## Foods for Plant and People: Maintaining the Garden

### Lesson Eight: Photosynthesis, Watering and Garden Maintenance

For April

“Photosynthesis” from GROWING IN THE GARDEN: ELEMENTARY CURRICULUM, Iowa State University Extension and Outreach; “Watering Garden Plants” from GARDEN MOSAICS, American Community Gardens and Cornell University Garden-Based Learning; “Caring for the Garden” from GOT DIRT?, Wisconsin Department of Health Services.

Students review photosynthesis and watering the garden. They make a plan for garden care during April and May. Now is time to start an optional Action Project based on what students have learned from gardening. Actions projects include doing background research, deciding what to do, completing the project and reporting on it.

### Content objectives:
Define photosynthesis; Identify the basic ingredients in photosynthesis and where they come from; Describe the basic photosynthesis process; Give reasons why photosynthesis is important to plants and animals; Demonstrate when, how, how much a garden should be watered.

### Life Skill objectives:
Healthy lifestyle choices, Critical thinking, Communication, Citizenship, Leadership, Decision making, Problem solving

### Core and STEM concepts and skills:
- **Science**: Science as inquiry, Earth and space, Life science
- **Math**: Operations and algebraic thinking, Numbers, Measurement and data, Geometry, Mathematical practices
- **Language Arts**: Reading for information, Vocabulary, Speaking, Listening, Viewing

### Healthy snack:
Green Smoothie

### Additional and supporting resources:
Cooperative Extension Master Gardener’s Program can be a resource for garden information.
LESSON PLANS FOR 2012-13 SCHOOL YEAR, GRADE 3

April:  Food for Plants and People

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BEFORE THE LESSON

1. **Grade 3, April: Food for Plants and People, 2012-13 School Year**
   This document contains all the curriculum items and resources you need for this lesson. All lesson downloads are located on the [www.peoplesgarden.wsu.edu](http://www.peoplesgarden.wsu.edu) Educational Toolkit. Please read through everything well in advance of delivering this lesson.

2. **Gardening Tips for Working With Kids**, Healthy Gardens, Healthy Youth Master Gardeners and Extension Educators created the tip list based on their experiences gardening with kids for this project and for related summer programs. You may want to make a copy to keep handy throughout the gardening season.

3. **Gardens**: Please follow-through with the notes from your January garden planning session, the January - Planning Our Food Garden, and the March - Planting Our Food classroom lessons and gardening activities. Look ahead at this month’s garden activity: Caring for Your Garden.

4. **Compost**: If you haven’t built a compost bin, volunteers such as Master Gardeners or student’s families that are familiar with gardening, can build one for your school. Please go to the October lesson in the Educational Toolkit.

5. **Supplies**: Make sure you have all the supplies you will need to do the activities for Photosynthesis and Watering as part of this Food for Plants and People lesson, Caring for the Garden, and the Green Smoothie snack.

6. **Garden Journals**: Continue to use the students’ individual Garden Journals to record plant growth, weather factors affecting the garden, observations, recipes, new knowledge, and future ideas. These journals will be helpful to compile data for the classroom, share stories, and make decisions.

7. **Recipes**: Green Smoothie Recipe makes about 3-1/2 cups. Tasting samples should approximately 2 ounces, or 1/8 cup.

   - 1 banana
   - 1 tightly packed cup of kale, stemmed, washed and chopped
   - 1 cup of fresh or frozen berries, diced apple or pear
   - 1 cup juice or 1 cup of non-fat or low-fat vanilla Greek yogurt
   - up to 1 cup of ice

1. Place the kale, fruit and juice or yogurt into your blender. (If you use fresh fruit, you may want to add up to 1 cup of ice to make it slushy; if you use frozen fruit you may not need any ice).

2. Blend the ingredients together until the kale looks like it is well incorporated into the smoothie.
8. **Action Project**: Since this is the second year for your gardens, we suggest that the students might want to share something they have learned or experienced through an Action Project. Garden Mosaics created Action Project guidelines and models. Please review the Expansion Activity: Action Projects found in The Lesson section below. A complete Garden Mosaics Action Project guide is included in this lesson. These resources will empower you and your students to make a difference in your community. It is similar to the students doing a community service or service learning project.

This is optional and should be conducted by the students and their teacher as a step to add sustainability and growth to their new gardening program. In April, the students can start with discussions and background research to decide what project they want to do and why. In May or June, they can actually implement or start to implement their plans.

**THE LESSONS**

1. Photosynthesis
   The outline below provides ideas so that you can determine how and when you want to complete the lesson. The activities in this lesson help students to identify the basic ingredients in photosynthesis and where they come from, describe the basic photosynthesis process, and give reasons why photosynthesis is important to plants and animals. Here is a basic outline of the lesson.

   **Introduction:** Plants, animals and food

   **Do:** Photosynthesis Experiment, Photosynthesis Skit

   **Reflect:** Review of photosynthesis

   **Apply:** Photosynthesis Diagram
   Plants and Animals as Partners

2. Water
   Follow lesson plan in “Watering the Garden.” Students will learn the proper way to water the plants in the garden. They will learn when and how much water each plant needs. Students will also review the importance of mulching to conserve water.

3. Caring for the Garden
   Review Caring for the Garden from “Got Dirt”. Make a plan with the students on how to maintain the garden during April and May. Consider thinning, weeding, watering and pest management. Talk with your Extension Educator to see if Master Gardener might be available to assist with teaching these gardening skills.
4. Read a book with your students: (optional). Check with your library to see if a copy is available. *Photosynthesis: Changing Sunlight Into Food* (Nature's Changes) by Bobbie Kalman. This book describes the history and behavior of plants, and focuses on how energy is produced.

**AFTER THE LESSON**

You may want to go back to the Garden Journals so students can update previous pages and record how the plants are growing. Below are previously suggested pages that could be updated with results:

a. Draw or right down how each plant was started (as seeds, sets, seed pieces or transplants) and how deep they planted them. UPDATE: was there a difference in plants growth for those started with seeds, sets, seed pieces or transplants?

b. Make predictions, with or without reading the seed packet, about when they will see the sprouts coming up out of the soil. UPDATE: when did the seeds sprout? How has the weather affected the seeds growth?

c. Add the Green Smoothie recipe to the journals for future use by students.
USDA FNS People’s Garden School Garden Pilot Project:
Healthy Gardens, Healthy Youth
Gardening Tips for Working with Kids

The following tips are from HGHY Master Gardeners and site leaders and are based on their experiences gardening with kids. These are tips for both school and the summer programs.

Be Prepared
1. Send home information about the garden program including the details about who is leading the program, what the kids will be doing, where the gardens are located, when the kids will be gardening, what is happening with the garden produce, and expectations of the young gardeners. All gardeners should be wearing close-toed shoes and have sun protection. They will not be allowed to work in the garden or with food if they are sick or have been sick within the last 24 hours.

2. Every time you go to the garden, take supplies such as a first aid kit, wet wipes, water jug with cups (or have kids bring their own water) and water for washing the produce.

3. Use lesson plans and educational resources to prepare for each session. Play a game, sing a song, act out a play, read a book, or make a garden-based craft each session. Remember to have fun! See the Sample Garden Session outline at the end of these tips.

Working With the Kids
4. Make sure the young gardeners know the 3 R’s garden rules: Respect, Responsibility, Readiness.

5. Be fully prepared before heading to the garden so there will be little down time for the kids. The tools and any supplies should be easy to access and ready to go. Break large groups into manageable sizes. Have more than one activity and rotate them. Keep every child busy and on task or their attention will shift and they will drift. Have enough adult supervision to make this happen.

6. Always demonstrate before letting the kids work on their own. The more adult helpers you have to float around and guide the kids, the better. Do not do things for the kids, show them how and have them show you how back.

7. Check their work. Don’t take their word for it when they say they have completed a task. You might find that things were missed.

8. Take frequent shade and water breaks. Break times are good times to introduce healthy snacks, books, garden journals, or other hands-on activities.

9. Every child will appreciate some one-on-one time with instructors while working in the garden. Let them tell their stories and show you the weeds they found and pulled, etc.

Planning the Garden
10. Use the hands-on, deeply aligned classroom lessons to help the students plan their gardens. The kids will have fun learning and taking ownership of the garden. They will get excited about choosing what to plant and how much they need to plant by doing these lessons. A Master Gardener or an experienced gardener is a valuable resource to help kids discover what crops can be grown in the climate and in the amount of space they will have to garden. Start a Garden Journal or Garden Records right away.

11. Young students are not able to prepare the site for gardening. Master Gardeners and others can provide leadership for that. FFA students, parents, Ameri-Corps, Food Corps, garden clubs, retired teachers, neighbors and others have been instrumental in preparing the gardens and helping the youth in the planning stages.

12. For the young children, have the sections of the garden already measured out and marked according to the garden plan. For the older youth, help them measure and mark the garden sections.

13. Kids like to use garden tools, but they LOVE to use child-sized tools such as kid-sized rakes, hoes, shovels, watering cans, and gloves. The type of garden tools they need depend on the type of garden they will be working with and how it is planted – square foot vs. rows. They can share tools. Older students have been using adult-sized tools and even tools that have been loaned by Master Gardener groups.

14. Master Gardeners and FFA members are using their green houses to start seeds and grow transplants for the school gardens.

15. Help the students start a compost bin and get the whole school involved.

**Planting**

16. Go over tool safety rules for hoes, trowels, and rakes. A tool safety game is part of the gardening curriculum.

17. Go over ways the plants in your garden are going to be planted: seeds, sets, transplants, seed pieces.

18. Plant fast growing (cool season) crops like radishes and spinach for early satisfaction. Try to stagger your crops for constant harvest opportunities. Make sure the students will have something to harvest when they return to school in the fall.

**Maintaining**

**Watering**

19. Watering is extremely important, especially in raised bed gardens. If you are meeting just once a week, you may have to make plans for additional watering. Families, youth groups, organizations, neighbors can sign up for times. Someone will need to be responsible to make sure the watering plans are carried out.

20. Using a watering wand is a good way to water the garden. Show how to water at the base of the plant. Teach the kids to count how long it takes to water a plant.
Weeding
21. Help the kids distinguish the difference between weeds and garden plants. Show them how to pull weeds so that the garden plants are not disturbed. Tell them where you want them to put the weeds. Have challenges such as finding the biggest weed, most unusual weed, most weeds, etc. Talk about why some parts of the gardens have more weeds than other parts, etc.

Insects and pests
22. Insects intrigue and scare children. They enjoy doing the lessons about pests and going on hunting missions to find and eradicate them. Getting to show everyone the squash bug they found – and sometimes their eggs – is a joy in and of itself!

23. Use the lessons to identify “good guys” and “bad guys” in the garden and to figure out what to do about them. Then help the kids take the next steps to protect their garden from unwanted pests.

Harvesting, Preparing and Eating the Produce!
24. Kids get excited when they see fruits/vegetables growing on the plants. Make sure that they show everyone by pointing and not picking! Describe what to look for to determine when the fruits/vegetables are ready to harvest.

25. Show kids HOW to harvest produce gently. For example, gently hold a bean plant before pulling off the bean, cut the lettuce with scissors, etc.

26. Kids love to harvest and taste the bounty. Try to include this in every lesson.

27. Include in the lesson, ideas for how the food can be eaten. Simple recipes such as cucumber-flavored water, radish or veggie sandwiches, veggies with dip, cucumbers and onions in vinegar, etc. are the best. Get a large bottle of Ranch dressing because the kids will try anything they can dip! There are several ideas in the lessons.

28. Show the whole vegetable before cutting it open. Have them find the seeds.

29. Plastic plates and knives can be used for cutting and preparing produce.

30. Help the kids put their gardens to bed.
Sample Gardening Session

1. Meet in gathering area
   a. Remind everyone about behavior expectations.
   b. Chat a bit – What’s up?
   c. Give garden plan for the day
   d. Split into smaller groups if necessary
   e. Have a planned garden activity for each group with an adult supervisor

2. Garden projects
   a. Planting
   b. Weeding
   c. Pest patrol
   d. Watering
   e. Harvesting
   f. Washing
   g. Cutting (if necessary)

3. Snack time
   a. Make their own snacks
   b. If there is nothing to harvest, consider produce from farmer’s markets
   c. Focus on fruits and vegetables
   d. Send ideas home to the families

4. Activity session – see lessons for ideas for games, songs, stories, plays, crafts

5. Go home!
**Photosynthesis**

**CONTENT OBJECTIVES**
Define photosynthesis, Identify the basic ingredients in photosynthesis and where they come from, Describe the basic photosynthesis process, Give reasons why photosynthesis is important to plants and animals

**LIFE SKILL OBJECTIVES**
Critical thinking, Learning to learn by experimenting and observing, Problem solving; Communication

**INDICATORS**
Draw the photosynthesis formula and diagram, Respond to questions, List reasons plants and animals benefit from photosynthesis

**EVALUATIONS**

**SUBJECT STANDARDS**
Science: Life (characteristics of organisms, organisms and their environment)
Language Arts: Vocabulary, Character development, Main idea, Interpreting, Inferring, Sequencing, Writing
Math: Algebra

**LEARNER TYPES**
Linguistic-words, Logical-mathematical, Bodily-kinesthetic, Spatial-visual, Music, Intrapersonal, Interpersonal, Natural

**MATERIALS**
At least 4 paper circles *(the size of a quarter, see the Photosynthesis Experiment in the Introduction section of this lesson)*
4 paper clips *(one paper clip per circle)*
2 sheets of green paper *(in big letters write “Chloro” on one and “Phyll” on the other)*
Tape to attach the green paper as name tags
Large plastic mixing bowl
Big mixing spoon
1 cup of water
Green construction paper with small holes punched in it
Flashlight
Marker board or large sheet of paper
Markers
“Photosynthesis” lyrics and “Diagram of Photosynthesis Process” *(project on screen or interactive board, found at the end of this lesson)*
Overhead projector
**Were You Born in a Barn?** CD by Chris Rowlands (contact Angela Rowlands at arowland1@woh.rr.com)
CD player
Blank sheets of white paper *(one per student)*
One week before the rest of the lesson

Talk to the school grounds maintenance staff to identify one or two plants to use for a photosynthesis experiment described in this section. You also could use plants in your school classroom. The plants need to have large leaves and a sunny location. You may want to try the experiment on two different plants. The experiment works best outside in the spring and early summer. Have the paper clips and circles ready for the experiment.

Everyone stand up.

What are some wild animals that live in our area?

Go around the room for answers such as rabbits, mice, insects, wild turkeys, deer, raccoons, snakes, frogs, birds, and so on. Have the students stand like their favorite animal and give them thirty seconds to pretend to find and eat their food.

What are some examples of domestic animals that live with us or on farms and depend on our care?

Go around the room for answers such as dogs, cats, horses, beef cattle, dairy cattle, pigs, layers (chickens that lay eggs), turkeys, sheep, and so on. Work in pairs and have one student be a person who cares for the animals and the other one choose which kind of domestic animal to be. Pretend that the caretaker is feeding the domestic animal. Switch roles.

What are some examples of plants that naturally grow in our area?

Trees, some grasses and flowers, weeds, etc.; stand like you are one of those plants and pretend to get your food.

What are some examples of plants or crops that people plant in our area?

Corn, soybeans, oats, grass, flowers, vegetables, apple trees, berries, grapes, etc.

In pairs, one person names a crop and stands like the plant. The other person is the one that grows that crop. Pretend that the plant needs food and act out what might happen such as watering or fertilizing the plant.

Think about pretending to be animals and plants trying to find food while you answer the following questions.

Plants and animals are living things; what makes them alike?

They both need food and water, and they reproduce. They both live and die.

What makes them different?

Plants cannot move to find food. They can make it for themselves from natural resources. Sometimes people help to feed plants with water and nutrients such as plant food, fertilizer, or animal manure.

Is it important to animals if plants get fed?

Yes.

Why?

Most animals eat plants. Plants are also used for shelter and protection.

What are the two major plant crops grown in Midwestern states, such as Iowa, that feed domestic animals on the farm, such as pigs, cattle, sheep, dairy cows, chickens, and turkeys, and are major ingredients in thousands of the food products we eat?

Corn and soybeans
We are going to figure out what plants need in order for them to make their own food in a process called photosynthesis. We’ll start our investigation with an experiment, and then we’ll check on the results of our experiment next week.

PHOTOSYNTHESIS EXPERIMENT

Have the students gather around the plant and explain that they are going to do an experiment. Have four (or more, depending on the number of plants or leaves available) students clip a circle securely on four different leaves. Remind them not to touch the circles until the class comes back to look at them. Return in a week to see what happens.

Before class, put the mixing bowl, mixing spoon, cup of water, green construction paper with holes, and flashlight on a table in the front of the room. Draw a blank “recipe card” on the board or flip chart.

Have the students return to the plants that have the circles clipped on their leaves. Have the students carefully remove the circles.

Do you see any differences in the leaf from when we put the circle on it?
The area under the circle should be lighter green.
What do you think caused that?
Lack of light to that area of the leaf

Let’s go back to the classroom to see how this could happen.

The way plants make food is similar to the way a chef makes bread. It takes a combination of ingredients and someone to mix them. Plant food begins with green pigment in the plants called chlorophyll. (Write “chlorophyll” on the board.) Chlorophyll gives plants their green color. These are very tiny molecules that act as “solar receptors” and absorb light in the plant. Plants need light to make chlorophyll.

Have you ever seen a house with solar receptors or panels on it?
What do they do?
They gather light and turn its energy into another form of energy. That is similar to what the chlorophyll does.

What happened to the leaves that we put circles on?
The circles shaded the leaves so they didn’t have enough light to make chlorophyll, the green pigment.

What color were the areas that didn’t have as much chlorophyll?
Lighter green or yellow

Do you think the circles on the leaves will turn a deeper green again if we leave the circles off?
We’ll check it again in a few days and see what happens.

There is a lot more to making plant food than that, though.
I need two volunteer chefs to come to the front of the room and mix a batch of plant food in a bowl. *(Attach the “Chloro” and “Phyll” name tags on their shirts.)*

**What are the names of our chefs?**

“Chloro” and “Phyll”

**Together, what is their name?**

Chlorophyll

**What color are they?**

Green

**Where is their kitchen?**

In the leaves of plants

“Chloro” and “Phyll” need a recipe to make their tasty plant food. We need one person to write the recipe on the recipe card I have drawn on the board. First, in big letters at the top of the card, write “Plant Food Recipe.”

Phyll, you can add the ingredients. Chloro, you can mix them up. The first ingredient we need in order to make this batch of plant food is water. Write “water” on our recipe. Next to the word water, write the short name for water, which is $\text{H}_2\text{O}$. This formula name means water is made up of two molecules of hydrogen and one molecule of oxygen. Phyll has some water in a cup to add to the mixing bowl.

**Where do you think Phyll got the water from?**

Water came into the plant through the plant’s roots, then it traveled up the stem and into the leaves where Chloro and Phyll are making plant food.

The stem is like a straw. We could have Phyll suck the water up through a straw and add it to the bowl, but that would be gross. Phyll, pour the water into the big bowl. Chloro, start stirring very carefully. Water is a precious natural resource. We don’t want to spill any of it.

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**Photosynthesis Skit**

**Plant Food Recipe**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>water</td>
<td>$\text{H}_2\text{O}$</td>
</tr>
<tr>
<td>carbon dioxide</td>
<td>$\text{CO}_2$</td>
</tr>
<tr>
<td>sun</td>
<td>light</td>
</tr>
</tbody>
</table>

Chlorophyll mixes the ingredients together to make plant food for one plant.
Now, we need the next ingredient. The recipe says to add carbon dioxide. Write “carbon dioxide” on the recipe. Next to the word, write the formula name for carbon dioxide, CO₂. This formula name means that carbon dioxide is made up of one molecule of carbon and two molecules of oxygen.

Where is Phyll going to find carbon dioxide?
Carbon dioxide is a gas in the air. Air is a natural resource, which means we don’t make it. Actually, people and animals can help us add carbon dioxide to the recipe.

How can we do that?
We can breathe into the mixing bowl. What people exhale or breathe out is carbon dioxide. We need just the right amount of carbon dioxide. Four people ought to do it.

Who wants to come up and blow carbon dioxide into the bowl?
The carbon dioxide enters the plant through tiny openings in the leaves called stomata (stow-MA-ta). Pick up the piece of paper filled with tiny holes or stomata and blow through the paper. Chloro, stir the water and carbon dioxide very carefully. It’s important to have them thoroughly mixed.

Chloro and Phyll are missing one last ingredient that causes the water and carbon dioxide to change to plant food. In order to make something change, you need energy.

Nature has provided the water and air containing the carbon dioxide, but where in nature can we find energy?
The sun

Phyll, turn on the sun (a flashlight). The sun provides light, which is a source of energy. The energy changes the water and carbon dioxide into the plant’s food. Shine that light into the bowl and stir it in. Add the word “light” to the recipe.

What have we done to make this recipe work?
We have Chloro and Phyll. They took water from the soil through the roots, carbon dioxide from the air through the leaves, light from the sun through the leaves, and mixed them together. The water and carbon dioxide are changed by the sun and the chlorophyll to make food.

In the directions under the recipe ingredients, write “Chlorophyll mixes the ingredients together to make plant food for one plant.”

Is there anything left in the bowl?
Yes.

What is it?
We can’t see it, but it’s there. It’s oxygen. When the ingredients are mixed together, oxygen is left over. Plants don’t use oxygen for plant food.

What do they do with it?
Similar to the way we exhale carbon dioxide, plants give off oxygen.

Who needs oxygen to live?
People and animals need oxygen to breathe. Phyll, tip the bowl out toward your classmates and scrape the oxygen out at them. The rest of the class, breathe in and fill your lungs with oxygen from the plants. Everybody is happy. The plants grow from the food they made, and people have healthy air to breathe.

Thanks for your help, Chloro and Phyll.
This process is called **photosynthesis**. (Write “photosynthesis” on the board.) Photosynthesis comes from the Latin words “photo,” which means light, and “synthesis,” which means make something. Chloro and Phyll used light to make plant food from water and carbon dioxide.

**What are the three natural resources needed for photosynthesis to occur?**
Sun, water, air

**What would happen if there were no water, air, or light?**
Photosynthesis wouldn’t happen, and we wouldn’t have food to eat or oxygen to breathe.

Let’s look at the process of photosynthesis using the formula names. It is kind of like a math equation. (Write the following on the board and discuss what each symbol means, whether all the equations mean the same thing, and whether the equations would end up the same if part of the equation was missing or the answer was incorrect.)

\[
\begin{align*}
H_2O + CO_2 + \text{light} & = \text{plant food} + \text{oxygen} \\
\text{Light} + CO_2 + H_2O & \rightarrow \text{plant food} + \text{oxygen} \\
CO_2 + \text{light} + H_2O & \rightarrow \text{plant food} + \text{oxygen}
\end{align*}
\]

People and animals eat the food made by photosynthesis. Fruits and vegetables store that food. Leaves from herbs also store the food made through photosynthesis. Potatoes are swollen underground stems that store starch, a sugar made through photosynthesis. The starch in the potato tuber is food for the new plant that grows from it. It’s also an important source of food for people.

(Project the lyrics to “Photosynthesis” by Chris Rowlands on a screen or interactive board. Follow the lyrics while you play the song from _Were You Born in a Barn?_ by Chris Rowlands. Ask the students where the nutrients come from. They enter the plant in the water coming from the soil up through the roots and to the stems and leaves. Write the new words such as **autotrophic**, **cells**, **organelles**, and **chloroplasts** on the board and discuss them.)

### PHOTOSYNTHESIS DIAGRAM

Take out a blank sheet of paper and draw a diagram of the photosynthesis process.

1. Start by drawing yourself or an animal standing next to a leafy plant. (Give them time to draw.)
2. Draw the natural resources needed for photosynthesis.
3. **What does the sun provide?**
   - Write “light” under the sun.
   - **What could you do if you wanted to grow plants indoors where there are no windows?**
     - Grow them under special lights.
4. **How does the plant get water?**
   - Through its roots; draw an arrow in the direction the water moves.
5. **What gas is needed by plants?**
   - Carbon dioxide
   - **Where does it come from?**
     - Air, people, and animals; draw arrows from those places to where the plant takes it in.
6. **What gas is given off by the plants as a byproduct of photosynthesis?**
   - Oxygen; draw arrows showing where the oxygen is coming from and going to.
**PHOTOSYNTHESIS**

*by Chris Rowlands*

**Chorus**

Photosynthesis is a chemical process
In which plants take things they use
Turn it into food
Energy from the sun, water, CO₂, and nutrients
These are things they use
When they're making their own food.

Sun shines down on the little plants
Visible light is what they eat
Autotrophic is what they call the plant
They make their own food naturally
From the smallest plant to the biggest tree
They have their own food factory
They give us lots of things we need
Like food and they give us air we breathe.

In the leaves plants have cells
Inside the cells are organelles
Organelles like chloroplast
Are where the sun’s energies are stored and stashed.

In the chloroplasts there still are
Smaller things called chlorophyll
Chlorophyll and chloroplast
Are where the sun’s energies are stored and stashed.
**Significant Photosynthesis**

Some scientists such as Devens Gust think photosynthesis is the most important biological process. In fact, Arizona State University thought it was so important that it has a Center for the Study of Early Events in Photosynthesis. The goal of this center is “understanding the process of photosynthesis, which is responsible for producing all of our food and filling the vast majority of our energy and fiber needs.”

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**Why do some scientists think that photosynthesis is the most important biological process?**

It is essential to plant growth because it makes the food that they eat. Plants are the basic source of food, even for carnivorous animals that eat other animals that probably eat plants.

**Why is it important for scientists to study the process of photosynthesis?**

To keep our food supply going

In some cases, plants are used to produce more oxygen, which is a byproduct, or it comes from the photosynthesis process.

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**PLANTS AND ANIMALS AS PARTNERS**

Are plants, animals, and people good partners?

Yes.

Let’s make a list of all the things that people, animals, and plants do for each other. Work in small groups to discuss one of these relationships: what plants do for animals, what animals do for plants, and what people do for plants and/or animals. Have someone in your group be the recorder and write down all the things your group comes up with. Someone else from your group will report your ideas to the class. *(Give them ten minutes for discussion in their groups. As you hear each group’s report and discuss it, have a student write the ideas on the board in the appropriate column.)*

<table>
<thead>
<tr>
<th>What plants do for people and/or animals</th>
<th>What animals do for plants</th>
<th>What people do for plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Give us oxygen</td>
<td>Give them carbon dioxide</td>
<td>Give them carbon dioxide</td>
</tr>
<tr>
<td>Give us food</td>
<td>Fertilize the soil (manure)</td>
<td>Cultivate them</td>
</tr>
<tr>
<td>Give us clothing (cotton)</td>
<td>Move their seeds</td>
<td>Sow their seeds</td>
</tr>
<tr>
<td>Give us shelter (wood)</td>
<td>Thin out populations by eating plants</td>
<td>Protect them from animal grazing</td>
</tr>
<tr>
<td>Give us beauty</td>
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**Resource**


Watering the Garden
Adapted from: Basic Vegetable Gardening, 4-H Global Knowledge Center and Garden Mosaics, Cornell University

Lesson Summary: Students will learn the proper way to water the plants in the garden. They will learn when and how much water each plant needs. Students will also review the importance of mulching to conserve water.

Objectives:
- Explain when and how much a garden should be watered.
- Describe several different watering methods that can be used in a garden.
- Evaluate watering methods to determine which is most suitable for a given situation.
- Explain how to conserve water in the garden.

Materials:
- Watering cans, pails/buckets, hose
- Measuring device such as a ruler, clear plastic container
- Plastic milk jug (see directions on Watering Science page; consider alternate methods for making small holes in the jug).
- Materials for mulching (if you have not mulched the garden already)

Review the Garden Mosaics Watering Science Page and Watering Teaching Tips

Lesson Steps
1. Introduction

Ask members to tell you why watering is important to plants. Ask if water is a problem for gardeners in your area. Do all farmers have enough water? Is there always enough rainfall? This lesson will review why knowing about proper watering can save both water and time.

2. Learning how to properly water the plants in the garden

Ask the group to brainstorm what they know about watering the plants in the garden. Expected results:

- Water is necessary for the plants to grow.
- Different plants grow at different rates, even if they are the same type of plant. They need different amounts of water. For example, bigger plants or trees may need more water than little flowers or vegetables.
- Some plants have long roots while other plants have branching roots (especially visible when they were transplanting plants).

Some questions to ask:
- Have we been watering each plant with the same amount of water?
- What differences have noticed in the plants? Have you noticed that some plants are growing taller than others, even if they are the same type of plant?
- Have you noticed some areas in the garden that look like they are not getting enough, or getting too much water? What does that look like?
- What can be done to conserve water?
  Answer: use drip irrigation, collect rainwater by setting large containers outside during a rain. If students want to try collection rain water, check with the school for permission. They can use that rainwater to water their garden. Be sure to discuss how properly saving and storing rainwater is important for to prevent mosquito infestation.
- How could we measure how much water, including rain, that our plants are getting?
  Answer: It is easy to put a container outside to measure the amount of rain in the garden. Place a container near the garden, away from any buildings that would change the amount of rain that goes into the container. Make inch markings on the outside or inside of the container. It is helpful if the container is clear.

In general, plants need about 1 inch of rain in 7 days. If they are receiving that much, then it may not be necessary to water the garden with additional water. If they are not receiving about 1 inch every week, then it may be necessary to supplement with additional water. The climate and soil in your area will determine how much water is needed.

- What time of day is best to water the plants?
  Answer: It is best to water the plants in the morning or in the night. If it is really hot during the middle of the day and you water the plants, the water can get too hot for the plants, and it can also evaporate before filtering into the soil.
- How do different watering cans, hoses or drip irrigation affect the way we water?

Remind students that plants have different depths of roots. Plants that have roots along the top of the soil may need to be watered more often than plants that have deeper roots. Draw plants with three different length roots. Which ones will need to be watered more often?

Make a milk-jug drip irrigation system from the Garden Mosaics Watering Garden Plants Science Page. Install it in the garden.

3. Review how to Mulch the garden (see February Lesson)
- Spreading mulch around the plants will help keep the water from evaporating.
- Mulch is made up of coarse plant materials such as leaves, fibers, or wood chips. They can be placed directly into the garden at the base of plants or used to create pathways and borders.
- Benefits include:
  - Conserves water by protecting the soil from sun and wind evaporation.
  - Controls weeds by blocking sunlight to reduce weed growth
  - Insulates soil by keeping soil cooler in hotter temperatures
  - Reduces erosion by slowing the flow of water during heavy rains
  - Improves soil structure by reducing the compaction of soil
  - Adds nutrients to the soil

4. Summary and Debrief
Ask the students the following questions:
Why is it important to keep track of the amount of water the garden is getting?
Answer: It is important so you can determine if the garden needs additional water.

Why is it important to spread mulch around the plants? Do you think it would be important to spread mulch around plants you are planting at home?

What materials do we have around the school or around your home that you can use for mulch?

Do you think it would be important to spread mulch around plants that were planted in small containers?
Answer: It would not be necessary because plants in small containers usually are not affected by a large amount of weeds. However, it would still help to stop the water from evaporating.

What are some other ways we could conserve water in the garden?
Answer: It may be possible to provide shade for the garden, which would limit the amount of water that evaporates. We can also plant crops close together, like in a square foot garden, so that plants use rainfall more efficiently.

Consider having them record their answers in their Garden Journal.
WATERING GARDEN PLANTS Science Page

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 is dry all the way down to the depth of the plant roots. It’s time to water.

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 plant roots. If you just water the soil surface, the roots will grow close to the surface and then the plants will wilt more quickly.

WATERING METHODS

1. A watering can and hose are useful for small gardens.

Direct the water to the base of the plant, not on the leaves.

I’m using a gentle rain nozzle so the water can slowly soak into the soil.

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.

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Water during early morning. At this time temperatures are cooler and it is less windy, so there is less evaporation.

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.

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. 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!
LEARNING OBJECTIVES
Youth will be able to:
* Explain when and how much a garden should be watered.
* Describe several different watering methods that can be used in a garden.
* Evaluate watering methods to determine which is most suitable for a given situation.
* Explain how to conserve water in the garden.

HOW TO USE THE WATERING GARDEN PLANTS SCIENCE PAGE
Have youth do a survey of watering techniques being used in the community garden. Find out where the water comes from and how gardeners transport it to their gardens. Observe how and when crops are being watered and compare their vigor. For example, look for different types of drip irrigation systems, including both homemade and store bought devices. Observe how the plants are doing under these watering systems. Are they being watered enough, and in the right way?

Look for plants that appear wilted and stunted because of lack of water. Try to figure out why they are stressed. Are they getting enough water? Is there enough organic matter in the soil? Are plants being mulched?

Look for techniques being used to conserve water. For example, do gardeners collect water in rain barrels? Do they add organic matter and mulch to their soil?

Youth may want to visit several gardens and possibly a farm or university agricultural experiment station to learn about different watering methods. They may also want to do research about watering techniques on the internet. Go over the general watering tips below with the youth. After youth have learned about watering methods for gardens, have them discuss what recommendations on watering they would give to gardeners. They may wish to draw a poster to illustrate their recommendations, and post it in the garden. Or they may want to make a poster on watering for children and other visitors to the garden.

Here are a few tips that many gardeners could use to improve water use in the garden. Water infrequently, but thoroughly. Frequent shallow watering causes plant roots to concentrate close to the surface, making the plant more susceptible to water stress. How often you must water depends on many factors, including the type of soil you have (sandy soils need watering more frequently than do clay soils), how much organic matter and mulch is present (soil without mulch or organic matter dries out faster), whether or not you have raised beds (raised beds tend to dry out faster), and the weather (obviously, you have to water more often in hot, windy, dry weather, and less often in rainy weather). Generally, unless the weather is very hot and windy, about 2 1/2 centimeters (1 inch) of water per week is adequate for most garden plants. To find out how much rainwater the garden is getting, you can place a straight-sided can in the soil, and then measure how much water is in the can after a rainstorm. If the garden is not getting 2 1/2 centimeters of rain, then you need to make up the difference by watering.

To find out for sure if you need to water, check the soil to the depth of the roots. When the soil is dry to a depth of 15-30 cm, water thoroughly until the soil is moist to the depth of the roots (at least 60 cm deep for tomatoes, pumpkins, winter squash, sweet potatoes, and watermelon; at least 45-60 cm deep for beans, beets, carrots, cucumbers, peas, peppers, and summer squash; at least 30 cm for cole crops, corn, lettuce, potatoes, radishes, spinach, and berries). 2 1/2 centimeters of water will penetrate to a 38 cm depth in a loam soil.

CROSSWORD PUZZLE

Answers
Across: 1. morning; 4. drip; 7. compaction; 9. trickle; 11. soaker.
Down: 2. organic; 3. sprinklers; 5. rain; 6. barrels; 8. mulch; 10. roots.

TRY THIS
This is a very simple drip irrigation device that works well for widely spaced plants in the garden. Youth should observe that crops irrigated with this device are more vigorous and have higher yields, compared to crops that are not watered during dry spells.

SPOTLIGHT ON RESEARCH
Got Dirt?

Garden Toolkit for implementing youth gardens
For more information about this garden toolkit contact:

Nutrition, Physical Activity and Obesity Program
Division of Public Health
P.O. Box 2659
Madison, WI 53701-2659
Phone: (608) 267-9194
Fax: (608) 266-3125
Email: amy.meinen@wisconsin.gov
Website: http://dhs.wisconsin.gov/health/physicalactivity/index.htm

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Centers for Disease Control and Prevention Obesity Prevention Grant:
This publication was supported by Cooperative Agreement Number U58/DP001494 from the Centers for Disease Control and Prevention. Its contents are solely the responsibility of the authors and do not represent the official views of the Centers for Disease Control and Prevention.
Caring for the Garden

**general upkeep**

1. **Thinning Seedlings:** Once your seeds have begun to sprout and grow in the garden, pull out the extras to provide growing space for the remaining plants. Make sure to remove the extras when the plants are still small, before they compete with others for light, air, and water. When fruits and vegetables grow too close together, the plants growth may be stunted, root crops become distorted, and vine crops grow poorly due to self-shading.

2. **Weeding:** If you keep weeds out of your garden, you'll have a better harvest! Weeds compete with your plants for water, light, and nutrients. Weeds also encourage insects and diseases that attack your garden plants. Mulch and cultivation can help keep the weeds in your garden under control. Use organic materials such as grass clippings (from a non-chemically treated lawn) or a good weed-free straw, specifically clean wheat or rye straw, as means for controlling weeds in your garden. Old newspapers combined with a top layer of grass clippings can be placed around and in between plants to provide an excellent barrier for weeds. The coarser the material, the thicker the layer of mulch.

**quick tip**

Check the Weather Forecast! View the Gardener’s Local Forecast, courtesy of The Weather Channel. Check here www.weather.com/activities/homeandgarden/garden/ and enter your zip code to find out if you’ll need to water your garden today.
3. **Watering:** The best time to water is in the early morning or early afternoon. This allows for the leaves to dry off before nightfall, reducing the chance for disease. Drip irrigation or soaker hoses can be used to keep plants dry during watering, which also reduces the chance of disease infection. However, drip irrigation can be done anytime during the day if used under newspaper, straw, or grass mulch. Some plants, like tomatoes, do not like their leaves wet. In this case drip hoses work especially well. Note: Watering between 10:00 am and 2:00 pm could burn the plants, unless it is an overcast or cloudy day.

5. **Adding Organic Matter:** "Organic matter" provides nutrients for plants. Plants take food from the soil as they grow, so organic matter needs to be applied yearly. Some organic matter sources include: well-rotted cow or horse manure, compost made from tree leaves, lawn clippings (without chemicals), garden refuse (disease-free), green manure, and other organic residues. It is important to keep in mind that some fruits and vegetables are "heavy feeders" (i.e. corn and tomatoes), while others are not (i.e. green peppers). It is best to incorporate organic matter in the fall or early spring, as you prepare the garden soil.

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_Sun_ how do I keep the weeds to a minimum in my garden?

At the Ho-Chunk Youth Fitness Garden, we found that a layer of leaf mulch did a great job of keeping the weeds down; especially around the squash, pumpkins, and vine plants.

— Roxanne Lane

Master Gardener
Sauk County
6. Integrated Pest Control Management
   a. Purchase Quality Seeds & Plants: Start by selecting healthy plants or seeds from reputable seed companies and nurseries. There are several different disease-resistant varieties of seeds you can purchase.
   b. Plant Spacing: Leave plenty of distance between plants to provide air movement, which reduces the chances for diseases to begin.
   c. Plant Appropriately: Setting plants out too early or late can make them weak and more susceptible to a pest attack.
   d. Set up Barriers: Use physical barriers between the plants and the pests by using row covers or nets that allow the sunlight and water to penetrate, but keep out pests. The barrier DOES have to be in place before the pest appears. Remember to remove the barriers during the blossoming stage so that insects will be able to pollinate the plants.
   e. Pick the Pests: Hand-pick and destroy insect pests.
   f. Prevent Weeds: A layer of mulch helps to control weeds and conserve soil moisture. A garden full of weeds is a major attraction to pests!
   g. Learn to Look: Monitor your garden weekly for any new pests. Regularly inspect your plants and their leaves for any trace of insect feeding, etc.
   h. Keep it Clean: After you have harvested everything from your garden, discard any diseased plant material from the site. Remove debris as soon as possible, as many pests will remain over winter in or under dead plant material. Plow or till the garden in the fall.
   i. Rotate Crops Next Year: Move crops to different garden locations each year to reduce buildup of plant-specific pests in the soil.

For more information for controlling diseases in your garden, visit the following websites:

- The Insect Diagnostic Lab, UW-Madison, Department of Entomology: www.entomology.wisc.edu/entodiag.html
- The Plant Diseases Diagnostic Lab, UW-Madison, Dept. of Plant Pathology: www.plantpath.wisc.edu/pddc
- University of Minnesota Extension Service: Controlling Diseases in the Home Vegetable Garden www.extension.umn.edu/gardeninfo
- Ohio State University yard and garden pest information: http://ohioline.osu.edu/hyg-fact/2000/
7. Keep the Beneficial Insects: Over 90% of insects around the garden are harmless to people and plants. Without the help of these “beneficial insects”, most plants would be overrun with pest insects every year. These beneficial insects feed on many different pest species. Furthermore, several of these beneficial insects are pollinators. With more pollination taking place, more high quality fruits and vegetables can be produced. To keep beneficial insects around your garden, limit or eliminate pesticide use. Consider leaving flowering weeds around the garden (i.e. dandelions and clover) to provide alternate nectar sources for pollination. To have beneficial insects attracted to your vegetable garden, be sure to add some flowers and herbs. Examples of annual flowers that attract pollinators include alyssum, marigolds, nasturtiums, dill, and cosmos.

8. Mulching: Mulching with untreated, chemically free grass clippings, leaves, or straw in late June provides several benefits. The mulch will help to suppress weeds, conserve soil moisture, prevent compaction of soil by heavy rains, and add more organic matter to your soil.

For Additional Resources on Composting:
- Wisconsin Department of Natural Resources: Recipes for Composting: http://dnr.wi.gov/org/caer/ce/eeek/earth/recycle/compost_waste.htm
- Iowa State University Horticultural Guide: Composting Yard Waste www.extension.iastate.edu/Publications/PM874.pdf

For Answers to General Gardening Questions, Visit These Websites:
- University of Wisconsin Urban Horticultural Website http://wihort.uwex.edu/
- University of Wisconsin Extension-Milwaukee County Yard & Garden Line (Milwaukee County Residents only) www.uwex.edu/ces/cty/milwaukee/hort/consumer/HortLine.cfm

— Patti Nagai
UW Horticultural Agent, Racine County

how can I engage youth in gardening?

Getting youth interested in gardening is easy — just provide a safe location, a hand trowel, some seeds and plants, and a volunteer to show them what to do — kids love learning how to grow things. Start small, either with a container garden or a small raised bed no larger than 4 x 4 feet. Square foot gardening is a technique that works well with kids. Have them map out their one foot squares and choose which plants they want in each square, then have them post their map at the garden while they plant. Caring for their garden and watching it grow will be a delight.
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.

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*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.*
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).

1. **Garden Research**
   Conduct a planting experiment, internet research, soil measurements, or observations in the garden.

2. **Garden Enhancement**
   Plant flowers, construct interpretive signs, or build a wheelchair-accessible raised bed.

3. **Nutrition and Health**
   Host a garden banquet using foods from the garden, or make a cookbook from gardeners’ recipes.

4. **Land Use**
   Create a green map of your neighborhood, or talk to elected officials about the value of community gardens.

5. **Art in the Garden**
   Make an art object with a gardening theme and present it to the gardeners at a gift-giving ceremony.

6. **Food Systems**
   Celebrate the garden harvest, research aspects of the local food system, or create a neighborhood food map.

7. **Garden Design**
   Design a new garden for your school or community center.

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
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 look out 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.
Art in the Garden
Action Projects

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 dyes using plants from the garden
- Paint a mural along a fence
- Build a scarecrow
- Make a sketchbook of garden plants
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.
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

Find out how much money gardeners save by growing their own produce

Create a neighborhood food map

Write a letter to school officials asking to include more local produce in school lunches

Conduct a survey of neighborhood residents about access to fresh produce

Conduct a vegetable taste testing party for children

Host a "local harvest" banquet

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 *i-m-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!
**Garden Design Action Project**

**Introduction**
A Garden Mosaics group in Sacramento CA, under the leadership of Ann Marie Kennedy and Daniela Tavares, contributed this Action Project. The Sacramento 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.

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 Garden Hike 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 Garden Hike 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 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.

Unlike the other Action Projects where we present several ideas and a general framework for completing the project, here we include a set of steps that landscape architects use when they are designing the garden. 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 create 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:

**Client Needs and Interests**
1. Garden Hike
2. Other Client Needs

**Site Description**
3. Measuring the Site
4. Taking Photographs
5. Photo Collage
6. Sketching

**Garden Plan**
7. Design Charette
8. Draft Plan
9. Master Plan

Before starting the Garden Design Action Project, have your youth pay a virtual visit to the Sacramento Garden Mosaics page, which has photos of youth designing a new garden based on what they learned from community gardeners.

*The Garden Design Action Project was written by Daniela Tavares, with assistance from Ann Marie Kennedy.*
Clients Needs and Interests
Client Needs and Interests involves learning about what gardeners and other “clients” like about gardens in general and what they would like to see in the new garden.

1. Garden Hike
When conducting the Garden Hike as preparation for the Garden Design Action Project, the youth should pay particular attention to documenting any unique and cultural planting practices. Follow the instructions for the Garden Hike with the following modifications.

Preparing Youth for the Garden Hike
In the pre-activity discussion, describe how other youth and garden designers have interviewed gardeners to gain an understanding of the garden site. (See Sacramento Garden Mosaics page). Ask the youth in your group:

- Why do designers need to know about the people who will use the garden?
- How can interviewing an older person help better design the garden?
- How can observing the characteristics of a garden help us to understand the history and customs of gardeners and other people who might use the garden?

Next ask the youth to brainstorm a list of questions for the gardeners that will be useful in designing a new garden or area of a garden.

Conducting the Garden Hike
During the interview, point out how what the gardener is saying might be related to designing a garden.

After the Garden Hike
The youth also may want to incorporate questions that would be useful in designing a new garden into the Gardener Story. Have the youth make drawings to visually record their notes from the Investigations.

2. Other Client Needs
Once the youth have learned about what is important to gardeners, they should make a list of other people who might use the new garden. They should brainstorm a list of questions for these individuals (for example, What kinds of plants do you like? Is there a way to design the garden so it is more accessible for you?). The youth should interview the other users to determine the answers to their questions.

Site Description
The site description involves four activities: (1) measuring the dimensions of the site where the youth will design the garden; (2) taking photographs of the site; (3) compiling the photos into a collage showing areas that meet and do not meet the gardeners’ and other users’ needs; and (4) identifying and drawing sketches of garden plants.

3. Measuring the Site
Time Needed
- Before meeting with youth: variable depending on time needed to obtain aerial photograph and base map
- Preparation with youth: 30 minutes
- Activity in garden: 2 hours
- Discussion: 30 minutes

Materials
For each group of youth:
- Aerial photograph of the site
- Base map of site or grid paper
- Measuring tape (100-200 ft or 30-60 meters)
- Clipboards
- Markers and pencils

Procedure
- Before Meeting with Youth:
  1. Obtain an aerial photograph of your site. If your group is too large to gather around the airphoto, make an enlargement or make laser color copies of the photo for the youth.

  2. If possible, obtain copies of a base map of the garden. School officials will likely have such maps for school grounds. For community gardens or vacant lots, these may be available through the gardeners or the city.
Reduce the original base map to fit on 8.5” x 11” paper. This will provide youth with the outline of the site and allow them to easily draw and label structures or other components of the garden onto the map.

3. If you are not able to obtain an existing base map, draw a rough outline of the site on paper and copy for the youth. Alternatively, draw an outline of the site on a chalk board, and provide the youth with grid paper to draw their own outline of the site.

• Preparing Youth:
  1. Pass out copies of aerial photographs of the garden or have the youth gather around one enlarged airphoto. Help the youth identify landmarks surrounding the garden (e.g., tall buildings, parking) and the borders and entrance to the garden. Point out North and other directions on the airphoto.
  2. Pass out the base map of the garden and help the youth label key landmarks, such as the entrance, on the map. If you don’t have a base map, have the youth draw the border and entrance of the garden on the grid paper.
  3. Divide the youth into teams of three (one note taker and two measurers) to take measurements and photos in the garden.

• Conducting the Activity:
  1. Remind youth that they should be respectful and non-disruptive inside the garden. They should explain what they are doing and why to anyone who asks.
  2. Pass out clipboards and the maps the youth prepared in the classroom.
  3. Assign the youth structures and other features to measure in the garden, such as the border, buildings, water sources, etc. The youth should measure the size of larger structures (e.g., buildings) and the location of all features so that they can place them on their maps.
  4. Youth should divide into their teams of three members and proceed to find their assigned features to measure.
  5. Remind youth to note on their map any key components of the that can not be captured on a photo or a sketch garden (e.g., a hot area, a windy area, an open area, a change in slope).

• After the Activity:
  1. Have the youth share their maps, measurements, and observations. They should add the features that other groups measured to their map, so each group has a map with all the features. Or they can make one composite base map with all the features.

4. Taking Photos

Time Needed
• Preparing the youth: 15 minutes
• Activity in garden: 90 minutes

Materials
For each youth group:
• Disposable or Polaroid camera (minimum 15 exposures)
• Copy of Photo Activity Checklist

Procedure
• Preparing Youth:
  1. Group the youth into teams of two.
  2. Provide a camera for each team with their names taped or written on it in a font that is fun for the youth.
  3. Have the youth tape the Photo Activity Checklist to their camera.

• Conducting the Activity:
  1. Instruct the youth to check off each feature as they photograph it. The order of photos doesn’t matter. Tell them not to worry if they don’t think they got a good picture of any particular feature. For each feature, they should go to the place that comes to their mind—not what they think other people would think of, or what they think you want them to answer.
  2. The youth may want to include each other in the photos. They can stand next to the feature from the checklist and point to it.
• After the Activity:
  1. If you used disposable cameras, label each film envelope with the team’s name and send them off to be developed. (If possible, get double prints and give the youth copies of photos.)

5. Photo Collage

Time Needed
• Before meeting with youth: 30 minutes
• Activity: 1.5 hours

Materials
For each youth team:
• Newsprint
• Photos from the garden
• Pencils
• Markers
• Masking tape
• 3” x 3” post-its

Procedure
• Before Meeting with Youth:
  1. For each youth team, divide a 24” x 36” sheet of newsprint into 15 sections and label each section with an item from the Photo Activity Checklist. Label each sheet with the team members’ names and tape them on the wall, leaving room for youth to move around and observe the charts.

• Conducting the Activity
  1. Explain to the youth that the purpose of the photo workshop is to share their impressions about the garden and to learn what the other youth thought about the garden.

  2. Distribute to each team the envelopes with their developed photos. Then have the youth discuss with their partner where each photo should go on the newsprint, based on how they had earlier interpreted it in the garden.

  3. Using masking tape, have the youth tape their photos in the appropriate box on their newsprint, one photo per section. Have the youth write a short comment on the newsprint about why they believe that photo should be under that category.

  4. Have the youth look at the photos taken by other youth. Using the post-its, have them write a short a comment on five key pictures that stood out for them from the other groups, and post them on the appropriate newsprint.

  5. Guide the youth in a discussion of what they saw and experienced during the activity. Make notes on a separate sheet of newsprint about consistent observations from the garden (e.g., the garden as a social place or a lonely place).

  6. Tell the youth that making observations is part of how landscape designers analyze a site. Designers take photos of key components of the garden that catch their attention and use those pictures when they are working in their studio to remind them of how they saw and felt about the garden.

6. Sketching

Time Needed
• Before meeting with youth: 15 minutes
• Preparation with youth: 20 minutes
• Activity in garden: 2 hours
• Discussion: 45 minutes

Materials
For each youth:
• Sketching paper (8.5” x 11” newsprint or acid-free sketch paper drawing pads are ideal)
• Sketching/drawing pencils (2B, 4B, 6B, 8B highly recommended, available at art supply stores)
• Clipboards
• Paper for notes
• Pencils

Procedure
• Before Meeting with Youth:
  1. Decide which concepts the youth need to go over from the Sketching Concepts Handout. If the youth are familiar with drawing/sketching techniques they can help out others who are new to drawing.
Preparing the Youth:
1. Suggest a few quick exercises to help the youth learn about shadowing, texturizing, and letting loose their hand when sketching.

2. Discuss the different ways a designer can record information in the field, both visual and using words (e.g., photos, maps, sketching, and note taking). Explain that when they sketch, the youth should quickly jot down notes to capture the essence of the object being observed without getting into too much detail.

3. The sketching should focus primarily on plants, especially plants the youth are unfamiliar with, and on structures found in the garden (e.g., tool shed, shade structure, casita, bench). Explain to the youth that by sketching, they will add to the visual understanding of the garden they gained through taking photos.

Conducting the Activity:
1. In groups of two-three, have the youth find a quiet spot that is not disruptive of any gardener and sketch a particular plant or structure in the garden.

2. Walk around and provide feedback to the youth on their sketches.

3. Have the youth show the drawings to the gardeners and ask them the names of the plants in English and in the gardeners' native languages. Have the gardeners also explain culinary and medicinal uses and cultural significance of the plants.

4. Have the youth take notes on what they learn from the gardeners.

Garden Plan
In this series of activities youth create a plan for the garden based on what they learned through talking with the gardeners, measuring the garden, and photographing and sketching plants and other features in the garden. There are three parts to creating the plan, including the design charette, draft plan, and final master plan.

7. Design Charette

Time Needed
- Before meeting with youth: 30 minutes
- Activity: 90 minutes

Materials
For each youth team:
- Newsprint
- Base map of garden (24" x 36" recommended)
- Markers (different colors)
- Scissors
- Glue or tape
- Construction paper: green for different circular forms for trees, shrubs; brown for paths, planting boxes, structures; and blue for water features (ponds, fountain).

Procedure
- Before Meeting with Youth:
1. Prepare copies of the base map the youth made in Measuring the Site on 24" x 36" newsprint. Include existing objects that are relevant to designing a new garden on the site, and that cannot be removed (e.g., trees, plant beds, water sources). The youth will use the base map to make their initial site plan.

Conducting the Activity
1. Explain that the purpose of the design charette is to brainstorm ideas for the garden plan. Drawing from the ideas they brainstorm, the youth will come to a consensus on what is important for the garden plan.

2. If you are working in an existing garden, guide the youth in a discussion of what part of the garden they might help by developing a new design. Have them consider what needs to stay as is and what the gardeners have expressed an interest in or concern about. Provide some examples of the photos the youth took at the garden to highlight important elements, both positive and
negative, in the garden. Issues they might discuss include:
• unique cultural practices
• plant needs (e.g., water)
• needs of the gardeners, their children, and other visitors to the garden
• areas with poor soil
• non-cultivated areas of the garden
• areas that get lots of sunlight and areas that are shaded by buildings.

3. If you are working in a site that is not presently a garden, guide the youth in a discussion of what they might like to include in their garden. They should consider what needs to stay the same and what might be changed at the site, what gardeners find important, and the interests of potential users of the new garden (e.g., students and teachers for a school garden).

4. Create a poster of brief bullets that capture the essentials of what youth discuss and what you remember from previous discussions and observations.

5. Help the youth decide what aspect of the garden they will create a design for.

6. Divide the group into teams of four-five members. Provide each team with a manila envelope with construction paper, scissors, glue/tape, and markers. Have the teams label their envelope with the names of the members.

7. Have the teams brainstorm designs that might help the garden and the gardeners. In addition to drawing from what they learned in the garden, they can think back to ideas from previous exposure to different landscapes (e.g., schoolyards, parks, other gardens).

8. To create an initial site plan, have the youth mark-up their copy of the base map with their ideas and place the construction paper shapes on the map with text explaining the shapes. Their site plan should begin to come to life!

9. Have the youth glue or tape down the construction paper shapes on this initial site plan and label it with their names.

10. Allow youth to walk around to view each other’s site plans and to jot down notes about their observations.

11. Hold a discussion of the various design ideas.

8. Draft Plan

Time required
• Before meeting with youth: 30 minutes
• Activity: 4 hrs

Materials
For each youth:
• Engineering ruler (available in art store) or regular ruler
• Mechanical pencils (available in art store, provide a consistent line and are easily erased)
• T-square and triangle to enable youth to create angles and squares (available in art store)
• White erasers (erase without smudging, available through art store)
• Base map or 8” x 11” paper
• Transparency paper (e.g., tracing or other flimsy paper, 18” x 24” recommended, available through art store)
• Masking tape
• Newsprint (18” x 24” or 24” x 36”)

Procedure
• Before Meeting with Youth:
  1. Because it may be expensive to buy engineering rulers for each student, you may want to obtain one ruler and copy the scale (side of the ruler) the youth will use for the site plan. Then the youth can cut out the copied scale and tape it on top of an inexpensive ruler.

  2. Prepare copies of the base map the youth made in Measuring the Site on 24” x 36” newsprint. Include existing objects that are relevant to designing a new garden on the site, and that cannot be removed (e.g., trees, plant beds, water sources). The youth will use the base map to make their initial site plan.
**Conducting the Activity**

1. Help the youth become acquainted with the engineer scale. Each edge of the ruler has a scale showing feet per inch. This amount is usually a multiple of ten (e.g., 20’ per 1”, 30’ per 1”, etc.). So, using a 60 scale, 60 feet on the site would measure 1 inch on the site plan. If you are developing a plan for a smaller site, you can divide by 10 so that 6 feet on the ground = 1 inch.

2. If a base map drawn to scale is already available, help the youth become acquainted with the scale provided. Make them aware of actual measurements in the garden, such as the dimensions of walkways, planting beds, and benches. Have them sketch these items using the scale chosen. If they are unfamiliar with scale, you may want to have them measure structures, sidewalks, etc. and then draw them to scale.

3. If a base map drawn to scale is not available, determine the perimeter of the garden, based on the measurements taken during Measuring the Site. Once the dimensions are sketched out on a regular 8.5” x 11” paper, help the youth choose a scale that captures the same dimensions to scale on a 18” x 24” or 24” x 36” sheet of paper. Use a T-square and triangle to achieve perfect 90 degree corners.

4. Tape a piece of tracing paper or other transparency, slightly smaller than the base map, onto the base map. Tape the base map to the table with masking tape.

5. Explain to the youth about line hierarchy. When drafting structures or walkways, the width of the line should reflect the thickness and importance of the structure. For example, a building will have the heaviest line since it is a solid and thick structure. A bench should be thinner than the building but thicker than a line for a walkway. To make thicker lines, press on the hand that holds the pencil.

6. Explain to the youth about shadows, which should vary from light to medium to dark, depending on the size or thickness of the structure and the way light falls on the plants and other objects.

7. Distribute the pencils, erasers, and paper necessary to begin tracing the site plan onto the transparency. Instruct the youth to create the site plan from the initial plan they made in the design charrette.

8. Youth should roughly, and very lightly, lay out on the site plan transparency the major components from their design charrette. This may include new pathways, beds, gathering areas, and other features.

9. Next youth should draw the structures and pathways to scale using their scale ruler, never forgetting to keep track of what scale they are using.

10. Instruct the youth to cover the part of the plan they are not working on with paper to prevent smudging.

11. Instruct the youth to distinguish between different types of plants by using different textures (see Sketching).

12. Throughout the activity, remind the youth about line hierarchy and the use of shadows.

13. Ask youth to clean up and erase any smudges and messy lines on their site plan.

14. Youth should make a neat and accurate border around their plan by using their triangles and t-square making a perfect 90 degree square.

15. Instruct the youth to leave enough room at the bottom of their site plan to put the title of the project (in the middle), the name of the youth organization and date (in the left bottom corner), and the scale that was used along with an arrow showing
North (bottom right corner). Youth can either type or neatly print out the text, making sure they keep their writing consistent.

16. Youth should label objects and structures in the garden, small enough as to not distract from the line hierarchy of the plan, but consistent with the importance of the object or structure.

17. The text for the site plan title should be the boldest, the name and scale should be less bold, and the text inside the plan should be smaller and not distract from the lines. Text should always face the same way.

18. Collect the site plans taped over the base maps and have them copied onto bond paper, which is more professional and lasts longer than newsprint. Youth can keep the original black and white drafts.

9. **Master Plan**
   In this activity, the youth will complete their site plans, including a master plan, sketches, maps, and written notes. They will then be ready to present their plans to the gardeners and other interested people.

   **Time Required**
   - Before meeting with youth: 30 minutes
   - Conducting the Activity: 2-4 hours

   **Materials**
   For each youth:
   - Their own draft site plan, copied onto bond paper
   - Coloring media (green colors are popular for gardens): soft pastel (soft visual effect), oil pastel (bold visual effect), colored pencils (detailed visual effect), watercolors (romantic visual effect)
   - Fixative or hair spray if using soft pastels
   - Foam board the size of the plan (may need cutting blade to cut foam board)
   - Adhesive spray

   **Procedure**
   - **Before Meeting with Youth:**
     1. Using a sharp, strong cutting blade, prepare foam board the same size as site plans.
   - **Conducting the Activity**
     1. Remind youth that the purpose of the master plan is to present a visual image of the garden to the gardeners and other interested people.
     2. Introduce youth to the different media and allow them to experiment and choose the media that best suit them. If available, show the youth plans using different media.
     3. Go over drawing concepts, including:
        - **Shadowing**
          Which side sun is coming from; south side gets the most light; north gets darker colors due to shadowing; distinction between light, medium, and dark colors; transition from very light colors to very dark/shadowy colors.
        - **Color scheme**
          No more than 4-6 colors should be used on a plan; more colors make the drawing “muddy;” mix and match colors to create new colors.
        - **Mix-match media**
          Use color pencils to highlight detail on pastel work; use pencil to highlight detail in any medium.
        - **Neatness**
          Keep the site plan clean at all times by putting scratch paper on top of area that is not being drawn.
        - **Boldness**
          Use bold colors to highlight important parts of plan through pressure on the pencil, color pastel, and using more detail and shadows.
     4. Distribute the youth’s site plans copied onto bond paper and have them complete the master plan using the various media. Provide enough scratch-paper to cover portions of the site plan they are not working on and to test the media as they go along.
     5. Ask youth to erase any accidental smudges.
6. For youth who used soft pastel, have them spray fixative on the plan to prevent fading and smudges. Hair spray also works but is heavier and smellier.

7. Pass out the foam boards and help youth glue their master plan down with the adhesive spray, following instructions on the can. Spray the adhesive onto the board first and then beginning at one side, slowly and carefully attach the master plan, making sure that no air bubbles appear.

8. Set up an appointment to meet with the gardeners and other interested individuals for a final presentation of the design project.

Photo Activity Checklist

**Small font for taping on camera**
1. A place to rest
2. A place where you would like to hang out
3. A place to talk with others
4. A lonely place
5. A place to play games (for example, cards, horseshoes)
6. An exciting place
7. A place where you would like to walk
8. A beautiful place
9. An ugly place
10. A boring place
11. An unsafe or stressful place
12. A safe, peaceful place

**Larger font for cutting out and putting on newsprint**
1. A place to rest
2. A place where you would like to hang out
3. A place to talk with others
4. A place to play games (for example, cards, horseshoes)
5. A lonely place
6. An exciting place
7. A place where you would like to walk
8. A beautiful place
9. An ugly place
10. A boring place
11. An unsafe or stressful place
12. A safe, peaceful place


**Sketching Concepts Handout**

If lines give structure and content to a drawing, then it is light, shade and shadow that make a drawing come alive. DaVinci advised: “You who draw from nature, look carefully at the extent, the degree and the form of the lights and shadows.” Tone and shadow breathe life into a landscape drawing while giving it depth and atmosphere. Landscape drawings are usually a combination of line and tone (Sullivan, 1997).

**Tone**

Tone refers to light and dark in a drawing. You can integrate light and dark to create a range of tones. To produce tone with a pencil or charcoal, place the strokes close together to create subtle, smooth, even gradations. With pen and ink, you apply light parallel and cross-hatched lines.

**Hatching**

Hatching refers to short parallel lines repeated in patterns. You can make tones appear light or dark by changing the variety and spacing (tight or loose) of the hatching. For added character, you can curve the hatch lines slightly or place them at different angles.

**Cross-Hatching**

Cross-hatching is a variation of hatching, but can produce a wider range of tones. To create cross-hatching, draw a series of short parallel lines. Then draw a series of lines on top of and at right angles to your first set of lines. Keep repeating this process by overlapping the hatched lines at a slightly different angle each time until you produce almost total blackness.

**Light**

Before beginning a drawing always note where the light is coming from.
Exploiting the light will illuminate your landscape drawing and make it appear three-dimensional. Work out the composition of your drawing using light lines, starting with the light areas and then adding the shade. The source and the quality of the light will affect your gray tones.

**Shadow**
The area of an object opposite the light source is shaded. The cast shadow generally appears darker than the shaded side of the object, and the shadow is darkest along its leading edge. The shadow also will reflect the form of the object that is casting the shadow.

**Texture**
The landscape contains an endless variety of textures. You may want to look at some famous paintings, such as those by Vincent Van Gogh, to get an idea of how a landscape artist can create an amazing array of textures. Every element in the landscape has texture, and you should reflect these unique textures in the drawing to give each element a separate identity. At the same time, develop a textural style that unifies the picture and avoids “chaos” in the drawing. Shadows reflect the various textures of the landscape upon which they are cast. Texture is more than just pattern—it is lively, interwoven lines that remind the viewer of the sense of touch and stimulate the imagination.

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
- Arrange for mulch to be donated and delivered to the garden
- Paint a mural along a fence
- Create and put up interpretive signs
- Plant flowers
- Build a raised bed
- Grade 3 Lesson 8 Food for Plants and People
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 *im*-*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 *im*-*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 *im*-*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.
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.

- **Experiments**
  - Conduct a controlled experiment to test the effect of one factor on plant growth.

- **Observations**
  - Make observations of plant growth in relation to the environment and formulate preliminary hypotheses that could be tested by an experiment.

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.

Idea from “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 safety risks of this insecticide?

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.
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 ornaments 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 lead level of the soil?
- How much rain did we get each week during the summer?
- What is the maximum and minimum temperature each day?
- 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 texture of the soil?
- What is the soil pH?
- How many tomatoes are produced on one plant?
- How tall do the sunflower plants grow?
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 plants are wilted on hot, dry days?
- What medicinal herbs are found in the garden?
- What plant diseases are found in the garden?
- What vegetables are commonly 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?
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 weeds?
- Does corn grow more rapidly when planted with beans?
- What is the effect of adding compost to soil on soil drainage?
- Does planting marigolds around the edge of a raised bed reduce insect damage to kale?
- What variety of chili peppers produces the most chiles?
- Does weeding result in larger eggplants?
- Is hot pepper solution effective in controlling insects?
- Does applying manure result in larger bitter melons?
**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*. 
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
- Write a letter to local politicians about the need to preserve and create new community gardens
- Organize a garden celebration and invite local politicians
- Make a presentation to government officials about the importance of community gardens to neighborhoods
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.

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**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.
**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?