☐ 50-100 ☐ 200-500 ☐ Over 1000 ☐ Other (please note)
☐ Information not available ______________________________

4) Who founded the garden?

Check one or more box

☐ City Agency ☐ Other (please note)
☐ Cooperative Extension ______________________________
☐ Non-profit Organization ☐ Information not available
☐ Residents in Neighborhood
5) When was the garden started?
Check one box
☐ Information not available

6) What was on the site before it was turned into a garden?
Check one box
☐ Abandoned building  ☐ Other (please describe)
☐ Park
☐ Vacant lot  ☐ Information not available

7) Plants
Check all boxes that apply
☐ Flowers  ☐ Vegetables
☐ Fruits  ☐ Other (please describe)
☐ Herbs
☐ Shrubs  ☐ Information not available
☐ Trees

8) Plant List (Optional). Submit a list of plants in the garden. See end of form.

9) Structures
Check all boxes that apply
☐ Bench or sitting area  ☐ Play area or play equipment for children
☐ Compost pile or bin  ☐ Shed
☐ Covered shelter (for example, casita, gazebo)  ☐ Water collection system (barrels)
☐ Educational signs  ☐ Water access (for example, faucet, hoses from hydrant)
☐ Fence  ☐ Other (please describe)
☐ Mural
☐ Notice board for community events  ☐ Information not available
☐ Picnic table
10) Garden Activities

10a) Social and cultural activities in the garden

Check all boxes that apply

☐ Barbecues or potluck meals
☐ Children playing
☐ Concerts
☐ Dances
☐ Gardeners chatting and sharing stories
☐ Gardeners playing games (for example, cards, pokeno)
☐ Parties
☐ Plays or puppet shows (theater)
☐ Religious activities or celebrations
☐ Sporting events
☐ Weddings
☐ Other (please describe)
☐ No social and cultural activities
☐ Information not available

10b) Educational activities in the garden

Check all boxes that apply

☐ Art classes
☐ Nature education
☐ Tours for school children
☐ Workshops or classes on gardening for gardeners
☐ Workshops or classes on gardening for gardeners
☐ Other (please describe)
☐ No educational activities
☐ Information not available

10c) Community organizing in the garden

Check all boxes that apply

☐ Community meetings
☐ Fundraising events
☐ Health clinics
☐ Protests
☐ Voter drives
☐ Workshops on community organizing
☐ Other (please describe)
☐ No community organizing activities
☐ Information not available
11) Ethnic groups and cultures represented by the gardeners (Optional)
11a) US ethnicities (Optional)
Check all boxes that apply
☐ African-American
☐ Asian-American
☐ European-American
☐ Hispanic-American
☐ Native American
☐ Other (please describe)
☐ Information not available

11b) Immigrant cultures (Optional)
Check all boxes that apply
☐ African
☐ Asian
☐ Caribbean
☐ Central or South American
☐ European
☐ Mexican
☐ Middle Eastern
☐ Russian and former Soviet Republics
☐ Other (please describe)
☐ Information not available

12) Languages spoken by the gardeners (Optional)
Check all boxes that apply
☐ Arabic
☐ Chinese
☐ Creole
☐ English
☐ French
☐ German
☐ Hindi
☐ Hmong
☐ Italian
☐ Japanese
☐ Korean
☐ Portuguese
☐ Russian
☐ Spanish
☐ Other (please note)
☐ Information not available
Photographs
Please send us several photos for display on the website with your Community Garden Inventory. You can send us digital or print photos (see Photo Guidelines, Section VII).

Submission Methods:
1) Online. We prefer this method!
Visit our website—www.gardenmosaics.org—and go to i-m-science. Click on Community Garden Inventory, then Submit Your Form. Complete the online Community Garden Inventory Form, attach digital photos, and submit.

OR

2) Mail
Complete the Community Garden Inventory Form and mail it along with any print photos, or digital photos on disk or CD, to:
Garden Mosaics
Department of Natural Resources
Fernow Hall
Cornell University
Ithaca, NY 14853

If you have any questions, please contact us at:
gardenmosaics@cornell.edu

The Community Gardening Inventory is a collaborative effort of the American Community Gardening Association and the Cornell University Garden Mosaics program.
Plant List (Optional). Which plants are in the garden?

Check all boxes that apply

Beans and Peas

☐ Asian Yard Bean, Long Bean, Snake Bean, Asparagus Bean, Yardlong Bean
☐ Bush Beans (includes French Bean, Filet Bean, Haricot, Green Bean, Wax Bean, String Bean)
☐ Butter Bean, Lima Bean
☐ Climbing or Pole Beans (includes Green Bean, String Bean, Wax Bean)
☐ Cowpea, Black Eyed Bean, Black Eyed Pea, Marble Pea
☐ Fava Bean, Broad Bean
☐ Pea (includes Sweet Pea, Snap Pea, Snow Pea)
☐ Pigeon Pea, Gandules, Yellow Dhal, Red Gram
☐ Purple Hull Pea
☐ Other (please list) ________________________ ________________________

Greens

☐ Amaranth
☐ Arugula
☐ Bok Choy or Chinese Cabbage
☐ Chard
☐ Claytonia, Winter Purslane, Miner’s Lettuce
☐ Collard
☐ Endive
☐ Kale
☐ Lambsquarters
☐ Lettuce
☐ Other (please list) ________________________ ________________________

☐ Mâche, Cornsalad
☐ Malabar Spinach, Indian Spinach, Ceylon Spinach, Basella, Vine Spinach
☐ Mesclun
☐ New Zealand Spinach
☐ Orach
☐ Purslane, Verdolaga
☐ Radicchio
☐ Spinach
☐ Turnip
### Squashes and Gourds

- Bitter Melon, Asian Melon, Bitter Gourd, Balsam Pear
- Chayote, Vegetable Pear
- Long Squash, Bottle Gourd
- Parvar, Pointed Gourd
- Pumpkin
- Summer Squash (includes Zucchini, Yellow Crook Neck Squash)
- Tindora, Ivy Gourd
- Winter Melon, Wax Gourd
- Winter Squash (includes Acorn Squash, Butternut Squash)
- Smooth Loofah, Sponge Gourd
- Other (please list)

### Root Crops

- Beet
- Carrot
- Garlic
- Jerusalem Artichoke, Sunchoke
- Jicama
- Parsnip
- Potato
- Radish
- Sweet Potato
- Taro
- Turnip
- Yucca, Cassava, Manioc
- Other (please list)

### Other Vegetables

- Artichoke
- Asparagus
- Broccoli
- Brussel Sprouts
- Cabbage
- Cauliflower
- Celeriac
- Celery
- Cucumber
- Eggplant
- Kohlrabi
- Leek
- Okra
- Onion
- Peanut
- Pepper
- Scallion, Green Onion
- Sugarcane
- Tomatillo
- Tomato
- Other (please list)
### Herbs

- Alache
- Basil
- Chamomile
- Chervil
- Chipile
- Chive
- Comfrey
- Coriander, Cilantro
- Dill
- Echinchina
- Other (please list)

<table>
<thead>
<tr>
<th>Edible Chrysanthemum</th>
<th>Epazote, Wormseed</th>
<th>Molem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fennel</td>
<td></td>
<td>Oregano</td>
</tr>
<tr>
<td>Horseradish</td>
<td></td>
<td>Papalo</td>
</tr>
<tr>
<td>Korean Basil, Dulkay</td>
<td></td>
<td>Parsley</td>
</tr>
<tr>
<td>Lavender</td>
<td></td>
<td>Pipicha, Pipicha</td>
</tr>
<tr>
<td>Lemongrass</td>
<td></td>
<td>Perilla</td>
</tr>
<tr>
<td>Lleva Buena, Good weed</td>
<td></td>
<td>Rue</td>
</tr>
<tr>
<td>Marjoram</td>
<td></td>
<td>Sage</td>
</tr>
<tr>
<td>Mint, Hierba Buena</td>
<td></td>
<td>Thyme</td>
</tr>
<tr>
<td>Wild Sesame</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Flowers

- Ageratum
- Alyssum
- Bachelor's Button
- Beebalm
- Begonia
- Calendula
- Chrysanthemum
- Cleome
- Coneflower
- Cosmos
- Crocus
- Daffodil
- Dandelion
- Other (please list)

<table>
<thead>
<tr>
<th>Delphinium</th>
<th>Flat Pea</th>
<th>Peony</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hollyhock</td>
<td></td>
<td>Petunia</td>
</tr>
<tr>
<td>Impatiens</td>
<td></td>
<td>Phlox</td>
</tr>
<tr>
<td>Iris</td>
<td></td>
<td>Poppy</td>
</tr>
<tr>
<td>Korean Ginseng, Chinese Bellflower, Balloon Flower</td>
<td></td>
<td>Portulaca</td>
</tr>
<tr>
<td>Larkspur</td>
<td></td>
<td>Rose</td>
</tr>
<tr>
<td>Lavatera</td>
<td></td>
<td>Snapdrag</td>
</tr>
</tbody>
</table>
Fruits and Nuts

☐ Apple  ☐ Grape  ☐ Pecan
☐ Apricot  ☐ Highbush Cranberry  ☐ Plum
☐ Blackberry  ☐ Hops  ☐ Raspberry
☐ Blueberry  ☐ Kiwi  ☐ Rhubarb
☐ Cherry (ornamental)  ☐ Melon (includes Muskmelon, Cantaloupe, Honeydew Melon)  ☐ Serviceberry
☐ Currant  ☐ Nectarine  ☐ Strawberry
☐ Elderberry  ☐ Peach  ☐ Walnut
☐ Fig  ☐ Pear  ☐ Watermelon
☐ Gooseberry
☐ Other (please list)  ________________________  ________________________
                           ________________________  ________________________

Grains / Cover Crops

☐ Alfalfa  ☐ Corn
☐ Amaranth  ☐ Oat
☐ Barley  ☐ Wheat
☐ Buckwheat
☐ Other (please list)  ________________________  ________________________
                           ________________________  ________________________

Ornamental Trees and Shrubs

☐ Ash  ☐ Fir
☐ Basswood  ☐ Forsythia
☐ Birch  ☐ Hawthorn
☐ Castor Bean, Red Tree  ☐ Lilac
☐ Cedar  ☐ Maple
☐ Cherry  ☐ Paradise Tree, Ailanthus
☐ Chestnut  ☐ Pine
☐ Cimicifuga, Black Cohosh  ☐ Spruce
☐ Dogwood  ☐ Willow
☐ Elm  ☐ Witch Hazel
☐ Other (please list)  ________________________  ________________________
                           ________________________  ________________________
Chapter 3. Neighborhood Exploration

Overview

In the Neighborhood Exploration, you first explore your neighborhood using aerial photographs and maps. You then take a walk around the neighborhood to “ground truth” what you observed on the airphotos and maps. You learn about access to fresh food, and places where people meet to talk, see concerts, and learn new things. You synthesize your findings by creating a collage of airphotos, maps, and photos you take during your walk. You can also share your findings and neighborhood photos online.

When youth and adults gather around an airphoto, they become engaged in a lively discussion of what they see. Everyone enjoys pointing out familiar landmarks, such as their school, playground, or house or apartment building. Youth and adults also enjoy taking a walk around the neighborhood and photographing meaningful sites. You might even want to use the Neighborhood Exploration as an ice-breaker activity with youth, gardeners, and other adults. Discovering your neighborhood using airphotos and maps, and by making observations and talking with knowledgeable people during a walk, is a good learning experience for all ages!

Garden Mosaics is very interested in the results of Neighborhood Explorations from other countries besides the US. If you prefer to submit a Neighborhood Exploration Form in another language besides English, please contact us at gardenmosaics@cornell.edu (we can respond to inquiries in Spanish, French, Arabic, Russian, German, and other languages). We will work with you to translate the questions into your language, and to post your Neighborhood Exploration in the original language and in English.

The Neighborhood Exploration online database is designed primarily as an educational resource. Website visitors can learn about the diversity of neighborhoods in countries around the world. Researchers who want to know about urban neighborhoods may also use the data posted on the website.

Anyone Can Conduct the Neighborhood Exploration...

If you wish to conduct the Neighborhood Exploration on your own or with a group of adults, go directly to the short, illustrated version of the Neighborhood Exploration following this overview, and then to the Neighborhood Exploration Form on the Garden Mosaics website or at the end of this chapter. You may also want to read more about the research objectives of the Neighborhood Exploration in this chapter. The rest of the information in this chapter is primarily for conducting the Neighborhood Exploration with a group of youth.

Conducting the Neighborhood Exploration with Youth

We have included in this chapter the following information for conducting the Neighborhood Exploration with youth: inquiry and content learning objectives, assessment ideas, and comprehensive instructions.

The instructions in this chapter are for conducting the Neighborhood Exploration in the area around a community garden. Youth conducting the Neighborhood Exploration gain an appreciation for what a community garden contributes to the neighborhood. Many school gardens also bring youth and adults together and play an important role in the community. Even home gardens provide some of these same benefits—such as a place where neighbors gather for a barbecue and to eat fresh vegetables from the garden. Thus, you can readily adapt the activity to any neighborhood where there is a garden or other green space, food markets or food being grown, etc, and where it is safe for youth to walk around.
NEIGHBORHOOD EXPLORATION

WHAT IS A NEIGHBORHOOD EXPLORATION?
A Neighborhood Exploration allows you to discover your neighborhood using aerial photographs, maps, and a walk.

WHY THE NEIGHBORHOOD EXPLORATION?
You can learn what is in the neighborhood and what is missing. Then you can share what you learn with others, and even develop a plan for improving the neighborhood.

WHAT DO YOU NEED?
✔ aerial photograph (airphoto)
✔ map
✔ paper
✔ pencils
✔ clipboards
✔ cameras and film
✔ poster board, glue, and other supplies for making collage
✔ drinks and snacks

WHAT TO DO...BEFORE THE WALK
Airphoto and map
✔ Look at the airphoto and map. If you need help recognizing things, go to the “Aerial Photographs” and “Topographic Maps” Science Pages.
✔ Mark on the airphoto or map, or list on a separate piece of paper, places where you would like to take photos on your neighborhood walk.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
NEIGHBORHOOD EXPLORATION

WHAT TO DO...DURING THE WALK

Walk around the neighborhood
✔ Walk to the sites marked on your maps and airphotos, or on your list.

Take photos
✔ Take photos of places where people can get fresh food, enjoy nature, relax and talk to friends, get exercise, and see concerts.
✔ Also take photos of vacant lots and other places that could become gardens or small parks, or where trees could be planted.
✔ Take photos of places that interest you!

Make notes
✔ Jot down notes about where you take the photos.

WHAT TO DO...AFTER THE WALK

Review findings
✔ Compare what you learned from the airphoto and map with what you saw on the walk.
✔ Talk about what you found in the neighborhood.

Did we figure out places correctly on the airphoto and map?

What kind of things can we do in our neighborhood?

Are there places in the neighborhood where trees could be planted or that could be made into new gardens or small parks?

What things are missing from the neighborhood?

What new features did we find on the walk?

How did the neighborhood differ from what we saw on the airphoto and map?

How might we improve the neighborhood?

Make collage
✔ Make a neighborhood collage with airphotos, maps, and the photos you took. Add comments about what you saw. Be creative!

We can use our collage for sharing what we’ve learned with other people.

Learn more
✔ Check out the online Science Pages. Click on any pages that might help you to understand more about what you learned.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
Neighborhood Exploration Research

Research Objective
To determine where in the neighborhood there are places for residents to access fresh food, talk to each other, enjoy nature, relax, get exercise, and participate in cultural, community, and educational events.

Research Questions
Where in the neighborhood are there places for people to:
• get fresh food?
• talk with friends and neighbors?
• enjoy trees, flowers, wildlife, and other kinds of nature?
• relax and play games?
• get exercise?
• see concerts, plays, and other cultural events?
• learn new things?
• hold community events (for example, voter drives, blood pressure clinics)?
• plant trees or create new parks or gardens?

Why Is Neighborhood Exploration Research Important?
Large grocery chains tend to be located in suburban areas, whereas many urban residents rely on a limited selection of produce at small neighborhood stores. This produce may be high priced and not very fresh. It often has traveled a long distance to reach the stores. Thus, in urban areas, community gardens may be the only sites where people can access fresh food.

High density and poor urban neighborhoods also may lack places where people can socialize, enjoy nature, relax, get exercise, and participate in cultural, community, and educational events. For some community gardeners, the social and other activities that occur in the garden are more important than the food that is grown.

Neighborhood Exploration Science Learning

The Neighborhood Exploration is a great opportunity for youth to learn about two aspects of science:
• Inquiry, or “doing science,” and
• Content, which includes facts and concepts.

Inquiry
If you follow the instructions for conducting the Neighborhood Exploration *i-m-science investigation*, youth will learn the following inquiry skills.

Inquiry Learning Objectives
Youth will:
• Make observations on aerial photographs and maps, and during a walk around their neighborhood.
• Synthesize their observations from the airphotos, maps, and walk to make a collage of their neighborhood.
• Present their results to members of the community.

Content
You can use the Garden Mosaics *Aerial Photographs* and *Topographic Maps* Science Pages to help the youth learn more about how to recognize buildings, parks, and other features on airphotos and maps.

You can also use “teachable moments” while the youth are gathered around their airphotos and maps, and during their walk, to help them observe features more closely. For example, you might point out that the long, narrow strip on an airphoto is a road, and the area that looks “rough” on the airphoto is vegetation in a park. While the youth are on their walk, you might ask them to think about where the produce on a street side stand comes from.

With your guidance and using the Science Pages, you can expect youth conducting the Neighborhood Exploration to learn the following content.
Content Learning Objectives
Youth will learn about:
• Location of significant features (for example, buildings, parks) in their community.
• Food access, green space, and sites for social, cultural, educational, and recreational activities in their community.

If you would like to delve further into airphoto interpretation with your youth, you may want to obtain a copy of the Explorations from an Aerial Perspective program manual and student workbook, available from the Cornell Institute for Resource Information Systems, email emb6@cornell.edu.

Neighborhood Exploration Assessment

<table>
<thead>
<tr>
<th>Inquiry Learning Objectives</th>
<th>Evidence of Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Youth will:</td>
<td></td>
</tr>
<tr>
<td>• Make observations on aerial photographs and maps, and during a walk around their neighborhood.</td>
<td>The collage created by the youth and the completed Neighborhood Exploration Form should serve as concrete evidence of their ability to observe and synthesize information about the neighborhood. Be sure to keep the collage after you finish the activity.</td>
</tr>
<tr>
<td>• Synthesize their observations from the airphotos, maps, and walk to make a collage of their neighborhood.</td>
<td>If the youth make a presentation that includes the collage, their explanation of how the items in the collage represent their neighborhood offers further evidence of learning.</td>
</tr>
<tr>
<td>• Present their results to members of the community.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Content Learning Objectives</th>
<th>Evidence of Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Youth will learn about:</td>
<td></td>
</tr>
<tr>
<td>• Location of significant features (for example, buildings, parks) in their community.</td>
<td>As the youth work with the maps and walk through the neighborhood, you will be able to observe them as they identify significant features. Note how many different features they are able to locate.</td>
</tr>
<tr>
<td>• Food access, green space, and sites for social, cultural, educational, and recreational activities in their community.</td>
<td>The specific items included in the collage and the data form will reflect youth learning about the availability of these resources in the community.</td>
</tr>
</tbody>
</table>

The puzzles and other activities on the Science Pages help to assess youth learning about specific concepts.
Additional Assessment Tools

**Participation**
To generate a summary of what youth and other participants did, **record number of:**
- **youth participants**
- **youth** for whom this is their **first experience with airphotos**
- **community members** (for example, store owner, park manager) youth interact with on the neighborhood walk, and their affiliation;
- **educators and volunteers** and their affiliation;
- **gardeners**, if any, who participate in the activity with the youth.

Also save the collage or a photo of it, and record information about **how the collage was used**. Was it posted in the garden? Did the youth use it to make a presentation?

**Notes and photos**
This will help you remember important learning moments during the activity.
- **During the walk and while youth assemble the collage, notice what the youth talk about.** Do they discuss what “fresh food” means? Do they notice that people gather in an unexpected place?
- **Use a camera** to document the activity. You will already be using a camera to take photos of various places in the neighborhood, but you can also take pictures of the youth as they conduct the activity and assemble the collage.

**Maps and airphotos**
Have the youth complete the activities on the Aerial Photographs and Topographic Maps Science Pages. Alternatively, make photocopies of the maps or airphotos you are using for this *i-m-science investigation.* Ask each youth to identify five features of the neighborhood that are important to him/her. Have them circle and label the features with a colored marker. This brief activity addresses the content learning objective related to airphotos and maps. The marked up maps and airphotos can be posted on a wall or become part of a program scrapbook or journal.

**Testing predictions**
Using the Neighborhood Explorations Testing Predictions table below as a guideline, at the beginning of the activity have the youth predict what resources are in the neighborhood. Next have them check off the resources they find on the airphotos and maps. Finally, have them check off the resources they see on their walk. How do their initial predictions compare to what they actually found? The completed charts and notes from group discussions document youth’s ability to make and test predictions and to identify neighborhood resources.
### Neighborhood Exploration Testing Predictions

<table>
<thead>
<tr>
<th>Neighborhood Resource</th>
<th>Prediction</th>
<th>Airphotos/Maps</th>
<th>Neighborhood Walk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh food</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place to talk with friends and neighbors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place to enjoy nature</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place to relax</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place to exercise</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place for cultural events (concerts, dances)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place to learn</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place to hold community events (such as barbecues, demonstrations, voter drives)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vacant lots</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Places where gardens could be created</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Places where parks could be created</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Places where trees could be planted</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Conducting the Neighborhood Exploration with Youth

Time Required
- Preparation: 2 hrs (make sure to plan so you obtain the airphotos and maps before meeting with youth)
- Observing airphotos and maps: 1-2 hrs
- Walk and taking photos in neighborhood: 2 hrs
- Making neighborhood collage: 2 hrs
- Submitting data online: 1 hr

Product
Youth will create a collage of airphotos, maps, and photos of the neighborhood. Youth will compile their results and contribute them to the online Neighborhood Exploration database.

Materials
For each group of youth
- A camera with film. You may want to use Polaroid or digital cameras so the youth can get the images right away. Disposable cameras are also possible.
- Clipboard, paper, and pencil
- Copies of Aerial Photographs and Topographic Maps
- Copies of the Neighborhood Exploration Guiding Questions
- Copies of Neighborhood Exploration Form
- Aerial photograph(s) of neighborhood, including garden
- Topographic or street map(s) of neighborhood, including garden
- Poster board, glue, and other supplies for making collage
- Drinks and snacks for the walk around the neighborhood

Procedure
Before Meeting with Youth
1. Obtain an aerial photograph of the neighborhood where the garden is located (or other neighborhood where you will conduct the activity). You may be able to borrow airphotos from Cooperative Extension or a local government office, or download them from the web. Or you can buy or download airphotos from the United States Geological Survey (USGS), TerraServer, or Aerial Photography Field Office (APFO). The USGS and TerraServer websites are more user-friendly. The USGS website has good background information, and includes digital images. The TerraServer has digital images only. For USGS, call 1-888-ASK-USGS or access the website: <www.usgs.gov>. For Terraserver, go to <http://terraserver.homeadvisor.msn.com>. For APFO, go to <www.apfo.usda.gov>. See also Obtaining Aerial Photographs and Topographic Maps at the end of this chapter.

2. Obtain a street map or topographic (“topo”) map of the neighborhood. Street maps are readily available at gas station convenience stores or bookstores or you can download them from Mapquest <www.mapquest.com>. Topo maps are available at outdoor stores, some bookstores, and through the USGS <www.usgs.gov> or TerraServer <http://terraserver.homeadvisor.msn.com> websites. If you are unfamiliar with topo maps, you can access the USGS “Topographic Map Symbols” <http://mac.usgs.gov/isd/pubs/booklets/symbols>. See also Obtaining Aerial Photographs and Topographic Maps at the end of this chapter.

3. In addition to resources on the web, you may want to purchase the Explorations from an Aerial Perspective program manual from the Cornell Institute for Resource Information Systems; email emb6@cornell.edu.
4. **Familiarize yourself with the airphotos and maps.** You should be able to locate the garden and several other landmarks.

5. **Make copies of the airphotos and maps** using a laser copier if possible (creates a clearer image). You can enlarge the airphotos and maps so that all the youth can gather around one image, or make copies so you have enough for each group of 3 youth.

6. **If you will be doing the Neighborhood Exploration with gardeners, contact the garden manager or other gardeners and discuss the Garden Mosaics project with them.** Be sure to describe your group and the activity, and arrange a time for the youth to conduct the activity with the gardeners.

7. **If you know or can easily contact neighborhood residents, you may want to include opportunities for the youth to interact with them during the walk.** For example, the group could visit a deli and talk with the owner about where they get their fruits and vegetables. Or the youth could stop at a park and talk with a park manager about the activities that occur in the park.

---

**Preparing Youth for the Neighborhood Exploration**

1. **Discuss with the youth polite and respectful behavior,** including how to introduce themselves to individuals they might meet with on their walk.

---

2. **Introduce the idea of the Action Project,** which will involve the youth taking an action to benefit the garden and neighborhood. Let the youth know the information they collect on the Neighborhood Exploration will be used for two purposes. The first is to familiarize themselves with the neighborhood and to share what they learn through a poster or collage and online data form. The second is to help them learn about the garden and what it contributes to the neighborhood, information that will be useful in planning their Action Project. If you have already decided on a focus for the Action Project, discuss with the youth what information they might gather to help plan the project.

3. **Explain that the Neighborhood Exploration has three parts:**

   - Exploring their neighborhood with airphotos and maps, going on a walk around the neighborhood and taking photos, and sharing what they learn by making a collage and submitting their data online.

4. **Before you go on the walk through the neighborhood, make sure you have permission from parents and from the community center or other program you are working with.**

---

**Conducting the Neighborhood Exploration**

**Part 1. Airphotos and Maps**

1. **Engage the youth in a discussion of their neighborhood.** Ask them:
   - What are the places you like in your neighborhood?
   - What activities do you like to do in your neighborhood?
   - Where do people buy food in your neighborhood?
   - Where do they meet to talk, play games, listen to concerts, etc?
   - Where are there trees, green spaces, or places for people to enjoy nature?
   - How do you contribute to your neighborhood?
2. **Have the youth read and do the activities on the Aerial Photographs and Topographic Maps** Science Pages.

3. **Hand out the airphotos and maps.** It’s ideal if you have a large enough airphoto and map for all the youth to gather around. If not, the youth can work in smaller groups, each with a copy of the airphoto and map. Working with others will facilitate discussion among the youth and makes the activity more fun.

4. **Allow the youth time to discover features they are familiar with on the airphotos and maps.** Likely the youth will be able to point out buildings, parks, and other features they are familiar with. Ask them to find the garden. If they cannot find it, you can help them by pointing out some characteristics of community gardens and other green space on airphotos. (Gardens are often rectangular in shape, are dark colored, and have uneven texture due to mix of plants and soil). On the topographic map, it may be difficult to locate the garden because areas where there are a lot of buildings are colored uniformly pink. However, you may be able to identify the nearest cross streets and locate the garden that way.

5. **Engage the youth in a discussion about the airphotos and maps.** Ask the youth:
   - What might the garden provide for the neighborhood (for example, food, place for relaxing)?
   - Can you locate additional places in the neighborhood that provide food or sites for relaxing and other things that the garden provides?
   - What other activities do neighborhood residents participate in (for example, talking with each other, concerts and other cultural activities, playing games)?
   - Can you find places in the neighborhood where these other activities occur?
   - Can you find other green spaces or trees in the neighborhood?

6. **Have the youth mark on the photo or map, or list on a separate piece of paper, places where they would like to take photos on their neighborhood walk.** They can refer to the Neighborhood Exploration Guiding Questions for additional suggestions about features to observe in the neighborhood.

**Conducting the Neighborhood Exploration**

**Part 2. Neighborhood Walk**

1. **Lay out ground rules for the walk appropriate for the age group you are working with.** For example, the group should stay together as they cross streets and stay within earshot of an adult leader at all times.

2. **Before setting out to visit the garden and its surroundings, the youth should determine a route for the walk.** Depending on the ratio of adults to youth in your group, you may want to divide into smaller groups to explore the neighborhood. The youth can use the list of features they identified on the airphotos and maps to guide their walk. Be sure they bring copies of the airphotos and maps to refer to on the walk.

3. **If some of your youth are more familiar with the neighborhood, you may want to give them extra responsibility (and motivation to participate in the activity) by appointing them as “tour guides.”** Similarly, if gardeners participate, they may be able to serve as guides and tell the story of the neighborhood from their perspective.

4. **Distribute cameras to the youth.** Make sure there are enough cameras so that each youth has a chance to take photos.

5. **During the walk, have the youth take photos of places where residents can get fresh food, talk to each other, enjoy nature, relax and play games, get exercise, and participate in cultural, community, and educational events.** Also have them take photos of vacant lots and other places that could become gardens or small parks, or where trees could be planted. Finally, encourage the youth to take photos of places that are of special interest to them.
6. Ask the youth to take notes about the places where they take photos. They can use the list they made or the Neighborhood Exploration Guiding Questions to take notes on what they observe and where they take photos.

Conducting the Neighborhood Exploration

Part 3. Sharing Findings

1. Have the youth look at the airphotos and maps after they return from their walk. Ask the youth:
   - Did you identify features correctly on the airphoto prior to the walk?
   - How did the neighborhood differ from what you expected after looking at the airphotos and maps?
   - What new features did you find during the walk?

Note that if the airphoto is several years old, there may be some differences between the airphoto and what they saw on the walk (e.g., buildings built or torn down).

2. Discuss with the youth what they found in the neighborhood.
   - Does the neighborhood around the garden have places where people can get fresh food, talk to each other, enjoy nature, relax and play games, get exercise, and participate in cultural, community, and educational events?
   - Does the garden offer these things?
   - What things are lacking in the neighborhood?
   - Are there places in the neighborhood where trees could be planted or that could be made into new gardens or small parks?
   - How might you improve the neighborhood?

3. Use the relevant Science Pages to help the youth understand or learn more about what they saw during their walk.

4. Once their photos are developed or printed, the youth are ready to make a neighborhood collage. The purpose of the collage is to display the features of the neighborhood and where they are located. Encourage the youth to be creative in designing the collage. One possibility is to have the airphoto in the center of a poster board surrounded by the photos taken by youth. The youth can have arrows from the photos they took to the same feature on the airphoto. Another possibility is to have photos of the garden in the center of the collage. Still another option is to draw a simple map of the neighborhood (based on the airphoto and topographical map) and place the photos on the map in the locations where they were taken. The youth also may want to add some short text describing what activities occur in the neighborhood.

5. The youth can refer to the collage throughout their other Garden Mosaics activities. They may want to add or change things as they learn more about the garden and neighborhood from the gardeners.

6. The collage also can be used for educating others about the importance of the garden and key features and activities in the community. It can be laminated and displayed in the garden. It can also be shared at a meeting with local residents and government officials.

7. Compile your results and enter them online. Review each question on the Neighborhood Exploration Form with the youth. Based on their notes, the group should write down the answer to each question. If they have access to the Internet, the group can fill out the online Neighborhood Exploration Form on the Garden Mosaics website. If your group cannot directly enter their data onto the website, have them use a paper or electronic file copy of the form, and email or send it to the address on the form. If it is not feasible for the youth to fill out the form, please fill it out yourself. Don’t forget to include photos of the activity when you send in your form.
Neighborhood Exploration Guiding Questions

Name of Group_________________________

Date______________

1. As you are walking through the neighborhood describe places where people can:

   a. Get fresh food

   b. Talk with friends

   c. Enjoy nature

   d. Relax and play games

   e. Get exercise

   f. See concerts, plays, and other cultural events
g. Learn new things

h. Hold community events (for example, voter drives, blood pressure clinics)

2. Describe any vacant lots or other sites where people might plant trees or create a new garden or park.

3. Can you think of any ways the neighborhood could be improved?
Neighborhood Exploration Form

Name of Group or Individual ______________________________________________________

Address where you started walk around neighborhood __________________________
(include street and number if available, or nearest cross streets if number not known).
____________________________________________________________________________
City_____________________  State_______  Zip Code/Postal Code ______________
Country ____________________
Name of Youth Program________
Name of Adult Contact_________
Email address of Adult Contact

Check here if you do NOT want your contact name and email address posted with your Neighborhood Exploration Form on our website.

Date of Walk
Month ___________  Day ___________  Year ______

Number of participants involved in Neighborhood Exploration
  Youth __________
  Gardeners __________
  Adult Educators/Volunteers __________

1. Total Distance Walked
Check one box for distance and indicate miles or kilometers
Distance
  □ 0 - 1/4  □ Miles
  □ 1/4 - 1/2  □ Kilometers
  □ 1/2 - 3/4
  □ 3/4 - 1
  □ 1 - 2
  □ > 2
2. Did you find places where people can (attach some photos of these places):
   □ get fresh food
   □ talk with friends
   □ enjoy nature
   □ relax and play games
   □ get exercise
   □ see concerts, plays, and other cultural events
   □ learn new things
   □ hold community events
   □ plant trees
   □ create a park or garden
   □ Other (please describe)
   □ Information not available

3. Did you find any (attach some photos of these features):
   □ vacant lots
   □ community gardens
   □ school gardens
   □ home gardens
   □ parks
   □ food stores or markets
   □ schools
   □ concert halls
   □ libraries
   □ community centers
   □ single family homes
   □ apartment buildings
   □ Other (please describe)
   □ Information not available
4. Write a short essay about what you learned on your Neighborhood Exploration. What did you observe? What could you do to improve the neighborhood?

Photographs
Please send us several photos for display on the website with your Neighborhood Exploration. You can send us digital or print photos (see Photo Guidelines, Section VII).

Submission Methods:
1) Online. We prefer this method!
Visit our website—www.gardenmosaics.org—and go to i-m-science. Click on Neighborhood Exploration, then Submit Your Form. Complete the online Neighborhood Exploration Form, attach any digital photos, and submit.

OR

2) Mail
Complete this Neighborhood Exploration Form and mail it along with any print photos, or digital photos on disk or CD, to:
Garden Mosaics
Department of Natural Resources
Fernow Hall
Cornell University
Ithaca, NY 14853

If you have any questions, please contact us at:
gardenmosaics@cornell.edu
Obtaining Aerial Photographs and Topographic Maps

You can view aerial photographs and topographic maps online. However, if the quality of the online images is poor, you may want to order hard copies. You also may be able to borrow airphotos and topographic maps from a local non-profit or government agency, or purchase them locally. If you obtain hard copies of airphotos and maps, you can make laser copies for youth to work with inside and to take out into the field. (Even though you may be using a black and white airphoto, black and white copies are not clear, whereas color laser copies work well.) You also can enlarge the airphotos with a color copier, so that more youth can gather around to see them.

1. **Decide on the location(s) you want to view.** You will need to know the street address for online searches. You will need to know the longitude and latitude (coordinates) to order hard copies.

2. **Go online to view the airphotos and topo maps and to find their latitude and longitude.**
   - Click on “Advanced Find” on the top of the page.
   - Click on address search.
   - Enter the address.
   - A list of the available images for the site should appear. Each site usually has at least one airphoto and one topo map.
   - Once you select the image, you can zoom in or out or use the arrows to center the garden or other location you are interested in.
   - Download and print options will appear along the top of the screen.
   - Depending on the quality of your printer you may be able to download a usable airphoto. However, often the airphotos and maps appear fuzzy when printed.

3. **Order airphotos and topo maps.** The USGS sells airphotos and topo maps. They have maps and photos available for all points in the continental US. Start your search by going to <http://ask.usgs.gov>. See more details below.

**Note on Aerial Photographs**

Airphotos come in different scales and sizes. The standard photos are:

- 9" x 9" print, scale is 1:40,000 where 1 inch on the photo = 3,333 ft on the ground
- 18" x 18" print, scale is 1:20,000 where 1" = 1,667’ on the ground
- 36" x 36" print, scale is 1:10,000 where 1" = 833’ on the ground.

A 9" x 9" photo may not provide enough detail to be able to identify the garden and other key features, Therefore you may need to get larger prints. Another option is to order a photographic enlargement.

**Note on Topographic Maps**

Topo maps come in different scales. We recommend 1:24,000 ($6 + handling from USGS). You should also access the Topographic Map Symbols guide online at <http://mac.usgs.gov/isb/pubs/booklets/symbols> or order free copies by calling 1-888-ASK-USGS.
Ordering airphotos and topo maps

- The USGS sells airphotos and topo maps. They have maps and photos available for all points in the continental US. Start your search by going to <http://ask.usgs.gov>.
- Click on “Maps and other products” for information about viewing and ordering airphotos and topo maps.
- If you know the coordinates of the area you want, you can place your order over the phone. Otherwise the standard procedure for ordering an airphoto is to submit a section of a map with the area for which you need a photo and a checklist with some additional information.
- The standard procedure for ordering a topo map is to download and submit the ordering form.
- For more information, contact the Earth Science Information Center at Tel: 800-252-4547, Tel: 605-594-6151, TDD: 605-594-6933, Fax: 605-594-6589, or email: custserv@usgs.gov.

Effective September 3, 2004, the US Geological Survey (USGS) no longer offers hard copies of aerial photographs as a paper product. Their images are now available in a digital format For more information on these products, visit the USGS website at: <http://edc.usgs.gov/products/aerial.html>.

For more information on ordering airphotos from the USGS, Phone: 303-202-4700 Fax: 303-202-4188 Email: infoservices@usgs.gov USGS Store: http://store.usgs.gov

The USGS has links to a range of digital image websites, including those that sell color infrared photos, at: <http://mapping.usgs.gov/partners/viewonline.html>.

The USGS also contracts with business partners who obtain the negatives and print quality copies. The list of business partners who sell airphotos and topo maps is available at: <http://rockyweb.cr.usgs.gov/acsia/map_dealers/bpcont.html>.

It is also possible to order airphotos from local companies (try “photographers, aerial” in your local Yellow Pages). In urban areas, especially, you may find that local airphoto companies will have better photos than the USGS.

Topo maps are commonly available at outdoor stores.

Other Useful Sites

TerraFly allows you to “fly over” your neighborhood <http://www.terrafly.fiu.edu>.

Key Hole allows you to “fly from space” to your home <http://www.keyhole.com>.

The Aerial Photography Field Office of the US Department of Agriculture also has an enormous collection of airphotos dating from the 1950’s. Directions for ordering can be found on their website <http://www.apfo.usda.gov/orderingimagery.html>.

The National Archives has airphotos dating from the late 1920’s that may be available for historical work <http://www.archives.gov/research_room/index.html>. To contact their reference center: <http://www.archives.gov/global_pages/inquire_form.html> or call 1-86-NARA-NARA OR 1-866-272-6272.

The Cornell Institute for Resource Information Systems produced a comprehensive guide to the study of airphotos and topo maps for educators and youth. You can order the Explorations from an Aerial Perspective Educator’s Manual and Student Packet by contacting Eugenia Barnaba at emb6@cornell.edu.

Aerial photographs are available, especially for cities, dating from the late 1920’s to the present. Your youth may be interested in viewing historical photos. Additionally, color infrared photos are now available for most cities, which are useful for viewing where vegetation is found. In addition to the USGS and other websites, a city planning office, Cooperative Extension, or other government office may be able to assist you.
Chapter 4. Weed Watch

Overview

Weeds are one of the most frustrating problems gardeners face. Through the Weed Watch i-m-science investigation, you can collect important data about weeds and weed control methods in urban vegetable gardens. You then submit your data using the online Weed Watch Forms, where it will be used by Cornell scientist Antonio DiTommaso and his colleagues to develop ways to control weeds in urban gardens. You will also gain a better appreciation for the beauty and diversity of these often times pesky plants.

Garden Mosaic Weed Scientist: Dr. Antonio DiTommaso

Antonio “Toni” DiTommaso was born in southern Italy. He immigrated with his parents to Montreal, Canada, when he was 9 years old. In Montreal, Toni watched his father and the other Italian immigrants create beautiful home and community gardens, incorporating practices from the different regions in Italy where they had grown up. Toni’s father was able to grow fig trees in the cold Canadian climate by turning the trees on their side and burying them during the winter. Currently, Dr. DiTommaso is a professor of weed science in the Department of Crop and Soil Sciences at Cornell University. He helps farmers with their weed problems and hopes to be able to help urban gardeners control weeds in the future. But first he needs to learn more about vegetable garden weeds in cities. You can help Dr. DiTommaso by taking measurements of weeds in urban gardens.

Anyone Can Become a Weed Watcher...

If you want to conduct Weed Watch on your own or with a group of adults, go directly to the short, illustrated version of the Weed Watch following this overview, and then to the Weed Watch Forms on the Garden Mosaics website or at the end of this chapter. You also may want to read more about the research objectives of Weed Watch. The rest of the information in this chapter is primarily for conducting Weed Watch with a group of youth or students.

Conducting Weed Watch with Youth

Weed Watch can be used as an educational activity for youth and students in rural or urban, vegetable or flower gardens. It provides an opportunity for students to apply many topics they learned in science classes, including classifying and identifying organisms, taking measurements, and testing hypotheses. We have included in this chapter the following information for conducting Weed Watch with youth: inquiry and content learning objectives, assessment ideas, and comprehensive instructions.

If you plan to submit data to the Weed Watch online database, you will need to conduct this activity in an urban vegetable garden. It can be a community, school, or home garden.
WEED WATCH

WHAT ARE WEEDS?
Weeds are plants growing where they are not wanted. Weeds are a big problem for gardeners because they compete with crops for light, water, space, and nutrients.

These weeds are shading sunlight from my vegetables!

I know, I spend hours pulling weeds. It would be nice to have a better way to control them.

WHAT IS WEED WATCH?
You collect data about weeds growing in a garden. Although you can be a weed watcher in any garden, if you want to contribute to the online Weed Watch database, you will need to collect data in an urban, vegetable garden.

Which weed is most common in the garden?

How many different types of weeds do you see?

What methods are used to control weeds?

WHY WEED WATCH?
The data you collect will help Cornell weed scientist Dr. DiTommaso and his colleagues. They will use the data to learn more about urban weeds and to develop methods to control them.

These data will help us answer questions about weeds.

This information may help me get rid of troublesome weeds....

...or work out which weed control method works best in my garden.

We might prove the hypothesis that weed diversity is greatest in gardens where there is the greatest diversity of crops...

...or that fertilized plots have more weeds than unfertilized plots!

You'll also learn about how fascinating weeds can be!

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
WEED WATCH

WHAT YOU NEED
✓ Weed Watch Data Forms 1, 2, and 3
✓ weed identification book
✓ copies of Gardener Permission Form
✓ paper and pencil
✓ clipboard
✓ permanent marker
✓ meter tape
✓ quadrat frame (see instructions for making frame under Weed Survey)
✓ flags or stakes to mark plot, or map of the garden
✓ plant press (optional)
✓ digital camera (optional)

WHAT TO DO
1. Background Research
✓ Get a guide to weed species so you will be able to identify weeds.

A great resource is the Weed Identification, Biology and Management CD. It can be ordered at <http://www.css.cornell.edu/WeedEco/>

Go to the website of Weed Science Society of America at <http://www.wssa.net/>

2. Gather information
✓ Use the Data Forms to collect information about the garden, the weeds, and how the gardeners control the weeds. You may have already collected some of this information during other Investigations.

To collect information...

... make observations in the garden,

... interview gardeners,

... and measure weeds.

3. Record information
✓ Use the three Weed Watch Data Forms to record the information.

4. Send information
✓ Send the completed Weed Watch Data Forms to Dr. DiTommaso by mail or enter the data you collect onto the online Garden Mosaics Weed Watch database.

You can send the data online, or by hard copy to me, Dr. Toni DiTommaso, at:
Department of Crop and Soil Sciences/ 903 Bradfield Hall, Cornell University
Ithaca, NY 14853

If you have any questions, send an email to gardenmosaics@cornell.edu

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
WEED WATCH
THE THREE WEED WATCH DATA FORMS

1. GARDEN INFORMATION FORM
✓ Arrange to meet the garden manager or other knowledgeable gardener.
✓ Interview the gardener about the garden size, history, soils, and weeding practices. Use the Garden Information Form to guide what questions you ask.
✓ Walk around the outside of the garden and observe any weeds and how abundant they are.
✓ Fill out the Garden Information Form.
✓ Enter the data you collect onto the online Garden Mosaics Weed Watch database.

This garden used to be a vacant lot where many different weeds grew. We brought topsoil into the site to start garden plots, but weeds are still a big problem.

2. WEED CONTROL PRACTICES FORM
✓ Decide which gardeners you are going to interview.
✓ Interview several different gardeners about weed problems in their plots, and how they control weeds. Use the questions on the Weed Control Practices Form to guide what questions you ask.
✓ Fill out a Weed Control Practices Form for each gardener you interview.
✓ Enter the data you collect onto the online Garden Mosaics Weed Watch database.

Thank you for letting us interview you.

May I take your photo?

What kinds of weeds are your biggest problem? Why?

What do you do to get rid of weeds? Does it work?

Do you know what this weed is called? I can't find it in the Guide.

I'll press its leaves and flowers between two pieces of paper, and take it to a weed expert at Cooperative Extension.

Take a photo of it, and send it to Dr. DiTommaso.

3. WEED SURVEY FORM
✓ Decide on up to five garden plots where you will conduct the weed survey. Also, choose two areas of the garden to survey where no crops are growing.
✓ Conduct a weed survey of each plot and area with no crops in order to estimate the numbers of different kinds of weeds growing there. Instructions for carrying out a weed survey are shown on the next page.
✓ Fill in the Weed Survey Form.
✓ Enter the data you collect onto the online Garden Mosaics Weed Watch database.
✓ If possible, repeat the Weed Survey several times throughout the growing season.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
**WEED WATCH**

**HOW TO DO A WEED SURVEY**

To estimate the number of different kinds of weeds growing in the garden, you are going to observe and measure weeds inside a quadrat. A quadrat is a square piece of ground in a garden plot.

1. Build a 0.5 m by 0.5 m frame, called a quadrat frame. Make the frame using PVC tubing, four meter sticks, or two meter sticks and string.

2. Choose five vegetable plots to survey. You can choose the plots at random or select ones that are representative of the entire garden.

3. For each plot, place the quadrat frame on the ground. Try to place it so that it covers some of the crops and some area between crops.

4. Mark the corners of the quadrat with stakes or flags that can be left in the ground. Or, note the location of the quadrat on a map of the garden. Then you can return to the garden and measure weeds in the same place every two weeks.

5. Observe the different plants, both crops and weeds, within the quadrat. Count the number of each plant species in the plot.

6. Fill out the Weed Survey Form and submit the data to the online Garden Mosaics Weed Watch database.

---

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
Weed Watch Research

Research Objective
The overall objective of this research is to gather baseline data on the abundance and diversity of weed species, and the practices used to control weeds, in urban vegetable gardens.

Hypotheses
Dr. DiTommaso has the following hypotheses about urban weeds. Perhaps you can add some of your own hypotheses!
- Fertilized garden plots will have a greater number of weeds than unfertilized garden plots.
- Weeds will be most abundant and troublesome in plants grown from seed compared with plants transplanted from "starts."
- Shaded sites will have fewer weeds overall but more weeds that tolerate shade.
- Weed diversity will be greatest in gardens with the greatest diversity of crops.
- Weed diversity will be greater in gardens located near to other green spaces than in gardens surrounded by asphalt and buildings.
- Annual and biennial weeds will be more abundant and troublesome than perennial weeds. (An annual weed grows for one year, produces seeds, and then dies. Biennial weeds grow two years, and perennial weeds grow many years.)
- Weeds will be less abundant around perennial crops than around annual crops.

Why Is Weed Watch Research Important?
Weeds are "plants growing where they are not wanted" or simply "plants out of place." Weeds compete with crops for essential resources such as nutrients, light, water, and space. As such, weeds can be a major problem for growing crops, including vegetables in home and community gardens. Knowledge about the biology and ecology of weeds is very important because it allows us to develop ways to manage these "unwanted" plants. To develop ways of controlling weeds, scientists need information about the number, types, growth, and reproduction of weeds within specific crops grown in gardens. Weed scientists can use these data to answer questions such as:
- Which weeds are most troublesome in which crops? For example, are weeds that are in the mustard family (such as wild mustard, wild radish, shepherd's purse) more often found with crops in the mustard family (such as broccoli, cabbage, Brussell sprouts, and radish)?
- Are weeds more troublesome in fertilized plots than in non-fertilized plots? Are weeds more of a problem in plots fertilized with compost and other organic fertilizers than in plots with inorganic fertilizers?
- Which weed control methods work best?

Dr. DiTommaso plans to use the data you collect to help develop new ways to control urban weeds. He will make this information available to gardeners and farmers through his Organic Weed Management website (http://www.css.cornell.edu/WeedEco/WeedDatabase/). Many vegetable growers are searching for new ways to control weeds, so your work is very important.
Weed Watch Science Learning
The Weed Watch *i-m-science investigation* is a great opportunity for youth to learn about two aspects of science:
- Inquiry, or “doing science,” and
- Content, which includes facts and concepts.

**Inquiry**
If you follow the instructions for conducting the Weed Watch *i-m-science investigation*, youth will learn the following inquiry skills.

**Inquiry Learning Objectives**
Youth will:
- Make observations and measurements of weeds in the garden.
- Apply interview skills to learn about weed control practices.
- Synthesize information they gather onto a data form.
- Submit their data forms electronically.

**Content**
Although youth may not initially be interested in weeds, you can help them appreciate how important and fascinating these plants are. Check out the Cornell Weed Ecology Lab website (http://www.css.cornell.edu/WeedEco/) and other resources listed under Materials to help youth learn about weeds. One of the best resources available is the *Weed Identification, Biology and Management* CD.

You can also use “teachable moments” in the garden to explain unfamiliar concepts to the youth. For example, if the gardener talks about using mulch to control weeds, you might help the youth understand what mulch is. You can use the *Mulch* Science Page to explain this concept to youth. There is also a *Weeds* Science Page and a number of Science Pages that describe different weed species.

With your guidance and using the Science Pages and other resources listed under Materials, you can expect youth conducting Weed Watch to learn the following content.

**Content Learning Objectives**
Youth will learn about:
- Weed biology and ecology.
- Weed identification.
- Weed evolution.
- Methods of controlling weeds.
- Why weeds are important.
**Weed Watch Assessment**

<table>
<thead>
<tr>
<th>Inquiry Learning Objectives</th>
<th>Evidence of Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Youth will:</td>
<td></td>
</tr>
<tr>
<td>• Make observations and measurements of weeds in the garden.</td>
<td>Written notes from observations and measurements and the completed Weed Watch Forms are evidence that youth were able to make observations and measurements, apply interview skills, and synthesize the information gathered.</td>
</tr>
<tr>
<td>• Apply interview skills to learn about weed control practices.</td>
<td></td>
</tr>
<tr>
<td>• Synthesize information they gather onto a data form.</td>
<td></td>
</tr>
<tr>
<td>• Submit their data forms electronically.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Content Learning Objectives</th>
<th>Evidence of Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Youth will learn about:</td>
<td></td>
</tr>
<tr>
<td>• Weed biology and ecology.</td>
<td>Youth synthesize what they learn from the gardeners about weeds and weed control methods on the data forms. The puzzles and other activities on the Science Pages help to assess youth learning about specific concepts.</td>
</tr>
<tr>
<td>• Weed identification.</td>
<td></td>
</tr>
<tr>
<td>• Weed evolution.</td>
<td></td>
</tr>
<tr>
<td>• Methods of controlling weeds.</td>
<td></td>
</tr>
<tr>
<td>• Why weeds are important.</td>
<td></td>
</tr>
</tbody>
</table>

**Additional Assessment Tools**

**Participation**
To generate a summary of what youth and other participants did, record number of:

- youth participants,
- gardeners who participate, and name of garden,
- educators or volunteers who participate and their affiliation.

Also, save the list of interview questions, notes from the activity, and a copy of the completed data forms.

**Notes and photos**
This will help you remember important learning moments during the activity.

- During the interview(s), notice the youths’ interview skills and interactions with the gardeners. Are they able to obtain the information needed to complete the data forms? Do they ask follow-up questions? Do they ask new questions based on their own interest?

- Use a camera to document youth participation in the activity. Take photos of the youth as they collect data and interview gardeners.

**“Weed ID” guide**
Have the youth make a poster or notebook that includes pictures of weeds found in the garden, names of the weeds, where they are found, and methods of controlling them. The poster can be laminated and hung in the garden. The poster or notebook can serve as evidence of youth learning about weed biology, ecology, and control methods.

---

Inquiry Learning Objectives:

- Make observations and measurements of weeds in the garden.
- Apply interview skills to learn about weed control practices.
- Synthesize information they gather onto a data form.
- Submit their data forms electronically.

Content Learning Objectives:

- Weed biology and ecology.
- Weed identification.
- Weed evolution.
- Methods of controlling weeds.
- Why weeds are important.

Evidence of Learning:

- Written notes from observations and measurements and the completed Weed Watch Forms.
- The puzzles and other activities on the Science Pages.
- Use a camera to document youth participation in the activity. Take photos of the youth as they collect data and interview gardeners.
- “Weed ID” guide: Have the youth make a poster or notebook that includes pictures of weeds found in the garden, names of the weeds, where they are found, and methods of controlling them.
Conducting Weed Watch

Time Required
- Learning about Weeds: 2-3 hrs
- Garden Information: 1-2 hrs
- Weed Control Practices: 1-2 hrs, depending on how many gardeners are interviewed
- Weed Survey: 1-3 hrs, to be repeated throughout the growing season if possible
- Additional time for inputting data onto web

Product
You will enter their results into the Weed Watch Forms, the results of which will be posted on the Garden Mosaics website.

Materials
- Weed guide. Dr. DiTommaso recommends the following resources:
  - Identification Guide to the Weeds of Quebec. (CPVQ, 1999). This guide can be ordered by calling Distribution de Livres Univers in Quebec, Canada at (418) 831-7474. Approximate cost of the guide is $13.00 US.
  - Weed Science Society of America Website (http://www.wssa.net/)
  - Cornell Weed Ecology Lab Website (http://www.css.cornell.edu/WeedEco/)
- Quadrat frames (see instructions for making under Weed Survey below)
- Weed Watch Data Forms
  - Form 1. Garden Information
  - Form 2. Weed Control Practices
  - Form 3. Weed Survey (multiple copies of tables required - one for each plot sampled)
- Paper and pencils
- Clipboard
- Permanent marker
- Meter tape
- Stakes for marking corners of weed survey plots
- Copies of Gardener Permission Form (Section VII)
- Copies of Weed Science Pages
- Plant press for saving weed samples and/or a digital camera (optional)

Procedure
1. Before you collect the information about weeds, you will want to obtain a guide to weed species. You can access or obtain one of the resources listed under Materials. You also might check for resources at your local university or Cooperative Extension office.
2. Contact the gardeners to arrange the visit. Discuss the Garden Mosaics project with them. Be sure to describe your group and explain your purpose for coming to the garden. Arrange a time to conduct the Weed Watch.
3. Ask for permission to interview and photograph the gardener and garden. Also ask for permission to use the photos on the Garden Mosaics website. Have the gardener sign the Gardener Permission Form (Section VII).
4. If conducting Weed Watch with youth, decide which concepts they need to go over prior to conducting this i-m-science investigation. Use the Science Pages and resources listed under Materials to help youth learn about weeds.
5. Use the three Weed Watch Forms to record information about the garden, the gardeners’ practices, and weeds.
6. If you conduct this project in an urban vegetable garden, be sure to submit your forms to the online database, or send them to Dr. DiTommaso. If you are unable to fill out all three forms, submitting forms 1 and 2, or 1 and 3 would be helpful.
**Form 1. Garden Information**

Fill out one time. Includes information about your group, garden location, garden size, history, soils, weeding practices, etc. **Gather this information on your own and from the garden manager.** You may have already collected some of this information through the Community Garden Inventory or Gardener Story. If the gardeners do not know the answers to some questions, leave them blank.

**Form 2. Weed Control Practices**

This form involves interviewing a gardener about his/her plot. Fill out one form for each gardener. Where possible, try to choose gardeners who tend plots where you will be surveying weeds (Form 3). Also if possible, fill out this form with several different gardeners, each having a different plot.

1. **Choose garden plots of gardeners who are willing to cooperate on this activity.**

2. **Interview the gardeners about their weed problems and how they control weeds.** If you are familiar with interviewing gardeners, you should be able to do this with no additional instructions. (Alternatively, you may want to refer to interview suggestions in the Gardener Story and Community Garden Inventory.)

3. **Identify the weeds.** If you are not familiar with the name of the weed, try to identify it using the guides. If you are not able to identify it, you can press it between two pieces of paper and bring it to an expert (for example, a university or Cooperative Extension weed scientist) to identify. You could also send it to Dr. DiTommaso for identification. Make sure to include leaves and flowers (or fruits) if possible. Alternatively, take a digital photo and send it to Dr. DiTommaso as an attached file for identification. If possible, take the photograph against a dark background and include leaves and flowers (or fruits).

4. **Enter the data onto Form 2: Weed Control Practices.** Feel free to include any additional information you learn from the gardeners. For example, what do they call the weed? What do they think causes weed problems? Do they use the weed for food or medicine?

**Form 3. Weed Survey**

Conducting the weed survey requires **taking measurements on crops and weeds.** This is a great way to learn about sampling plants and about weed biology.

The form includes two sets of tables: one for the crops in a plot and a second for the weeds in the same plot. If possible, fill out the two tables for five different plots. Then fill out just the weed table for two areas of the garden with no crops. If possible, repeat every two - four weeks over the growing season.

1. **Obtain a 0.5 x 0.5 m quadrat frame.** This will mark the outer edges of your weed sampling plot. You can build a square quadrat frame out of PVC tubing or meter sticks. If you will be placing the quadrat frame over short vegetation, you can attach the PVC tubing with elbows to form a square. If you will need to slide the quadrat frame under taller plants (for example, tomatoes), you can construct the two halves separately using PVC tubing, elbows, and sleeves. (Both halves are in the shape of a square “C.”) Using right angle elbows, attach both ends of a 0.5-m piece of tubing to 0.25-m long pieces of tubing. Place sleeves at the end of the 0.25-m pieces so they can be joined in the field to form a square. Another method used to construct quadrat frames is tying 0.5-m long pieces of string between both ends of two meter sticks. This method is best for short vegetation as the strings may get caught on taller plants. Another method is to fasten meter sticks to each other using screws.
2. Choose 5 different vegetable garden plots to measure the weeds. You can choose locations randomly or select plots because they are representative of the entire garden.

3. Place the quadrat frame in the vegetable garden plot. The quadrat frame should be placed in a raised bed or other area where crops are being grown. It is best to locate the quadrat so that it covers some of the crop and some area between crops.

4. Mark the location of the quadrat permanently using stakes, or note it on a map you draw of the garden. This way you can return to the garden and measure weeds in the same place every two weeks.

5. Fill in the measurements on Form 3: Weed Survey.

6. Repeat steps 3-5 for the four remaining plots.

7. If time allows, use the quadrat frame to sample weeds in two areas of the garden where there are no crops. Fill out the weed data table for these two areas. This will provide information on the weed potential in this garden.

8. Feel free to include additional notes on items not covered on the forms.

9. Repeat the weed survey every 2-4 weeks if possible. This way you can collect information on how weeds change over the growing season. Even if you are only able to do the survey one time, please send your data to Dr. DiTommaso.

Questions/ Suggestions/ Sending Forms
If you have any questions related to the collecting of weed data, please contact Dr. DiTommaso by email at ad97@cornell.edu. Please send forms as attached file or hard copies to:

Dr. Antonio DiTommaso
Department of Crop and Soil Sciences
903 Bradfield Hall
Cornell University
Ithaca, NY 14853
Weed Watch Form 1: Garden Information
(Fill out this form once for the entire garden.)

Garden Name __________________________________________________________
_____________________________________________________________________
Address of Garden
(include street and number if available, or nearest cross streets if number not known).
City _____________________ State _________ Zip Code/Postal Code ____________
Country ____________________________________________
Name of Youth or Other Program __________________________________________
Name of Adult Contact ___________________________________________________
Email address of Adult Contact _____________________________________________

Check here if you do NOT want your contact name and email address posted with
your Weed Watch Form on our website.

Date
Month _____________  Day__________ Year __________

Number of participants involved in Weed Watch
  Youth ______
  Gardeners ______
  Adult Educators/Volunteers ______

Type of Garden
  __ community
  __ school
  __ home

Name of garden manager or other gardener interviewed
1. Describe the area next to the garden. Is the garden located near an open
space (such as a park, vacant lot, or yard), next to apartment buildings, etc?

2. What is the approximate size of the garden? (Please specify units, such as
square meters or acres).
   ___ square meters
   ___ square feet
   ___ acres
   ___ hectares

3. How many years has this site been a garden?

4. What occupied this site before?

5. How many months of the year is the garden active?

6. What control methods are being used in the garden?
   ___ hand-weeding
   ___ rototilling
   ___ hoeing
   ___ herbicides
   ___ mulching
   ___ plastic sheets
   ___ other (please describe)
7. Soils.
7a. Was the soil brought in to the site? ___Yes ___ No

If yes, what type of soil?

If yes, where was the soil brought in from?

7b. If soil tests have been done, please indicate results. Specify units.

Soil texture

pH

Nutrients
  Nitrogen
  Phosphorus
  Potassium

Organic matter

Salinity

Lead

Other contaminants

Other
8. Take a walk around the outside of the garden. List the weed species in the immediate vicinity (within 50 ft) of the garden and note which are most abundant.

<table>
<thead>
<tr>
<th>Weed Species</th>
<th>Abundance (1= very abundant, 3= not at all abundant)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other observations

Please return form as attached file to ad97@cornell.edu
or hard copy to:
Toni DiTommaso
Department of Crop and Soil Sciences
903 Bradfield Hall
Cornell University
Ithaca, NY 14853
Weed Watch Form 2: Weed Control Practices
(Fill out this form one time for each gardener you interview.)

Date (month/day/year)

Garden Name

Address of Garden
(include street and number if available, or nearest cross streets if number not known).

City
State Zip Code/Postal Code
Country

Name of Youth or Other Program

Name of Adult Contact

Email address of Adult Contact

Check here if you do NOT want your contact name and email address posted with your Weed Watch Form on our website.

Date
Month Day Year

Name of gardener interviewed

Draw a map of the location of the gardener’s plot.
Ask the gardener the following questions. Write your answers in the tables and spaces below.

1. What crops do you grow? For each crop, what date was it planted in the garden? Did you use seeds or transplants? (Transplants are seedlings that were planted in pots inside and then transplanted to the garden).

<table>
<thead>
<tr>
<th>Name of crop</th>
<th>Date planted in garden</th>
<th>Seed/Transplant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2. Are weeds a problem in your garden? ___ Yes ___ No

If yes, what crops are weeds found with? What problems do they cause?

<table>
<thead>
<tr>
<th>Name of weed</th>
<th>Crop(s) associated with</th>
<th>Problem(s) caused (for example, produces too many plants, difficult to pull out, grows too fast, spiny)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. **Control Methods.** How do you control weeds?  
   __ hand-weeding  
   __ rototilling  
   __ hoeing  
   __ herbicides  
   __ mulching  
   __ plastic sheets  
   __ other (please describe)

4. **Timing**  
   How *often* do you weed?

   *When* do you weed?

5. **Do some weeds in your plot typically go to seed?**  
   __Yes  __No  
   If yes, *which ones?*

6. **Do you water your garden plot?**  
   __Yes  __No  
   If yes, generally *how often do you water if it has not rained for a week?*

7. **Do you fertilize your garden plot?**  
   __Yes  __No  
   If yes, *when do you fertilize?*

   **What type of fertilizers do you use?**  
   __ compost  
   __ manure (specify type: dairy, sheep, poultry, horse)  
   __ granular inorganic fertilizers  
   __ lime  
   __ bonemeal  
   __ other, please describe
8. **At the end of the growing season what do you do to your garden?**
   - [ ] leave as is
   - [ ] bury remaining plant material in the soil
   - [ ] pull all crop and weed plants out and place in a compost pile or in the garbage
   - [ ] other (please describe)

9. **Other comments**

   Please return form as attached file to **ad97@cornell.edu**
   or hard copy to:
   
   Toni DiTommaso  
   Department of Crop and Soil Sciences  
   903 Bradfield Hall  
   Cornell University  
   Ithaca, NY 14853
Weed Watch Form 3: Weed Survey
(Fill out this form several times throughout the growing season.)

Garden Name

Address of Garden
(include street and number if available, or nearest cross streets if number not known).

City

State Zip Code/Postal Code

Country

Name of Youth or Other Program

Name of Adult Contact

Email address of Adult Contact

Check here if you do NOT want your contact name and email address posted with your Weed Watch Form on our website.

Date
Month Day Year

Date of last weeding

Plot Map and Identification (can be a gardener’s name or plot number).
Remember to draw a map showing locations of all areas you sample, including plots with crops and areas with no crops. This way you can find them again the next time you sample.
Crops

Date

Plot number or id __________________________________________

Copy and fill out this table for five plots with crops.

<table>
<thead>
<tr>
<th>Crops</th>
<th>No. of plants or % cover¹ (indicate no or % cover.)</th>
<th>Average height of plants or average diameter of patch² (indicate ht or patch diameter in cm)</th>
<th>% of plants in flower</th>
<th>% of plants with fruits/ seeds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>□ No.</td>
<td>□ %cover</td>
<td>□ 0</td>
<td>□ 0</td>
</tr>
<tr>
<td></td>
<td>□ 1 - 5</td>
<td>□ 1 - 5</td>
<td>□ 1 - 5</td>
<td>□ 1 - 5</td>
</tr>
<tr>
<td></td>
<td>□ 6 - 25</td>
<td>□ 6 - 25</td>
<td>□ 6 - 25</td>
<td>□ 6 - 25</td>
</tr>
<tr>
<td></td>
<td>□ 26 - 50</td>
<td>□ 26 - 50</td>
<td>□ 26 - 50</td>
<td>□ 26 - 50</td>
</tr>
<tr>
<td></td>
<td>□ 51 - 100</td>
<td>□ 51 - 100</td>
<td>□ 51 - 100</td>
<td>□ 26 - 50</td>
</tr>
<tr>
<td></td>
<td>□ &gt; 100</td>
<td>□ &gt; 100</td>
<td>□ &gt; 100</td>
<td>□ &gt; 50</td>
</tr>
</tbody>
</table>

¹ Count the number of plants of any one species if there are fewer than 25 in the plot. For small plants where it may be difficult to count each individual, estimate the percentage of the ground in the plot that is covered by the plant.

² For low growing plants, measure the average diameter of patches in cm, rather than the average ht of plants in cm.
Weeds in Plots with Crops
Date
Plot number or id

Copy and fill out this table for 5 plots with crops.

<table>
<thead>
<tr>
<th>Weeds</th>
<th>No. of plants or % cover</th>
<th>Average height of plants or average diameter of patch</th>
<th>% of plants in flower</th>
<th>% of plants with fruits/ seeds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>□ No.</td>
<td>□ %cover</td>
<td>□ 0</td>
<td>□ 0</td>
</tr>
<tr>
<td></td>
<td>□ 1 - 5</td>
<td>□ 1 - 5</td>
<td>□ 1 - 5</td>
<td>□ 1 - 5</td>
</tr>
<tr>
<td></td>
<td>□ 6 - 25</td>
<td>□ 6 - 25</td>
<td>□ 6 - 25</td>
<td>□ 6 - 25</td>
</tr>
<tr>
<td></td>
<td>□ 26 - 50</td>
<td>□ 26 - 50</td>
<td>□ 26 - 50</td>
<td>□ 26 - 50</td>
</tr>
<tr>
<td></td>
<td>□ 51 - 100</td>
<td>□ 51 - 100</td>
<td>□ 51 - 100</td>
<td>□ 51 - 100</td>
</tr>
<tr>
<td></td>
<td>□ &gt; 100</td>
<td>□ &gt; 100</td>
<td>□ &gt; 100</td>
<td>□ &gt; 100</td>
</tr>
</tbody>
</table>

1 Count the number of plants of any one species if there are fewer than 25 in the plot. For small plants where it may be difficult to count each individual, estimate the percentage of the ground in the plot that is covered by the plant.

2 For low growing plants, measure the average diameter of patches in cm, rather than the average ht of plants in cm.
# Weeds in Area of Garden with No Crops

## Date

## Area id

Copy and fill out this table for two areas with no crops.

<table>
<thead>
<tr>
<th>Weeds</th>
<th>No. of plants or % cover(^1) (indicate no or % cover.)</th>
<th>Average height of plants or average diameter of patch(^2) (indicate ht or patch diameter in cm)</th>
<th>% of plants in flower</th>
<th>% of plants with fruits/seeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of Weed</td>
<td>□ No. □ 1 - 5 □ 6 - 25 □ 26 - 50 □ 51 - 100 □ &gt; 100</td>
<td>□ No. □ 1 - 5 □ 6 - 25 □ 26 - 50 □ 51 - 100 □ &gt; 100</td>
<td>□ 0 □ 1 - 5 □ 6 - 25 □ 26 - 50 □ &gt; 50</td>
<td>□ 0 □ 1 - 5 □ 6 - 25 □ 26 - 50 □ &gt; 50</td>
</tr>
</tbody>
</table>

1. Count the number of plants of any one species if there are fewer than 25 in the plot. For small plants where it may be difficult to count each individual, estimate the percentage of the ground in the plot that is covered by the plant.

2. For low growing plants, measure the average diameter of patches in cm, rather than the average ht of plants in cm.

Please return form as attached file to ad97@cornell.edu or hard copy to:

Toni DiTommaso, Department of Crop and Soil Sciences
903 Bradfield Hall, Cornell University, Ithaca, NY 14853
Science Pages

Overview
While interviewing elders, or just plain wandering around in a garden, you may encounter unfamiliar plants and growing practices. You can use the online or print versions of Science Pages for teaching purposes or simply to learn more for yourself. For example, you can use the Science Pages during “teachable moments” in the garden, or before or after the Instructional Science investigations, to help youth understand the concepts related to what they see in the garden. Alternatively, you can use the Science Pages to reinforce important topics in classroom teaching or environmental education programs. For gardeners, you could laminate the pages and post them in a garden, or use the pages in a workshop. Or use the Science Pages to satisfy your own curiosity about something you find in the garden.

English and Spanish versions of the Science Pages are available in color and downloadable black and white format on the website. This chapter includes black and white English versions of all Science Pages available at the time of printing this manual. Check the Garden Mosaics website for new pages and information, including how to obtain color print Science Pages, and translations into additional languages.

--

20 The Science Pages were written and produced by Sharen Kahkonen and Gillian Dorfman of Green Ink.
List of Science Pages Topics and Titles

Conducting Research
- Conducting an Experiment

Gardening
- Composting
- History of Community Gardening
- Interplanting for Pest Control
- Mulch
- Raised Beds
- Water in the Garden
- Watering Garden Plants

Insects & other Organisms
- Controlling Insect Pests
- Earthworms
- Insects in the Garden

Land Use
- Aerial Photographs
- Topographic Maps

Plants
- Alache
- Alfalfa
- Buckwheat
- Chinese Cabbage and Bok Choy
- Cilantro and Coriander
- Collards
- Cucurbits
- Epazote
- Papalo
- Peppers
- Rue
- Snap Beans
- Tomatoes

Soils
- Soil Life
- Soil pH
- Soil Testing
- Soil Texture
- What's In Soil?

Weeds
- Weeds
- Common Purslane
- Field Bindweed
- Lambsquarters
- Redroot Pigweed
- Yellow Nutsedge
CONDUCTING AN EXPERIMENT Science Page

MAKE AN OBSERVATION
I spilled a packet of seeds on the ground. They all sprouted, even though I didn’t cover them up. I wonder if some seeds sprout better in light than in darkness?

DO BACKGROUND RESEARCH
This article says that some seeds do germinate better in light, and other seeds germinate better in darkness.

ASK QUESTIONS
I wonder if these tomato seeds will germinate better in light or in darkness?

FORM A HYPOTHESIS
I hypothesize that these seeds will germinate better in light.

DESIGN AND CONDUCT AN EXPERIMENT TO TEST YOUR HYPOTHESIS
Replicate treatments
Control variables (A variable is any factor in the experiment that could affect the result.)
In my experiment all variables need to be constant, except for the one I’m testing. So other than keeping them in darkness or light, I’ll treat both groups of seeds exactly the same.

TRY AGAIN
All the seeds in this group dried up. I’ll have to try again, but this time I’ll make sure all the seeds in both groups stay moist.

COLLECT AND ANALYZE DATA
I need to count and record how many seeds in each group sprout.

Does your experiment work?

No

Yes

DRAW CONCLUSIONS
25 out of 30 seeds germinated in the light. Only 10 out of 30 germinated in the dark. My experiment supports my hypothesis.

I wonder if my hypothesis is true for seeds of other kinds of plants. I can do another experiment to find out!

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
CROSSWORD PUZZLE

Across
2. and 4. What you must do to find out what others have already discovered. (2 words)
6. What you should record during an experiment.
7. What you need to control in an experiment.

Down
1. What you do when you look carefully at something.
3. What you should do to each treatment group to make sure results are due to treatments.
5. A prediction.

TRY THIS

SEED GERMINATION IN LIGHT AND DARKNESS
In this activity, you will form a hypothesis, and design and conduct an experiment to test your hypothesis.
What you need
* plastic sandwich bags
* seeds to germinate, such as tomato, corn, bean, or cucumber seeds
* paper towels
* water
* aluminum foil
* paper and pencil

What to do
1. Choose one type of seed to test for germination. Based on what you have read and observed, form a hypothesis about whether the seeds will germinate better in light or in darkness. Write down your hypothesis.

2. Design an experiment to test your hypothesis. Decide how many seeds you will include in each treatment (light versus dark), how often you will check your seeds, how you will control variables, and how you will record your data.
3. Set up your experiment and observe your seeds for a week or more, depending on the type of seed you choose. Carefully make observations (count the number of seeds that germinate in each treatment group), and record your observations.
4. If something goes wrong in your experiment, then figure out a better way to do it, and try again.
5. Once you are satisfied that you have designed your experiment well (that is, you have included replicates and controls), and you have collected your data, then you can analyze your results. Figure out a way to present your results to others. For example, you may want to draw a graph or a picture, and you may want to summarize your results in writing.

SPOTLIGHT ON RESEARCH
An experiment that went “wrong”
During World War II there was a shortage of rubber in the U.S., so the government asked big companies to have their engineers and scientists try to develop a synthetic rubber. A scientist at General Electric by the name of James Wright was working on this problem. He accidentally spilled boric acid into silicon oil, and discovered a substance with very unusual properties. It could not be used as a rubber substitute, but it bounced higher than a rubber ball. It broke when given a sharp blow. It stretched, yet snapped. When pressed on comics in the newspaper, the ink transferred to it, and the comics could then be stretched out. Samples of this new material were sent to 12,000 engineers around the world. They could find no practical use for it, but they loved playing with it! A marketing expert by the name of Peter Hodgson bought the production rights for the substance for $147.00. He packaged it in plastic eggs, and it became wildly popular as Silly Putty!

“...” QUOTE
"The important thing is not to stop questioning. Curiosity has its own reason for existing.”
Albert Einstein

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
WHAT IS COMPOSTING?
Composting is the controlled decay of plant and animal matter to produce compost—a dark, rich soil-like material. Compost can be added to soil to improve its structure and nutrient content.

In nature, bacteria, fungi, worms, and other soil organisms help to break down dead plants and animals, as well as animal wastes. The decomposed organic material becomes part of the soil. This natural decay process usually takes place very slowly.

Leaves that fall to the forest floor slowly decay to form part of the organic matter in soil.

Composters create ideal growing conditions for compost organisms. This speeds up the natural decay process.

WHAT COMPOST ORGANISMS NEED
1. A balanced diet of compost materials
   "Browns" are compost materials that are brown and dry. "Browns" are high in carbon, which is energy food for microbes.
   "Greens" are compost materials that are green and moist. "Greens" are high in nitrogen, which microbes need to make proteins.
   If I add about 3 parts browns to 1 part greens, then the compost organisms will have a balanced diet.

2. Just the right amount of air and water
   If there's the right amount of oxygen and moisture, microbes can rapidly grow and multiply. Too much—or too little—water, and microbes will die.
   Compost materials should have a thin film of water around them, and lots of pore spaces filled with air.

3. The right temperature
   Organic materials will eventually decay, even in a cold compost pile. But the decay process is speeded up in a hot compost pile. When bacteria and fungi grow rapidly, they burn a lot of food, and give off a lot of heat. If the compost pile is big enough, the heat will build up inside the pile. Bacteria that grow well at high temperatures take over and speed up the decay process.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.

CROSSWORD PUZZLE

Across
2. Compost materials that are high in carbon.
4. Dark, rich, soil-like material.
6. A compost pile should be big enough so builds up inside it.
7. A balanced diet for microbes is about ______ parts browns to one part greens.

Down
1. Microbes that help break down plant and animal matter.
3. Compost organisms need just the right amount of ______.
5. Compost materials that microbes use to make proteins.
6. A compost pile should be big enough so builds up inside it.

TRY THIS
BUILD A COMPOST PILE

What you need
* 3-meter length of wire mesh fencing
* wire cutters
* twist ties
* compost materials
* duct tape

What to do
1. Choose a site to set up your compost bin. Try to find a shady, well-drained, level place that is convenient.
2. Snip off the fencing close to the cross wires and cover the sharp ends with duct tape to avoid getting scratched. Lap the ends of the fencing together and tie together with twist ties to make a cylinder one meter high and one meter in diameter.
3. Put a layer of twigs in the bottom of the bin to help air to reach the center of the pile.
4. As you collect compost materials, layer them in the compost pile, as shown in the picture.
5. Stir or turn the compost every week or so to let in more air. To reach the compost, undo the twist-ties and open the fencing.
6. The length of time it takes for compost to be ready depends on many factors, such as weather conditions, the type of materials included, and the amount of turning. If you want your compost to be finished faster, keep it moist and turn it a couple of times a week. Finished compost is about one-third or less of its original size, dark brown, and has a nice, earthy odor.

SPOTLIGHT ON RESEARCH

Compost Can Help Control Plant Diseases
Recent research has shown that compost not only improves soil. It can also help to control plant diseases caused by fungi. Fungi that attack plants include molds, rusts, mildews, and smuts. They over-winter in the soil and in plant debris. When the weather is warm, they produce spores, which can be splashed or blown onto wet leaves. Then the spores can germinate and can infect plants.

Scientists are testing different composts to find out what types are most effective at suppressing harmful fungi. In one study, a team of scientists tested different composts to see which one would be best for controlling fruit rot in pumpkins. Fruit rot is a serious problem that affects pumpkins, melon, squash, peppers, tomatoes, and eggplants. In greenhouse trials, scientists first screened composts made from several different materials. One product, made from brewery wastes, stood out as very effective. In the following year, the brewery waste compost was applied to two fields where fruit rot had been a big problem in the past. In one field, no disease occurred, and the growth and yield of pumpkins improved a great deal compared to untreated fields. In the other field, the brewery waste compost was not effective in suppressing fruit rot. Scientists think that perhaps there was just too much of the fruit rot fungi present. If brewery compost were added to this field for several more years, then the disease might be suppressed. Time will tell.

Answer: Because he wanted his soil to be rich!

TRY THIS

RIDDLE

Why did the gardener bury money in his compost pile?

Answer: Because he wanted his soil to be rich!
HISTORY OF COMMUNITY GARDENS IN THE U.S.

From the late 1800’s through the 1940’s, the main purpose of community gardens in the U.S. was to grow food.

LATE 1800’s
POTATO PATCH MOVEMENT
Cities were growing rapidly. Many people were out of work. Across the country, cities began offering garden plots to poor people so they could grow their own food.

EARLY 1900’s
LIBERTY GARDENS
The U.S. government recruited people to grow Liberty Gardens during World War I. Growing your own food was a way that every American could contribute to the war effort.

1930’s
RELIEF GARDENS
The Great Depression began. Relief Gardens were promoted to improve people’s spirits, and to provide food and work.

1940’s
VICTORY GARDENS
When the U.S. entered World War II, the government launched a Victory Garden campaign. By 1944, 20 million Victory Gardens produced 44% of the fresh vegetables in the U.S.!

From the late 1960’s to the present day, community gardens have served many different purposes.

IMPROVING NEIGHBORHOODS
People in cities turn vacant lots into beautiful gardens. Gardens provide a quiet place to sit in the shade, or to meet and talk with friends. Children play in gardens and older people get exercise while gardening.

EXPRESSING CULTURAL TRADITIONS
Many immigrants and Americans from all ethnic backgrounds bring plants and cultural traditions to the gardens, creating multi-cultural garden mosaics.

GROWING FOOD
Many people grow their own food because they like the taste of fresh vegetables. Others are concerned about rising food prices or about chemicals in foods. Some simply want to teach their children where their food comes from.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
COMMUNITY GARDEN TIMELINE

Write the letter of each of the following in the correct place on the timeline.

A. Liberty Gardens
B. Potato Patch Movement
C. Beginning of modern day community garden movement
D. Relief Gardens
E. Victory Gardens

TRY THIS

MAKING A COMMUNITY GARDEN TIMELINE

You can make a timeline of major events in U.S. history during the last century. You can add information about community gardening to your timeline to show how historical events have influenced community gardening.

What you need

* sheet of butcher paper
* scissors
* ruler or meter stick
* pencils
* glue

What to do

1. Do research in the library or on the Internet to find out about specific dates and events in U.S. history during the last century. List the events in order from earliest to latest.
2. Collect interesting pictures to add to your timeline. Copy pictures from books, or do an image search on the Google search engine to find interesting drawings or photos of important historical events. Also look for photos or drawings related to community gardening throughout the century. For example, do a Google image search for "World War II" and another image search for "Victory Garden." Write captions for the pictures you find.
3. Draw the timeline down the center of a sheet of butcher paper. You need to decide how long to make the timeline, and how to divide it up into segments. These decisions may be a matter of trial and error, based on the size of your paper and the amount of information you want to include. For example, you may wish to draw the timeline from 1900 to 2000, and let every 5 centimeters equal one year. Then you would need a sheet of butcher paper 5 meters long. Measure and mark off the time segments, for example, every 5 years, on your timeline, left to right.
4. Mark exact dates of historical events above the timeline. Then glue any information and pictures that you have collected about these historical events above the timeline. Mark dates of community gardening events below the timeline. Glue information and pictures you have collected about gardening below the timeline.
5. Display the timeline on a wall. Study the pictures and information carefully. Does the timeline give you a better understanding of how events in history have affected community gardening?

SPOTLIGHT ON RESEARCH

Why people garden

A researcher at the University of California at Berkeley conducted a survey of community gardeners in San Jose to find out why people garden. A total of 485 surveys were mailed to gardeners in 8 community gardens, and 146 surveys were returned. Of those people who responded, most thought of gardening as a hobby. Recent immigrants said they also garden because they want to beautify the neighborhood and because they want to grow vegetables that are hard to get. Among other reasons given, Mexicans said they garden to connect with their homeland, Europeans to relieve stress, and Laotians to save money.


RIDDLE

What do you call a country where everyone drives a pink car?

Answer: a pink carnation
**INTERPLANTING FOR PEST CONTROL**

Interplanting is growing one kind of plant alongside a different kind of plant. Some plants attract helpful insects. Other plants confuse or repel insect pests. When these plants are interplanted, they can help protect your crops from insect pests.

### INTERPLANT TO ATTRACT AND SHELTER HELPFUL INSECTS

Most insects that eat insect pests also eat nectar and pollen from flowers. They have short mouth parts for chewing, rather than long tubes for sipping, so they need flowers with easy-to-reach nectar and pollen.

Flowers in the Aster family, such as marigolds and sunflowers, have wide, open flowers, so they are an excellent choice for attracting helpful insects.

Herbs like parsley, dill, and coriander have flat-topped clusters of small flowers. They also have strong fragrances that attract beneficial insects.

### HOW TO CONFUSE OR REPEL INSECT PESTS

Many insect pests attack only certain kinds of crops. They spread more quickly if a large area is planted with only the kind of crop they eat. If you interplant crops, it’s not as easy for insect pests to spread and cause damage.

Many gardeners interplant with herbs and flowers that have strong scents, which may confuse or repel insect pests looking for crops to feed on. Here are some combinations that many gardeners use.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
CROSSWORD PUZZLE

Across
1. Flowers of dill and parsley attract these insects, which feed on insect pests.
5. Try planting these among squash.
7. Flowers in this family attract helpful insects.
8. Plant these to confuse or repel insect pests and attract helpful insects.

Down
2. Do this instead of planting a large area with only one kind of plant.
3. Try growing these plants among tomatoes.
4. Try planting these among eggplants.
6. Helpful insects often eat ______ from flowers.

TRY THIS
CHECK ON INTERPLANTING FOR INSECT CONTROL IN THE GARDEN

What you need
* Paper and pencil
* Magnifying lens, if available
* Insect field guide, if available

What to do
1. Go to a garden to look for examples of interplanting for pest control. For example, try to find these flowers and herbs interplanted among crops: marigolds, zinnias, tansy, or other flowers in the Aster family; strong smelling herbs such as basil or dill; nasturtiums; and chives and garlic.
2. Look for insects around the interplanted flowers or herbs. Spend at least 5 to 10 minutes observing insects that you find. Use a magnifying lens to observe them more closely. Do they have mouth parts for sucking or chewing? Are they feeding on the nectar and pollen of the interplanted flowers and herbs? Draw pictures of the insects.
3. Try to identify the insects that you see. If possible, look them up in an insect field guide. Find out if they eat any insect pests.
4. Share your observations with other youth and adults.

SPOTLIGHT ON RESEARCH

How do you know what crops to combine when interplanting?

Researchers at Cornell University in Ithaca, New York, tested a method for selecting vegetables suitable for interplanting. They listed all the vegetables commonly grown in New York State, and then listed all the pests common to each vegetable. They reasoned that interplanting vegetables that have different insect pests would make it harder for insect pests to find their food. They also thought that plots planted with a variety of vegetables would attract a greater variety of beneficial insects.

They planted five different kinds of plots:
A. Only squash;
B. Plants with different ways of growing and different pests (beets, broccoli, sweet corn, squash);
C. Plants with different ways of growing but with similar pests (sunflowers, cucumbers and squash);
D. Plants with similar ways of growing but different pests (eggplant, snap beans, squash);
E. Plants with similar ways of growing and similar pests (peppers, watermelon, squash, cucumbers).

The scientists sampled the insects by vacuuming each plot for one minute. They repeated this on five different days during the summer. Then they calculated the average number of beneficial and pest insects for each plot.

So far, their results show that interplanting of any vegetables increases the variety of beneficial insects. They will continue their research to test their hypothesis that combining crops having different pests and different growth habits will attract greater numbers and a greater variety of beneficial insects.


RIDDLE

What is the difference between a fly and a lacewing?

A lacewing can fly, but a fly can’t lace wing.

www.gardenmosaics.org

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
Mulch is a covering that is placed on top of bare soil. Some materials that are used for mulching include:

- Hay, straw, or wood chips
- Compost
- Black plastic
- Yard wastes, such as grass clippings and leaves

**WHAT ARE THE BENEFITS OF MULCHING?**

* Mulch protects the soil.
  When it rains on bare soil, water washes away taking a lot of soil with it. The soil also gets compacted and crusty when hit by hard rains. Then neither air nor water can enter the soil and get down to the roots of plants. Rainwater trickles through a mulch, and slowly seeps into the soil rather than washing away. The soil stays loose, and the soil surface does not get crusty. Mulch keeps muddy rainwater from splashing crops, so they are cleaner and less likely to get diseases.

* Mulch prevents loss of water from the soil surface.
  Under a hot sun, bare soil gets very warm. A lot of water evaporates from the soil surface. That means a lot more watering is needed. Mulch shades the soil, keeping it cooler. Less water evaporates from the soil surface.

* Mulch prevents weeds from growing.
  Weeds can sprout and grow on bare soil. That means a lot of weeding is needed. Mulch shades out weeds, which compete with crops for nutrients, water, and light. The few weeds that grow are easy to pull out.

* Mulch improves the soil.
  Over time, organic mulch materials decay, adding nutrients and humus to the soil.
CROSSWORD PUZZLE

Across:
3. Yard wastes, such as ______, can be used as a mulch.
5. When it rains on bare soil, the soil gets ______.
6. Mulch keeps crops ______.
8. Mulched soil stays ______.
9. Mulch adds nutrients and_______ to soil.

Down:
1. Mulch prevents loss of ______ from the soil surface.
2. Mulch prevents ______ from growing.
7. A covering that is placed on top of soil.

TRY THIS

COMPARE MULCHED AND UNMULCHED SOIL

What you need:
* two flower pots
* garden soil that is not high in organic matter
* mulch, such as grass clippings, straw, or compost
* water and watering can

What to do:
1. Fill the two flower pots with soil.
2. Put mulch on one and not on the other.
3. Use the watering can to water both containers thoroughly. Hold the watering can at least a meter above the pots as you water.
4. Place both flower pots out in the sun.
5. Let the pots sit for a day or so, and then remove the mulch from the one pot.
6. Look at the soil in the two pots. Has a crust formed on the soil surface in either of the pots? Which soil is more moist? Discuss the differences that you observe.

SPOTLIGHT ON RESEARCH

In search of an effective mulch

Many vegetable growers in the northeastern U.S. use black plastic as a mulch. The use of black plastic increases their yields and speeds up the growth of their crops. How does black plastic mulch help crops grow? It suppresses weed growth, improves the soil, prevents water loss from the soil surface, and keeps crops clean. However, black plastic has one big disadvantage--it is very difficult to take up and dispose of at the end of each growing season. Scientists are looking for a good substitute that has all the advantages of black plastic, but that would not have to be removed after each season. In other words, they are looking for a mulching material that does not decay too quickly, but that could be tilled into the soil, where it would eventually decay.

For several years they have been testing various paper mulches. The first ones they tried decayed too quickly, but each year the quality has improved. The latest version is a paper coated with a substance made from cornstarch. The coating on the top side has carbon added to make it black, and the underside is clear. When this paper mulch was used to grow melons on raised beds, the yields were similar to those with black plastic mulch. The paper mulch shows promise for melons and other crops, but it is not available commercially because the cost of the coating is very high. Scientists will continue to develop and evaluate new mulches.


RIDDLE

What did the soil say to the black plastic?

Answer: I love you so much!
WHAT IS A RAISED BED?
A raised bed is a mound of soil in which gardeners plant their crops and flowers. Many raised beds are framed or enclosed. Frames help keep the soil in place during rainstorms and watering.

WHAT ARE THE BENEFITS OF A RAISED BED?
* Once the soil is prepared, you don’t have to walk on it again during the growing season.
  - Make sure the beds are no more than two arm lengths wide, so that you can reach everywhere within the bed without stepping in it.
* If you have contaminated or poor soil, it’s easier to bring in good soil to create a raised bed than to amend the soil in the whole area. In soggy areas, the soil in raised beds will drain more quickly.
  - Raised beds are ideal for gardening on rubble-filled city lots.
* The soil in raised beds warms up earlier in the spring and stays warm longer in the fall. This extends the growing season.
* It’s easier to tend the garden when it is raised above ground level, because you don’t have to do as much bending.
  - Gardening in raised beds that are 30 cm high is easier for disabled and elderly gardeners.

HOW DO YOU BUILD A RAISED BED?
1. Making a raised bed on a city lot
   - Use string to mark off where the bed will be. Use a pickaxe to loosen up hard, compacted soil and rubble in the bed. This will help the bed drain, and will allow roots to grow deeper.
   - Have good topsoil delivered to the site. Work some of the topsoil into the existing soil to a 15 cm depth. Build the frame around the bed, and fill it with soil.

2. Making a raised bed using existing soil
   - Rake the soil from the walkways to the top of the bed. Make the soil mound about 15 cm high. To make the bed more permanent, build an edge with wood planks, or another material that will keep the soil in place.

3. Making a raised bed frame
   - You can build the sides of a raised bed out of cinder blocks, stones, or landscape timbers. Do not use treated lumber or railroad ties. They contain poisons that you do not want in your garden soil. Hold the planks in place with stakes or steel rods or pipes. You can also use wood screws to fasten the corners together. Do not use nails, as they might split the wood.

4. Preparing soil
   - Mix lots of compost or other organic matter into the soil in your raised bed. Flatten the top with a rake before planting.
   - You can plant crops closer together than in a regular garden. You do not need space between rows of plants, because you walk outside the beds.

---

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
CROSSWORD PUZZLE

Across
4. With raised beds, you can _______ earlier and harvest later.
5. Mounds of prepared soil.
7. Make _______ between raised beds.
8. Elderly gardeners like raised beds because they do not have to _______ to garden.

Down
1. Work lots of this into raised beds.
2. With raised beds, you can work in the garden without getting your feet _______.
3. Use a _______ to flatten the top of a raised bed.
4. To make beds permanent, edge with _______, bricks, or concrete blocks.
6. In wet areas, raised beds _______ more quickly.

TRY THIS
LOOK AND LEARN ABOUT RAISED BEDS IN YOUR COMMUNITY GARDEN
1. Watch people working in the raised beds. List some of the pros and cons that you think this system of gardening might have for gardeners.
2. Are the raised beds surrounded by an edge? If so, what material is being used for the edge? What are the advantages or disadvantages of this material? Can you think of a different material that might be better for the edge?
3. With permission from gardeners, observe the condition of the soil in the raised beds. Is the soil better than the soil that is not in raised beds? Does the soil in the raised beds have more organic matter? (Is it darker in color?) Are there more earthworms and other soil organisms? Does the soil have a better texture, pH, and drainage? (You can find directions for doing soil tests in the Water in Soils, Soil pH, and Soil Texture Science Pages.)
4. Look at the plants growing in the raised beds. Does the raised bed system seem to be meeting the needs of the plants? Would it be possible to grow the same plants at that location without raised beds?
5. Summarize your findings in a report to your group. Answer the question: How useful are raised beds in community gardens?

SPOTLIGHT ON RESEARCH
Ancient raised bed methods still work wonders!
Before the arrival of the Europeans in 1492, ancient raised fields covered 1,000 square kilometers of Latin America. The raised fields were about 3 meters wide, and lay between canals. The canals had a number of useful purposes. The water in the canals could be used for watering the raised fields during dry periods. The water also kept the temperatures around the fields higher during cold weather, and so kept the crops from freezing. And the canals produced organic muck that could be used to fertilize the raised fields. It is believed that the canals even may have been used to raise fish and useful water plants.

Scientists wondered if these ancient farming techniques might be useful for farmers today. To find out, they began the Raised Field Agriculture Project. The project took place in the Lake Titicaca Basin in Peru and northern Bolivia. This is a very difficult area for farming. It is located 3,810 meters above sea level in the Andes Mountains. The soil is very poor, and there are frequent frosts, hail storms, floods, and droughts. Despite these limitations, the area supported dense human populations for thousands of years before the Europeans arrived. Scientists on the research team included archeologists, soil scientists, and horticulturists. Archeologists researched how the ancient raised fields and canals were built. Soil scientists investigated how the soil in the raised fields could be improved. Horticulturists and local farmers rebuilt the raised fields and planted potatoes. The results were astonishing. The raised fields yielded two to three times more potatoes than other farms in the area!


RIDDLE
Why didn’t the vegetables have to get up in the morning?

Because they were already in a raised bed!

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
WATER IN THE GARDEN

WATER CYCLE IN THE GARDEN

Water falls on the soil when it rains, or when the garden is watered. What happens to this water?

Some water flows away over the top of the soil. This is called runoff.

Some water seeps into the soil, filling spaces between soil particles. Water seeps through sandy soils much faster than through clay soils or compacted soils.

Water soaks into the soil down to the roots of plants. Water taken up by roots moves through the stems to the leaves.

Water may seep through the soil beyond the root zone.

Some water evaporates directly from the soil surface, especially in hot, dry climates. This causes water from lower layers in the soil to be pulled to the surface. As water is pulled up through the soil, it may carry dissolved salts. When the water evaporates, salt deposits are sometimes left on the surface of the soil.

WATER EVAPORATES leaVing salt deposits

The water in clouds eventually forms clouds.

Leaves have thousands of tiny openings through which water vapor comes out of the plant into the air. This process is called transpiration.

Water rises by capillary action

GROUNDWATER water rises by capillary action

Some water evaporated or transpired eventually forms clouds.

Groundwater water rises by capillary action

TOO MUCH OR TOO LITTLE WATER

Plants need both water and air in the soil. Ideally, half the volume of soil should be pore spaces. About half of each pore space should be filled with water, and about half with air. When soil does not have the right balance of air and water, plants may suffer from stress.

Plants are most affected by water stress right after they are planted or transplanted, and while fruits are forming. Root crops, such as beets and carrots, are vulnerable to water stress while the roots are growing.

Neither air nor water can enter compacted soil.

If soil does not get enough water, the roots cannot take up water to replace what is lost through transpiration.

Watering the soil too much will fill all the pore spaces with water. Without air, plant roots suffocate and die.

These tomatoes have blossom end rot because they did not get enough water when they were forming fruits.

Our garden did not get enough water, so this carrot has a hard core. The lettuce is bitter, and the cucumbers are small and misshapen.

Plants need both water and air in the soil. Ideally, half the volume of soil should be pore spaces. About half of each pore space should be filled with water, and about half with air. When soil does not have the right balance of air and water, plants may suffer from stress.

Watering the soil too much will fill all the pore spaces with water. Without air, plant roots suffocate and die.

These tomatoes have blossom end rot because they did not get enough water when they were forming fruits.

Our garden did not get enough water, so this carrot has a hard core. The lettuce is bitter, and the cucumbers are small and misshapen.

Plants need both water and air in the soil. Ideally, half the volume of soil should be pore spaces. About half of each pore space should be filled with water, and about half with air. When soil does not have the right balance of air and water, plants may suffer from stress.

Watering the soil too much will fill all the pore spaces with water. Without air, plant roots suffocate and die.

These tomatoes have blossom end rot because they did not get enough water when they were forming fruits.

Our garden did not get enough water, so this carrot has a hard core. The lettuce is bitter, and the cucumbers are small and misshapen.
What to do

1. Use the can opener to cut the bottoms and tops off 3 of the cans. Mark each can 9 cm from one end.

2. Go to a garden and pick out three sites where you think the water will soak in at different rates.

3. On each of the sites you have selected, set a can on the ground, so that the 9-cm level is near the ground. Place the block over the can and tap with the hammer so the can is pushed into the ground to a depth of 9 cm, and the 9-cm mark is level with the ground (see picture).

4. Make a chart similar to the one shown in the next column.

5. For each site, fill the fourth can with a liter of water, and pour the water into the can in the ground. Record the time when the water was added.

6. Observe the water level every minute for the first 10 minutes, and every 10 minutes or every hour after that, depending on the rate of water flow. Record the time when the water has completely soaked into the ground.

7. Figure out the time it took for water to soak into the ground at each site. Where does water soak into the ground the slowest? The fastest? Can you explain your results?

TRY THIS

PERC TEST

What you need

* 4 1-gallon metal cans
* can opener
* ruler
* wood block
* watch with second hand
* pencil and paper
* hammer

What to do

1. Use the can opener to cut the bottoms and tops off 3 of the cans. Mark each can 9 cm from one end.

2. Go to a garden and pick out three sites where you think the water will soak in at different rates.

3. On each of the sites you have selected, set a can on the ground, so that the 9-cm level is near the ground. Place the block over the can and tap with the hammer so the can is pushed into the ground to a depth of 9 cm, and the 9-cm mark is level with the ground (see picture).

4. Make a chart similar to the one shown in the next column.

5. For each site, fill the fourth can with a liter of water, and pour the water into the can in the ground. Record the time when the water was added.

6. Observe the water level every minute for the first 10 minutes, and every 10 minutes or every hour after that, depending on the rate of water flow. Record the time when the water has completely soaked into the ground.

7. Figure out the time it took for water to soak into the ground at each site. Where does water soak into the ground the slowest? The fastest? Can you explain your results?
TO WATER OR NOT TO WATER?
In most areas, rain alone does not meet all the water needs of garden plants. You need to water the garden.

The soil in raised beds dries out faster, so we have to water more often.
At least these beds drain well. If the soil were compacted, the water would not drain and the plant roots would drown.

You need to add enough water so that it seeps all the way down to the depth of the plant roots. It’s time to water.

WATERING METHODS
1. A watering can and hose are useful for small gardens.

I’m using a gentle rain nozzle so the water can slowly soak into the soil.

Direct the water to the base of the plant, not on the leaves.

2. Sprinklers are cheap and convenient, but they waste a lot of water to evaporation, especially on hot, windy days.

I’ll move the sprinkler around to other spots so all the garden gets enough water.

3. A drip or trickle irrigation system applies water directly to the area in the soil where roots are growing.

Many farmers in hot, dry places use drip or trickle irrigation.

Little water is lost to evaporation or run-off when you use the drip or soaker hose methods because the water goes into the ground near the plant.

4. A soaker hose is a plastic or canvas hose with holes all along its length. It is placed along one side of plants or underneath mulch. Water seeps out slowly.

The gentle stream of water causes little or no compaction of the soil.

SAVING WATER IN THE GARDEN
Make the most of available water in the garden.

Collect rain water from roof-tops in rain barrels. Keep the rain barrel covered to prevent mosquitoes from breeding.

Add organic matter to the soil. It holds the water, which then can be used by plants.

Water during early morning. At this time temperatures are cooler and it is less windy, so there is less evaporation.

Cover the soil with mulch, which smothers weeds and allows water to seep slowly into the soil. A mulch cover also reduces evaporation of water from the soil.

In most areas, rain alone does not meet all the water needs of garden plants. You need to water the garden.

The soil in raised beds dries out faster, so we have to water more often. At least these beds drain well. If the soil were compacted, the water would not drain and the plant roots would drown.

You need to add enough water so that it seeps all the way down to the depth of the plant roots. It’s time to water.

WATERING METHODS
1. A watering can and hose are useful for small gardens.

I’m using a gentle rain nozzle so the water can slowly soak into the soil.

Direct the water to the base of the plant, not on the leaves.

2. Sprinklers are cheap and convenient, but they waste a lot of water to evaporation, especially on hot, windy days.

I’ll move the sprinkler around to other spots so all the garden gets enough water.

3. A drip or trickle irrigation system applies water directly to the area in the soil where roots are growing.

Many farmers in hot, dry places use drip or trickle irrigation.

Little water is lost to evaporation or run-off when you use the drip or soaker hose methods because the water goes into the ground near the plant.

4. A soaker hose is a plastic or canvas hose with holes all along its length. It is placed along one side of plants or underneath mulch. Water seeps out slowly.

The gentle stream of water causes little or no compaction of the soil.

SAVING WATER IN THE GARDEN
Make the most of available water in the garden.

Collect rain water from roof-tops in rain barrels. Keep the rain barrel covered to prevent mosquitoes from breeding.

Add organic matter to the soil. It holds the water, which then can be used by plants.

Water during early morning. At this time temperatures are cooler and it is less windy, so there is less evaporation.

Cover the soil with mulch, which smothers weeds and allows water to seep slowly into the soil. A mulch cover also reduces evaporation of water from the soil.
CROSSWORD PUZZLE
Across
1. Water in the ______ when it is cooler.
4. This type of irrigation system applies water directly to the roots of plants.
7. Watering with a gentle stream of water causes little ______.
9. Farmers in hot, dry countries use this method of watering.
11. A hose with holes all along its length is called a ______ hose.

Down
2. Add ______ matter to soil so that the soil will hold more water.
3. They waste a lot of water to evaporation.
5. Use a gentle ______ nozzle for watering plants.
6. Gardeners can collect rain in rain ______.
8. ______ will help reduce evaporation from the soil surface.
10. When watering add enough water so it seeps all the way down to the ______.

TRY THIS
DRIP IRRIGATION FOR GARDEN PLANTS
What you need
* plastic one-gallon milk jugs
* candle
* clothespin with spring
* pin

What to do
1. Light the candle. Use the clothespin to hold the pin. Place the sharp end of the pin in the candle flame until it is hot. Use the hot pin to melt about 8 to 10 small holes in the bottom of the milk jug. CAUTION: Do this only under the supervision of an adult.
2. Put some water in the jug to make sure the water will slowly drip out of it.
3. Bury the milk jug between widely spaced plants in the garden, such as tomatoes, peppers, eggplants, or squash. The bottom 15 cm of the jug should be buried (see picture).
4. Fill the jug with water every few days during dry spells.
5. Observe how well the plants near the jug grow, compared to plants without drip irrigation.

SPOTLIGHT ON RESEARCH
Dream up a watering invention
Can you think of a creative irrigation idea for gardeners and small farmers? Each year the World Bank and the United Nations sponsor a contest to promote irrigation systems for small farmers and gardeners. The irrigation systems must be affordable, creative, easy to operate, and useful in many areas around the world.

One of the contest winners was a “Dream Kit” for drip irrigation, designed by Stephen Ngigi at the University of Nairobi in Kenya. The Dream Kit consists of a bucket mounted on a wooden stand above the ground. The bucket is connected to pipes with tiny holes in them, through which water drips out along a row of crops. In dry areas, the bucket is filled twice a day. Thanks to the Dream Kit, small farmers in Kenya have been able to grow much needed vegetables to sell and to eat. The kit can easily be put together and repaired by farmers, and costs only U.S. $15.00. Within three months, farmers can make four times this much by selling crops that would otherwise be difficult to grow. The Dream Kit truly deserves its name!


RIDDLE
Where do vegetables go to have a drink?

Answer: A salad bar!
CONTROLLING INSECT PESTS Science Page

You can control insect pests using physical, cultural, biological, and chemical methods.

**Physical control** includes methods such as removing insect pests by hand and using physical barriers or traps to keep insect pests away from plants.

These butterfly larvae are eating all the leaves! I'm picking them off the plants and putting them in a bucket of soapy water.

**Cultural control** includes carefully choosing what, how, when, and where you plant in order to avoid insect attack.

Last year insect pests destroyed my squash plants. This year insects have not been a problem because of the control methods I've used.

What did you do?

I prepared my soil well, so my plants stayed healthier and were better able to resist insect attack.

Which squash did you plant?

Summer and winter squash. I planted butternut as a winter squash because it’s resistant to squash vine borer. I waited until July to plant summer squashes so they matured after the adult borers finished laying their egg.

Where did you plant the crops?

Far from where squash grew last year. That way I avoided the insect pests that over-wintered in the soil.

**Biological control** is the use of natural enemies, such as insect predators and parasites, to keep down the number of insect pests. Helpful insects may be released into the garden, or they may be attracted to the garden by certain flowers or herbs.

A parasitic wasp lays eggs inside the body of the tomato hornworm. When the eggs hatch the larvae feed on the inside of the hornworm. Then the larvae emerge and turn into pupae.

Look! A tomato hornworm covered with wasp pupae. I'll leave it in the garden. When the adults emerge, they will attack other hornworms.

**Chemical control** is the use of pesticides to control insect pests.

No control treatment has worked. So the gardeners may have to use this pesticide. Both the insect pest and my infested crops are listed on this label. The gardeners will read the directions carefully and use only the amount of pesticide that is needed.
Unscramble each of these words to find out some methods that can be used to control insect pests.

1. SUE SNREATITS SAETIRVEI
2. RETTOA SOCERP
3. EPKE RCPOS HEYTAHL
4. TATRTAC MIESEEN
5. LAEEERS TROPSEADR
6. DAHN CIKP
7. SUE SIRRBEAR
8. SUE CEDSISTEPI

Controlling insect pests in the garden requires careful observation and research. Check your garden often for insect damage, such as chewed or wilted leaves. Observe insects causing the damage. Identify the insects, and find out all you can about them.

What do lady beetles really eat?
Gardeners welcome lady beetles to their gardens because they eat aphids. But how many aphids do lady beetles actually eat? Do they eat only aphids all summer long, or do they eat other things as well? During a two-year study, scientists set out to answer these questions. They collected adult seven-spotted lady beetles during the growing season, and analyzed the contents of the beetles’ guts.

During the spring, they found soil particles, aphids, and the spores of fungi in the lady beetles’ guts. (Fungi are organisms like mushrooms and molds that produce spores, or tiny reproductive cells.)

During the summer, when the lady beetles were reproducing, aphid remains were present in almost all the beetles collected. Spores were also commonly found in the lady beetles’ guts during this time of year.

In the late summer and autumn, spores and pollen, and not aphids, made up the bulk of the lady beetle diet. Scientists were very surprised to learn that the spores of fungi were such an important part of the lady beetle’s diet during that part of the year. That means lady beetles cannot be relied upon to control aphids in late summer and fall, but they can be very helpful from spring until late summer.

EARTHWORMS Science Page

EARTHWORMS ARE ADAPTED FOR LIVING IN SOIL

MOVING
A worm moves through soil by using special muscles and hydraulics. Hydraulics is the movement of liquids under pressure.

BREATHING
The earthworm’s skin has glands that give off mucus. This mucus helps the earthworm breathe because it keeps the body moist. The earthworm breathes through its thin skin. Oxygen dissolves in the moisture on the earthworm’s body, and then passes into the body.

FEEDING
The earthworm is specially adapted for feeding underground.

1. A hard area on the head forces open cracks in the soil. The earthworm can then crawl into the cracks in search of food.
2. When the earthworm swallows small particles of soil and bits of dead plants and animals, muscles push the food to a chamber or sac called a crop. The crop stores food for a short time.
3. Food enters the gizzard, where it is ground up with the help of tiny stones.
4. The ground up food passes into the intestine. Digestive fluids break down the food, and nutrients are absorbed into the body.
5. The waste material passes out of the body through the anus.

EARTHWORMS CULTIVATE AND FERTILIZE SOIL.

As earthworms move through soil, they make tunnels. These tunnels let air reach plant roots, and let water drain through soil. Mucus that earthworms produce helps bind soil particles together, so that the tunnels keep their shape. Earthworms also mix soil layers as they burrow.

The waste coming out of the earthworm’s body is called worm casts. Worm casts contain valuable plant nutrients. They reduce the acidity of soil. Worm casts also soften the soil, so roots can grow more easily.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
WORD SEARCH
Find these earthworm words in the puzzle on the right: crop, circular, mucus, anus, intestine, gizzard, setae and worm casts

| S | I | M | D | J | S | E | T | A | E |
| U | N | O | Y | R | T | K | K | X | W |
| C | T | O | C | E | A | P | V | O | M |
| U | E | K | G | R | E | Z | R | W | H |
| M | S | H | T | O | O | M | Z | T | I |
| A | T | G | V | Q | C | P | U | I | M |
| N | I | X | V | A | C | O | V | A | G |
| U | N | K | S | X | M | Y | B | F | X |
| S | E | T | B | U | B | K | Q | D | G |
| K | S | R | A | L | U | C | R | I | C |

TRY THIS

EARTHWORM STUDY
What you need
- earthworm  * eyedropper  * ruler
- paper towels  * water  * Q-tip
- stiff paper  * pan  * vinegar
- flashlight

What to do
1. Place the earthworm on a moist paper towel in a pan. Observe it for a few minutes. How does it move? What muscles are necessary for the earthworm to move?
2. Roll the worm over and observe what happens. The side that the worm prefers up is the dorsal or top side. The side it prefers down is the ventral or underside.
3. The body of the earthworm is made up of segments. At around segment 30 from the front end of the worm, look for a wide thick band around its body. This swelling is called the clitellum, and is found on adult worms. The clitellum is used in mating.
4. On the underside of the earthworm are small bristles called setae. Put the earthworm on a piece of stiff paper. Can you hear it make any noise as it moves? Hold the paper up level with your eyes. Do you see the setae? Run your fingers along the underside of the worm. Can you feel the setae?
5. Study the earthworm’s head. Does it appear to have any sense organs, such as eyes, ears, or a nose? Do you think the earthworm is able to sense moisture, light, or odors? Make your predictions, and then find out.

Can an earthworm sense moisture?
Place a dry paper towel on one side of the pan and a moist paper towel on the other. Stretch the worm so that it lays across both towels. Observe the earthworm’s response. Try this ten times, but each time change the direction that the worm’s head is pointing. Which direction does the earthworm move?

Does a worm have a sense of smell?
Dip a Q-tip in vinegar. First, wave the Q-tip near the worm’s rear end, and then near its front end. Do not touch the worm with the Q-tip. Does the earthworm show any response?

Can an earthworm sense light?
Now darken the room, and shine the flashlight on the worm. What does the earthworm do? Were your predictions accurate?

SPOTLIGHT ON RESEARCH
An earthworm has both male and female sex organs in its body
An earthworm has both male testes and female ovaries in its body, but it usually needs another worm to mate. Mating worms put their bodies together, and sperm passes from one worm to the sperm storage sac of the other worm. After mating, a mucus ring is formed by the clitellum on each worm. As the worm wriggles out of the ring, the ring passes over the worm’s ovaries and sperm storage sacs. Eggs and sperms are deposited in the ring. As the ring slips off the worm, both ends of the ring seal to form a cocoon. Inside, the sperm fertilizes the eggs. A short time later, baby worms hatch.

Worm casts makes plants grow faster
Scientists at Ohio State University wanted to know how well vegetables, fruits, and flowers would grow if worm casts were added to the soil. They fed worms a special diet of pig and cow manure, and then collected the worm casts. They added the worm casts to some soil, and left other soil alone. Then the scientists compared the growth of crops planted in the two soils. In the greenhouse, lettuce, tomatoes peppers, carrots, radishes, onions, marigolds, and petunias grew faster in the soil with the worm casts added. In fields, tomatoes, peppers, strawberries, raspberries, and grapes all grew faster, and produced fruits faster when worm casts were added to the soil.

Sources:
**INSECTS IN THE GARDEN Science Page**

**HOW CAN YOU TELL AN INSECT FROM OTHER ANIMALS?**

All insects have 3 pairs of legs and 3 body parts (head, thorax, and abdomen). A hard outer covering protects the insect’s body. This covering is called an exoskeleton.

Insects are cold-blooded animals, so the rate at which they grow depends on the temperature. Cooler temperatures slow down their growth, and warmer temperatures speed up their growth.

Some insects have only one generation per year. Others have up to 12 generations per year, depending upon the temperature.

**HOW DOES AN INSECT GROW?**

An insect begins life as an egg and changes shape as it grows. This is called metamorphosis.

In insects such as butterflies, moths, and beetles, the egg hatches into a larva, which becomes a pupa. Then a mature adult emerges from the pupa.

In other insects, such as grasshoppers and aphids, the young insect (nymph) looks like the parent when it hatches. It sheds its exoskeleton several times as it grows.

**WHAT DOES AN INSECT EAT?**

Lots of insects come to a garden to eat. Some come to suck nectar and eat pollen. Others chew on leaves, stems, and fruits. Some are predators and prey on insects and other small creatures. Mouthparts of most insects are specialized for a particular kind of food. Some mouthparts are adapted for biting or chewing. Others are adapted for sucking up blood, nectar, or other fluids.

A sucking insect, such as an aphid or bug, has needle-like styles inside its beak that pierce stems.

A chewing insect has jaws called mandibles that move together when the insect is eating.

Both the adults and the larvae of ladybug beetles have chewing mouthparts for feeding on aphids.

The cabbage butterfly larva chews on plants, but the mature butterfly has a long tube called a proboscis for sucking nectar.

The proboscis of a moth or butterfly curls up when the insect is not feeding.

The honey bee has an extended proboscis to suck up nectar.

**Garden Mosaics** is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
PUZZLE

Follow the line from each insect mouthpart to find out what food the mouthpart is able to obtain.

A. 

B. 

C. 

spotted on Research

Using Green Lacewings in Biological Control

Imagine a creature that looks like a tiny green-gray alligator with ice tongs for a mouth. It seizes and punctures its prey, injects it with poison, and sucks out the body fluids. Sounds like science fiction? This creature, called an aphidlion, actually exists. It is the larva of the green lacewing. Its prey is the aphid, a garden pest. The adult lacewing is light green, with long slender antennae, golden eyes, and large, thin, “lace-like” wings. (An intricate pattern of veins in the wings creates the lacy effect.) Because of what it looks like, and the fact that it flies around at night feeding on nectar and pollen, some people mistake a lacewing for a fairy!

Although not as pretty as the adult lacewing, the aphidlion is extremely effective at controlling aphids. One aphidlion feeds on up to 200 aphids a week. Worldwide they rank as one of the most commonly used biological controls. However, it is very expensive to produce lots of aphidlions. Scientists are trying to find better ways to mass-rear aphidlions, so that they can be made available at a lower cost to growers of vegetables, fruits, nuts, and flowers. One reason why aphidlions are costly to rear is that they eat each other when other food is not available!

Scientists have developed a new diet for aphidlions that is cheap and does not spoil quickly. When it becomes available to lacewing growers, scientists believe that the cost of rearing will be reduced from $0.35 to $0.00025 per insect. Engineers and biologists are also working together on ways to harvest, package, and ship the insects. When a mechanized way of doing all these things is fully developed, the cost of this natural insect control should be cut drastically.


TRY THIS

OBSERVING INSECTS IN THE GARDEN

What you need

* shallow cardboard box, about 25 cm by 30 cm
* white paper to line the box if it is not already white
* plastic bag to fit over the end of the box
* tape
* plastic jar with lid
* paper and pencil
* magnifying lens, if available
* insect field guide, if available

What to do

1. To make a shake-it box, cut off one side of the box. If the inside of the box is not white, line it with white paper, taping the paper in place.
2. Tape the plastic bag to the bottom and two sides of the box (see picture).
3. To use the shake-it box, hold the box under a plant in the garden and gently shake the box and the plant. Insects on the leaves and stems will drop into the box.
4. You can observe the insects in the box. You can also transfer the insects to a jar, where they are less likely to escape. To do this, untape the bag from the box and close the bag so the insects don’t get out. HOLD THE PLASTIC BAG OVER THE JAR AND SHAKE THE INSECTS DOWN.
5. Observe the insects you have collected with the naked eye and with a magnifying lens. How many different kinds of insects did you collect? If possible, use an insect field guide to identify the insects that you collect.

RIDDLE

Why do bees hum?

Answer: because they forgot the words!
An aerial photograph—or airphoto—is a picture of the Earth taken from above the ground. Airphotos are valuable tools for studying both natural features, such as forests, waterways, and soil, and human-made features, such as roads and buildings. You can see how land use and communities change over time by studying a series of airphotos taken of the same place at different times.

Here is an aerial photograph of Prospect Park in Brooklyn, New York, taken in 1989.

HOW TO ‘READ’ AIRPHOTOS
When you view the Earth from overhead, as if from an airplane, objects look different from normal. These clues will help you recognize features in the airphoto.

Tone: the blackness or whiteness of an object
1. Large black areas are water.
2. The tiny white spots are roofs of houses.
3. Light cement sidewalks border dark asphalt streets.

Texture: how coarse or smooth an area appears
4. Grassy areas have a smooth texture.
5. Forests have a coarse texture.

Size
6. Highways are wider than streets.
7. Museums, factories, churches, schools, stores, and apartment buildings are larger than houses.

Shape
8. The circle at the end of the park is a traffic circle.

Location
9. The white circles in grassy areas are ball fields. Circles at the end of a road are traffic circles.

SCALE
An aerial view close to the ground shows lots of detail. The further away from Earth a photograph is taken, the smaller the features appear on the photo. The scale of an airphoto indicates how much smaller an object in the photo is compared to its actual size. The photo on the right has a larger scale than the photo shown above. Sometimes people confuse large scale and small scale. Remember that features on large scale photos appear large, and features on small scale photos appear small.

The scale of the airphoto above is 1:24,000. This means that one centimeter on the photo is equal to 24,000 centimeters—or 240 meters—on the ground. The airphoto on the left is a section of the above photo, and is shown at a scale of 1:12,000. This larger scale photo shows features in more detail. Look carefully at the large scale airphoto. Can you find this area on the small scale airphoto above?

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
CROSSWORD PUZZLE

Across
2. How you can tell a factory from a house.
3. What clue helps you to tell the difference between a circle in a park from a circle along a road?
4. How coarse or smooth an object appears.

Down
1. Blackness or whiteness of an object.
2. How you can tell a football field from a baseball diamond.

TRY THIS
INTERPRETING AN AIRPHOTO
Here are some questions about the small scale airphoto of Prospect Park. Use clues such as tone, texture, size, shape, and location to answer as many questions as you can. Write your answers on a separate sheet of paper.
1. Near what number on the airphoto does the park have dense woods? What clues did you use to figure this out?
2. What are the white, winding lines in the park? What clues did you use to guess?
3. How many blocks is it from the large traffic circle at the top end of the park to the small traffic circle on the left side of the park (near number 8)?
4. Are there any buildings in the park? How can you tell?
5. The area near number 2 is a residential neighborhood. What do you think some of the larger buildings could be?
6. Measure the length of the park on the airphoto in centimeters. Then multiply this length by 240 to get the actual length of the park in meters.

SPOTLIGHT ON RESEARCH

Satellite images show that vegetation can cool cities
Satellite images are similar to airphotos in that they are taken looking down on Earth from above. Scientists can use satellite images to help understand our environment. For example, scientists wondering about the effect of plants and pavement on air temperatures examined two different kinds of images of Rochester, NY. One was a thermal image, which showed warmer areas in lighter tones and cooler areas in darker tones. The other was a color composite image, which showed different kinds of surfaces in different colors. For example, vegetation appeared green, bare soil was pink, and pavement and rooftops were blue.

When the scientists compared the two images, they discovered that the cooler areas in the city were over vegetation. They hypothesized that areas over vegetation were cooler because of water moving out of plants into the air, or “transpiration.” Through transpiration, plants give off lots of water. As the water moves from plants to air, heat is taken from the air. The more plants there are, the more water they give off and the cooler the air.


RIDDLE
Why are airphotos like fish?

Answer: They both have scales.
WHAT IS A TOPOGRAPHIC MAP?

A topographic map is a very accurate and detailed map of a region. It includes natural features, such as rivers, lakes, valleys, and hills, and human-made features, such as roads, bridges, and buildings.

Here is a topographic map of Prospect Park, Brooklyn, New York City.

COLORS AND SYMBOLS

To read a topographic map, you need to know what the colors and symbols represent. Vegetation, such as grass and trees, is green. Water, including lakes and rivers, is blue. Contour lines are brown.

Towns and cities are pink or gray. Symbols are used to represent features, such as churches and schools. The meanings of symbols are explained in a key, which is sometimes called a legend.

CONTOURS

Topographic maps show the shape or relief of land—where it goes up and down, as in hills or valleys. Contour lines join up places that are the same height—or elevation—above sea level.

The diagram below shows contour lines at every 10-foot change in elevation. Where spacing between contour lines is close, it means the land is steep. Where spacing is wide, the slope is gentle.

On the topographic map of Prospect Park, there is a contour line at every 10-foot change in elevation. Numbers along the lines show actual elevation (for example, 150, 100).

SCALE

The scale of a map indicates how much actual features are shrunk or scaled down. The scale may be shown as a ratio such as 1:12,000. This means 1 unit of length on the map equals 12,000 units of distance on the ground. The scale may also be written in words or shown as a line:

1 inch represents 0 500 1,000 1,500 2,000 feet.
1 cm on the map equals 12,000 cm, or 120 m on the ground.

The scale of the map above is 1:12,000. One inch on the map equals 12,000 inches, or 1,000 feet, on the ground. Or 1 cm on the map equals 12,000 cm, or 120 m on the ground.

USING MAPS

Many different people use topographic maps.

Scientists use topographic maps to study the environment. City planners use the maps to help locate suitable places for buildings, roads, or parks. Aircraft pilots need topographic information for flight planning and navigation. Topographic maps are also used by hikers.

Using the scale and contour lines on a map, you can not only measure how far you have to travel to get from one place to another, but also how far up and down hill you have to go to get there.
WORD SEARCH

All of these things can be found on topographic maps. Can you find them in this word search?

hills, valleys, contours, forests, lakes, rivers, cities, parks, roads, houses, railroads, schools

T S N V B J L H S S
S Y E K A R O R E C L
G D G S I L U A K H K
R I A V U O L X A O Y
X F E O T O S E L O P
R R V N R L H P Y L O
S O O S L L J K V S B
G C A I S E I T I C J
P C H D C F P A R K S
F O R E S T S O R T I
K M R M V P B J S R

TRY THIS

STUDYING TOPOGRAPHIC MAPS

How good a map detective are you? Use the map on the front of this page to find the answers to the questions below. Write your answers on a separate sheet of paper.

1. Where is the steepest slope? Is it (a) in Brooklyn Botanic Gardens, (b) left (to the west) of Lefferts Homestead, or (c) left (to the west) of Central Library?

2. Where is the railroad? Is it (a) at the top (north end) of the map, (b) on the right (east) side of the map, or (c) near the bottom (south end) of the map?

3. How many churches are on 8th Avenue?

4. How many blocks is it from Methodist Hospital to P.S. (Public School) 107?

5. How many blocks is it from John Jay High School to P.S. (Public School) 77?

6. What is the elevation of Litchfield Mansion?

7. How far is it from the Central Library to the Museum?

8. How far is it from Litchfield Mansion to the zoo?

9. What is the length of the Brooklyn Botanic Gardens?

SPOUTLIGHT ON RESEARCH

The Space Shuttle Endeavor helps make accurate topographic maps

In February 2000, the Shuttle Radar Topographic Mission (SRTM) was launched into space on board the Space Shuttle Endeavor. During a ten-day mission, SRTM gathered data on the height and shape of land over four-fifths of the Earth’s land surface. These data will result in the most accurate and complete topographic maps of the Earth’s surface that have ever been made.

Before SRTM, topographic maps of various parts of the world did not exist or were not accurate. For example, many mountains, deserts, and dense rain forests were unmapped, simply because of the difficulty in getting to these locations. The data collected by SRTM are now being processed to create topographic maps. As the maps are completed, they are being made available to the public. Check out this website for more information: www.jpl.nasa.gov/srtm.

RIDDLE

What part of a map is in the school band?

Answer: the symbols (cymbals)

This is a long way to come to map our route from home to school!

---

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
DID YOU KNOW?
Alache is a multi-purpose plant. People use it as a vegetable, an herb, and as medicine. When the plant gets big, farmers cut it to feed their animals.

I hope this tea made from alache leaves gets rid of my cough.

ORIGINS
Alache is native to tropical America, north to Arizona and Texas.

For centuries, farmers in Central America have allowed alache to grow freely in their cornfields. Seeds from plants in one growing season sprout and grow in the next rainy season. Farmers gather the plants as needed.

GROWING AND HARVESTING ALACHE
In most parts of the U.S. you can grow alache as an annual. This means it lasts for only one growing season.

Will alache grow here? I know alache likes sunny and sheltered places like this, but the soil is poor.

That’s true, but it’s well-drained. These alache plants will grow to about 1.5 meters.

Harvest the alache leaves and stems when they are young and tender. Cut the stems near the bottom. The plants resprout easily after cutting. Once alache forms seeds, the leaves become too old and tough to eat.

USES IN COOKING
In Latin America, alache is used as a vegetable and cooking herb.

You can prepare young alache leaves and buds as a vegetable. Boil them and season with salt, red pepper, lemon, and onion. The leaves are also eaten with squash, corn, and beans.

CLASSIFYING ALACHE
Alache belongs to the Malvaceae, or Mallow, family. About 1,000 species are in this family, including cotton, hollyhock, and okra.

The seed pod of alache has ridges radiating out from its center.

FAMILY
Malvaceae (Mallow family)

GENUS
Anoda

SPECIES
cristada means "crest" or "ridge."

Flowers of plants in this family are large and showy, with five petals.

Nodes are places along a stem where leaves are attached. The flower stem of alache has no nodes or leaves attached.

The seed pod of alache has ridges radiating out from its center.

Alache is a soft-stemmed plant, with pointed leaves.

It has white, lavender, or purple-blue flowers with five petals.

The seed pods are shaped like stars.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
TRY THIS

DISCOVER ALACHE RECIPES

Alache is traditionally prepared in several different ways. In this activity, you will collect information and write a traditional recipe for alache.

1. Try to find alache growing in a community garden. You will most likely find it growing in a Latino garden.
2. If possible, interview gardeners who grow alache. Find out what country the gardeners originally come from. Ask them to describe when and how alache is grown and harvested. Record this information.
3. Ask the gardeners to describe different ways it is used. For example, do they use it as a medicine or as a food?
4. If it is used as a medicine, what ailments is it used to treat, and how is it prepared and administered?
5. If it is used as a food, ask them to describe exactly how it is prepared. Write down the directions, and then use your notes to develop a recipe. The recipe should include a list of ingredients, the number of servings, and step-by-step directions.
6. If possible, try out your recipe. You may wish to invite people who cultivate and use alache to help you prepare your dish.
7. Send in your recipes to Garden Mosaics, Department of Natural Resources, 16 Fernow Hall, Ithaca, NY 14853, or as an attached file to gardenmosaics@cornell.edu. We will share them with other Garden Mosaics participants.

CAUTION

Please get advice from a doctor before using alache for medicinal purposes.

Alache belongs to the Malvaceae family.

Oh, and you're looking after it for them while they're out of town?

ALACHE LETTER TILES

Unscramble the tiles below to reveal a message.

ANT A TIP IS

CHE MUL

PL URP ALA OSE

THE JOKER

Alache is a versatile plant that grows in diverse environments. It is often used as a medicine or as a vegetable. In some communities, alache is grown in fields and orchards, while in others, it can be found wild in forests and along pathways. The cultivation methods vary, reflecting the cultural practices and environmental conditions of the area.

SPOTLIGHT ON RESEARCH

Alache in fields grows taller than alache in forests

In central Mexico, alache grows wild in forests and along pathways. It also grows in farmers' fields and orchards. Scientists wanted to find out how the size and other traits of the plant vary from one place to another. They also wanted to find out how people in this area use alache.

They randomly selected 134 plants from forests, fields, and orchards, and measured the height, number of branches, and number of seed pods for each plant. They found that alache growing in fields and orchards is taller and has more branches and seed pods than wild alache. The scientists proposed an explanation for this difference: Plants in fields and orchards are growing in richer soil and do not have to compete with weeds. How might the scientists design a study to see if their proposed explanation, or hypothesis, was correct?

The scientists also interviewed 34 farmers who grow, use, and sell alache. They discovered that most use alache as a vegetable. It is an important part of the diet during the rainy season. Farmers boil the fresh leaves and buds until they are soft and the water becomes slimy. Next they mix the leaves and buds with mushrooms, squash, beans, or meat. The scientists tested the nutrient content of alache, and discovered that it is high in protein and starch. Some people also use alache as a medicine, mostly as a tea for coughs. Many people harvest and sell alache at the local market.

SPOTLIGHT ON RESEARCH

Sources:
**DID YOU KNOW?**
Alfalfa has deep roots. Believe it or not, miners in Nevada once found alfalfa roots 40 meters (129 ft) down into the soil!

**ORIGINS**
Alfalfa is native to Asia, Europe, and North Africa. The Medians, who lived in what is today Iraq and Iran, grew alfalfa 3,300 years ago.

Alfalfa is sometimes called “Queen of Forages” because it is the oldest known plant used to feed animals.

**CLASSIFYING ALFALFA**
Alfalfa belongs to the legume family. All legumes have their seeds in pods. Many legumes have root nodules where special bacteria, called Rhizobia, live. These bacteria can take nitrogen from the air and change it into a form that plants can use.

**FAMILY**
Fabaceae (Legume Family)

**GENUS**
Medicago
In Latin, “medica” means native of Media. Alfalfa was first grown by the Medians.

**SPECIES**
*sativa*
In Latin, “sativa” means that which is sown.

**THE ALFALFA PLANT**
Alfalfa grows to about 1 meter (about 3 ft) high. The purple flowers are grouped at the ends of stems. Leaves have three leaflets. Pods are curl.

Alfalfa has one long taproot with many side branches.

**GROWING ALFALFA**
If you are not using a section of your garden, you can plant alfalfa to protect and improve your soil.

When I turn this alfalfa under, it will add lots of organic matter and nitrogen to my soil.

Sow in spring or summer. Sprinkle 2-3 grams of seeds per square meter (about 1 oz. per 12 sq. yards). Do not allow the alfalfa to grow for more than a year or it will be difficult to dig up. Turn it under and allow it to decay for six weeks before planting crops.

**USES**
Alfalfa is not only grown for animal food. Many people eat alfalfa sprouts in salads. Some people even eat the leaves, either cooked or raw.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
CROSSWORD PUZZLE

Across
5. Alfalfa was first grown by the ______.
7. All legumes have their seeds in ______.
9. Alfalfa has one very long ______.
10. Planting legumes can add ______ to the soil.

Down
1. Alfalfa is the oldest known plant used to feed ______.
2. Alfalfa belongs to the ______ family.
3. The scientific name for alfalfa is ______
4. To improve your soil, you can grow alfalfa for not more than one ______, and then turn it under.
6. People eat alfalfa ______ in salads.
8. Alfalfa leaves have ______ leaflets.

TRY THIS!
GROWING ALFALFA SPROUTS
What You Need
* alfalfa seeds for sprouting
* glass, clear quart jar
* piece of clean panty hose or cheesecloth
* tablespoon
* scissors
* rubber band
* water and sink

What You Do
1. Cut a piece of panty hose or cheesecloth that you can put on the top of your jar.
2. Measure and put a tablespoon of alfalfa seeds into your quart jar.
3. Put some water in the jar so that the seeds are completely covered up.
4. Put the cheesecloth or piece of panty hose on the top of the jar. Keep it in place by stretching a rubber band around the outer edge of the jar.
5. Let the seeds soak overnight.
6. The next day, drain out the water. Rinse the seeds with cool water. Place the jar on its side out of direct sunlight. The seeds need to be damp but not totally wet.
7. Every day, three times a day, rinse the alfalfa seeds with cool water. Each time be sure to drain the rinse water and place the jar back on its side.
8. In 3 or 4 days, the sprouts will be ready to eat! Make a garden or tossed salad and put your sprouts on top. Or, make a sandwich and add some sprouts!

SPOTLIGHT ON RESEARCH
Alfalfa: a Legume with Many New Uses
For thousands of years, alfalfa has been used to feed horses, cows, and other livestock. It has also been used to improve soils. Because it is a legume, it can grow on poor soils and add nitrogen to the soil. But now scientists in Minnesota are developing new varieties of alfalfa with important new uses. In this changing world, gasoline and plastics may become too expensive to make from oil. In place of oil, new varieties of alfalfa may be able to supply the raw materials to make fuel and plastics. For example, some varieties are being developed that have a lot of sugar in the stems, which can be used to produce fuel. Scientists also are developing alfalfa varieties that make beads of plastic in their leaves. They are still trying to figure out how to extract the plastic.

And these are not the only possible new uses for alfalfa! Some scientists are developing ways to use alfalfa for cleaning up soil and water pollution. Alfalfa is very good at taking up excess nitrates in soil. If soil has excess nitrates, rain may carry these nitrates into ground water or into lakes and rivers. When people drink water with excess nitrates, they can get health problems. But if the water high in nitrates runs through a field of alfalfa, the roots take up the nitrates and clean the water. Other new varieties of alfalfa can take up other pollutants, such as atrazine, a longlasting chemical used to kill weeds.


JOKE
Knock, knock. Who’s there?
Al.
Al who?
Al-fall-fa you because I think you’re so cute!

www.gardenmosaics.org
DID YOU KNOW?
Roasted buckwheat is called kasha. You can boil kasha until it is soft, and eat it as a cereal or add it to many main dishes.
Kasha is a basic food in Russia and Eastern Europe.

ORIGINS
Buckwheat is native to the Himalayas in southern China.
The Chinese were growing buckwheat over a thousand years ago.

THE BUCKWHEAT PLANT
The buckwheat plant grows to about one meter high.
The white flowers are at the ends of branched stems.
Leaves are shaped like triangles.
Fruits are shaped like little pyramids.

GROWING BUCKWHEAT
Plant in the spring or fall. Sprinkle about 1 tablespoon of seeds per square meter. Rake in and water.
In two weeks buckwheat will make a dense cover over the soil. I'll cut it when it flowers. It will rot quickly and add lots of organic matter to the soil.

USES
Buckwheat is a multipurpose crop. It makes a good cover crop, because it smothers weeds very well. You can feed it to animals. You can roast the fruit to make kasha, or grind it to make flour.
In Japan, noodles called "soba" are made from buckwheat flour.

NUTRIENT VALUE
Buckwheat contains plenty of protein, B vitamins, and minerals.
One cup of buckwheat flour has the same amount of...
...protein as 3 hot dogs.
...calcium as 1/6 cup of milk.
...potassium as 2 cups of milk.
WORD SCRAMBLE

Learn about buckwheat when you unscramble the letters in bold:

(1) cukethbaw is a (2) elutusniprop crop. It makes a good (3) rvoce proc because it smoothens weeds. You can feed it to (4) nasalim. You can (5) drign the fruits to make (6) rufol. You can also (7) sorat them to make (8) shaka.

SPOTLIGHT ON RESEARCH

Bringing back buckwheat to New York State

Dutch settlers brought buckwheat to New York State in the 1600’s. For the next 300 years, it was a popular crop among New York State farmers. They grew buckwheat both for food and to feed animals. Each year, farmers kept the seeds from plants that grew best and replanted them. Thus, the buckwheat became well-adapted to the local climate and soils. But at the beginning of the 20th century, high-yielding varieties of corn and wheat were developed, so farmers began to grow these crops instead of buckwheat.

In the 1990’s, a plant breeder in New York State and a plant breeder in Manitoba, Canada began working to produce high-yielding varieties of buckwheat for New York State. At that time, there were some Japanese varieties of buckwheat that grew very well in Manitoba, but they did not grow well in New York State. Summer days are shorter in New York than they are in Manitoba, and short days trigger buckwheat to stop producing new flowers and start making seeds. Thus, in New York, the Japanese varieties only produce a few flowers before making seeds, so yields are poor.

The plant breeders reasoned that a buckwheat variety for New York should make the most of a short growing season. It should make big leaves early in the season. Large leaves can produce more food that the plants can use to produce more flowers and seeds.

The plant breeders took the most promising varieties from Manitoba and grew them in New York. They measured leaf growth, date seeds ripened, and seed size. They also calculated the ratio of seeds to plant by weighing the dry plant and seeds and then weighing the seeds alone. Then the plant breeders grew varieties with one or more desirable traits, and crossed them. (They used pollen from the flowers of one variety to pollinate the flowers of another variety.) After making several crosses, the plant breeders successfully developed three high-yielding varieties of buckwheat for New York State.


QUOTE

"Kasha is on the spoon, baby will walk soon."

Russian saying

These words are spoken when kasha is fed to children when they are baptized.

BROCCOLI STIR-FRY WITH SOBA

This dish comes from Japan, where it is considered polite to slurp up the noodles!

Serving size: 4-6

Ingredients

* 2 tablespoons oil
* 2 bunches of broccoli
* 1 cup diced scallions
* 2 tablespoons minced ginger
* 4 cloves minced garlic
* 1 package soba (buckwheat noodles)

Instructions

1. Cook the soba according to the directions on the package.
2. Slice broccoli on the diagonal for stir-frying.
3. Using a small amount of broccoli at a time, stir fry in a little oil, along with scallions, ginger, and garlic. Add more oil if needed.
4. Serve the stir fried broccoli over the soba.
CHINESE CABBAGE AND BOK CHOY Science Page

DID YOU KNOW?
Turnips, Chinese cabbage, and bok choy are all the same plant species.
Around the Mediterranean, ancient farmers saved seeds from the plants with the largest roots. They wanted plants with large roots that could be stored for winter. In ancient China, farmers saved seeds from the plants with the fleshiest stems and leaves. After hundreds of years of selecting seeds, the species evolved into the turnip in the Mediterranean and Chinese cabbage and bok choy in China.

THE CHINESE CABBAGE AND BOK CHOY PLANTS
Chinese cabbage leaves are in a “head” and bok choy leaves are loosely joined together.
Chinese cabbage leaves are crinkly, and have thick, white veins. The outside leaves are green. The inside leaves are green or yellow.
The heads of Chinese cabbage can have different shapes.

CLASSIFYING CHINESE CABBAGE AND BOK CHOY
FAMILY
Cruciferae or Brassicaceae (mustard family)

GENUS
Brassica
In Latin, this means “like cabbage.”

SPECIES
rapa
There are many varieties of this species, including:

USES
The leaves of bok choy and Chinese cabbage are crisp and have a mild flavor. They can be used in salads, stir-fries, and soups.

GROWING AND HARVESTING CHINESE CABBAGE AND BOK CHOY
These plants do best when the weather is cool and the days are short. If days are long or temperatures too hot or too cold, then flowers form instead of leaves. In areas with cold winters and hot summers, plant in the late summer and fall. In areas with cool or warm winters, plant in winter.

Harvest before seed stalks form. Cut close to the ground.

It's fall, so I can finally plant my bok choy. I'm going to grow some from seeds and some from transplants.

These plants like a rich, moist, loamy soil.

Chinese cabbage

Bok choy has smooth, glossy green leaves and white stalks.

Chinese cabbage

Bok choy

B. rapa

B. rapa variety rapa

B. rapa variety chinensis

B. rapa variety pekinensis

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
Growing and Marketing Chinese Vegetables in the U.S.

In China, fresh vegetables are an important part of the traditional diet. On average, each person in China eats 1/2 kilogram (about 1 pound) of vegetables per day. Traditional Chinese dishes are becoming more and more popular in the U.S. The demand for Chinese vegetables, such as Chinese cabbage and bok choy, is increasing.

Researchers at the University of Kentucky conducted experiments and marketing research for five years to find out how best to meet this increasing demand. They were trying to find out how farmers can grow and market high-quality Chinese vegetables, and make a good profit.

They found out that in Kentucky, they could rotate different Chinese vegetables, and harvest crops in spring, summer, and fall. For example, they planted bok choy in March and harvested it in June. Then they planted bitter gourd and yard long beans in the same place. They harvested these two crops in September, and then planted bok choy, tai cai, or daikon in the same place and harvested them in late fall. The researchers discovered that they can grow and harvest Chinese vegetables in Kentucky at times when the crops are not available in other parts of the U.S. This means that Kentucky farmers can market these crops when there is less competition from other farmers.


CHINESE CABBAGE STIR-FRY

Yield: 4 servings

What you need
1. 1 pound Chinese cabbage
2. 1 tablespoon sesame seeds
3. 2 tablespoons canola oil
4. 2 cloves of garlic, minced
5. 2 teaspoons ginger root, grated
6. 1 tablespoon soy sauce
7. 1 teaspoon sesame oil
8. 4 cups of cooked rice

What to do
1. Heat the oil in a wok or heavy skillet over high heat.
2. Stir-fry the garlic and ginger for about 30 seconds.
3. Add the cabbage and cook, tossing, until it just begins to wilt (about 2 minutes).
4. Stir in the soy sauce and sesame oil and sprinkle with sesame seeds.
5. Serve over rice.
DID YOU KNOW?
The herb cilantro and the spice coriander come from the same plant. Cilantro is the name used for the plant’s leaves. Coriander is a spice made from the seeds. The seeds and leaves taste completely different.

ORIGINS
Coriander is native to southern Europe and the Mediterranean. It is one of the oldest spices in recorded history, and was used as long as 7,000 years ago.

CLASSIFYING CILANTRO

FAMILY
Umbelliferae (Carrot family)
In Latin, umbella means umbrella or parasol to provide shade from the sun.

GENUS
Coriandrum
means “bed bug” in Greek.

SPECIES
sativum
means “that which is planted.”

All of the plants in this family have tiny flowers arranged on stalks that radiate from a central point, like the frame of a parasol or umbrella.

THE CILANTRO PLANT

The tiny white or pink flowers are arranged in flat-topped clusters.

The upper leaves are feathery.

The lower leaves are fan-like.

The seeds are in ribbed pods.

GROWING AND HARVESTING CILANTRO AND CORIANDER
Cilantro is easy to grow in almost any well-drained soil. Sow seeds after the last frost date. Begin harvesting when the plant is at least 15 cm high. If the stems are cut at about 2.5 cm above the ground, the plant will continue to grow.

USES
Cilantro is used in Latin American and Southeast Asian salads, soups, and meat dishes. Coriander is used in European, Indian, and Middle Eastern dishes.

I planted cilantro in the shade so it will stay cooler. That way, it won’t produce flowers and seeds so quickly, but will keep producing leaves.

Coriander is one of the spices I use in curries.
CROSSWORD PUZZLE

Across
2. The scientific name for coriander is Coriandrum _______.
3. Coriander and _______ come from the same plant.
6. Cilantro is an _______.
7. The seeds of coriander are in _______ pods.
8. Coriander is a _______.

Down
1. Cilantro belongs to the _______ family.
2. Plant cilantro in the _______ so it will not produce flowers and seeds so quickly.
4. Coriander is one of the _______ spices in recorded history.
5. Plant cilantro seeds after the last _______ date.

SPOUTLIGHT ON RESEARCH

How to keep coriander seeds fresh
Coriander contains chemicals called essential oils. These oils give the coriander spice its distinctive taste and smell. They also are extracted for use in perfumes and medicines. High quality seeds are needed for this purpose.
A researcher at the Russian Academy of Sciences in Moscow wanted to find out how storing coriander under different conditions affects the essential oils. He stored some coriander seeds in the dark and some in the light for one year. Then he analyzed the oil composition of the seeds in the two groups. The oil composition of seeds that were stored in the dark changed only slightly. However, those stored in the light changed a great deal. That means, if you want to keep coriander fresher, store it in the dark, not in the light!


“...QUOTE

“The children were nestled all snug in their beds,
While visions of sugar-plums danced in their heads.”

from 'Twas the Night Before Christmas
by Major Henry Livingston Jr.

Sugar-plums are candied coriander, a sweet that was popular in 1822, when this poem was written!

CILANTRO CORN RELISH
This is good served with enchiladas, burritos, and grilled meats.
Yield: about 2 cups

Ingredients
* 4 ears of corn, or one 10-ounce package frozen corn
* 1 teaspoon ground cumin
* 1 small red onion, chopped
* 1/2 cup vinegar
* 1/4 cup sugar
* 2 teaspoons fresh oregano, or 1/2 teaspoon dried
* 1 small chili pepper, seeded and chopped
* 1/2 teaspoon salt
* 1 red bell pepper
* 1/3 cup minced cilantro

Instructions
1. Cut the kernels from the ears of corn. You should have about 2 cups.
2. Remove the seeds from the red bell pepper and chop.
3. Remove the seeds from the chili pepper and chop.
4. Add the cumin to a medium saucepan. Toast until you just begin to smell it.
5. Add chopped onion, vinegar, sugar, oregano, chili pepper, and salt to the pan, and bring to a boil. Simmer for 5 minutes.
6. Add the bell pepper and the corn and simmer for 3 to 4 minutes.
7. Put the mixture in a container, cover the container, and refrigerate.
8. Just before serving, add minced cilantro.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
**DID YOU KNOW?**
Collards are descended from wild cabbages that once grew on the Atlantic coast of Europe.

**CLASSIFYING COLLARDS**
Collards belong to the mustard family. Its scientific name is *Brassica oleracea* var. *acephala*. This means collards is a vegetable that is like cabbage, but does not form a compact ball of leaves or “head.”

**FAMILY**
Cruciferae or Brassicaceae (mustard family)
This family includes about 350 genera and over 3,000 species of herbs, shrubs, and trees.

**GENUS**
*Brassica*
In Latin, this means “like cabbage.”

**SPECIES**
*oleracea*
means “vegetable.”

**VARIETY**
*acephala*
means “without a head.”

**GROWING COLLARDS**
Today collards are grown throughout North America. In the north, you can plant collards in the early spring, and harvest them all summer, fall or early winter. South of Virginia, collards survive the winter, and you can harvest year round.

**THE COLLARD PLANT**
Collards are leafy, green vegetables.

The edible leaves and stem grow from a thick, main stem.

The plant takes 60-80 days to mature. It can reach 60 cm if left to grow. That’s higher than the knee of an average male adult.

**HARVESTING COLLARDS**
You can harvest the outer leaves from the bottom of the stalk as soon as the collard plant is about 30 cm tall. Younger leaves will continue to grow for harvesting later on.

**USES**
You can eat collards raw in salads or cooked as greens. Cooked greens are an important part of traditional cooking in the southern U.S. They are becoming more and more popular in other parts of the country as well.

**NUTRITIONAL VALUE OF COLLARDS**
Collards are rich in protein, minerals, and vitamins A and C. They contain antioxidants and other substances that may reduce the risk of cancer and heart disease.

1 cup of chopped collards has the same amount of...
- calcium as 5/6 cup of milk
- vitamin A as 1/2 a large carrot
- vitamin C as 1/2 an orange
- protein as a hot dog

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
CROSSWORD PUZZLE

Across
3. The scientific name of collards is _______ *oleracea* var. acephala.
4. South of Virginia, collards can be harvested _______ _______.
6. Collard greens are a traditional dish in the _______ United States.

Down
1. Collards are rich in protein, minerals, and _______ A and C.
2. Collards descended from wild _______.
5. To harvest collards, pick the ______ leaves.

RIDDLE
How does a gardener mend her pants?
Answer: With collard patches!

QUICK SAUTEED COLLARD GREENS
Yield: 6 (1-cup) servings

Instructions
1. Heat oil in large skillet over medium heat until hot.
2. Add garlic and scallions or onions, and saute until slightly wilted, about 1-2 minutes.
3. Add the greens, seasonings, and water, stirring the ingredients well.
4. Cover the pan, and cook the greens over low heat for 10 to 20 minutes, stirring occasionally.

Healthful Hints for Cooking Collards
* Cook greens as little as possible to retain more of their bright, darkgreen color and nutrients.
* If cooking collards with ham hocks or salt pork, boil meat in water for at least half an hour, and drain off the water and fat. Then put new water in the pot, and continue to cook until the meat is done. Then add greens.
* When collards are boiled, nutrients are leached out into the water. Do not pour this water down the drain. It is full of valuable nutrients. Save it to add to soups or soak it up with a piece of hot cornbread.

SPOTLIGHT ON RESEARCH
Why southern farmers were so healthy
During the early 1900’s, nutritionists could not understand why southern farmers were so healthy and well-nourished, even though their diet seemed very poor. At that time, no one realized that collards are an excellent source of protein, vitamins, and minerals. When this became known in the mid-1900’s, nutritionists came up with a possible explanation as to why southern farmers were so well-nourished. There were collard patches on every farm, and by nearly every door. People were probably getting a lot of the vitamins and minerals they needed from collards!
Source: Boswell, V. R. (1949). Our vegetable travelers. National Geographic Magazine. 96 (2)

Which collards resist whiteflies best
The whitefly is a big pest of collards in some parts of the country. Plant scientists at the U.S. Vegetable Laboratory in Charleston, South Carolina, are trying to find varieties of collards that whiteflies do not like to eat. For three growing seasons, the scientists planted and studied 14 different varieties of collards. They discovered that whiteflies prefer collards that do not have glossy leaves. So if whiteflies are a problem in your garden, try planting a variety with glossy leaves!
DID YOU KNOW?
The largest fruits in the plant kingdom are pumpkins. The biggest pumpkin ever grown weighed 606.7 kilograms (about 1,338 lb)!

ORIGINS
Most of the cucurbits are native to the Americas. They were among the first plants to be domesticated in the New World. Squash is one of the three sisters (corn, beans, and squash) in the Native American cropping system.

CLASSIFYING CUCURBITS

FAMILY
Cucurbitaceae
There are about 800 species in this family.

GENUS
Cucurbita
In Latin, this means gourd.
There are 14 species in this genus.

SPECIES
Scientists have grouped cucurbits into different species based on differences in the structure of the flowers and other plant parts. Three species commonly grown in gardens are:

- Cucurbita maxima
- Cucurbita moschata
- Cucurbita pepo

USES
Summer squash can be eaten—rind, seeds, and flesh. Winter squashes must be cooked. They are usually baked or steamed. You can also use them in breads, pies, cakes, cookies, and casseroles.

GROWING AND HARVESTING CUCURBITS
Cucurbits are warm-season crops. Plant in full sun at least one week after the last frost date. Summer squash can grow close together, but the vines of pumpkins and winter squash need more space to grow. Add lots of organic matter to the soil. Cucurbits have deep roots and need lots of water, so water deeply and slowly.

I pick summer squashes when their fruits are young, small, and tender. Pumpkins and winter squash won't be ready until later in the fall when they have a hard shell.

You can store winter squash and pumpkins in a dry, cool, airy place for winter use.
**CROSSWORD PUZZLE**

Across
4. A type of summer squash.
7. Cucurbits are native to the ______.
8. Squash, corn, and beans are part of the Native American three ______ cropping system.

Down
1. Pumpkins and squash are all ______.
2. ______ squash should be picked when the rind is hard.
3. Winter squash have long ______.
5. ______ squash should be picked when they are young and tender.
6. The flowers of cucurbits are either ______ or ______.

**Ingredients**
- 4 small summer squash, such as zucchini or yellow crookneck
- 2 tablespoons olive oil
- 1 clove garlic, pressed
- 4 medium tomatoes, diced
- 1 teaspoon dried oregano, or 1 tablespoon fresh oregano, chopped
- salt and pepper
- 1 bunch fresh basil, chopped
- 1/2 cup grated parmesan cheese

**Instructions**
1. Slice clean, unpeeled squash into ribbons, using a vegetable peeler and turning the squash as you go.
2. Warm 1 tablespoon of olive oil in a saucepan on medium heat.
3. Saute the garlic briefly, and add tomatoes and oregano.
4. Simmer uncovered for a few minutes.
5. Heat the remaining oil in a large skillet.
6. Add the squash
7. Stir for several minutes while cooking, until squash is soft.
8. Add salt and pepper to taste, then mix in the sauce.
9. Stir in basil, and transfer to a serving dish.
10. Top with parmesan cheese.

**SPOTLIGHT ON RESEARCH**

Seedlings get the red light treatment

If you go to a pumpkin field at Halloween to find that perfect pumpkin, you may be in for a real shock — a field full of rotten pumpkins! A fungus, called *Phytophthora capsici*, could be the culprit. It has become a threat to many U.S. crops, including cucurbits, eggplants, peppers, and tomatoes.

The good news is, Dr. Babadoost and his colleagues at the University of Illinois have made great progress in stopping the spread of this disease. Fungicides are effective in the short term, but Dr. Babadoost and his team are also looking for long-term solutions.

One promising solution is red light treatment. The scientists have discovered that if you start pumpkins, peppers, and tomatoes under red light in a greenhouse, the plants become resistant to the disease. The scientists grew seedlings under red light for four weeks. Less than 36% of the red-light treated plants became infected after being exposed to the fungus. Between 78 and 100% of the untreated plants became infected and died.

Why does red light make plants resistant to disease? The scientists do not know all the facts. They have found that leaves treated with red light contain chemicals that can fight off the fungus. Perhaps, plants have the genes for producing these chemicals, but these genes only work if the plants are treated with red light.

So far, scientists have found that red light treatment protects young plants, but the plants’ resistance may not last for the entire growing season. Nevertheless, red light treatment may prove to be effective in preventing disease when used with other treatments.


**RIDDLE**

What do you get when you drop a pumpkin?

Answer: Squash!
DID YOU KNOW?
Epazote has been used for centuries to flavor foods and to rid people of intestinal worms. The early Mayans were the first to use it. Many Latin Americans still use it today.

ORIGINS
Epazote is native to Central America.

Native people in central Mexico speak Nahuatl. The name “epazote” comes from the Nahuatl words “eptl” and “tzotl,” which mean “skunk sweat.” As you might guess, epazote has a very strong scent.

CLASSIFYING EPAZOTE

FAMILY
Chenopodiaceae
Members of this family are grown as root and leaf vegetables, flowers, herbs, and grains.

GENUS
Chenopodium
In Greek this means “goose foot.” The name refers to the shape of the leaves of some plants in this genus.

SPECIES
ambrosioides
In Greek this means “food of the gods.” The name probably refers to its strong scent.

THE EPAZOTE PLANT
The epazote plant can reach 60 to 120 cm high.

The yellow-green flowers are in clusters along the stems.

Epazote produces thousands of tiny black seeds in small fruit clusters.

GROWING AND HARVESTING EPAZOTE
Epazote is easy to grow. It grows almost anywhere, but prefers a sandy loam soil and full sun. The plant produces thousands of tiny seeds, and can become a weed in your garden.

USES
Latin Americans use epazote as both a medicine and as an herb to flavor many different dishes.

Epazote has a strong taste, so I only need one or two sprigs to flavor my rice and beans.

I’m glad I planted epazote in my garden. This corn dish with epazote tastes just like my mother used to make when I lived in Mexico.
Across:
3. Because it produces thousands of tiny seeds, epazote can become a garden _______.
5. The scientific name for epazote is Chenopodium _______.
7. Epazote has a strong _______.
8. Epazote is used traditionally as a medicine to rid people of _______.

Down:
1. The early _______ were the first to use epazote.
2. _______ use epazote as an herb to flavor many different dishes.
4. Epazote is native to _______ America.
6. A root vegetable that is in the same family as epazote.

Warning: Large doses of epazote can be poisonous to animals and humans. Always remember that you should consult a doctor before using plants for medicinal purposes.

RIDDLE
What does the worm plant in his garden?
Answer: Wormseed!

BLACK BEANS WITH EPAZOTE
Mexicans often use epazote to flavor beans. It can actually stop gas from forming, a well-known side effect of eating beans!

Ingredients
* canola oil
* 1 large onion, chopped
* 3 cloves garlic, minced
* 2 cups dried black beans
* 1 teaspoon ground cumin
* 1 small dried red chili pepper, crushed
* 1 sprig of fresh epazote
* 6 cups of water
* salt

For toppings:
* green onions
* tomatoes
* sour cream
* chili flakes
* shredded Monterey Jack or cheddar cheese

Instructions
1. Heat oil in a pot. Add onion and garlic and cook until lightly browned. Then add the cumin.
2. Rinse the beans well. Add beans and epazote to the pot and pour in water. Raise heat to high and bring to boil. Reduce heat, cover, and simmer until beans are tender (for 2 to 2 1/2 hours). (Tip: Never soak beans in cold water before cooking, as this gives them a bad taste. To save energy, you can bring them to a boil, and then turn off the heat, cover, and let them sit for an hour before cooking until tender.)
3. Add salt to taste. (Tip: Never salt beans until they are soft, as salt will toughen them.)
4. Serve with chopped green onions, tomatoes, sour cream, chili flakes, and cheese.
**DID YOU KNOW?**
In Mexico, papalo branches are kept in water on café tables, so diners can tear up fresh leaves and add them to beans or tortillas.

**CLASSIFYING PAPALO**
Papalo is a member of the Asteraceae, or Compositae, family. The composites make up the largest family of flowering plants, with about 20,000 species, including sunflowers and daisies.

**FAMILY**
Asteraceae
(or Compositae)

**GENUS**
Porophyllum
In Latin, this means "leaves with pores."

**SPECIES**
ruderale means "growing in rubble or waste places."

Papalo grows well on dry slopes, ravines, and roadsides. It has even been known to grow on nearly bare rock.

**ORIGINS**
Papalo is native to Mexico, Central and South America, growing as far north as Texas. Papalo is being introduced to gardeners in the U.S. as "a great new herb from Mexico."

**THE PAPALO PLANT**

Papalo has egg-shaped leaves, which have a lovely, spicy, sharp scent and flavor.

The flower looks like an unopened marigold bloom, and then it opens into a ball that looks like a dandelion flower.

In the U.S., the plant grows up to 1 meter tall during one growing season. In warmer climates, the plant can grow over 2 meters high.

**GROWING AND HARVESTING PAPALO**
Papalo is easy to grow in sunny places where the soil is well-drained.

You can use papalo instead of cilantro in cooking. Papalo has the advantage that it does not go to seed in the early summer, like cilantro does.

Pick papalo leaves when young for a milder flavor. The flavor gets stronger the older the leaves are.

**USES**
Papalo leaves are used to flavor soups and stews, grilled meats, beans, salsa, and salads. The leaves also are used as a medicinal herb for many ailments, such as high blood pressure, upset stomach, and infections.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
CROSSWORD

Across
2. Papalo is a member of the Asteraceae ___.
3. The species name for papalo, ruderale, means "growing in _____."
5. Because cooking destroys the flavor, use only _____ leaves.
6. Pick papalo leaves when they are _____ for a milder flavor.
7. Papalo leaves are used to flavor _____.

Down
1. You can use papalo from cooking instead of this herb.
2. Papalo cannot survive ______ temperatures.
4. The genus name Porophyllum means "leaves with _____."

GUACAMOLE
You can add papalo to guacamole. Serve guacamole with tortilla chips and tacos, or as a vegetable dip.

Ingredients
* 1/2 onion, finely chopped
* a handful of papalo leaves, finely chopped
* 1/2 teaspoon chili powder
* 1 avocado
* 1 tablespoon lemon juice

Instructions
1. Cut the avocado in half lengthwise. Use a spoon to remove the pit and scoop out the flesh of the avocado. Throw the skin away.
2. Add lemon juice, which keeps the avocado from turning brown.
3. Mash all the ingredients together with a fork.

SALSA CRUDA (RAW SALSA)
Here is a tasty salsa to serve with tacos or tortilla chips.
Mix the following ingredients together:
* 6 medium-sized tomatoes, finely chopped
* 1/2 cup (more or less to taste) finely chopped whole chillies
* 1/3 cup finely chopped onions
* handful of papalo leaves, finely chopped
* 1 teaspoon salt

SPOTLIGHT ON RESEARCH

Papalo chemicals may help ward off insect attacks

The oils secreted from glands in papalo leaves give the plant its spicy scent. Scientists at the University of Ottawa in Canada wanted to find out if these oils play a role in defending the plant against insect attack. The glands that secrete the oils have openings, or pores, that are very large. The scientists were able to insert a micropipette through the pores and into the glands to extract the oil. They put these oils on the larvae of European corn borers and measured their growth rate. They discovered that the oils from the glands alone did not affect growth rate of the larvae. However, when the oils were combined with other compounds also found in papalo leaves, the larvae did grow slower. This suggests that perhaps someday scientists can use the compounds in papalo to make pesticides.

**PEPPERS Science Page**

**DID YOU KNOW?**
When Christopher Columbus set out for the New World, he hoped to find black pepper, a spice that grew in Asia. Instead he found the Arawak Indians eating another plant that was spicy, but not related to black pepper. He called it "red pepper" because it had red pods.

**ORIGINS**
Peppers are native to South America. People there ate wild peppers nearly 10,000 years ago, and farmers began growing the plant over 7,000 years ago.

**THE PEPPER PLANT**
In temperate climates, pepper plants last only one growing season. In tropical areas, they are woody shrubs that grow from year to year.

The fruits come in a variety of shapes, sizes, and colors.

**CLASSIFYING PEPPERS**

**FAMILY**
Solanaceae
The Latin name "solanum" means "nightshade."

**GENUS**
Capsicum
This name comes from the Greek word "kapto" meaning to bite. Hot peppers have a taste that bites your mouth!

The heat in hot pepper is from capsaicin, a substance mostly found in the tip of the fruit, in the ribs, and in the seeds.

**SPECIES**
Three capsicum species are widely cultivated.

Most varieties belong to the species Capsicum annuum.

Capsicum frutescens
Capsicum chinense

**NUTRITIONAL VALUE OF PEPPERS**
Peppers are an excellent source of vitamins A and C.
As green pods turn red, the vitamin content increases. One red bell pepper has ...

... the same amount of vitamin C as 3 oranges.
... the same amount of vitamin A as 1/3 of a carrot.

**GROWING AND HARVESTING PEPPERS**
Peppers thrive in well-drained, fertile soil. They must have a constant supply of water in order to set fruit.

These peppers are ripe and full of flavor. I'll leave the green peppers on the plant until they ripen fully and turn red, yellow, and orange.

**USES**
Peppers are used raw in salads or in cooking. They can be used fresh or dried, whole or ground into spices. The capsaicin in hot peppers is also used in medicine.

Fresh, dried, whole or crushed, cayenne peppers are used in fiery dishes in many parts of the world.

Paprika is a spice that is made from any dried red pepper that is not hot.
CROSSWORD PUZZLE

Across
1. Peppers belong to this genus.
5. Hot peppers are hottest when ______.
6. The name ‘pepper’ was given to the plant by this explorer.
7. Peppers are native to South ______.

Down
2. Peppers belong to this family.
3. One red pepper has as much ______ as a third of a carrot.
4. This is made from dried red peppers that are not hot.

CHILI RELLENOS
Yield: 4 servings

In Mexico, this popular dish is often eaten with rice and refried beans.

Ingredients
* 4 medium-size hot peppers, like Cubanelles or Hungarian hot wax peppers
* 1/2 pound of Monterey Jack cheese
* 6 eggs, separated
* oil
* salsa

Instructions
1. Broil the hot peppers on a tray under the broiler of an oven until brown and blistered. Then turn and broil the other side.
2. Put the peppers inside a paper bag and allow them to steam for 10 minutes. Cut off the stems and pull off the thin outer skin. Slit them about 2 inches down on one side, and remove the seeds.
3. Slice four finger size pieces of cheese, and put one piece of cheese inside each hot pepper. Grate the remaining cheese.
4. Separate the eggs. Beat the egg whites until stiff. In a separate bowl, beat the egg yolks until smooth. Gradually fold the whites into the yolks, keeping the mixture as puffy as possible.
5. Put about one tablespoon of oil in a frying pan. Spoon some of the puffy egg batter about the size and shape of a hot pepper into the pan. Allow it to cook for about one minute, until it is slightly firm. Lay a stuffed hot pepper gently in the batter, spoon some batter on top, and gently flip. Cook on the second side until the egg is slightly golden around the edges. Put the relleno in a baking dish, and prepare the other rellenos in the same way.
6. Cover the rellenos with salsa, and sprinkle with the grated cheese. Bake at 350˚F for 15 to 20 minutes. The rellenos should puff up and the cheese should be melted.
7. Serve with rice and refried beans.

RIDDLE
What sounds cold but burns?

HA! HA! HA! HA! HA!

Answer: Hot chili peppers!

Do spices preserve food?
There is an age-old belief that people living in hot climates use a lot of spices, like hot pepper, to keep their food from spoiling. In contrast, traditional dishes from colder climates are not as spicy, because food does not spoil so quickly at lower temperatures. Two Cornell scientists wondered if these beliefs were really true.

To find out, they tested 43 different spices to see which ones, if any, keep bacteria from growing on meat. At warm temperatures, some bacteria that land on meat will multiply and cause the meat to rot. The scientists found that 30 of the spices they tested actually do slow down the growth of bacteria on meat. Among the most effective spices were garlic, onion, allspice, oregano, hot peppers, thyme, cinnamon, cumin, and cloves.

Next, the scientists looked at 4,578 traditional recipes from around the world. They found that traditional recipes from the hottest climates used the greatest number of antibacterial spices. In fact, all the recipes from the tropics called for at least one spice, whereas a third of the recipes from the north were spice-free. Based on their findings, the scientists concluded that people living in hotter climates traditionally use spices as a way to preserve food.


Garden Mosaics Program Manual 181
DID YOU KNOW?
The club on a deck of cards is a rue leaf.

ORIGINS
Rue is native to the Mediterranean region. Ancient Egyptians, Romans, and Greeks believed that rue could treat many illnesses. During the Middle Ages, Europeans believed it had magical powers.

THE RUE PLANT
Rue is a small evergreen shrub that is shaped like a mound. It grows up to 60 cm high.

The silver-green leaves have a strong smell.

The tiny yellow flowers are in loose clusters above the leaves.

CLASSIFYING RUE
FAMILY
Rutaceae (Citrus family)
There are more than 1,600 species of shrubs and trees in this family. Most have strong scents.

The best-known members of this family are those that produce edible fruits.

GENUS
Ruta
In Latin, this means “bitter.”

Species in this genus have leaves that taste bitter.

SPECIES
graveolens
In Latin, this means “strong smelling.”

GROWING RUE
Rue thrives in well-drained soil in full sun.

Rue is a bush that grows year after year. You can start new rue plants from seeds. You can also start a new plant by cutting a piece of stem and sticking it in potting mix. Sometimes little plants start growing around a rue plant. They can be dug up and replanted.

USES
Today, rue is mostly used as an ornamental plant in rock gardens and herb gardens. It has also been used as a medicine for earaches, an insect repellant, and an herb for flavoring foods. Some processed foods are flavored with rue. Some cosmetics and perfumes also contain rue.

Be careful if you grow rue in your garden. Some people get a rash when they touch it.

I’m going to transplant these little rue plants all around my garden.
CROSSWORD PUZZLE

Across
5. Rue is mostly used as an ______ plant in gardens.
6. Rue is a small evergreen ______.
7. The scientific name for rue is Ruta ______.
8. In the Middle Ages, Europeans thought rue had ______ powers.

Down
1. Rue is native to the ______ region.
2. Rue belongs to the ______ family.
3. Some people get a ______ from touching rue.
4. A ______ on a deck of cards is a rue leaf.

TRY THIS

A RUE SURVEY
Rue has been used as a medicine and “anti-magic” herb for centuries. People have used it to treat almost every kind of sickness. During the Middle Ages, people used rue in a potion to protect themselves from the black plague and to defend against witches. Artists, including Michelangelo and Leonardo da Vinci, thought they could improve their creativity and eyesight by eating rue. Rue is a symbol of regret, sorrow, and repentance. Catholics used sprigs of it to sprinkle holy water on worshippers.

What to do
Find someone who is growing rue. Ask them what they use it for. Also ask if they have heard any stories, sayings, or beliefs about rue. Take notes as you conduct your interview. (You may wish to work with a partner. One person could do the interview, and the other could take notes.) Discuss your findings with others. As a group, prepare a presentation of your findings. This could be in the form of a written essay, a picture essay, a poster, or a video.

SPOTLIGHT ON RESEARCH

Rue: A New Cancer Drug?
Medical researchers are always looking for new drugs to treat cancer. Many of the drugs now used to kill cancer cells also kill a lot of normal cells. This causes serious side effects. Patients often get very ill from the drugs that they have to take. An ideal cancer drug would be one that only kills cancer cells, and not normal cells.

One promising new drug, called Ruta 6, comes from rue! Researchers have been testing the cancer-killing activity of Ruta 6. They treated 15 patients who had brain cancer with Ruta 6 and tricalcium phosphate. Seven of these patients had glioma, which is a cancer of the connective tissue in the brain. Of these, six showed complete regression of tumors. That means their tumors disappeared! Researchers have been working with cancer cells in the laboratory to find out exactly how Ruta 6 works. Results so far indicate that Ruta 6 prevents cancer cells from dividing. Normal cells are not affected. The researchers propose that Ruta 6 could be an effective new drug for treating brain cancers, especially glioma.


RIDDLE
What does a rue plant do when it doesn’t feel like going to work?

Answer: It takes a leaf of absence.
**SNAP BEANS Science Page**

**DID YOU KNOW?**
Snap beans and dry beans come from the same species of plant. Different varieties are harvested at different stages of growth.

Snap bean varieties are harvested when the pods are young and tender.

Dry bean varieties are harvested when the bean pods are dry and the seeds are hard.

**ORIGINS**
Snap beans come from a plant that is native to Central and South America. People were growing beans in Peru over 7,500 years ago — before they were growing corn or making pottery.

**CLASSIFYING BEANS**
Snap beans, also called green or string beans, belong to the Legume family. Many legumes have root nodules where special bacteria, called Rhizobia, live. These bacteria can take nitrogen from the air and change it into a form that plants can use.

**FAMILY**
Fabaceae (Legume family)

There are about 18,000 species in the legume family, which includes peas as well as many other vegetables that have seeds in pods.

**GENUS**
*Phaseolus*
In Latin this means “small boat.”

The bean pod is shaped like a little boat.

**SPECIES**
*vulgaris*
means “common.”

This bean species is commonly grown, both as a snap bean and a dry bean.

**THE SNAP BEAN PLANT**
There are two main types of snap beans - bush beans and pole beans.

**GROWING AND HARVESTING SNAP BEANS**
Snap beans are very easy to grow. Do not plant until all danger of frost has passed and the soil is warm. They like full sun and well-drained soil. Keep well-watered.

Snap beans are ready to pick when they are the width of a pencil and the pods snap when you break them.

**USES**
Snap beans are used in stir fry, stews, and soups. You can also steam them and eat them right away, or add them to a salad.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
Garden Mosaics Program Manual

CROSSWORD PUZZLE

Across
5. ______ beans need support.
6. Beans belong to the genus ______.
8. People in ______ were growing beans as early as 7,500 years ago.

Down
1. Rhizobia bacteria can take ______ from the air and change it to a form plants can use.
2. A bean leaf has ______ leaflets.
3. Green beans belong to the species ______.
4. Many beans have root ______ where special bacteria live.
6. All legumes have their seeds in ______.
7. There are two types of snap beans, pole beans and ______ beans.

SPOTLIGHT ON RESEARCH

Is it possible to raise the calcium level of snap beans?

Snap beans are a good source of calcium. Calcium is very important for building strong bones. Many people, especially children, eat lots of snap beans. Because of this, researchers wanted to find out if it is possible to raise the calcium levels in beans.

First, they did experiments in the field to find out if there are differences in the amount of calcium in different varieties of snap beans. To do this, they raised 64 different varieties in plots at two different locations. They harvested the beans and analyzed the calcium content of each variety. They discovered that some varieties were much higher in calcium than others. That showed that there must be genes that determine the calcium content of beans. Through breeding, it should be possible to improve the calcium content of many varieties of snap beans. They also learned that the amount of calcium in snap beans decreases as the beans mature. Thinner snap beans have more calcium than older beans. This research is important because it could lead to the development of snap beans with a higher calcium content. Snap beans with extra calcium would provide children with another good source, besides milk, of that important mineral.


JOKE

Knock, Knock. Who's there?
Bean.
Bean who?
Bean to any good movies lately?

SNAP BEAN SALAD

Yield: 4-6 servings

Ingredients
* 1 kg (2 lbs) snap beans
* 2 tablespoons oil
* 3 tablespoons vinegar
* 1–2 cloves garlic, minced
* salt and pepper to taste
* 2 tablespoons each of fresh basil, parsley, and oregano, minced (optional)

Instructions
1. Trim the stems from the beans.
2. Cook the beans by steaming until they are bright green (about 5 minutes). Drain beans.
3. Combine the oil, vinegar, garlic, herbs, salt, and pepper in a jar with a tight fitting lid. Place the lid on the jar and shake until well blended.
4. Pour the dressing over the beans and toss.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
**DID YOU KNOW?**
Spanish explorers brought tomato seeds to Europe in the early 1500’s. At that time, most Europeans thought tomatoes were toxic, and would not even taste them. Italians were the first Europeans to use tomatoes as a key ingredient in their cooking.

**ORIGINS**
Tomatoes are native to the Andes Mountains in South America. By the time the Spanish arrived in Mexico, the native Mexicans were growing and eating tomatoes. The name “tomato” comes from the Mexican word “tomatl.”

**USES**
Most tomato varieties can be used for both fresh eating and cooking. However, Italian paste tomatoes are best for cooking into sauces. Large beefsteaks are good for slicing.

**GROWING AND HARVESTING TOMATOES**
Tomatoes thrive in full sun in well drained, fertile soil. Set out transplants one week after the last frost date. Most varieties need to be supported by stakes or cages. Keep well watered. Once fruits begin to ripen, pick them daily.

**THE TOMATO PLANT**
There are more varieties of tomatoes than of any other vegetable. Some varieties are bushy, with fruit produced at the tips of branches. Other varieties are more like vines. The fruits come in many shapes, sizes, and colors.

**CLASSIFYING TOMATOES**

**FAMILY**
Solanaceae
(Nightshade family)

| tomato | eggplant | deadly nightshade | bell pepper | potato | hot pepper |

This family includes many poisonous species, such as deadly nightshade, as well as many edible species.

**GENUS**
Lycopersicon
In Greek this means “wolf peach.”

Scientists gave tomatoes this genus name at the time when most people thought they were poisonous. This wild tomato relative is one of several species in this genus found in Ecuador and Peru.

**SPECIES**
esculentum
means “something that can be eaten.”

Scientists gave tomatoes this species name after people realized that they were not poisonous.

**CLASSIFICATION**

**FAMILY**
Solanaceae
(Nightshade family)

**GENUS**
Lycopersicon
In Greek this means “wolf peach.”

**SPECIES**
esculentum
means “something that can be eaten.”

Scientists gave tomatoes this species name after people realized that they were not poisonous.

**THE TOMATO PLANT**

| tomato | eggplant | deadly nightshade | bell pepper | potato | hot pepper |

Some varieties are bushy, with fruit produced at the tips of branches. Other varieties are more like vines. The fruits come in many shapes, sizes, and colors.

**ORIGINS**
Tomatoes are native to the Andes Mountains in South America. By the time the Spanish arrived in Mexico, the native Mexicans were growing and eating tomatoes. The name “tomato” comes from the Mexican word “tomatl.”

**GROWING AND HARVESTING TOMATOES**

| tomato | eggplant | deadly nightshade | bell pepper | potato | hot pepper |

By the time the Spanish arrived in Mexico, the native Mexicans were growing and eating tomatoes. The name “tomato” comes from the Mexican word “tomatl.”

**USES**
Most tomato varieties can be used for both fresh eating and cooking. However, Italian paste tomatoes are best for cooking into sauces. Large beefsteaks are good for slicing.

**THE TOMATO PLANT**

| tomato | eggplant | deadly nightshade | bell pepper | potato | hot pepper |

Some varieties are bushy, with fruit produced at the tips of branches. Other varieties are more like vines. The fruits come in many shapes, sizes, and colors.

**ORIGINS**
Tomatoes are native to the Andes Mountains in South America. By the time the Spanish arrived in Mexico, the native Mexicans were growing and eating tomatoes. The name “tomato” comes from the Mexican word “tomatl.”

**USES**
Most tomato varieties can be used for both fresh eating and cooking. However, Italian paste tomatoes are best for cooking into sauces. Large beefsteaks are good for slicing.

**GROWING AND HARVESTING TOMATOES**

| tomato | eggplant | deadly nightshade | bell pepper | potato | hot pepper |

By the time the Spanish arrived in Mexico, the native Mexicans were growing and eating tomatoes. The name “tomato” comes from the Mexican word “tomatl.”

**USES**
Most tomato varieties can be used for both fresh eating and cooking. However, Italian paste tomatoes are best for cooking into sauces. Large beefsteaks are good for slicing.

**GROWING AND HARVESTING TOMATOES**

| tomato | eggplant | deadly nightshade | bell pepper | potato | hot pepper |

By the time the Spanish arrived in Mexico, the native Mexicans were growing and eating tomatoes. The name “tomato” comes from the Mexican word “tomatl.”

**USES**
Most tomato varieties can be used for both fresh eating and cooking. However, Italian paste tomatoes are best for cooking into sauces. Large beefsteaks are good for slicing.

**GROWING AND HARVESTING TOMATOES**

| tomato | eggplant | deadly nightshade | bell pepper | potato | hot pepper |

By the time the Spanish arrived in Mexico, the native Mexicans were growing and eating tomatoes. The name “tomato” comes from the Mexican word “tomatl.”

**USES**
Most tomato varieties can be used for both fresh eating and cooking. However, Italian paste tomatoes are best for cooking into sauces. Large beefsteaks are good for slicing.

**GROWING AND HARVESTING TOMATOES**

| tomato | eggplant | deadly nightshade | bell pepper | potato | hot pepper |

By the time the Spanish arrived in Mexico, the native Mexicans were growing and eating tomatoes. The name “tomato” comes from the Mexican word “tomatl.”

**USES**
Most tomato varieties can be used for both fresh eating and cooking. However, Italian paste tomatoes are best for cooking into sauces. Large beefsteaks are good for slicing.

**GROWING AND HARVESTING TOMATOES**

| tomato | eggplant | deadly nightshade | bell pepper | potato | hot pepper |

By the time the Spanish arrived in Mexico, the native Mexicans were growing and eating tomatoes. The name “tomato” comes from the Mexican word “tomatl.”

**USES**
Most tomato varieties can be used for both fresh eating and cooking. However, Italian paste tomatoes are best for cooking into sauces. Large beefsteaks are good for slicing.
CROSSWORD PUZZLE

Across
4. Tomatoes are _____-season crops.
6. Tomatoes are native to _____ America.
7. A type of tomato that is good for cooking.
8. Tomatoes belong to this family.

RIDDLE
How do you fix a broken pizza?

Answer: with tomato paste!

SPOTLIGHT ON RESEARCH
Are wild relatives of crop plants useful?

In 1962, two young plant explorers were studying wild potatoes in Peru. Wild species of many important crops in the Solanaceae family are native to the Andean region. Botanists look for these wild relatives because they may have important traits, such as disease resistance, which can be incorporated into cultivated plants. Eating lunch on a rocky mountain slope, the two plant explorers picked some fruits from a wild tomato plant that was growing nearby. The fruits were green and only the size of marbles, but very sweet. The botanists saved the seeds, and later mailed them to a well-known geneticist named Charles Rick.

When Rick grew the seeds, he realized that the plants were a species new to scientists. The tiny fruits of this wild species were very high in sugar — almost twice as high as that found in most garden tomatoes. After ten years of cross-breeding the wild species with the common tomato, Rick was able to produce new varieties of tomatoes that have the desirable features of both species. They were large and red, and very sweet. The scraggly wild tomato plant with the marble-sized, green tomatoes found on that rocky mountain slope proved to be very useful!


GAZPACHO
Yield: 6 servings

Ingredients
* 6 large tomatoes
* 1 large cucumber, peeled, seeded, and finely diced
* 1 large bell pepper, finely chopped
* 1 medium-sized red onion, minced
* 3 tablespoons red wine vinegar
* 2 tablespoons olive oil
* juice of 1/2 lemon
* 2 to 3 tablespoons chopped fresh parsley to taste**
* 2 tablespoons chopped fresh basil or 2 teaspoons dried basil**
* salt and freshly ground pepper to taste
* hot sauce to taste

**Variation: Use 3 to 4 tablespoons of cilantro instead of parsley and basil.

Instructions
1. Peel the tomatoes by submerging them in boiling water for 15 seconds. Remove to a strainer and rinse under cold water. The skins should slip right off.
2. Core the tomatoes and gently squeeze out the seeds, which are discarded. Chop half of the tomatoes coarsely and puree the other half in a blender. Combine the puree and chopped tomatoes in a large mixing bowl.
3. Blend the remaining ingredients with the tomatoes. Cover and refrigerate. Serve chilled.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
SOIL LIFE Science Page

The soil is home for billions of living things. They are working all the time, helping to create healthy soil for growing plants.

ANIMALS
Animals, such as rabbits and moles, dig holes and help mix up the soil. Their tunnels let air reach plant roots, let water drain through soil, and provide spaces where plant roots can grow.

SMALL CREATURES
Small animals stir up the soil and make holes where air and water can enter the soil. They chew up dead plants into tiny pieces so fungi and bacteria can break them down more easily. They also feed on bacteria, fungi, and protozoa, and help release the nutrients in them for plants to use.

SMALL CREATURES
Protozoa are tiny organisms that can only be seen with the aid of a microscope. When they feed on bacteria, fungi, and other protozoa, they release nutrients that plants can use.

BACTERIA
One teaspoon of topsoil may contain 50 million one-celled bacteria! They help to break down dead plant and animal matter. In doing so, they release nutrients for use by other microbes, small animals, and plants. Bacteria are shaped like rods, spirals, and spheres.

Fungi start the decay of fresh organic matter. They soften up plant matter, and make it easier for bacteria to join in the decay process.

BACTERIA
Nitrogen-fixing bacteria can take nitrogen gas from the air, and convert it into a form that plants can use to grow. Some of these bacteria live in nodules on the roots of beans, peas, and other plants called "legumes."

FUNGI
Fungi start the decay of fresh organic matter. They soften up plant matter, and make it easier for bacteria to join in the decay process.

Fungi usually have two parts. Their thin, thread-like strands grow in soil, rotting logs, and roots. In some fungi, the strands spread from the roots through the soil. In this way, the fungi help plants get nutrients from the soil.

HELPING SOIL LIFE
You can help provide soil life with food, water, and air. When their needs are met, soil organisms will grow and multiply, and keep your soil healthy.

Add organic matter to the soil, and use organic mulch on the surface. Turn over soil as little as possible and do not compact the soil.
WORD SEARCH

All the living things in the list below can be found in soil. Can you find them in this word search?

nematodes protozoa millipedes bacteria ants earthworms slugs fungi spiders sowbugs

TRY THIS

COMPARE SOIL LIFE IN DIFFERENT SOILS

What you need

* an 8 ounce metal can with both lids removed
* plastic bags for soil samples
* small glass jars with lids
* newspaper
* magnifying glass
* paper and pencil

What to do

1. Collect soil samples of the same size from several different locations, such as a garden, lawn, a well-worn dirt path or playground, and a forest. A metal can with the lids removed may be used to collect soil samples. Gently tap the can into the soil, and carefully lift it out of the ground so that all the soil stays inside. Put each soil sample into a plastic bag, and label the bag with the location where the soil sample was taken.

2. Once you have collected all your samples, you are ready to examine them and compare the living things in the different soils. Spread out one soil sample at a time on a newspaper. Carefully sort through the soil and look for signs of plant and animal life. Do you see any thread-like strands of fungi? These are often found on pieces of rotting wood. Put living organisms you discover into glass jars and look at them more closely. Use the magnifying glass to help find very small creatures. Make a chart like the one below to record your results.

3. Repeat step 2 for each soil sample. Then compare your results. Does the number of soil creatures vary? How does the type of the soil affect the amount of soil life it contains?

RIDDLE

Why is the mushroom always the life of the party?

Answer. He is a fungi (fun guy)!

Sources:
SOIL pH Science Page

WHAT IS SOIL pH?
Some substances, like lemon juice, are acids. Acids have a sour taste. Other substances, like aspirin, are bases. Bases have a bitter taste. Substances that are neither acidic nor basic are said to be neutral.

The pH of a substance, such as soil, is a measure of how acidic or basic it is. The pH scale goes from 0 to 14. The halfway point, pH 7, is neutral. A pH value below 7 is acidic; a pH value above 7 is basic.

Each time you move one unit lower on the pH scale, acidity increases ten times. For example, a pH of 6 is ten times more acidic than a pH of 7.

WHY IS SOIL pH IMPORTANT?
Soil pH is important because it affects the health of plants. Before a nutrient can be used by plants, it must be dissolved in soil water. Most plant nutrients dissolve when the soil is slightly acidic. Many plants do well at a pH range of about 6 to 7.

Soil pH levels for best growth of common vegetables

<table>
<thead>
<tr>
<th>pH</th>
<th>Vegetable</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0</td>
<td>Potato 4.8-6.5</td>
</tr>
<tr>
<td>4.5</td>
<td>Carrot 5.5-7.0</td>
</tr>
<tr>
<td>5.0</td>
<td>Onion 5.8-7.0</td>
</tr>
<tr>
<td>5.5</td>
<td>Lettuce 6.0-7.0</td>
</tr>
<tr>
<td>6.0</td>
<td>Tomato 5.5-7.5</td>
</tr>
<tr>
<td>6.5</td>
<td>Cabbage 6.0-7.5</td>
</tr>
</tbody>
</table>

When soil is acidic, minerals, such as iron and manganese, dissolve in soil water. In small quantities, these minerals help plants to grow. However, when the soil is too acidic, these minerals become so abundant that they can harm, or even kill, plants.

HOW DO YOU MEASURE THE pH OF SOIL?
Many liquid dyes change color when they come into contact with acids or bases. You can measure the pH of a soil by saturating the soil with dye for a few minutes, and observing the color of the liquid.

HOW DO YOU CHANGE THE pH OF SOIL?
You can add substances to soil to make them more or less acidic.

You can add lime or wood ash to acidic soils to make the soil less acidic.

You can add sulfur or peat moss to basic soils to make the soil more acidic.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
PUZZLE

Here is a pH scale. Use the letter key below to label the scale:

A Neutral pH
B pH ten times more acidic than 4
C pH 100 times more basic than 7
D soil pH suitable for most vegetables
E pH of a soil with toxic levels of iron, aluminum, and manganese

TRY THIS

TEST THE pH OF SOIL

What you need:
* 2 cups of red cabbage, chopped
* 1 cup of water
* vinegar
* baking soda
* 1 tablespoon of dry soil samples to test
* stove or hot plate
* pot with lid
* strainer
* white dish
* tablespoon
* eyedropper

What to do:
1. Boil a cup of water in a pot. Add the cabbage leaves. Cover the pot, and boil until the water turns dark purple.
2. Strain the cabbage water through a strainer and set it aside to cool. You are going to use this cabbage water to measure soil pH.
3. Put a couple of tablespoons of the cabbage water in a white dish. Add 1/8 teaspoon of baking soda. What color does the cabbage water turn? Then add some vinegar, a drop at a time, until the cabbage water turns another color. What color does it turn?
4. Place about a half teaspoon of a soil sample on a clean white dish. Add fresh cabbage water a drop at a time until the soil is just saturated. Do not flood the soil. Move the dish slightly from side to side for about one minute to allow the cabbage water to react with the soil.
5. Tip the dish so that a drop of the cabbage water will flow from the soil. Note the color of this cabbage water.

Conclusion

Red indicates the soil is too acidic for most crops; blue or green indicates it is too basic; purple or slightly bluish-purple indicates the soil is just right. Does the pH of your soil sample indicate that the soil is suitable for crops?

SPOTLIGHT ON RESEARCH

Plants can change the pH of soil

Grapes are grown in a wide variety of soils in New York State. Farmers wanted to know how soil pH affects the growth of grape vines, so an experiment was conducted to find out. The experiment consisted of seven soil pH treatments. Seven 25-gallon plastic pots were filled with soil from the grape vineyards. Scientists adjusted the soil pH with limestone or sulfur. The original soil pH was 5.2. Ground sulfur was used to create three soil pH treatments more acidic than 5.2. Limestone was used to create three soil pH treatments more basic than 5.2.

Scientists discovered grape plants grew worse in soil with pH below 4.5 compared with grape plants in soils with pH between 5 and 7.5. Interestingly, scientists also discovered the pH of the soil around the roots of grapes planted at pH 4.0 increased to pH 4.5. And the pH of the soil around the roots of grapes planted at pH 7.0 decreased to pH 6.5. Somehow the roots of the grapes changed the soil pH to make it more favorable!


Weeds may serve as soil pH indicators

Some weeds, such as sorrels, docks, dandelions, and Queen-Anne's-lace, grow in poor, acidic soils. Other weeds, such as mustards and thistles, are often found in soils with a high pH. If you have these weeds growing in your garden, change the soil pH, and many of these weeds may leave on their own!

RIDDLE

Why did the cabbage water turn red?

ANSWER: BECAUSE IT SAW THE SALAD

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
WHY TEST SOIL?

By testing the soil, you can determine how suitable your soil is for growing different types of plants. You can also find out if you need to add fertilizer, lime, or other soil amendments to help plants grow. Some tests help you find out if your soil is polluted with toxic substances. High levels of lead and other heavy metals are a health risk, especially for small children.

IS THIS SOIL GOOD FOR GROWING VEGETABLES? DO I NEED TO BUY LIME AND FERTILIZER? IS THERE LEAD IN THE SOIL THAT WILL HARM MY FAMILY'S HEALTH?

TYPES OF TESTS AVAILABLE

A **pH test** measures the acidity of the soil. It tells you how much lime or sulfur should be added to make the soil suitable for growing plants.

A **soil nutrient test** measures the levels of phosphorus, potassium, and other plant nutrients in soil. It tells you how much fertilizer is needed to make up for the lack of certain nutrients in your soil.

A **soil texture test** measures the amounts of sand, silt, and clay in your soil. You can also measure how fast water drains in soil using the soil percolation or “perc” test. The results suggest how to best use or improve the soil.

A **salinity test** tells you if your soil is too salty for plants to grow well.

A **heavy metal test** shows how much lead and other heavy metals are in your soil. If toxic amounts are found, you will be given some safety tips.

HOW TO TEST YOUR SOIL

Garden stores sell kits that you can use to measure the pH and nutrient levels of your soil. These kits will give you fairly accurate results. You can also send a soil sample to a lab for more accurate measurements of pH and nutrient levels.

You can test your soil for **organic matter**. If levels are too low, you will be given suggestions for adding organic matter.

The lab sent me the results of my soil test. Now I know what I have to do to improve my soil.
**TRY THIS**

**COLLECT SOIL SAMPLES FOR TESTING**

Whether you test your own soil, or send it to a lab for testing, the most important first step is to get a good soil sample. A soil sample is only about 1/4 kg in weight, but it should represent all of the soil in the area you are testing. The sample should be made up of 10 soil samples collected from 10 points within 9 square meters of garden. Here is one way to get a good soil sample from your garden.

**What you need**

- a plastic bucket
- spade and trowel (not galvanized)
- a clean sheet of plastic

**What to do**

1. Wash the tools and bucket. Any left-over fertilizer on your tools or hands can contaminate your sample.
2. Open a hole about 20 cm deep with a spade.
3. Remove a 1-cm thick slice from the open hole.
4. Trim both sides of the slice to get a strip 2.5 cm wide.
5. Remove any rocks, grass, dead leaves, or sticks from the surface of the sample.
6. Follow a zig-zag pattern around the garden to collect soil samples from 9 more spots.
7. Thoroughly mix the ten soil samples in a clean bucket. Break up clumps and remove roots, stalks, and rocks.
8. If the soil is moist, place it on a clean sheet of plastic, and let it dry at room temperature. Once dry, your soil sample is ready for testing.
9. If you are sending your soil sample to a lab, get a soil sample box and information sheet. Carefully follow the directions for sending your soil sample to the lab.

**SPOTLIGHT ON RESEARCH**

**Soil Tests Are Reliable**

Suppose you sent identical soil samples to two different labs. Would the two sets of test results be identical? A team of scientists set out to find the answer to this question. They sent 24 soil samples from across the U.S. to several soil testing labs. They found that the results of tests on the same soil sent to different labs were similar. Why was it important for scientists to know this? Now scientists can compare soils from across the country, even though the soils have been tested at different labs.


**QUOTE**

"To be a successful farmer one must first know the nature of the soil." — Xenophon, Greek soldier and historian, 400 B.C.
SOIL TEXTURE Science Page

SOIL PARTICLES

Soil is made up of particles of rock that have broken down over time. These particles vary in size. They are classified into three sizes—sand, silt, and clay. Soil texture is a measure of how much sand, silt, and clay a soil contains.

Soil texture is important because it determines how fast water drains through a soil. It also determines how much water a soil can hold, and can be used by plants.

If a large clay particle were the size of a pea, then a silt particle would be as big as a ping pong ball or bigger, and a grain of sand would be the size of a basketball or bigger.

CLAY

Clay is less than 0.002 mm in diameter. Clay particles are extremely small, and can be seen only through an electron microscope.

Clay feels sticky when wet. It easily forms into a ball and a ribbon at least 5 cm long.

Water drains very slowly through clay soil. Therefore, clay soil remains saturated after a heavy rain. When this happens, there is little air in the soil, and plant roots cannot find oxygen. Clay soils can be difficult for gardeners to plant in.

SILT

Silt is 0.002-0.05 mm in diameter. You can see silt particles only through a microscope.

Silt feels like flour. It forms into a ball that easily breaks apart. If you squeeze it between your thumb and fingers, it will not form ribbons.

SAND

Sand is the largest size rock particle in soil—0.05-2 mm in diameter. You can see sand particles without a microscope.

Sand feels gritty. You cannot make wet sand form a ball that holds together.

LOAM

Loam is a mixture of sand, silt, and clay particles. It is ideal for gardeners. Usually loam is easy to dig, and is neither too dry nor too wet during the growing season.

Composition of different types of loam soils

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
PUZZLE

Look at the pie graphs on the front of this page. They show the composition of different types of loam soils.

1. Which soil would form into the longest ribbon? _____________The shortest ribbon? _____________

2. Which soil would feel the grittiest? ________ the stickiest? ____________

3. Water would drain through which soil the fastest? ________ the slowest? ________

4. Which soil would hold the most water? ____________ the least water? ___________

TRY THIS!

Here are two simple methods for testing the texture of your soil.

1. Soil texture by feel
   1. Take a small handful of soil, about the size of an egg.
   2. The soil should feel as moist as a wrung out sponge. You should not be able to squeeze any water out of it. Spray with water if it is dry. Add more dry soil if it gets too wet.
   3. Form the soil into a ball. Squeeze the soil between your thumb and forefinger. Gently push forward with your thumb to form a ribbon. Measure the length of the ribbon in centimeters.
   4. Look at the chart on this page. Based on your results, what is the texture of your soil?

2. Soil texture by settling
   1. Fill a liter-size jar 2/3 with water. Add soil until the water level is nearly to the top of the jar.
   2. Put the top on the jar and shake vigorously. Set the jar on a level surface and wait for the particles to settle. The smallest particles may take several days to settle.
   3. Observe the distinct layers of soil that settle in the jar. Are some layers thicker than others? What kinds of particles make up these layers?

SPOTLIGHT ON RESEARCH

Farmers in different parts of the world use soil texture to decide what crops to grow

All over the world, farmers have their own ways of classifying soils. In Burkina Faso, for example, farmers classify soils by texture and by how suitable they are for different crops. A sandy soil called Bflisi is suitable for growing peanuts. A loamy soil called Bfloogo is suitable for both red and white sorghum. Soil scientists recognize that they can learn from local farmers about classifying soils.


RIDDLE

What did the clay soil say when the sun came out?

Answer: “You crack me up!”

<table>
<thead>
<tr>
<th>Soil Texture</th>
<th>How It Feels</th>
<th>How It Handles</th>
</tr>
</thead>
<tbody>
<tr>
<td>sand</td>
<td>gritty; does not stain fingers</td>
<td>does not form a ball</td>
</tr>
</tbody>
</table>
Soil is made of rock particles, organic matter, and spaces—or pores. The pores are filled with water and air. The soil is home to billions of living things.

**ROCK PARTICLES**
Rock particles come from rock that has been broken down by weathering.

Moving water wears down rocks with the help of particles of sand and gravel.

Many plant nutrients, such as potassium and phosphorus, come from rock particles. Nutrients within rocks are not readily available to plants. But as rocks are weathered, mineral nutrients are slowly released and become available to plants.

Wind blows sand against rock and wears it away.

**ORGANIC MATTER**
Organic matter is broken down—or decomposed—by bacteria, fungi, and other tiny organisms that live in soil. It provides nutrients for plants. Organic matter improves the soil in other ways, too.

Adding organic matter makes this clay soil lighter, and easier to work with when you are planting a garden.

**PORE SPACES**
Animals create pore spaces as they burrow through the soil.

Moles are animals like mice that make tunnels in the soil.

An earthworm pulls leaves down into its tunnel.

A millipede makes tunnels in the soil.

Spaces exist in soil because rock particles do not fit together perfectly. Soil pores are filled with air and water. Plant roots and soil life use the air in soil when they burn food to make energy. Plants take up water that is stored in the pore spaces. The nutrients they need to grow are dissolved in the soil water.

Organic matter acts like a sponge in this sandy soil. It holds water and nutrients for my plants. Now I don’t have to water so often.
Unscramble these words. They are all things that can be found in soil:
GICORAN TEMART COKR SATECLIPR
RESOP ARI
RAWET VILING NITGHS

TRY THIS

WHAT'S IN YOUR SOIL?

Are all soils the same, or do they differ? Are they all made up of the same kinds of soil particles and living things? Take a closer look and find out!

What you need
* trowel or small shovel
* newspaper
* magnifying glass
* tablespoon

What to do

1. Go to a site where plants are growing, such as a garden or wooded area. Gently dig up the top few centimeters of soil, and place the soil on newspaper. There may be a top layer called soil litter, which is made up of partly rotted plants, dead insects, and other organic materials. Separate out all the animals and plant parts that you can find in the litter.

2. Below the litter, you may find almost completely decayed organic matter. This may be a layer or mixed in with the soil. Decayed organic material is usually black in color.

3. Now observe the soil samples more closely. Place a tablespoon of soil on a sheet of paper. Spread the soil around, and look at it carefully through a magnifying glass. Is there anything in the soil that looks like a piece of plant or animal? A piece of rock? Try to separate out the different kinds of soil particles.

4. Look at the size of the soil particles. Are they large grains of sand or small like clay?

Rub some of the soil between your thumb and forefinger. Does it feel gritty, silky, smooth, or sticky?

5. Do the soil particles form clumps? Do the clumps have a shape? Do the clumps easily break apart or stay together when you touch them?

6. Record your observations in words or drawings.

7. Go to a second site where there are no plants growing and the soil is compacted. For example, this might be along a well-worn path or in an empty lot. Repeat steps 1 - 6 with soil from this site. Compare this soil sample to your first one. Discuss your findings with others.

It is possible to make artificial soil

Throughout Europe, the U.S., and other industrialized countries are thousands of “brown field sites.” These are areas that used to be mines and factories. Such unsightly places are stripped of healthy soil, filled with rubble, and nearly lifeless.

People also have created millions of tons of waste that needs to be disposed of. This includes sludge from sewage and water treatment plants, waste products from factories and power plants, and household wastes. How can you get rid of all these wastes, and restore brown field sites at the same time?

Engineers at the Imperial College of Science, Technology, and Medicine in England are working on a creative solution. They mix together rubble, sewage sludge, wood chips, plastics, and whatever else they can find locally to produce artificial soil. Once they find a non-toxic artificial soil in which plants can thrive, they can use it to transform brown fields into green open spaces!


“...only rarely have we stood back and celebrated our soils as something beautiful and perhaps even mysterious. For what other natural body, worldwide in its distribution, has so many interesting secrets to reveal to the patient observer?”

— Les Molloy, scientist and award-winning author from New Zealand

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
WEEDS Science Page

DID YOU KNOW?
Weeds are plants growing where they are not wanted. They can quickly grow and take over bare patches of soil. Weed seeds can be buried in the soil for many years. When they are uncovered, they can still sprout and grow.

Weeds are plants growing where they are not wanted. They can quickly grow and take over bare patches of soil. Weed seeds can be buried in the soil for many years. When they are uncovered, they can still sprout and grow.

WEED SEEDS
Most weeds make lots of seeds. Weeds also have unique ways to spread their seeds.

Dandelion seeds have parachutes that float in the wind. Burdock seeds hitch a ride on fur and clothing.

WEEDS ARE HARDY
Most weeds can grow very rapidly, and they can grow in many different places.

Fireweed

WEEDS GROW FROM PLANT PARTS
Many weeds can also sprout from roots, stems, or leaves.

Field bindweed grows lots of roots. New plants sprout up from the roots.

WEEDS CAN BE FRIENDS...
While weeds can become pests in fields, lawns, and gardens, they can also be useful. They can be used as food or medicine for humans and animals. They can protect and improve the soil. They can also be beautiful to look at!

Weeds quickly sprout and grow on bare soil, and keep it from washing or blowing away.

Many weeds, such as comfrey, have been used as food and medicine for hundreds of years. Deep-rooted weeds can bring up nutrients from deep in the soil. When they die, weeds add organic matter to the soil.

...AND CAN BE FOES!
It can be difficult to get rid of weeds, especially in areas where humans have disturbed the soil. Weeds can reduce crop yield in fields and gardens.

Where did all these weeds come from?

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.

www.gardenmosaics.org
**CROSSWORD PUZZLE**

**Across**
2. Grows where it is not wanted.  
5. Weeds can be ______ in gardens.  
7. A plant that lives from year to year.  
9. Completes its life cycle in one season.

**Down**
1. Weeds have many ways to spread ______.  
3. Some weeds can be used as ______.  
4. A plant that lives for two years.  
6. Some weeds can ______ from roots or stems.  
8. Weeds can reduce crop ______.

**TRY THIS**
WHERE DO WEEDS COME FROM?

**What you need**
- about 4 liters (1 gallon) of soil from three different places, such as a garden, an empty lot, a roadside, or a lawn
- 3 growing containers of the same size (about 30 cm [1 ft] in diameter)
- hand lens
- 3 popsicle sticks
- paper and pencil
- weed identification book

**What to do**
1. Use a hand lens to search each soil sample for weed seeds. Remove any large stones or debris from the samples.
2. Punch drainage holes in the bottom of the three containers, if needed.
3. Place each soil sample in a container. Use the popsicle sticks to label where they came from.
4. Place the containers outside or in a well-lit room. Water the soil in each container for a few days until some weed seedlings sprout. Try to identify the weed seedlings.
5. Count the number of weeds over a 4-week period or longer, and measure the area of the soil surface in each container. Then calculate the number of weeds per square meter (or per sq yd) for each soil sample.
6. Summarize your results on a chart and/or a graph. For example, you can put soil type on the x-axis and weeds/m² on the y-axis.
7. Can you think of a hypothesis for why more weeds are growing per m² in one type of soil than in another? How might you test this hypothesis?

**SPOTLIGHT ON RESEARCH**

**Velvetleaf Seeds Are Not All Alike**

Velvetleaf is a large weed that produces thousands of seeds. It can cost farmers millions of dollars in lost crop yields. Scientists are studying velvetleaf seeds, so that they can find better ways to control it. In one study, scientists at McGill University in Canada tried to answer these questions: Do large velvetleaf seeds sprout (germinate) better than small ones? Do seeds from one plant sprout better than seeds from another?

They randomly picked 10 velvetleaf plants, and then collected up to 1000 seeds from each plant. They separated the seeds from each plant by weight—small, medium, and large. Then they put the seeds in growth chambers. Inside the chambers, the moisture, temperature, and daylight were similar to what one would find outside in the spring.

More medium-sized seeds sprouted than heavier seeds. Some of the heavier seeds became dormant, that is, they may sprout at some later time. The percentage sprouting also depended a lot on which plant the seeds were from.

The scientists believe that the differences between seeds may help velvetleaf plants survive. Different seeds may sprout and grow better under different conditions. The live but dormant seeds could be a kind of insurance for the velvetleaf plant. Even if all the velvetleaf plants in a field die off, the dormant seeds in the soil could sprout later and grow into new plants.


Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
**DID YOU KNOW?**

Common purslane is a weed in gardens and farm fields throughout much of the world. But for hundreds of years, many people have also used it as a vegetable and a medicine.


**ORIGINS**

No one knows for sure where common purslane originally came from. Many botanists believe it is native to the desert in North Africa. Its fleshy stems and leaves help it to thrive in dry desert soil.


**CLASSIFYING COMMON PURSLANE**

**FAMILY**
Portulacaceae
(purslane family)

The flowers of the purslane family may have several petals, but only 2 green sepals under the petals.

**GENUS**
Portulaca

In Latin, this means “little door,” which refers to the door-like opening of the seed pods.

**SPECIES**
oleracea

In Latin, this means “edible.”


**FRIEND . . .**

Common purslane can be eaten raw in salads or it can be cooked like spinach. It is very high in Omega-3 fatty acids and vitamins A and C.

I can pull up this purslane and use it in a salad...


**. . . OR FOE?**

Common purslane plants can quickly take over a farm field or garden. Their leaves and stems are full of stored water, so the plants can survive even the worst dry periods. Each common purslane plant can produce thousands of seeds. Broken bits of stems or leaves can also take root and grow. Within a few weeks of sprouting, a plant can make ripe seeds.

... but I won’t leave any cut stems on the ground because they can root and grow.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
Growing Purslane as a Power Food

Plant foods are not only important for nutrition. They also contain substances that protect us against diseases. Omega-3 fatty acid is one of these important substances. It helps prevent a wide range of medical problems, including heart disease, cancer, and arthritis.

All the cells in our bodies are surrounded by cell membranes, which contain fatty acids. The cell membranes are important because they allow nutrients into our cells and allow waste products to exit the cells. Thus, Omega-3 fatty acid helps to keep all the cells in our bodies healthy.

Purslane contains a lot of Omega-3 fatty acid. Scientists at the University of Connecticut are trying to find out how to grow purslane so that it has the maximum amount of Omega-3 fatty acid. They grew purslane in the greenhouse in many different ways. For each treatment, they measured the amount of Omega-3 fatty acid in the purslane leaves. The scientists found the Omega-3 fatty acid content was highest when plants grew under low light but with many hours of light each day.

Based on these studies, the scientists can now recommend ways to grow purslane so that it is rich in Omega-3 fatty acid. In winter (low light intensity and short days), grow it in the greenhouse and use lights to increase day length. During summer (high light intensity and long days), shade it to lower light intensity.


Purslane Salad

4-6 Servings

Ingredients
- 4 cups (1 liter) young purslane plants
- 2 tablespoons (30 ml) olive oil
- 1 tablespoon (15 ml) fresh lemon juice
- 1 teaspoon (5 ml) salt
- 1 teaspoon (5 ml) ground black pepper
- 2-3 cloves of garlic, minced

Instructions
1. Rinse and drain the purslane. Taste the stems. If they have a mineral taste, then strip the leaves off, and use only the leaves. Chop into 3/4 in (2 cm) pieces.
2. Add the oil, lemon juice, garlic, salt and pepper.
3. Toss and serve at once.

Variation
Add 1 cup (240 ml) of plain yogurt, 1 cup (240 ml) chopped cucumber, and 2 tablespoon (30 ml) chopped fresh mint. Toss and serve.
FIELD BINDWEED Science Page

DID YOU KNOW?
Field bindweed is used as a medicine. It is also a weed that can be very difficult to destroy. Its vines can wrap around and choke many crop plants and flowers.

A piece of its root only 5 cm (2 in) long can grow into a new plant. Its seeds can still sprout and grow after being buried in the soil for 50 years!

THE FIELD BINDWEED PLANT
Field bindweed is a perennial. Its long, slender stems trail on the ground or wrap around other plants.

The vines grow 0.3 to 1.8 meters (about 1-6 ft) long.

The funnel-shaped flowers are white to pink in color.

The leaves are shaped like arrowheads.

The seeds grow in pods about 5 mm (0.2 in) long. On average, one plant produces about 550 seeds.

The plant has a thick taproot, which can grow to a depth of 7 meters (about 25 feet). Many side roots grow out from the taproot.

ORIGINS
Field bindweed is native to Europe and Asia. People accidentally brought it to other parts of the world. Its seeds were mixed in with grains that were being shipped.

CLASSIFYING FIELD BINDWEED

FAMILY
Convolvulaceae (morning glory family)
The family is commonly called the morning glory family because most of the flowers open in the morning, and close again in the afternoon.

GENUS
Convolvulus
In Latin, this means "to wrap around."

The stems of this family run along the ground and wrap around plants and other objects.

SPECIES
arvensis
"Arvensis" is Latin for "of the field." Field bindweed grows as a weed in orchards, and in fields of corn, small grains, sugar beets, and grapes.

For many years, people have used field bindweed as a medicine. Native Americans have used it to treat spider bites, fevers, and wounds. Europeans have used it as a laxative.

FRIEND . . .

. . . OR FOE?
Field bindweed can quickly choke out other plants. The roots take up a lot of water from the soil, so crops and flowers growing near field bindweed cannot get enough water.

I'll keep cutting down the shoots. That way the food stored in the roots will be used up and the plant will eventually die. I'll also put a heavy layer of straw on the soil.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
HOW FAST DOES FIELD BINDWEED GROW FROM ROOTS?

What you need
* several pieces of field bindweed side roots, total length of at least 50 cm (1 ft 8 in)
* measuring stick marked in centimeters
* scissors
* 25 popsicle sticks
* paper and pencil
* garden plot, about 1 meter² (about 11 ft²)

What to do
1. Prepare the garden plot. Remove all weeds and smooth out the top of the soil.
2. Use the measuring stick to mark out 9 squares each 30 cm x 30 cm (1 ft x 1 ft) in size. Mark the corners of each square with a popsicle stick.
3. Measure and cut different lengths of roots, as follows:
   3 pieces 3 cm (about 1 in) long
   3 pieces 5 cm (about 2 in) long
   3 pieces 7 cm (about 3 in) long
4. Label 3 popsicle sticks with each length — 3 cm, 5 cm, and 7 cm (a total of 15 sticks).
5. To make the locations of each treatment plot random, close your eyes and pick the popsicle sticks one at a time. Place them in the squares from left to right, top to bottom.
6. Read the label in each square to find out what length of cutting to plant there. Plant one root cutting in each square, about 1-2 cm (about 1/2 - 1 in) deep.
7. Draw a sketch of your test plot, labelling the root length planted in each square, in case the sticks are lost.
8. For each square, observe how fast shoots grow from the bindweed roots. Measure the lengths of the stems at least once per week.
9. Summarize your results on a chart. For example, you could put length of root on the x-axis and height of tallest shoots on the y-axis.
10. Can you explain your results? Did the longer roots produce bigger or more shoots? If not, how might you explain your results?
DID YOU KNOW?
In 9th century England, the yearly calendar was divided into four quarters. August 1st, called Lammas Quarter, marked the start of one of the quarter periods. On that day people had a festival to celebrate harvesting the first wheat of the season. They often ate a leafy green at that time of year, which they called lambsquarters!

THE COMMON LAMBSQUARTERS PLANT
Lambsquarters is an annual. It grows from about 1 to 2 meters (3-6 ft) high in one growing season. Leaves are shaped sort of like triangles. Tiny green flowers are means white. The tips of branches. They have no petals. The underside of leaves are covered with a white powder.

CLASSIFYING COMMON LAMBSQUARTERS

FAMILY
Chenopodiaceae

GENUS
Chenopodium
In Greek, this means "goose foot." Some members of this family have leaves shaped like a goose foot.

SPECIES
album
In Latin, "album" means white. The flowers and undersides of leaves are whitish.

A FRIEND...
Young lambsquarters can be eaten raw or cooked like spinach. It contains more iron, protein, vitamin B2, and vitamin C than either spinach or cabbage. Seeds can be eaten raw. They can also be dried and ground, and then used in hot cereals or baked goods. In winter, song birds eat the tiny lambsquarters’ seeds.

...OR FOE?
One lambsquarters plant can produce 75,000 seeds. The seeds can sprout and grow in almost any soil. Lambsquarters can outgrow most crop plants, and quickly take over any bare soil.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
CROSSWORD PUZZLE

Across
3. Lambsquarters belongs to this family.
6. The leaves of lambsquarters are shaped like a ______ foot.
7. The underside of lambsquarters leaves are ______.
8. In winter, the seeds of lambsquarters are an important food for ______.

Down
1. The scientific name for lambsquarters is Chenopodium album.
2. One lambsquarters plant can produce 75,000 ______.
4. Young lambsquarters leaves can be eaten raw or ______.
5. The flowers of lambsquarters have no ______.

RIDDLE
What do you get when you divide a lamb into four equal parts?

Answer: Lambsquarters

CAUTION: Never pick weeds to eat unless you are very sure you can identify them. Do not harvest weeds that grow near roadsides or that may have been sprayed with chemicals. These plants may not be safe to eat.

STEAMED LAMBSQUARTERS
Yield: 4 servings

Ingredients
* 1 pound (0.9 kg) lambsquarters (about four handfuls; tender, young leaves and stalks are best)
* 1 cup (240 ml) water
* 1 teaspoon (5 ml) olive oil
* 1 teaspoon (5 ml) garlic, finely chopped
* salt

Instructions
1. Steam the greens until tender-crisp (about three to five minutes).
2. Remove the greens from the steamer and place onto serving dish.
3. Sprinkle olive oil over the greens.
4. Top with minced fresh garlic.
5. Sprinkle with salt to taste.
**DID YOU KNOW?**
One redroot pigweed plant can produce over 100,000 seeds! Some can live up to 40 years in the soil.

**ORIGIN**
Redroot pigweed is native to tropical America. Today it can be found on every continent.

**THE REDROOT PIGWEED PLANT**
Redroot pigweed is an annual. The plant can reach to 2 meters (6 1/2 ft) high in one growing season. The black, shiny seeds sprout and grow in late spring and early summer when the soil becomes warm. Small green flowers are tightly packed in tall spikes at the top of the plant. It flowers in late summer and fall.

**CLASSIFYING REDROOT PIGWEED**

**FAMILY**
Amaranthaceae
In Greek, this means everlasting. Amaranth flowers last much longer than most other flowers.

**GENUS**
Amaranthus
Since ancient times, people have used plants in this genus as a grain crop, a vegetable, a decorative flower, and for dying cloth.

- A. gangeticus
  - (leafy vegetable)
- A. cruentus
  - (grain)
- A. caudatus
  - (ornamental flower)

**SPECIES**
*retroflexus*
In Latin this means "bent back.” The species was given this name by Swedish naturalist, Carl Linnaeus, in 1753. We still use the name today.

**FRIEND...**
Small plants that do not yet have flowers are used in salads or are cooked like spinach. The seeds can be roasted and ground to make flour. The whole seeds can be cooked to make cereal.

**...OR FOE?**
Farmers and gardeners consider redroot pigweed to be one of the worst weeds. Each plant can produce thousands of long-lasting seeds that can sprout and grow in almost any soil.

I'm hoeing out this redroot pigweed before it goes to seed. They say, "One year of seeding means seven years of weeding!"

---

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
**STIR-FRIED PIGWEED WITH COCONUT**

This delicious recipe is from Southeast Asia, where pigweed leaves are often eaten as vegetables.

**Serves 4-6**

**Ingredients**

- 4 cups (1 liter) young redroot pigweed leaves
- 2 tablespoon (30 ml) oil
- 1 onion, finely chopped
- 1 teaspoon (5 ml) crushed garlic
- 1 teaspoon (5 ml) grated fresh ginger
- ½ tablespoon (2.5 ml) ground tumeric
- 1 teaspoon (5 ml) chili powder
- ¼ teaspoon (1.3 ml) salt or to taste
- 3 tablespoon (45 ml) dried coconut flakes


Instructions

1. Wash the leaves and shake off the water. Roll them in a bundle and chop finely.
2. Heat the oil and fry the onion, garlic, and ginger over low heat, stirring frequently, until onions are soft.
3. Add the ground tumeric and chili powder, then the leaves. Stir-fry for a minute, and then sprinkle with salt and a few tablespoons of water.
4. Mix in coconut.
5. Cover and simmer for 5 minutes.

---

**SPOTLIGHT ON RESEARCH**

**Using Pigweed to Clean Up Polluted Soil**

At many nuclear weapons testing sites, soil is polluted with radioactive wastes. Also, some nuclear power plants accidentally release radioactive wastes, which end up in the soil. Removing all this polluted soil would cost hundreds of billions of dollars.

However, it is very important to clean up these soils, because radioactive wastes are very harmful to human health. The wastes can be taken into the body by eating food grown in polluted soil. They can also be taken in by breathing polluted air or drinking polluted water. Once in the body, these wastes give off radiation that can cause cancer.

Scientists have been searching for cost-effective ways to clean up polluted soils. They have discovered that some plants can take up radioactive wastes through their roots. The wastes collect in the plant shoots without harming the plants. Once fully grown, the plants can be removed from the area. In this way, the soil can be cleaned up.

Scientists at Cornell University grew three plant species in polluted soil at the Brookhaven National Laboratory in New York State. Nuclear testing took place at this site in the 1950s and 1960s. The scientists tested how well the plants could take up radioactive cesium and strontium from the polluted soil. They discovered that redroot pigweed took up more radioactive cesium and strontium than the other two plant species, partly because it grew the fastest and biggest. They estimate that if they grow two crops of redroot pigweed a year, it will take 7 years to clean up half the radioactive strontium, and 18 years to clean up half the radioactive cesium at this site.


**Puzzle**

Fill in the blanks using one of the numbers at the end of the sentences:

1. A redroot pigweed seed can lie in the soil for over ______ years before sprouting.
   - (a) 5 (b) 20 (c) 40
2. A pigweed plant can grow ______ meters high.
   - (a) 1 (b) 2 (c) 3
3. A redroot pigweed plant may produce ______ seeds.
   - (a) 100 (b) 1,000 (c) 100,000

---

**CAUTION**: Never pick weeds to eat unless you are very sure you can identify them. Do not harvest weeds that grow near roadsides or that may have been sprayed with chemicals. These plants may not be safe to eat. Only eat young redroot pigweed plants. Do not eat redroot pigweed that has grown on heavily fertilized soil. It may contain toxic amounts of nitrogen, and taste bitter.

---

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.

Garden Mosaics Program Manual 207

---

**DID YOU KNOW?**
People think yellow nutsedge is one of the world’s worst weeds. Yet in the United States, many poor farmers in Florida and Georgia used to grow yellow nutsedge to feed to hogs and cattle. The tubers also made tasty snacks for farm families during the winter.

**ORIGINS**
Yellow nutsedge, sometimes called chufa, is native to the Middle East. It was an important food crop in ancient Egypt.

**THE YELLOW NUTSEDGE PLANT**
Yellow nutsedge is a perennial. Its tubers over-winter in the ground. When the weather becomes warm, the tubers send up shoots. The plant grows very well where the ground is wet.

- The plant is 20 to 90 cm (8 in to 3 ft) tall.
- The stem of a sedge has three sides while a grass stem is round.
- The flower has no petals, but 3-9 spikes, which bear seeds.
- V-shaped leaves are bright green when young, but become pale green with age.
- The round tubers are ready to dig up when the seeds appear.

**THE YELLOW NUTSEDGE PLANT**
- **FAMILY** Cyperaceae
- **GENUS** Cyperus
- **SPECIES** esculentus

**CLASSIFYING YELLOW NUTSEDGE**

<table>
<thead>
<tr>
<th>FAMILY</th>
<th>spike rush</th>
<th>yellow nutsedge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FAMILY</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyperaceae</td>
<td>spike rush</td>
<td>yellow nutsedge</td>
</tr>
<tr>
<td>In Latin, this</td>
<td></td>
<td></td>
</tr>
<tr>
<td>means sedge.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>papyrus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow nutsedge looks a lot like grass, but it belongs to a completely different family.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**FRIEND . . .**

Today, yellow nutsedge is grown in West Africa, Spain, and China. The tubers can be boiled and then eaten as a vegetable. They can be ground and used to make a drink. They can also be toasted, ground, and used as flour. The tubers are high in fatty acids that can protect against heart disease. They are also high in iron and potassium.

**. . . OR FOE?**

Yellow nutsedge can invade farm fields and gardens, especially where the soil is wet. It is very difficult to control.

- A single plant can make several thousand tubers. Each tuber can sprout and grow into a new plant. Underground stems (rhizomes) can also sprout and grow into new plants.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
CROSSWORD PUZZLE

Across
2. Yellow nutsedge belongs to this family.
4. Yellow nutsedge can sprout and grow from ______.
5. Yellow nutsedge is an important food for ______.

Down
1. The ______ of yellow nutsedge are V-shaped.
2. Yellow nutsedge is sometimes called ______.
3. The species name esculentus means ______.
4. The tubers of yellow nutsedge can sprout and grow where the soil is ______.
5. ______

CAUTION: Never pick weeds to eat unless you are very sure you can identify them. Do not harvest weeds that grow near roadsides or that may have been sprayed with chemicals. These plants may not be safe to eat. If you let yellow nutsedge grow in order to harvest tubers, be very careful not to let the plant invade new areas. Clean your garden tools to prevent the spread of tubers.

How Do You Grow Chufas?

In the summer, people who live in Valencia, Spain, often enjoy a refreshing drink called horchata de chufas. Since this drink is becoming more and more popular, farmers are growing more and more chufas—yellow nutsedge tubers.

Scientists at the University of Valencia have been trying to find better ways to grow chufas. In field trials, they found that chufas growing in sandy soils are larger and taste better. In clay soils, the tubers are smaller, get thicker skins, and do not taste as good. They also found that adding nitrogen fertilizer increases the growth of stems and leaves, but decreases the growth of tubers. Adding potassium and phosphorus fertilizer increases the growth of tubers.


HORCHATA DE CHUFA

This refreshing summer drink is popular in Spain and Mexico. The nutsedge tubers can be harvested in the spring or fall.

Yield: 10-12 servings

Ingredients
* 2.2 lb (1 kg) chufas
* 2.2 lb (1 kg) sugar
* 5.3 quarts (5 l) water
* a cinnamon stick

Instructions
1. Wash the chufas well. Rinse in clean water and remove hairy fibers.
2. Soak in water for at least 14 hours.
3. Rinse the chufas again in clean water, until the water runs clear.
4. Put chufa in a blender and blend until it is a soft paste. Add a little water if necessary.
5. Add water to the paste. Place the cinnamon stick into the mixture, and stir.
6. Store in a cool place for 2 hours. Then add sugar and stir until dissolved.
7. Strain the mixture as many times as required until a fine, milky liquid remains. Horchata de Chufa will stay fresh in the fridge for about 4 days.

Knock, knock!
Who's there?
A nut!
A nut who?
A nut sedge you’re a nut too! (It takes one to know one!)

HORCHATA DE CHUFA

www.gardenmosaics.org

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
Action Projects

Overview
This Section provides guidelines for conducting Garden Mosaics Action Projects with youth, gardeners, and other members of the community. You can view Action Projects that Garden Mosaics participants have conducted in the past on the Garden Mosaics website (www.gardenmosaics.org).
What are Action Projects?

Action Projects often serve as the culmination of a longer-term Garden Mosaics program. Youth apply what they have learned through the *i-m-science investigations* and other activities to help gardeners and their community. Action Projects can also be conducted as stand-alone projects, or in conjunction with other civic and environmental education programs. Whatever way you conduct Action Projects, be sure to have youth submit the online *Action Project Form* so that others can learn about and be inspired by their accomplishments.

You can use Action Projects to motivate youth who want to do more than learn about the neighborhood, garden, and gardeners. Many older youth want to do something meaningful for the gardeners, to create something beautiful for the garden, and to answer questions about gardening that come up during the *i-m-science investigations*.

Action Projects are carried out in cooperation with the gardeners and other neighborhood adults. They vary widely, depending on the type of youth program, and the interests of the youth and adults. For example, youth at a summer art camp can make sculptures for the garden, or youth in a community action program could meet with elected officials to explain the importance of community gardens to their neighborhood. Youth choose an Action Project related to Art in the Garden, Food Systems, Garden Design, Garden Enhancement, Garden Research, Land Use, or Nutrition and Health.
ACTION PROJECTS

Action Projects allow you to make a difference in your community. You can design your own Action Project based on what you have learned from the gardeners and what interests you.

SOME IDEAS FOR ACTION PROJECTS

PRESENT!
We’re going to tell you about our community garden and how it helps our neighborhood.

CREATE!
Let’s paint a mural on that wall!

PUBLISH!
This recipe sounds healthy... and good to eat!

BUILD!
When this path is finished, people in wheelchairs will be able to reach their garden plots more easily.

EDUCATE!
Look at this sign!

CELEBRATE!
We helped the gardeners grow and cook this food.

EXPERIMENT!
This experiment may help gardeners control garden weeds.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
ACTION PROJECTS

WHAT TO DO

1. Do Background Research
   ✓ Read some of the Action Project reports on the Garden Mosaics website.
   ✓ Discuss what you have learned about the gardeners and the neighborhood.

2. Decide what to do
   ✓ Discuss your ideas with the gardeners.
   ✓ Fill out the Action Project Planning Form.
   ✓ Discuss the steps you will take and who will be responsible for what.

3. Do it
   ✓ Carry out your Action Project.

4. Tell others about your Project
   ✓ Share the results with gardeners and other community members.
   ✓ Describe your Action Project using the Online Action Project Form and submit it to the Garden Mosaics website.

Garden Mosaics is funded by the National Science Foundation Informal Science Education program, and by the College of Agriculture and Life Sciences at Cornell University.
Chapter 1. Conducting an Action Project

Ideas for Action Projects
You and your group can choose an Action Project in any of these areas. You can view actual examples of Action Projects that other groups have completed on the Garden Mosaics website (www.gardenmosaics.org).

Conducting an Action Project

**Choose the Project**

1. **At the start of your project, let the youth know they will be doing an Action Project.** They will use what they learn from their interviews and observations in the gardens and neighborhood to plan the project.

2. **Have the youth read about other groups' Action Projects on the Garden Mosaics Action Projects online database.**

3. **Decide on the general topic of the Action Project.** You can make this decision before the youth program starts. For example, if you are running a summer science program, you can decide that the Action Project will focus on garden research.

We have included guidelines for Action Projects in the following areas:
- Art in the Garden
- Food Systems
- Garden Design
- Garden Enhancement
- Garden Research
- Land Use
- Nutrition and Health

- **Garden Research**
  Conduct a planting experiment, internet research, soil measurements, or observations in the garden.

- **Garden Enhancement**
  Plant flowers, construct interpretive signs, or build a wheelchair-accessible raised bed.

- **Nutrition and Health**
  Host a garden banquet using foods from the garden, or make a cookbook from gardeners’ recipes.

- **Art in the Garden**
  Make an art object with a gardening theme and present it to the gardeners at a gift-giving ceremony.

- **Food Systems**
  Celebrate the garden harvest, research aspects of the local food system, or create a neighborhood food map.

- **Garden Design**
  Design a new garden for your school or community center.

- **Land Use**
  Create a green map of your neighborhood, or talk to elected officials about the value of community gardens.
4. Help the youth decide on the specific Action Project based on the results from their i-m-science investigations. If you will be conducting a Garden Research Action Project, during the i-m-science investigations the youth should ask the gardeners what information they might need about plants, insects, soils, and related areas. The youth can conduct research to answer the gardeners’ questions and report back to the gardeners what they discovered. Or if you will be conducting an Art in the Garden Project, the youth should ask the gardeners about their interests in garden improvements and be on the lookout for an area of the garden that could be “spruced up,” such as a fence that would look nice with a mural painted on it. In addition to taking into account the gardeners’ input and the youth’s own observations, you will need to make sure the project is feasible given the time and resources available to your group, and the youth’s ages and abilities.

**Plan for the Project**

5. **Have the youth complete the Action Project Planning Form.** Included in the plan should be the objectives, steps needed to reach each objective, background information needed, materials needed, the role of each member of the group, how they will involve gardeners and others (e.g., scientists, artists), and how they will present their project.

**Collaborate with Others**

6. **Discuss ideas for the Action Project with the gardeners to see if the plan addresses the gardeners’ interests.** The youth may revise their ideas based on these discussions.

**Understand the Science Related to your Project**

7. **Use the Science Pages and other resources** to help the youth understand the concepts and skills necessary to conduct the project. Have the youth conduct the activities on the Science Pages and guide them in a discussion to make sure they understand the concepts.

**Conduct the Project**

8. **Have the youth conduct the Action Project, including taking photos** (See Photo Guidelines, Section VII).

**Share your Results**

9. **Have the youth present their results to gardeners and other community members.**

10. **Have the youth describe their Action Project using the online Action Project Form and submit their form and photos to the Garden Mosaics website.**
Youth can create any number of art objects to give to gardeners for their Art in the Garden Action Project. For example, they might create mosaics from tile fragments, paint a mural, or make paper from plant fibers. They could build a scarecrow, install bird houses, make dye from garden plants, or create a photographic display of the garden.

Other possibilities include making a book of plant sketches or pressed plants found in the garden. The youth should ask the gardeners what kind of art they might enjoy and use this information to decide on their Art in the Garden Action Project. Although the examples here come from community gardens, you should be able to adapt them for home or school garden or other youth programs.

**Ideas for Art in the Garden Action Projects**

- Create a “Garden Mosaic” from tile fragments
- Make birdhouses and bat houses
- Create or decorate container plantings
- Make paper from plant fibers
- Create a collection of pressed plants
- Create a photo book of the garden
- Make a sketchbook of garden plants
- Paint a mural along a fence
- Build a scarecrow
- Make dyes using plants from the garden
Example Projects

Following are example Art in the Garden Action Projects. Our intent here is to give you a range of possibilities, which we hope will prove useful as you help youth develop their own project.

Create a “Garden Mosaic” from Tile Fragments

The youth notice that the path in front of the garden shed is dusty and no longer has grass. They think it would be nice to put in stepping stones or a short brick path. They discuss their idea with the gardeners and talk about possible materials. They find out that the gardeners have a pile of salvaged bricks that they could use. The youth decide to create colorful mosaics on the bricks by joining the tile fragments with grout and attaching them to the brick with a tile adhesive. They contact a local plumber and a home improvement store and learn that they have a large quantity of broken tile fragments. The youth then arrange the bricks in front of the shed to see how the path will look and dig out the area for setting the bricks. They dig about an inch deeper than the bricks so that they can place a layer of sand to create a more level surface. Then they adorn the bricks with mosaics and set them in the ground.

Make Paper from Plant Fibers

The gardeners are very helpful and generous of their time during the i-m-science investigations. The youth hold a brainstorming session to think of a gift that they could make for the gardeners as a sign of their appreciation. During the session, they decide to make paper using the garden plants. They research paper making from plants on the Internet. They ask the garden manager for permission to use a few of the hollyhock plants in the common area. They use the stems of the hollyhock along with other fibers and materials as the ingredients for their paper. Once the paper is made, they present it to the gardeners as a gift.

Build a Scarecrow

During the i-m-science investigations several gardeners mention that squirrels and certain birds feed on their corn, sunflowers, and fruit trees. This is particularly a problem at harvest time. The youth think it might be neat to make scarecrows. After doing some Internet research, they find that there are many different types of scarecrows and just about any old material can be used. When they talk to a local Cooperative Extension agent they learn that scarecrows can sometimes be effective and are worth trying. They talk with the gardeners about their idea and the gardeners think that a few scarecrows that are put up during the growing season would be useful. The youth hold a scarecrow making day in the garden.
**Create or Decorate Container Plantings**
During the Neighborhood Exploration, the youth notice a construction site that is throwing out old planter boxes and a sink. They talk about how these materials could be used for container plants and decide to share their ideas with the gardeners. The gardeners are not interested in the old sink (although several gardeners think it would be fun, the garden manager does not approve). However, they think that if the youth decorated the planter boxes, they would look nice by the shed. The youth decorate the boxes and plant flowers in them.

**Make Dyes Using Plants from the Garden**
When the youth interview one of the gardeners during the Gardener Story, they learn that she enjoys knitting and used to dye her own wool. The gardener offers to teach the youth how to make dye from plants. With the help of the gardener and a book from the library, the youth make several different colored dyes from garden flowers. The group dyes some cotton fabric to make a tablecloth for the picnic table in the garden.

**Create a Photo Album of the Garden**
During the Neighborhood Exploration, the youth enjoy using cameras and creating a photo collage. They decide they would like to make a photo album of their activities, the gardeners, and the changes in the garden over the summer. At the end of the summer, they present the photo album to the gardeners.

**Make a Sketchbook of Garden Plants**
Several of the youth enjoy drawing. The group decides to create a poster of drawings of garden plants to give to the gardeners as a gift of appreciation. They talk to a local artist about scientific drawings. At the end of the program they present their poster to the gardeners.

**Make a Collection of Pressed Plants from the Garden**
During the Gardener Story, the youth learn that the gardeners would love to have children carry on their gardening traditions, but the children do not even know the names of the plants. The youth decide to create a book of pressed plants from the garden, labeling the plants and pointing out identifying features. They talk to a local botanist about the best way to press plants. They also copy the relevant Science Pages describing the different plants and include the copies in the book. They give the book to the gardeners to use when children visit the garden.
Build Bird Houses and Bat Houses
The garden manager mentions during the Community Garden Inventory that the garden used to have a bird house but it had to be taken down because it was falling apart. The gardeners say they would like to attract more birds and even bats to keep down the mosquitoes in the garden. The youth decide to make and install bird and bat houses. They research bird and bat houses on the Internet and contact a technology teacher who is willing to help with the project. The youth construct the houses and present them to the gardeners at a final garden celebration.

Create a Mural
During the Community Garden Inventory, the youth observe that the fence bordering the garden is covered with flaking paint and old graffiti. They talk with the gardeners about creating a mural and secure permission of the property owner to paint on the fence. The youth next search the Garden Mosaics website for photos of other community gardens with murals. They also look at Science Pages to get ideas for garden science concepts that might be displayed on a mural. They then contact a local artist and art teacher to help them work with the gardeners to sketch out a plan for the mural. Finally, they hold a mural day during which the youth and gardeners paint the pictures on the fence.
Chapter 3.
Food Systems Action Projects

In the Food Systems Action Project, youth learn about our complex, modern day food system, starting at the local level. For example, they may create a neighborhood map showing sites where residents can buy or grow food. Or they could arrange for extra garden produce to be donated to a soup kitchen. Another possibility would be to conduct a garden produce taste testing party for children and their parents. The youth’s conversations with the gardeners and observations in the neighborhood during the *i-m-science investigations* will help them define their Food Systems Action Project. Although the examples here come from community gardens, you should be able to adapt them for home or school garden or other youth programs.

Ideas for Food Systems Action Projects

- Help establish a local produce stand
- Write a letter to school officials asking to include more local produce in school lunches
- Conduct a vegetable taste testing party for children
- Find out how much money gardeners save by growing their own produce
- Create a neighborhood food map
- Host a "local harvest" banquet
- Conduct a survey of neighborhood residents about access to fresh produce
- Arrange for extra garden produce to be donated to a soup kitchen
Example Projects
Following are example Food Systems Action Projects. Our intent here is to give you a range of possibilities, which we hope will prove useful as you help the youth develop their own project.

Produce Stand
Youth learn during the *im-science investigations* that there are few places to buy vegetables in the neighborhood. During the Community Garden Inventory, several of the gardeners mention that they would be interested in selling their produce at a Saturday market. Similarly, several neighborhood residents visiting the garden mention that they would like to buy fresh produce. The youth meet with staff from local government agencies and non-profit organizations that work on food systems issues, and ask for advice on how they could start a produce stand. They work with the gardeners who are interested in selling produce and arrange for permission to have a stand in the neighborhood. The youth assist the gardeners with their stand by helping to harvest vegetables, make signs, and sell the produce. This activity is recommended for older youth and young adults.

Neighborhood Food Map
Youth learn during the *im-science investigations* that the gardeners obtain most of their produce from the garden. They are curious about how other residents in the neighborhood obtain food, especially fresh vegetables, and decide to create a map of all the places in the neighborhood where residents could obtain fresh food. To make their map, the youth walk through the neighborhood, taking notes and photographing places food is purchased (e.g., stores, green markets, or corner stands), grown (e.g., backyard, community, or school gardens), and distributed (e.g., soup kitchens). The youth visit several convenience and grocery stores along the route to ask about the produce and see if it is fresh. They then create a map/photo collage that highlights the places where food is available in the neighborhood. They laminate the map and give it to the gardeners, along with a presentation about their findings.

Food Systems Research
The youth are surprised when they learn how much produce the gardeners grow and wonder how much money they might be saving. The youth decide to conduct a study to determine the cost of the garden grown vegetables if purchased in local markets. They talk with the gardeners and create a list of the most commonly grown vegetables. They also ask the gardeners to estimate the amount produced of each vegetable. The youth then divide the list so that each person is responsible for finding out the cost at the local market of one or two vegetables. For each vegetable, the youth determine the amount of money saved by multiplying the amount the gardeners produce by the price in the store. They organize their results in a table and make a presentation to elected officials about the value of food produced in the garden to local residents.
Taste Tests
During the *in-science investigations*, the gardeners share their produce and the youth are surprised to learn how good fresh vegetables taste. The gardeners express concern that young people have poor diets and do not appreciate fresh vegetables. The youth decide to conduct a taste testing party for children from the neighborhood. They buy tomatoes from the store and help the gardeners harvest several tomato varieties from the garden. They then make a list of the different tomatoes and give each one a number. Next they cut up the tomatoes into small pieces and place them on plates with their numbers. (The children should not know which tomatoes are from the store and which are from the garden.) The children then taste each tomato, and vote on the tomato they like best. The youth share information on the importance of nutrition and eating healthy foods with the children. The gardeners then share tomatoes with the children to take home to their families.

Letter Writing
During their visits to the garden, the gardeners share tomatoes, squashes, and other fresh vegetables with the youth. These vegetables taste far better than those in the store or in school lunches. The youth feel that schools, nursing homes, and other institutions should be serving more fresh and locally grown produce. They write letters to their school administrators to emphasize the importance of fresh, locally grown food and request the use of more of these foods in their cafeterias.

Sharing the Harvest
The gardeners are always sharing their produce with garden visitors, including the youth. The gardeners mention that although they take home produce and share it with friends and family there is always more than they can use. The youth ask the gardeners if they would be interested in sharing their harvest with an organization that serves meals to the hungry. The gardeners are open to this possibility and the youth find a church soup kitchen that is interested in donations of fresh produce. They work with the gardeners and the church staff to arrange the donations.

Food Access Survey
The gardeners appear to get most of their produce from the garden. However, the youth are wondering if there are fruits and vegetables that the gardeners purchase instead of grow. Where do they go to buy them? Also, where do people in the neighborhood who do not garden go to get their produce? The youth decide to create a survey for the gardeners and neighborhood residents that asks these questions. They contact a social studies teacher to help design and implement the surveys. They compile their results and host a presentation to share their information with the gardeners and community residents.

Local Harvest Celebration
The gardeners grow a diversity of vegetables and the youth have enjoyed the opportunity to try some unfamiliar foods. They decide that it would be fun to have a celebration featuring food grown in the garden, as well as other locally grown fruits and vegetables. They learn from their local Cooperative Extension that many foods, such as apples, are grown just outside the city limits. The youth visit the city’s Saturday Farm Market to learn about local produce and how it is grown. They share their findings with the gardeners and get permission to host a celebration for the gardeners and neighborhood residents. They use the Science Pages and the Internet to print out information on the different fruits, vegetables, and herbs they will feature. They then buy produce at the Farm Market and help the gardeners harvest their own produce. For the celebration, they set up tables for people to sample the different foods, and to read about how and where the foods are grown. Everyone enjoys the bounty of the region!
Chapter 4.
Garden Design Action Project

In Sacramento California, Garden Mosaics youth discovered that there was a long waiting list to get plots at a local community garden. They decided to design a garden at their school and to provide plots for community members. To help design the new garden, they interviewed gardeners at the existing garden.

Unlike the other Action Project chapters where we present several ideas, for the Garden Design Action Project we have included a detailed set of steps for designing a garden on our website only (www.gardenmosaics.org). In this chapter, we simply introduce the Garden Design Action Project. This Action Project is suitable for older youth.

Through the Garden Design Action Project, youth use landscape architecture methods to create a design for a new garden. For example, youth may want to create a plan for a school garden or a garden next to a community center. Regardless of where the youth build the garden, you should obtain permission from the necessary authorities.

It is important for youth to learn from experienced gardeners about considerations in designing a garden. You can adapt the Community Garden Inventory investigation to incorporate questions that will be helpful in designing a new garden. This will allow the youth to see what kinds of things are important to gardeners and to get ideas about their own garden.

Occasionally, the youth may have the opportunity to work with gardeners to redesign an area in an existing community or home garden. If this is the case, you can adapt the Community Garden Inventory to include questions about the needs of the gardeners already in the garden. The garden manager should be able to help you determine whether there might be any interest in redesigning part of an existing garden.

In addition to learning about the needs and interests of existing gardeners, it is important to learn about the ideas of others who might use the garden. Landscape architects call this step “client needs.” For example, in the case of a school garden, it will be important for the youth to talk to teachers, school officials, and other students to find out about their interests and what is possible at the site.

After determining client needs and interests, landscape architects describe the existing site, including taking measurements and photographs and making sketches of plants and other features. Finally, they complete their garden plan, which includes creating a design, drafting the plan, and making the final master plan. Thus, the steps in a Garden Design Action Project are:

1. Client Needs and Interests
   - Community Garden Inventory
   - Other Client Needs
2. Site Description
   - Measuring the Site
   - Taking Photographs
   - Photo Collage
   - Sketching
3. Garden Plan
   - Design Charette
   - Draft Plan
   - Master Plan

See www.gardenmosaics.org for complete instructions on how to conduct a Garden Design Action Project.

21 The Garden Design Action Project was written by Daniela Tavares, with assistance from Ann Marie Kennedy.
Chapter 5.
Garden Enhancement
Action Projects

In the Garden Enhancement Action Project, youth make improvements or build something for the garden. For example, youth can construct raised beds or a compost system. Or they might want to help gardeners repair or paint a fence. The youth should ask the gardeners questions about what is needed in the garden during the *i-m-science investigations*. They should then use this information to decide what to build or improve as part of their Action Project. Although the examples here come from community gardens, you should be able to adapt them for home or school garden or other youth programs.

Ideas for Garden Enhancement Action Projects

- Build a compost system
- Construct a bench
- Paint a picnic table or a fence
- Build a water collection system
- Organize and participate in a day where youth help gardeners weed their plots
- Create and put up interpretive signs
- Plant flowers
- Arrange for mulch to be donated and delivered to the garden
- Paint a mural along a fence
- Build a raised bed
- Plant flowers

226 Section VI. Action Projects
Example Projects
Following are example Garden Enhancement Action Projects. Our intent here is to give you a range of possibilities, which we hope will prove useful as you help the youth develop their own project.

**Raised Beds**
During the *i-m-science investigations*, the youth learn that the garden needs a wheelchair accessible raised bed. (Such a bed would need to be higher than the beds currently in the garden.) The youth ask the garden manager if they could meet with other gardeners and talk about ideas for the new bed. To prepare for their meeting, the youth read the *Raised Beds* Science Page and talk with an occupational therapist to learn about needs of people in wheel chairs. They also spend time observing in the garden to see what location might be best for the new bed. They make several phone calls to local hardware stores to figure out the cost of supplies. They then develop a design for the bed and present it to the gardeners and explain the different materials that could be used and their costs. They ask the gardeners to help them select which materials and location would be best. The youth obtain the materials and supplies and organize a work day to construct the bed. The gardeners get soil delivered from the city parks department to fill the bed.

**Compost System**
During the *i-m-science investigations*, the youth observe that gardeners are throwing weeds and clippings into the trash. They also note that the soils are gray and appear to lack organic matter. They discuss with the gardeners the possibility of building a compost bin to recycle the weeds and clippings. They use the *Composting* Science Page to learn about the science behind composting, and the Internet to learn how to construct a compost pile. Then they contact a local "Master Composter" from Cooperative Extension to speak with their group and the gardeners about different types of compost systems. They work with the gardeners to build a compost system from scrap lumber. Finally, they create a poster for the gardeners about how to maintain the composting system.

**Mulch**
During the *i-m-science investigations*, the youth observe that one gardener is mulching his plots, and that his plants seem to be healthier during hot, dry weather. The youth talk with the other gardeners and learn that they also would like to mulch their plots, but have not been able to find a source of mulch. The youth become familiar with different kinds of mulching through reading the *Mulch* Science Page. Next they contact a local greening organization that works with community gardens and ask them to help locate a source of mulch. It turns out that mulch is available through the Parks Department and the greening organization will deliver it. The youth organize a garden workday with other youth from the neighborhood. They help the gardeners to haul and spread the mulch in their plots.
**Watering System**

During the *i*m-science investigations, the youth observe that the gardeners do not have access to the city water supply and obtain water from barrels located throughout the garden. The barrels get filled by rainwater, and so are empty during dry spells. They talk with an urban gardening expert to learn more about different types of systems used by gardeners to collect water. They notice that the casita in the garden has a sizable metal roof and might be perfect for collecting rain water. They discuss their ideas with the gardeners and present several options for constructing a rainwater collection system. Finally they help the gardeners obtain the materials and organize a workday to build the collection system.

**Interpretive Signs**

During the *i*m-science investigations, the youth note that children’s groups often visit the garden. They also observe that, due to their limited ability to speak English, the gardeners have a difficult time talking to the youth about their plants and planting practices. The youth ask the gardeners if they might work together to create interpretive signs for children visiting the garden. They talk with the gardeners about what would be the most important things they want the children to learn. They then use the appropriate Science Pages to learn more about the garden plants and practices, and laminate appropriate color Science Pages for posting in the garden. They also develop some of their own signs for the garden.

**Plant Flowers**

During the *i*m-science investigations, the youth observe that on both sides of the entrance to the garden, there is a section of bare dirt that is at times dusty or muddy. They notice another garden during their Neighborhood Exploration that has a beautiful flower bed planted along the fence. They talk with the gardeners about putting in a flower bed on both sides of the entrance. The gardeners are interested and take a walk with the youth to observe the flower bed at the other garden. The youth obtain seeds through a local greening organization and then plant the flower bed with the gardeners.

**Create a Mural**

During the Community Garden Inventory, the youth observe that the fence on the side of the garden is covered with flaking paint and old graffiti. They talk with the gardeners about creating a mural and secure permission from the property owner to paint on the fence. The youth next search the Garden Mosaics website for photos of other community gardens with murals. They also look at Science Pages that are of interest to them to get ideas for garden science concepts that might be displayed on a mural. They then contact a local artist and art teacher to help them work with the gardeners to sketch out a plan for the mural. Finally, they hold a mural day during which the youth and gardeners paint the pictures on the fence.
Chapter 6.
Garden Research Action Projects

In the Garden Research Action Project, youth conduct research to answer a question that the gardeners or youth raise during the *im-science investigations*. You can help the youth decide which questions and methods are best, given the gardeners’ interests, and time and other constraints of your program. The focus of the Garden Research Action Projects can be on plants, soils, water, light, or insects or other animals in the garden. Although the examples come from community gardens, you should be able to adapt them for home or school garden or other youth programs.

Youth can conduct observations, take measurements, or learn from other scientists to answer any number of questions. Alternatively, they may want to conduct a longer-term research project involving an experiment. Experimental research usually incorporates the three other types of research.

**Types of Garden Research Action Projects**

- **Learn From Other Scientists**
  Contact a local expert or conduct an Internet or library search.

- **Measurements**
  Take measurements of soils or plants.

- **Observations**
  Make observations of plant growth in relation to the environment and formulate preliminary hypotheses that could be tested by an experiment.

- **Experiments**
  Conduct a controlled experiment to test the effect of one factor on plant growth.

Often an experiment begins with observations in a garden. For example, youth may observe that collard plants growing in the shade seem to have fewer leaves than collards growing in the sun. This may lead to a question that the youth want to investigate further: What is the effect of sunlight on growth of collards? The youth may form a hypothesis: Collards growing in the sun are more productive than collards growing in the shade. The first step in testing their hypothesis would be to conduct background research, or learn from what other scientists have already discovered. This can be done either by talking with scientists or reading about their work, often on university or government agency websites. Based on what they learn from other scientists, the youth may want to refine their question and hypothesis. They likely also will learn about methods for testing their hypothesis. Conducting the experiment can involve taking measurements and making additional observations.
If they are conducting research on a practice the gardeners are using, the youth need to be aware of issues related to gardener knowledge and scientific knowledge. Gardeners generally use practices that they feel give desired results, but there may not be any scientific research to back their claims. For example, many gardeners use companion planting to reduce pests, but there is little research that shows this is effective. The youth need to be aware that experiments conducted under controlled conditions are one form of knowledge, but that the knowledge of gardeners based on many years of experience is also important. You will need to work with the youth so they present their research results but also are respectful of the gardeners’ knowledge. The youth should also be open to further research where their results may conflict with what the gardeners believe is true from experience.

Example Projects
Following are examples of each of the types of Garden Research Action Projects. Our intent here is to give you a range of possibilities, using different research methods and resulting in different actions. We hope these examples prove useful as you help youth develop their own project.
Learning from other Scientists

Youth can use the Internet or library to research a question that comes up during the i-m-science investigations. They should be aware of the source of information on the Internet. If a website is developed by university or government scientists, you can generally count on the scientific information being accurate. Commercial and other websites sometimes promote a product or point of view rather than present unbiased information.

Example Learning from other Scientists Project: Insecticide Safety

During the i-m-science investigations, the gardeners express concern about the safety of an insecticide they are using. The youth decide to research the question: “What are the safety risks of this insecticide?” They decide to use the Internet and local experts to answer their research question. They search for sites describing the pesticide and its risks, and compile information from university and government websites. They next ask an entomologist to come to the garden to discuss insecticide uses and risks. They present their results in a poster for the gardeners. They also laminate the poster and post it along the fence in the garden for others to read, and report their results to the Garden Mosaics website using the online Action Project Form.

Ideas for “Learning from other Scientists” Action Projects

- What are the health risks of a pesticide used by the gardeners?
- How do farmers and gardeners in other cities grow taro?
- What lead levels in soil are dangerous to children?
- Are marigolds effective in protecting plants from soil insects?
- What varieties of trees grow well in urban gardens?
- Does using treated lumber in raised beds contaminate the soil?
- What varieties of collards are resistant to whiteflies?
- How do the “beneficial” insects attracted to cilantro benefit other plants?
- What are the health risks of a pesticide used by the gardeners?
Measurements

Some questions can be answered by taking measurements on soil or plant samples. Whenever youth take measurements, they need to decide where and when to sample. This is because the plants and soils may vary depending on where they are in the garden. The research question should guide decisions about where and when to sample. For example, if the gardeners want to know whether lead is a problem in soils, the youth would need to ask if they are concerned about soils only in the plots with vegetables or also where flowers and other ornamentals are grown.

In some cases, the youth may collect samples and send them to a lab for testing. For example, youth could measure plant height or soil pH, but they will need to send plant or soil samples to the lab to be tested for lead or other contaminants. Check university and other website guidelines for collecting and sending in samples, and for costs associated with different analyses.

Example Measurements Project: Soil Percolation

During the *i-m-science investigations*, the youth observe that the soils look very hard and that water seems to collect on top of the soils. They decide on their research question: “How fast does water move in soils in each plot in the garden and in the paths between the plots?” They next read the *Water in the Garden* and *Watering Garden Plants* Science Pages to gain background understanding for their research. They discuss their question with the gardeners to get their input and to explain what they will do. They use the “Soil Perc” test to measure the soils in each plot and along the paths (see Try This, *Water in the Garden* Science Page). They discover that water percolates very slowly in some plots, so they contact their Cooperative Extension agent to learn how to reduce soil compaction. The youth and gardeners conduct a workshop for other gardeners to share the results, demonstrate the Soil Perc test, and discuss ways to enhance water movement in soils. They also send photos of their project and report their results to the Garden Mosaics website using the online Action Project Form.

Ideas for “Measurements” Action Projects

- How fast does water move through the soil?
- What is the texture of the soil?
- How much rain did we get each week during the summer?
- What is the lead level of the soil?
- How many tomatoes are produced on one plant?
- What is the soil pH?
- How many hours a day are the garden plots in the sun?
- How many days does it take mustard greens to mature?
- What is the maximum and minimum temperature each day?
Observations
Youth can conduct observations in the garden and compile them into reports that are useful to the gardeners.

Example Observations Project: Plant List
The youth realize that the Hmong gardeners use names for insects in their own language but aren’t always familiar with the English names. The youth decide to answer the question: “What are the English and Hmong names of all the plants in the garden?” Working with the gardeners and a horticulturalist from a nearby university, the youth observe and compile a list of the plants growing in each plot. They also take photos of each plant they observe. Throughout the observations, they refer to the Science Pages to learn more about the plants. They then develop a table of the English and Hmong names of each plant. They create a poster with the names and a photograph of each plant and present it to the gardeners. They also add their plant list to the Community Garden Inventory Form that they submitted to the Garden Mosaics website. Finally, they report their results, including photos, to the Garden Mosaics website using the online Action Project Form.

Ideas for “Observations” Action Projects

- What insects feed on leaves of plants in the garden?
- What insects pollinate flowers in the garden?
- What plant diseases are found in the garden?
- What vegetables are commonly found in the garden?
- What medicinal herbs are found in the garden?
- What different methods do gardeners use to control weeds?
- What weeds are present in the garden?
- What plants do birds visit in the garden?
- What plants are wilted on hot, dry days?
Experiments

Experiments usually involve all three research methods we have discussed so far: learning from other scientists, taking measurements, and making observations. Youth conducting experiments define a hypothesis in addition to defining a research question. The hypothesis makes a prediction about what the results will show. For example, youth in Chicago may hypothesize that a variety of a plant developed for northern climates will grow better than a variety developed for the south.

When conducting an experiment, the youth should vary only one factor at a time. For example, if they test two varieties of a plant, the only factor they should vary is the plant variety. (The plant variety is called the “treatment.”) Everything else, including soils, watering, and light, should be kept the same for both varieties. If two or more factors are varied at the same time (e.g., amount of fertilizer and plant variety), then it will be very difficult to say which factor caused any differences in plant growth.

Ideas for “Experiments” Action Projects

- What is the effect of mulch on growth of weekds?
- Does planting marigolds around the edge of a raised bed reduce insect damage to kale?
- What is the effect of adding compost to soil on soil drainage?
- Does corn grow more rapidly when planted with beans?
- Is hot pepper solution effective in controlling insects?
- Does applying manure result in larger bitter melons?
- What variety of chili peppers produces the most chiles?
- Does weeding result in larger eggplants?
- What is the effect of adding compost to soil on soil drainage?
Example Experiments Project: Use of Homemade Sprays to Deter Insects

During the *i-m-science* investigations, youth learn that gardeners use a homemade soap spray to deter insects on amaranth. The youth define their research question: “Is the soap spray effective in controlling insects on amaranth?” They use the *Controlling Insects* and *Conducting an Experiment* Science Pages to gather background information. They then ask the gardener if they can conduct a controlled experiment in the garden. They decide what measurements they will take (e.g., number of insects observed during 15 minutes in the morning and afternoon five days/week over a two-week period, number of leaves with insect damage). They create a data form for taking the measurements. They also choose two plots with amaranth, making sure that other factors (soil, sunlight, water) are the same for both plots. The youth next apply soap solution to amaranth in one plot and leave the amaranth in the other plot alone. They record the number of insects they observe and the amount of damage done to the leaves in both plots. To analyze their results, the youth average the measurements for each plot. They then summarize the results by making bar graphs of the average number of insects and average number of leaves with insect damage for each treatment (plants sprayed and not sprayed). In presenting the results to the gardeners, the youth are sensitive to the fact that if their results do not show an effect of the soap solution, this does not necessarily mean the gardeners are wrong in all cases. The educator leads the youth in a discussion of what other factors might affect their results (e.g., unusually dry or wet weather), and of the importance of years of experience versus an experiment. The educator asks the youth how they might conduct further research to determine the effectiveness of the spray. They report their results, including photos, to the Garden Mosaics website using the online *Action Project Form*. 
Chapter 7.
Land Use Action Projects

In the Land Use Action Project, youth learn about the relationship of people to land in their neighborhood. For example, the youth may meet with a city planner, survey vacant lots, or create a Green Map™ of the neighborhood. Or they might learn about threats to green spaces and gardens and conduct a campaign to support community gardens. The youth’s interactions with the gardeners and their observations of the neighborhood during the i-m-science investigations will help them define their Land Use Action Project. Although the examples here come from community gardens, you should be able to adapt them for home or school garden or other youth programs.

Ideas for Land Use Action Projects

- Create a Green Map of your neighborhood
- Inventory multiple gardens and submit the data to the Community Garden Inventory
- Make a presentation to government officials about the importance of community gardens to neighborhoods
- Write a letter to local politicians about the need to preserve and create new community gardens
- Organize a garden celebration and invite local politicians
Example Projects

Following are example Land Use Action Projects. Our intent here is to give you a range of possibilities, which we hope will prove useful as you help the youth develop their own project.

**Inventory Multiple Gardens**

The youth have conducted the Community Garden Inventory *i-m-science investigation* and submitted their data online. They are aware that many community gardens in the neighborhood have not been added to the inventory. They decide to conduct the Community Garden Inventory and submit the data for all the gardens in the neighborhood. They work with Garden Mosaics to also post the data on the website for their youth organization.

**Create a Green Map™**

During the Neighborhood Exploration, youth observe the variety of ways that people use space in the neighborhood. They think it would be interesting to create a map of the neighborhood that would be a guide for residents and visitors, as well as a tool for influencing policy makers. They use the Aerial Photographs and Topographic Maps Science Pages to learn more about land use. They visit the Green Map™ website ([www.greenmap.org](http://www.greenmap.org)) and learn about how other youth have mapped their community. After discussion and reviewing a street map, they establish the boundaries of their map. They next break into teams to look for the different types of places identified on Green Maps™, including farmers’ markets, parks, public and community gardens, recreation areas, and pollution sources. When their map is complete, they make copies and distribute them to the gardeners, community members, and local officials.

**Garden History**

Youth learn from the garden manager that the garden is on the site of a former parking lot. The youth are amazed that what was once a barren landscape is now a thriving vegetable and flower garden. They realize, however, that because of polluted soils, the gardeners must grow their plants in raised beds with soil that is delivered to the site. This story inspires them to further investigate the history of the land on which the garden now grows. Through contacting the local historical society and the city records office, and through conversations with elderly gardeners and neighborhood residents, the youth are able to create a timeline of the garden site history. They incorporate various photographs and airphotos from different time periods into the timeline. They present and discuss their findings with the gardeners and interested community members.

**Garden Open House**

Several of the youth live near the garden. Before participating in Garden Mosaics, they didn’t realize that there was a place like this in their community. They suggest to the gardeners hosting a garden open house or neighborhood block party as a way to introduce the garden to more neighborhood residents. The gardeners agree that this would be a nice way to tell community members that they are welcome to visit the garden and share its beauty. Also, the gardeners feel that vandalism would decrease if more neighborhood residents were aware of the garden and helping to keep an eye on it. The youth and gardeners discuss plans for the event with several neighborhood leaders and the youth offer to help advertise and organize the event. They invite friends and family to the garden block party and share what they’ve learned about the garden with the broader community.
**Meet with a City Planner**
On their walk around the neighborhood, the youth become aware of the lack of green spaces, such as parks, gardens, and tree-lined walkways. They discuss questions with their group leaders: What are other sections of the city like? Who decides where parks are located? Who decides where trees are planted? The group leader suggests that they talk with a city planner to learn more about green space in their city and about why the city ends up looking the way it does. During their meeting with the planner the youth learn a lot about green spaces and the urban development process. They also learn that the planner is very interested in having meetings with residents from different parts of the city and learning more about community gardens. The planner visits the garden to meet with the gardeners and everyone learns from each other.

**Create a Plan for Vacant Lots**
Visiting the garden, and learning about the history of the community gardening movement, inspires the youth to think about how vacant lots could have other uses. They decide to survey the neighborhood’s vacant lots and come up with plans for how these lots might be used. They call a city planner who is very interested in hearing their plans and who will help them organize an event where they share their ideas with local officials. The planner explains how some lots are owned by the city and others by absentee landlords. He also tells the youth that the city has to pay several hundred dollars a year to maintain one vacant lot. Some of the city-owned lots might be available for lease by people interested in starting gardens. The planner shares with the youth the latest map showing the location of vacant lots. The youth next “ground truth” the map, adding any new vacant lots and indicating former vacant lots that now are community gardens or that have been developed. They present the updated map to the planner, and arrange for a meeting of the planner with gardeners, other neighborhood residents, and local officials to discuss the future of the lots.

**Support Community Gardens**
The group leader arranges for the youth to meet with a Cooperative Extension educator who works with community gardens. The educator takes the youth on a tour of gardens and the youth meet with several gardeners. During the tour, the youth learn about the problems gardeners face, such as lack of funding for supplies and the need for more garden plots. The youth are inspired by their tour and ask how they could support community gardens in the city. The educator makes suggestions about organizations that help with supplies and creating new gardens. The youth contact these organizations and arrange for a meeting between their staff and the gardeners to discuss the gardeners’ needs.
Chapter 8. 
Nutrition and Health 
Action Projects

In the Nutrition and Health Action Project, youth carry out an activity to promote good nutrition and health related to the garden. For example, they could host a banquet, develop a recipe book, create interpretive signs, research a health issue, or host a health and nutrition educational event. They can use what they learn during the *i-m-science investigations* to help decide the specifics of their Action Project. Although the examples here come from community gardens, you should be able to adapt them for home or school garden or other youth programs.

Ideas for Nutrition and Health Action Projects

- Hold a banquet using dishes prepared with vegetables from the garden
- Host a barbecue in the garden for elders from the neighborhood
- Create a poster about diet and health and laminate it for display in the garden
- Use the Internet to find out more about the nutritional value of plants in the garden
- Invite a Cooperative Extension agent to the garden to speak about diet and disease
- Make a cookbook from gardeners’ recipes
- Present a workshop on the health benefits of vegetables for elders or children
Example Projects
Following are several example Nutrition and Health Action Projects. Our intent here is to give you a range of possibilities, which we hope will prove useful as you help the youth develop their own project.

Garden Banquet
Youth learn during their *i-m-science investigations* that the gardeners will be celebrating the fifth anniversary of the founding of the garden. They plan a banquet for the gardeners and their families, using produce from the garden. The youth and gardeners do the cooking for the banquet.

Recipe Book
Youth learn during the *i-m-science investigations* about the ways in which the gardeners use their plants in cooking. They work with the gardeners and a nutritionist from Cooperative Extension to create a cookbook. The cookbook includes not only the recipes but also their nutritional and health value. The youth sell copies of the cookbook to earn money for the garden.

Interpretive Signs
Youth create interpretive signs focusing on the plants they learn about from the gardeners. They use the plant Science Pages, the Internet, and interviews with the gardeners to learn about the nutritional and medicinal value of the plants.

Educational Event
The youth make observations of health issues facing the gardeners, children, and other members of the community. They also express their own health concerns (e.g., weight, diabetes). They talk to a community nutritionist to learn more about their concerns. They then organize a Health Day at the garden, where they invite local health and nutrition organizations to set up booths to educate community members.

Research a Health Issue
Youth use the Internet or library to research a question about cancer and diet that comes up during their *i-m-science investigations*. They use websites developed by university scientists to ensure that the scientific information is accurate. They synthesize what they learn into a poster or PowerPoint presentation for the gardeners.
Action Project Planning Form

1. What is your goal for the project? (What do you hope to accomplish or make?)

2. List the steps needed to reach your goal.

3. What background information do you need? Where will you find it?

4. What supplies do you need?

5. What will be each person’s role in your Action Project? (List each member of your group and what they will do.)

6. How will gardeners, scientists, and others be involved in your Action Project?

7. How will you present your project to the gardeners and other community members?

Don’t forget to take photos and include them with your online report!
Action Project Form

Garden Name __________________________________________________________

Garden Address ________________________________________________________
(include street and number if available, or nearest cross streets if number not known).

City __________________ State ____________ Zip Code/Postal Code ____________

Country ______________________________________

Name of Youth Program _____________

Name of Adult Contact ______________

Email address of Adult Contact

☐ Check here if you do NOT want your contact name and email address posted with your Action Project on our website.

Name(s) of Gardener(s) and other Adults involved in Action Project

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Date of Action Project
Month(s) ___________________________ Year _____________________

Number of participants involved in Action Project:

Youth __________

Gardeners __________

Other Community Members __________

Adult Educators/Volunteers __________
Write a short description of your Action Project covering the information below. The completed description should be no more than one page single-spaced. Include photos with your report—this will make it more interesting for others to read.

1) **Goal** (1 paragraph)
   - What was the goal of the project?
   - How did you decide on the goal?
   - What did you learn during the *i-m-science investigations* that helped you plan your project?

2) **Steps Taken** (1 paragraph)
   - What steps did you take to reach the goal?
   - What did you do for the garden or community?
   - What was the result of the project?

3) **Reflections** (1 paragraph)
   - Why was what you did important?
   - What did you learn from the Action Project?
   - Based on what you learned, what might you do differently in the future?
   - Based on what you learned, what new Action Projects might you conduct?

**Photographs**
Please send us several photos for display on the website with your Action Project. You can send us digital or print photos (see *Photo Guidelines*, Section VII).

**Submission Methods:**
1) **Online. We prefer this method!**
   Visit our website—www.gardenmosaics.org—Click on Action Projects, then Submit Your Form. Complete the online *Action Project Form*, attach digital photos, and submit.

OR

2) **Mail**
   Complete a hard copy of the *Action Project Form* and mail it along with any print photos, or digital photos on disk or CD, to:
   Garden Mosaics
   Department of Natural Resources
   Fernow Hall
   Cornell University
   Ithaca, NY 14853

   If you have any questions, please contact us at:
   gardenmosaics@cornell.edu
Section VII.

Resources, Permission Forms, and Photo Guidelines

Overview
This Section includes references used in preparing this manual and additional resources about community gardens and youth gardening and science education programs. We also have included permission forms for educator, youth, and gardener participants, and guidelines for taking photographs for the Garden Mosaics website.
References and Resources

Community Gardening


Garden Mosaics References


**Gardening Education**


Science Education, Plant-based Education, and Youth and Adult Well-being


Forms

Copy the following forms and use them as appropriate in your program. You may also want to add your program name to the forms, especially if you will be using photos from the participants in your materials or website. Please keep the Garden Mosaics name on the forms even if you add the name of your organization.

Please keep the forms on file or send them to Garden Mosaics.
Garden Mosaics
Educator Permission Form

Thank you for participating in the Garden Mosaics program. During the program, you may be observed and notes, photographs, and video recordings may be taken to document program activities. You may also be asked to complete a brief written evaluation of the program, or to talk with staff about your experience with the program.

To make Garden Mosaics a success, we need your permission. Please check off the following items if you accept them.

I voluntarily agree to be observed, photographed, or video taped by program staff.

I grant permission for the notes, photographs, or video images to be used in the Garden Mosaics website and in Garden Mosaics program materials.

_______________________________________
Name

_______________________________________
Signature

_______________________________________
Date

Thank you for your assistance and cooperation. Please contact Garden Mosaics if you have any questions or comments about this form.

Garden Mosaics
Fernow Hall
Cornell University
Ithaca, NY 14853
gardenmosaics@cornell.edu
www.gardenmosaics.org
Dear Parent or Guardian,

We would like to invite the child for whom you are the parent or guardian, to participate in a garden project called Garden Mosaics. Garden Mosaics is an international program that involves youth, gardeners, community educators, and scientists in studying gardens. During the program, staff may observe youth and take notes, photographs, and video recordings to document program activities. They may also ask youth to discuss their ideas and opinions about Garden Mosaics.

To make Garden Mosaics a success, we need your permission for your children to participate.

Please check off the following items if you accept them.

I voluntarily agree to allow my son/daughter/child for whom I am the guardian, ____________________, to participate in Garden Mosaics program activities.

I voluntarily agree to allow the youth named above to be observed, photographed, or video taped by program staff.

I grant permission for the notes, photographs, or video images to be used in the Garden Mosaics website and in Garden Mosaics program materials.

I understand that the name of the youth indicated above will not be used in any of the documents.

_______________________________________
Name of child

_______________________________________
Signature of Parent / Guardian

_______________________________________
Date

Thank you for your assistance and cooperation. Please contact Garden Mosaics if you have any questions or comments about this form.

Garden Mosaics
Fernow Hall
Cornell University
Ithaca, NY 14853

gardenmosaics@cornell.edu
www.gardenmosaics.org
Formato de Autorización para Menores de Edad
Mosaico de Jardines / Jardín de Mosaicos

Estimados padres o tutores,

Queremos invitar al menor de edad, del cual usted es padre o tutor, a participar en un programa llamado Garden Mosaics (Mosaico de Jardines). Garden Mosaics es un programa a nivel nacional que consiste en colaboración entre menores, adultos, educadores comunitarios y científicos de la Universidad de Cornell que estudian jardines comunitarios. Durante el programa personal del programa de Garden Mosaics visitara los sitios de estudio. Las actividades de los menores serán observadas en varias ocasiones durante el curso del programa y se tomarán notas, fotografías, y vídeo para documentar las actividades del programa.

Para que Garden Mosaics sea exitoso, necesitamos su aprobación para que participen los menores. Por favor marque los siguientes cuadros si acepta.

Yo acepto voluntariamente para que mi hijo/a o menor de edad a mi cargo _____________________, participe en las actividades del programa de Garden Mosaics.

(nombre del menor)

Yo acepto voluntariamente que el menor de edad arriba mencionado sea observado, fotografiado o vídeo filmado por personal del programa Garden Mosaics.

Doy autorización para que las notas, transcripciones de las entrevistas, fotografías o imágenes de video sean usadas en la pagina web de Garden Mosaics o en otros materiales del programa Garden Mosaics.

Doy autorización para que sólo se use el nombre (no el apellido) del menor arriba mencionado en la página web y en otros materiales del programa Garden Mosaics. El apellido del menor mencionado no será usado en ninguno de los documentos.

Entiendo que el nombre del menor de edad no será usado en ninguno de los documentos.

______________________________
Nombre del menor de edad

______________________________
Firma del padre o tutor

______________________________
Fecha

Gracias por su ayuda y cooperación. Por favor contacte a Garden Mosaics si tienes alguna pregunta o comentario.

Garden Mosaics
Cornell University
Fernow Hall

gardenmosaics@cornell.edu

www.gardenmosaics.org
Garden Mosaics
Gardener Permission Form

I, ___________________________, am aware that the information I provide (your name—please print) may be featured on the Garden Mosaics website.

Please check all of the following that you agree with:

____ Garden Mosaics may use my name on their website and in their program materials.

____ Garden Mosaics may post information about myself and my garden on their website and in their program materials.

____ Garden Mosaics may post a picture of my garden on their website and in their program materials.

____ Garden Mosaics may post a picture of me on their website and in their program materials.

Please sign and date below.

_________________________________________ Date __________________

Signature

Please return form to the Garden Mosaics educator or to the address below. Thank you for your assistance and cooperation. Please contact Garden Mosaics if you have any questions or comments.

Garden Mosaics
Fernow Hall
Cornell University
Ithaca, NY 14853
gardenmosaics@cornell.edu
www.gardenmosaics.org
Formato de Autorización para Miembros del Jardín

Jardín de Mosaicos / Mosaico de Jardines

Yo, ________________, estoy consciente de que la información que proporcione a los jóvenes participantes en el programa podrá ser mostrada en la página web de Garden Mosaics.

Por favor marque las secciones donde este de acuerdo:

____ Garden Mosaics podrá usar mi nombre en su página web y en otros materiales del programa.

____ Garden Mosaics podrá poner información sobre mi y mi jardín en su página web y en otros materiales del programa.

____ Garden Mosaics podrá mostrar imágenes de mi jardín en su página web y en otros materiales del programa.

____ Garden Mosaics podrá mostrar mi foto en su página web y en otros materiales del programa.

Por favor firme y ponga la fecha a continuación.

_________________________________________ Fecha __________________

Firma

Por favor devuelva este formato al educador de Garden Mosaics. Gracias por su ayuda y cooperación. Por favor contacte a personal de Garden Mosaics si tiene alguna pregunta o comentario.

Garden Mosaics
Fernow Hall
Cornell University
Ithaca, NY 14853
gardenmosaics@cornell.edu
www.gardenmosaics.org
Garden Mosaics
Photo Guidelines

• Do not submit very large photos! Submission time increases with photo size.

• The form will reduce and crop your photos to 200 pixels wide by 150 pixels high. This process works best if the subject of your photo is centered, and the camera is held horizontal (not vertical).

• If using a digital camera, set to jpeg format and the lowest size available (usually 640 x 480 pixels).

• If using a 35mm camera, scan your prints at 150 dpi and save in jpeg format. Or send a hard copy to Garden Mosaics.

• If jpeg is not available, we can accept bmp, gif, png, or tif.

• When taking pictures on bright days, make sure your subjects are not lost in shadows or glare. The sun should be in front of, not behind, your subjects.

• Try moving in close to people, plants, and objects. Fill the frame to capture details. Keep in mind that your photos will be smaller on the website.

Garden Mosaics
Fernow Hall
Cornell University
Ithaca, NY 14853
gardenmosaics@cornell.edu
www.gardenmosaics.org
NOTES